5-19-2014

Can videogames be addicting? An investigation into the specific game features and personal characteristics associated with problematic videogame playing

Gregory Pouliot

Can Videogames be Addicting? An Investigation into the Specific Game Features and Personal Characteristics Associated with Problematic Videogame Playing

by
Gregory Pouliot, M.S.

Dissertation

Submitted to the Department of Psychology
Eastern Michigan University
in partial fulfillment of the requirements
for the degree of
DOCTOR OF PHILOSOPHY
in
Clinical Psychology

Dissertation Committee:
Karen Saules, Ph.D., Chair
Stephen Jefferson, Ph.D.
Natalie Dove, Ph.D.
Howard Lerner, Ph.D.

May 19th, 2014
Ypsilanti, Michigan

Abstract

The number of individuals who play videogames has increased dramatically in recent years. Unsurprisingly, the frequency with which patients seek psychotherapeutic services to help cope with problematic videogame playing (PVGP) behaviors has also risen. Thus, explorations into the specific characteristics of PVGP are essential now more than ever before. However, the current state of the literature primarily relies on comparisons between PVGP and pathological gambling, utilizing modified measures of the latter to assess the former. To date, no studies have attempted to adapt the diagnostic criteria for substance use disorder (SUD) in an effort to understand PVGP within the context of addiction. Further, few studies have explored the specific game characteristics and individual factors that contribute to the presence of PVGP.

The current study sought to address these questions by adapting the SUD criteria to address videogame-related behavior via a measure labeled as the Videogame Addiction Scale (VGAS). Comparisons of the psychometrics and criterion validity of the VGAS and leading measures of PVGP suggested the former was superior. Further, results indicated that higher levels of addiction were present in players who prefer the MMORPG and Shooter genres over all other types of games, with the former yielding significantly higher VGAS scores than the latter. Further, many of the structural characteristics of videogames were considered to be more enjoyable, important, and associated with longer playtimes for individuals with higher "addiction" scores than their low scoring counterparts. Lastly, a model of videogame addiction was generated that aligns with the current literature on substance use disorders. Specifically, impulsivity, maladaptive coping, weekly playtime, and particular structural characteristics all seem to relate to videogame addiction.

Table of Contents

List of Tables

List of Figures

Can Videogames be Addicting? An Investigation into the Specific Game Features and Personal Characteristics Associated with Problematic Videogame Playing

Introduction

The Construct of Problematic Videogame Playing (PVGP)

Developing a specific definition for a "videogame" is an ever-evolving process, as technology continually changes what this term refers to. While the central tenet of playing an electronic game via a television, computer screen, or arcade cabinet remains static, the games themselves have grown in significant ways. For example, one of the first home console experiences was the game "Pong," which was a digital version of ping pong comprised of several white lines on a black screen (Williams, 2006). Thus, the predominant interactive experience occurred between two individuals in the same room together, using the electronic game as a medium with which to relate. However, with subsequent generations of console hardware and advancements in personal computing, games began to develop complex storylines utilizing archetypes and themes found in literature and movies (Ip, 2011a, 2011b), changing the landscape of consuming plot-based media from a passive (e.g., television) into an active process (Klimmt & Vorderer, 2003). Further, the development of games played via the internet allowed for interactivity without the need to be physically with someone else. The advent of massively multiplayer online (MMO) games, such as World of Warcraft, has literally provided gamers with new worlds to explore and an entire cohort of individuals to digitally befriend. In fact, this social aspect is purported to be the primary reason many individuals play MMOs in the first place (Griffiths, Davies, & Chappell, 2004). Thus, any conceptualizations of or empirical literature about videogames from even two decades ago may have little ecological validity today.

Traditionally, videogames are played in two primary ways: via a videogame console or a computer. Consoles generally consist of boxes that connect to a television and allow a user to interact with the events onscreen via a controller containing buttons, although newer console technologies can register the physical movements of players, either through gyroscopic handheld human interface devices (e.g., Wii remote or Playstation Move) or by having body movement interpreted via infrared camera (e.g., Kinect). Consoles are generally less expensive to purchase than gaming computers and easier to operate, as games can be purchased on retail discs and played with minimal installation. PC gaming, on the other hand, typically requires greater time and cost investments, but allows for richer interactive experiences, due to greater input (e.g., utilization of all keys on a keyboard) and technological abilities (e.g., more advanced hardware that can be continually upgraded).

However, in recent years, the landscape of the videogame industry has changed, particularly with the advent of social gaming and mobile gaming. Social games refer to inexpensive or free-to-play titles that are available on social networking sites (e.g., Facebook) or other browser-based locations. Social games typically require little familiarity with gaming principles and have drawn an entirely new demographic into the videogame space. For example, according to Digital Buzz, 58% of social gamers are over the age of 40 and 29% are married with children (2012). Mobile games refer to the downloadable "apps" available on smartphones, such as the iPhone or an Android-powered device. These generally "bite-sized" gaming experiences allow users to play for as little as several minutes per session and can be instantly available in the pocket of the individual. TheTechLabs.com (2011) reports the mobile gaming industry generated $800 million in revenue during 2010 alone, and it is easy to imagine that this number has increased substantially, as more consumers have upgraded to phones capable of

playing these games. Further, the aforementioned consoles that previously served exclusively as videogame devices now perform a variety of other functions, such as streaming digital (movie or music) content or browsing the internet, broadening their appeal to a wider audience. In fact, according to the Entertainment Software Association (2012), the average household in the United States owns at least one device capable of playing a videogame, the average gamer is 30 years old, and the total revenue for the videogame industry as a whole in 2011 was $24.75 billion. Clearly, playing some form of videogame has become a normative experience for individuals across the entire demographic spectrum. However, this has also opened up entirely new sects of the population to the possibility of problematic play that can result in a host of psychological, behavioral, and interpersonal problems.

When referencing the problems associated with videogame play, several terms have been used in the literature, including "pathological video-game use" (Gentile, 2009), "problematic videogame play" (Salguero & Moran, 2002), and "video game addiction" (Griffiths & Meredith, 2009). However, the current body of research is still unclear about the level of "pathology" associated with videogames, and the term "addiction" references specific features that have not been conclusively demonstrated with regard to videogame play (Petry, 2010). Thus, "problematic videogame play" (PVGP) has been suggested as the most appropriate term (Tolchinsky & Jefferson, 2011; Wood, 2008). Although the conceptualization of PVGP and its accompanying symptomatology varies across studies, most researchers agree that the term refers to negative consequences resulting from playing and not simply the amount of time spent playing. In fact, the existence of a group of heavy users who do not appear to suffer from PVGP has been demonstrated (e.g., van Rooij et al., 2010). Thus, PVGP likely represents a constellation of symptoms encapsulating more than just excessive play that may potentially

parallel pathological gambling or substance use disorder (SUD), both of which have been conceptualized as addictions. A more detailed account of the current addiction literature of both videogames and gambling will be discussed further in this paper.

Literature Review

Problems and Benefits Associated with Videogame Play

Connection between violent content and aggression. One of the most well researched areas in the videogame literature pertains to the effects of violent videogames on aggression. Specifically, a plethora of studies have suggested that playing violent games is either associated with or leads to increases in aggressive affect, cognition, and/or behavior (Anderson et al., 2004, 2008, 2010; Anderson & Carnagey, 2009; Ballard & Weist, 1996; Bartholow, Sestir, & Davis, 2005; Bluemke et al., 2010; Dill & Dill, 1998; Gentile et al., 2004; Irwin & Gross, 1995; Lemmens et al., 2011; Moller & Krahe, 2009; Olson et al., 2009; Wang et al., 2009). Further, these aggressive shifts seemed to be higher when playing as a digital character that had been personalized by the player (Fischer et al., 2010; Williams, Kennedy, & Moore, 2011). Additionally, violent videogames are associated with increased dehumanization of self and others (Bastian et al., 2012; Greitemeyer & McLatchie, 2011), decreased helping behaviors (Bushman & Anderson, 2009), as well as less negative judgment of violent criminals (Lee et al., 2010). Results from behavioral and neuropsychological studies have suggested that neural desensitization and habituation occur after lasting exposure to violent videogames (Bartholow et al., 2005; Engelhardt et al., 2011; Hummer et al., 2010; Montag et al., 2012; Wang et al., 2009). Regarding game mechanics, individuals exposed to increased levels of blood within the game and more realistic graphics had more elevated hostility and physiological arousal than individuals playing the same game with less blood present (Barlett et al., 2008; Krcmar & Farrar,

2009; Krcmar, Farrar, & McGloin, 2011). Lastly, adolescents who actually played a violent videogame exhibited higher levels of aggression during a subsequent free play session at school than individuals just watching the game being played (Polman et al., 2008). Thus, actively controlling the violence in-game may potentially increase the chances of later manifestations of aggression in the real world.

Thus, a strong argument has been made for the negative effects of videogame violence. However, contrasting findings suggest that aggressive reactions actually decrease the longer the particular gaming session's length (Krcmar & Lachlan, 2009; Sherry, 2007), with the associated violent thoughts and feelings typically lasting four minutes after play has stopped and elevated heart rate and aggressive behaviors persisting less than nine minutes (Barlett, Branch, Rodeheffer, & Harris, 2009). Further, neither randomized short-term exposure to violent videogames nor previous real-life exposure had an effect on aggressive behavior (Ferguson & Rueda, 2010; Ferguson et al., 2008). Violent videogame play during a 3 year longitudinal study was not associated with increased aggression (Ferguson et al., 2012), and in one study by Ferguson (2011a), the presence of aggression was better explained by the interaction between antisocial traits and depression than by videogame play. In addition, several authors have noted methodological issues with the literature demonstrating a connection between violent games and aggression, such as the presence of confounding variables, including competitiveness, difficulty, and pace of action (Adachi & Willoughby, 2011). Further, when matched samples are used, the relationship between violent videogames and violence (Gunter & Daly, 2012) as well as hostility (Valadez & Ferguson, 2012) is diminished. Ferguson and Kilburn (2010) criticize previous meta-analyses, explaining that biased samples of unpublished studies, analyses inducing effect size inflations, and studies that do not measure serious aggression were all included. In addition,

when the virtual violence committed by the player within the game was unjustified, individuals reported elevated levels of guilt (Hartmann et al., 2010). Further, less shame and guilt were reported by players when fighting monsters instead of human characters (Lin, 2011), suggesting that they differentiated humans from fantasy creatures. Taken together, these studies highlight the conflicting nature of the current empirical literature. Worse yet is that the lay public often raises concerns about the effects of videogame violence, leading to "media-focused moral panics" that have previously occurred with movies, television, and so forth (Ferguson, 2010, p. 68). Thus, empirical findings that corroborate the association between videogame violence and aggression may receive more attention than nonsignificant findings.

While several articles have suggested that violent videogames decrease prosocial behavior (Anderson et al., 2010; Chambers & Ascione, 1987; Fraser et al., 2012; Sheese & Graziano, 2005; Silvern & Williamson, 1987; Wiegman & van Schie, 1998), a series of experiments by Greitemeyer and colleagues have demonstrated that prosocial games increase prosocial behavior. For example, Greitemeyer and Osswald (2009) demonstrated that participants randomly assigned to play a prosocial game generated narratives for ambiguous story stems containing less aggressive behaviors, thoughts, and feelings than players given a neutral puzzle game to play. A later study by Greitemeyer and Osswald (2010) compared players assigned to prosocial, aggressive, or neutral videogame groups, reporting that the prosocial group was more likely to engage in both low-cost (e.g., picking up pencils) and high-cost (e.g., intervening when a verbal fight began) helping behaviors. Lastly, Geitemeyer, Osswald, and Brauer (2010) found that individuals tasked with prosocial gaming experienced a decreased level of schadenfreude (deriving pleasure from another's misfortune) and increased empathy as compared to a neutral gaming group. However, it is important to note that in this last

study, playing an aggressive game did not increase shadenfreude or decrease empathic concern. Several authors have similarly found that prosocial gaming appears to generate positive social responding (Gentile et al., 2009; Greitemeyer, Agthe, Turner, & Gschwendtner, 2012; Sestir & Bartholow, 2010; Whitaker & Bushman, 2012), lending further support to the idea that games can lead to a variety of either positive or negative effects depending on the specific game content.

Neuropsychological processes. A surprisingly large body of literature exists demonstrating cognitive differences between videogamers and nonplayers. Assessing many areas of cognitive functioning, Barlett and colleagues (2009) reported improvements in working memory, visual attention, mathematical decision making, and auditory perception among individuals tasked with playing a videogame as compared to a control group of nonplayers. Interestingly, similar findings were found in older adults, suggesting a potential method to attenuate cognitive decline (Basak et al., 2008; Nouchi et al., 2012). Regarding specific processes, visual attentional abilities appear enhanced in individuals who play videogames (Boot et al., 2008; Bialystok, 2006; Castel, Pratt, & Drummond, 2005; Chisholm, Hickey, Theeuwes, & Kingstone, 2010; Feng, Spence, & Pratt, 2007; Green & Bavelier, 2003, 2006a, 2006b, 2007; Greenfield, deWinstanley, Kilpatrick, & Kaye, 1994; Trick, Jaspers-Fayer, & Sethi, 2005). Additionally, videogamers exhibit increased performance with regards to target detection (Mishra, Zinni, Bavelier, & Hillyard, 2011), change detection (Clark, Fleck, & Mitroff, 2011), visual search (Hubert-Wallander, Green, Sugarman, & Bavelier, 2011), and visuospatial performance (Sanchez, 2012). Interestingly, these visual benefits appear to generalize to other multisensory processes, such as the capacity for "discriminating the non-simultaneity of the auditory and visual stimuli at smaller intervals compared to NVGPs [non-videogame players]"

(Donohue, Woldorff, & Mitroff, 2010, p. 1127). Furthermore, not only did task switching on physical tasks (Cain, Landau, & Shimamura, 2012) improve, but such abilities generalized to vocal responses on cognitive (rather than perceptual) tasks (Green et al., 2012). However, Karle, Watter, and Shedden (2010) have argued that such benefits result from selective attention abilities and not because of task switching improvements. Further, gaming has been associated with implicit sequence learning (Bergstrom, Howard, & Howard, 2012), greater detail of representations of objects (Sungur & Boduroglu, 2012), and greater contrast sensitivity (Caplovitz & Kastner, 2009). Taken together, the aforementioned literature lends strong support that neuropsychological differences exist between videogame players and nonplayers.

However, several studies have reported negative or nonsignificant findings as well. For example, Durlach, Kring, and Bowens (2009) found no evidence to suggest habitual videogame players had enhanced change detection, a finding that contradicts other studies (e.g., Clark et al., 2011). Further, research investigating cognitive control, defined as "the ability to maintain goal-directed information processing in the face of distraction or competing response alternatives" (Bailey, West, & Anderson, 2010, p. 34), found deleterious effects associated with videogame play (Kronenberger et al., 2005) that appeared to affect proactive (as measured by the conflict adaptation effect), but not reactive (determined via the Stroop interference effect), forms of cognitive control (Bailey, West, & Anderson, 2010). Lastly, Richardson, Powers, and Bousquet (2011) demonstrated that while videogame players experienced an increase in spatial performance when digitally navigating virtual environments, these abilities did not generalize to tasks in the real world. These less promising findings certainly represent the minority in the neuropsychological literature, although they still warrant consideration. Future examinations may find alternative ways of understanding the aforementioned positive findings in a way that

changes current theory. A good example is the previously discussed study by Karle, Watter, and Shedden (2010), which posits that what appear to be improvements in task switching may instead relate more to selective attention.

Associated psychological and physical features. Little research has sought to determine the comorbid psychological factors associated with PVGP, especially outside of just a few particular disorders. Literature examining the connection between videogame play and substance use disorders will be discussed later in this paper within the context of addiction. However, with regard to other disorders, Bioulac, Arfi, and Bouvard (2008) reported that children with ADHD could be vulnerable to developing PVGP, and Chan and Rabinowitz (2006) noted higher rates of ADHD, Inattentive Type among gamers. Conversely, research has also indicated that videogame play did not predict attention problems using hierarchical multiple regressions (Ferguson, 2011b) and that poor time management skills may mediate the relationship between ADHD and PVGP, at least in males (Tolchinsky & Jefferson, 2011). Thus, little can be gleaned from the paucity of investigations into comorbidity with ADHD. One interesting study by Starcevic and colleagues (2011) assessed videogame players using the Symptom Checklist 90 (SCL-90; Lipman et al., 1979) and found that problematic players yielded higher scores on all scales of psychopathology than videogame players not exhibiting signs of PVGP (Somatization, Obsessive-Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Anger-Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism). Further, PVGP has been associated with depression and suicidal ideation (Messias et al., 2011) as well as risky behaviors, such as an increase in sexual partners (Padilla-Walker et al., 2010) and risky driving (Beullens, Roe, & Van den Bulk, 2011; Fischer et al., 2009). With the exception of a few notable research

endeavors, the associated psychological features of PVGP is an area sorely needing empirical attention.

Interestingly, there has also been a growing area of research investigating the health problems related to excessive videogame play. For example, game play time was positively associated with body mass index (BMI) and negatively associated with frequency of exercise (Ballard et al., 2009) and sufficient sleep (Foti et al., 2011). King and Delfabbro (2009) found that individuals defined as "heavy" gamers experienced negative effects in the areas of physical functioning, mental health, vitality, general health, and social functioning. Further, individuals snacked more while gaming, consuming 166% more calories than required (Mellecker et al., 2010), and experienced a sustained increase in heart rate and blood pressure while playing (Borusiak et al., 2008). Further, immersion in the narrative of a videogame accounted for greater energy intake than other distraction-related variables (Lyons, Tate, & Ward, 2013). However, it should be noted that other studies have reported that screen time did not predict BMI (Jackson et al., 2011; Wack & Tantleff-Dunn, 2009).

Videogame "Addiction" Prevalence and Debate

With the increase of videogame players in society, therapists have also reported a rise in the number of clients seeking services for game-related concerns (Young, Pistner, O'Mara, & Buchanan, 1999). Several papers have highlighted case studies of patients who experience addiction-like symptoms that include rich anecdotal examples of tolerance, withdrawal, and so forth (Chappell, Eatough, Davies, & Griffiths, 2006; Griffiths, 2000). However, such studies offer little in the way of nomothetic data, and while several empirical studies do exist (e.g., Salguero & Morán, 2002), Griffiths and Meredith (2009) succinctly sum of the current state of the videogame addiction literature with the following quote: "To date, there has been very little

research directly investigating videogame addiction" (p. 248). Further, many of the prevalence rates for PVGP are obtained specifically with children or adolescents, ranging from 5% to 19.9 % (Gentile, 2009; Gentile et al., 2011; Griffiths & Hunt, 1998; Thomas & Martin, 2010). One of the only known studies to calculate prevalence in adults reported a rate of 12% (Grüsser, Thalemann, & Griffiths, 2007). These numbers vary widely, partly due to the fact that "[videogame] research itself is inconsistent in its definition of problematic gaming" (Petry, 2010, p. 213), potentially confounding the results of various studies. As an example, Mentzoni and colleagues (2011) reported that while 4.1% of individuals experienced problematic videogame use, only 0.6% met their criteria of addiction. Thus, the way in which "problematic" or "addiction" are defined has major implications in terms of prevalence estimates. Given that "there are not yet any clearly defined or well-established clustering of symptoms that characterizes gaming 'addiction'" (Petry, 2010, p. 213), researchers often develop criteria that answer their specific empirical questions without an appreciation for the larger research community.

Blaszczynski (2008) has noted that simply experiencing negative consequences from excessive playing, which is the common focus of current literature, is not sufficient for addiction. He argues that impaired control (e.g., difficulty stopping the behavior despite motivation to do so), which is central to the concept of addiction, has not been effectively demonstrated. Referencing internet addiction, Shaffer, Hall, and Vander Bilt (2000) argue that so-called technological addictions may represent manifestations of other disorders or maladaptive patterns and are not necessarily unique psychiatric conditions. Similarly, Gentile et al. (2011) found that lower social competence and greater impulsivity predicted the onset of problematic videogame playing during a two-year longitudinal study, suggesting that gaming may have served as a social

medium in which it was easier to interact with others. Online gamers in a study by Ng and Wiemer-Hastings (2005) indicated they "have more fun with in-game friends than people they know, found it easier to converse with people while in-game, did not find social relationships as important, and felt happier when in the game than anywhere else" (p. 112), mirroring results reported by Hussain and Griffiths (2009), and further lending support to the notion that socializing via the videogame may be more reinforcing and less anxiety provoking for some individuals. Lastly, Jaffe (1990) expresses concerns about the trivialization of the term "addiction" when used for a variety of behaviors. However, it should be noted that a cursory review of the specific criteria for substance dependence in DSM-IV-TR (APA, 2000) or substance use disorder in DSM-5 (APA, 2013) suggests that adaptations could be made to symptoms for use in assessing PVGP, although this will be more fully discussed later in this paper.

Not all behavioral addictions raise such concern among dissenters, particularly with regard to problematic gambling. Comprising the bulk of the available literature on pathological "game" playing, gambling not only provides interesting insight into potential future directions for videogame researchers, but also findings may have direct implications, given that some gambling activities are akin to videogames. Griffiths and Meredith (2009) have even argued that "videogames and slot machines have more inherent similarities than differences" (p. 247). Thus, an overview of the pathological gambling literature will be provided as a roadmap for how the videogame field can better empirically establish itself.

Pathological Gambling as a Behavioral Addiction

In many ways, problematic gambling has been suffering from a diagnostic identity crisis within the past few years. In DSM-IV-TR (APA 2000), Pathological Gambling was classified as

an “Impulse-Control Disorder” and consisted of symptoms highlighting preoccupying thoughts, increasing the amount of money gambled for desired excitement, unsuccessful efforts to curtail gambling and resultant restlessness or irritability, use of gambling as an escape, chasing of losses, concealing level of involvement, committing illegal acts to finance gambling, loss of relationships or opportunities, and relying on others for financial assistance. Interestingly, although this conceptualization of gambling has existed largely unmodified for over 30 years (APA, 1980), the DSM-5 has shifted problematic gambling to align more closely with substance use disorders (SUDs). Specifically, the SUDs Workgroup suggested that disordered gambling join other dependence disorders in the “Addiction and Related Disorders” category (O’Brien, 2011). Further, the proposal recommended the removal of the aforementioned criterion related to committing illegal acts and an overall reduction in the necessary number of criteria from five to four (Petry, 2010). Such alterations represented an ideological shift in the concept of “addiction” away from purely physiological dependence, allowing for behavioral addictions to be examined and appreciated as potentially having similar underlying mechanisms and adverse consequences as their substance-related cousins. In fact, the current version of DSM (DSM-5; APA, 2013) now classifies Pathological Gambling as an Addictive Disorder under its new diagnostic name of “Gambling Disorder.” The literature examining pathological gambling will be outlined below, as it sheds an important light on behavioral addiction that has direct implications for understanding problematic videogame playing. The term “pathological gambling” will still be utilized for research that assessed participants via the aforementioned DSM-IV-TR criteria.

One of the strongest arguments for gambling being an addiction is the presence of tolerance and withdrawal symptoms, generally considered core components of the cycle of

addiction (Bozarth, 1994; WHO, 1993). As noted above, the DSM-IV-TR (APA, 2000) defines tolerance as a need to increase the amount of money used in order to achieve the same level of arousal and withdrawal as anxious or irritable feelings that manifest when trying to cut down or stop gambling (Wareham & Potenza, 2010). In addition, the increased level of parasympathetic arousal experienced by problem gamblers while engaging in the activity (Sharpe, Tarrier, Schotte, & Spence, 1995) could be likened to the "high" of substances that perpetuates use, suggesting that models of drug tolerance and withdrawal may at least partially translate to gambling. In terms of symptom prevalence, Toce-Gerstein, Gerstein, and Volberg (2003) report that for high-severity pathological gamblers (persons who have risked a job/relationship or committed illegal acts to finance gambling), 88.9% endorse symptoms of withdrawal and 83.3% indicate tolerance. For individuals still meeting criteria for pathological gambling but representing a low-severity group, rates were 64.4% and 46.7% respectively. Similarly, Blaszczynski and colleagues (2008) report that 71.4% of their sample endorsed the DSM-IV-TR criterion related to tolerance, with the number increasing to 85.7% when the word "excitement" was replaced with "effect." In terms of withdrawal, 66% of pathological gamblers noted restlessness and irritability when trying to cease gambling, although other withdrawal-like symptoms were common, such as general discomfort (72.2%), depression (72.2%), headaches (66.6%), and distrust of others (61.1%). Taken together, these numbers suggest that tolerance and withdrawal are common features of the symptom presentation of pathological gamblers.

However, despite the aforementioned rates of symptom endorsement, it should be noted that differences may still exist between more traditional addictive disorders and pathological gambling. For example, Orford, Morison, and Somers (1996) assessed problematic drinkers using the Severity of Alcohol Dependence Questionnaire (SADQ; Stockwell et al., 1979) and

problem gamblers using a modified version of the SADQ that incorporated gambling-relevant language. Results suggested that gamblers had significantly lower levels of psychological and physical withdrawal symptoms, with 75% of problem gamblers falling in the "very moderate" or "low" dependence categories. Additionally, when pathological gamblers who increased their bet size were asked the primary reason for doing so (Blaszczynski et al., 2008), 69.2% of individuals reported a desire for bigger wins or for changing their luck, which the authors posit is "more consistent with a cognitive rather than an addiction interpretation of gambling" (p. 188). However, it could be argued that individuals with substance dependence may lack insight into their behaviors and could respond in a similar fashion, such as alcoholics who report that they "drink to be more social" or "to have a good time." Thus, such responses from problematic gamblers may reflect cognitive misattributions that do not relate to the unconscious mechanisms of addiction driving behavior. Regardless, while the diagnostic descriptions in the DSM-IV-TR may have some linguistic overlap, the underlying symptomatology and centrality of particular criterion may differ, although this is unclear with the current state of the literature.

Given that pathological gambling was formerly classified as an Impulse-Control Disorder, it is expected that impulsivity would be associated with diagnosis. However, impulsivity is also a central feature of addiction (Goldstein & Volkow, 2002; Jentsch & Taylor, 1999) and appears in the users of a variety of substances (Verdejo-Garcia et al., 2008). Thus, understanding the way in which impulsivity manifests across disorders can help to detect similarities and differences between them. Interestingly, in a study by Lawrence et al. (2009), when alcohol dependent individuals were compared to pathological gamblers, both groups featured elevated trait impulsivity over controls using a self-report measure, but only the alcohol users presented with response inhibition on neurocognitive tasks. Ledgerwood and colleagues

(2009) similarly found that pathological gamblers did not differ from nongamblers on a task of response inhibition even though they reported difficulty planning, acting on the spur of the moment, and preferred small immediate rewards over large distant ones.

In contrast, other authors have demonstrated that pathological gamblers experience longer reaction times (Goudriaan et al., 2006; Grant et al., 2010) and more commission errors on tasks of response impulsivity (Fuentes et al., 2006; Goudriaan et al., 2005), which corresponds to findings in the substance use literature (Fillmore & Rush, 2002; Kamarajan et al., 2005; Li et al., 2006; Monterosso et al., 2005). Neuropsychological studies have also suggested similar areas of activation with regard to impulsivity for pathological gambling and substance use, such as the frontal cortical and striatal regions (Brewer & Potenza, 2008; Everitt & Robbins, 2005; Fineberg et al., 2010; Kalivas, 2009; Volkow et al., 2007), as well as decreased D2/D3 (dopaminergic) autoreceptor activity (Buckholtz et al., 2010; Campbell-Meiklejohn et al., 2011; Schultz, 2011) and serotonergic activity in the ventral cortico-striatal circuitry (Fineberg et al., 2010). Further, the opioidergic and glutamatergic systems also appear to relate to substance use and pathological gambling (Grant et al., 2007; Kalivas, 2009; Volkow, 2010). Lastly, medications used to treat substance use disorders, such as acamprosate (which is a glutamate agonist and GABA antagonist), seem beneficial in the treatment of gambling addiction (Black et al., 2011). Thus, while some conflicting studies exist (e.g., Lawrence et al., 2009; Ledgerwood et al., 2009), the connections between pathological gambling and substance use at both the behavioral and physiological levels appear likely. Further, it is also possible that some of the observed differences relate to the lasting effects of substance use (Potenza, 2009) and not the mechanisms of addiction. Additionally, "few studies distinguish between impulsivity as a single construct and impulsivity as one of a range of multiple facets of risk-taking that manifests in a single

behavioural episode or a range of recurrent appetitive behaviours" (Nower & Blaszczynski, 2006, p. 62), suggesting that operational definitions and methodological variance may also explain some of the disparities between research results.

While many distinct disorders have high comorbidities, such as the connection between mood and anxiety disorders (Brown & Barlow, 1995; Brown et al., 2001), diagnostic overlap can serve as a form of convergent validity. If substance use and gambling do represent different manifestations of similar underlying mechanisms, there should logically be comorbidity between these diagnoses as well. In fact, within the pathological gambling community, between 33.3% (Ibanez et al., 2001) and 73.2% (Petry et al., 2005) excessively drink alcohol, 38.1% meet criteria for substance abuse (Petry et al., 2005) with 31% having a history of substance abuse treatment (Ladd & Petry, 2003), and 60.4% experience nicotine dependence (Petry, Stinson, & Grant, 2005), with cigarette use being associated with higher gambling severity (Petry & Oncken, 2002). Conversely, about 29% of those who abuse substances also meet criteria for pathological gambling (Shaffer, Hall, & Vander Bilt, 1999); specifically, rates are 24% for those who abuse marijuana (Toneatto & Brennan, 2002), between 16 – 18% for those who abuse opiates (Lesieur et al., 1986; Spunt et al., 1995), 17.7% among members of a methadone maintenance program (Ledgerwood & Downey, 2002), around 14 – 15% for those who abuse cocaine (Lesieur et al., 1986; Steinberg et al., 1992), and 13% for alcohol dependent patients (Elia & Jacobs, 1993). Additionally, both gamblers and those who abuse drugs are more at risk for developing the other disorder (Vitaro et al., 1998), and an additive effect has been demonstrated, such that individuals who meet criteria for both substance use disorders and pathological gambling are more impulsive than individuals with either disorder alone (Petry, 2001; Vitaro et al., 1998). Lastly, individuals consuming alcohol while gambling were more

likely to develop pathological gambling than non-drinking gamblers (Welte, Barnes, & Tidwell, 2004). Although conflicting results exist regarding which disorder precedes the other (e.g., Cho et al., 2002; Hall et al., 2000), it seems clear that addictions to gambling behaviors and psychoactive substances commonly overlap and may exacerbate each other.

In their assessment of the literature from just over 10 years ago, Moreyra and colleagues (2002) concluded that "research from different areas seems to suggest that a majority of pathological gamblers have characteristics that resemble those of substance abusers" (p. 164). Additionally, Shaffer et al. (2004) have proposed a "syndrome model" of addiction that highlights the fact that various addictions, including substance use and pathological gambling, share neurobiological and psychosocial antecedents that follow similar pathways to addiction. In this model, the exposure to and subsequent interactions with a particular object or activity, coupled with underlying vulnerabilities, can eventually lead to problematic usage. Each type of addiction has both common outcomes (e.g., tolerance, withdrawal, psychopathology, deviancy, relapse, etc.) and unique sequelae (e.g., gambling debt vs. liver cirrhosis). Thus, according to this model, not only would pathological gambling be conceptualized as an addiction, but so would other behaviors, such as videogame playing.

Electronic and internet gambling. Although gambling machines have existed since 1895 (Holmes, 1985), many modern machines are operated via computerized terminals (Boyle, 1998) that more closely resemble a videogame than a traditional slot machine. As such, exploring the unique differences of electronic gambling has direct implications for bridging the gap between the aforementioned gambling research and the concept of videogame addiction. Interestingly, electronic gambling actually leads to problematic usage more often than other forms of gambling (Doughney, 2002; Echeburúa et al., 1996; Smith & Wynne, 2004; Turner &

Horbay, 2004; Volberg, 1997; Wynne, 2002), with the average progression from normative gambling to pathological levels taking 1.08 years as compared to 3.58 years for other forms of gambling (Breen & Zimmerman, 2002). There are a variety of characteristics unique to electronic gambling that may lead to the formation and maintenance of pathological usage (Delfabbro & Winefield, 1997), such as the illusion of control. Specifically, electronic machines often have a variety of play features, buttons/levers, and options that provide the player with an illusory sense of control and personalization (Dickerson, 1993, 1996; Fabian, 1995; Griffiths, 1993, 1999a). Additionally, electronic gambling has the shortest interval between placing a bet and receiving the outcome (Korn & Shaffer, 1999; Smith & Wynne, 2004), with virtual reel spins lasting typically between three and five seconds (Echeburúa et al., 1996; Fisher & Griffiths, 1995). Similarly, payout intervals are just as quick, with many machines allowing for the dispersion of money with the press of a button (Griffiths, 1993), which "provides little time for reflection on losing, allows no respite from play and allows immediate replay on winning" (Dowling, Smith, & Thomas, 2005, p. 40).

This fast pace of electronic gambling machines may be a crucial aspect of their addictive potential, as slowing down the process leads to less subjective enjoyment and less difficulty stopping for pathological gamblers (Blaszczynski et al., 2001; Loba et al., 2001). This is likely due in part to the fact that electronic machines produce more frequent wins than traditional gambling, albeit in smaller payouts (Blaszczynski et al., 2001). In fact, the winning amount is typically lower than the initial bet placed by the user (Griffiths, 1993), although auditory and visual effects make winning more reinforcing and obscure this fact (Fisher & Griffiths, 1995). Thus, many of the advantages of the electronic medium may actually increase the potential for abuse among gamblers. This is notable, given that many of the aforementioned features exist

within videogames, such as immediate feedback to the player, personalization and a sense of mastery, frequent (non-monetary) rewards, quick game play, and an exciting audiovisual experience.

Even more recently, gambling has moved directly into the home and workplace environments via online gambling (Griffiths & Parke, 2002). As access to the internet has grown significantly in the past several decades, so too has the online gambling market, with "the number of gambling websites… [growing] from about 15 in 1995 to 2,358 in 2010. Global Internet gambling revenues have increased from $3 billion in 2000 to $24 billion in 2010" (Kairouz, Paradis, & Nadeau, 2012, p. 175). Unsurprisingly, several studies have found higher rates of pathological gambling in online gamblers when compared to their offline counterparts (Kairouz et al., 2012; Ladd & Petry, 2002; Wood & Williams, 2007, 2011). Griffiths (2003) has conjectured that the affordability of internet services, the anonymity provided by the online environment, the convenience and comfort of gambling from home, and the disinhibition effect of the internet (Joinson, 1998) all contribute to the higher addictive potential of online gambling. Further, studies of traditional gambling have shown that problematic users are more likely to play alone as an escape behavior (Griffiths, 1990, 1995), which is notable given that virtually all online gambling and videogame playing is conducted in isolation.

Several studies have specifically examined the differences between online and offline gamblers. For example, Kairouz and colleagues (2012) found that online gamblers were more likely to be male, younger, single, and problematic alcohol or cannabis users. Additionally, online players engaged in a more diverse array of gambling activities, bet more frequently, spent more money annually, and had longer gambling sessions than offline users. In contrast, Gainsbury et al. (2012) found no significant difference in age between the types of gamblers and

reported a higher rate of marriage among online gamblers. However, occasional substance use was higher for online gamblers, and further comparisons were provided, such as online users having higher incomes, more full-time employment, and more positive gambling attitudes. Using a large international sample, Wood and Williams (2011) found online gamblers were more likely to be male, younger, single, employed full-time, a student, and have a higher household income. Further, higher rates of substance use (tobacco, alcohol, "street drugs") were noted as well. Gamblers who use the internet as their method of engagement also have significantly higher rates of problematic internet use as well (Tsitsika et al., 2011). Taken together, it appears that online gambling attracts a different demographic and is associated with more cross addictions to substances or other forms of internet use. Given this group's proclivity for using more than one addictive medium (substances and gambling) and enjoyment of online electronic entertainment (both gambling and internet use), it is possible that PVGP may manifest more frequently in such individuals, although no such research exists as of this writing.

The investigations of online gambling are particularly relevant for videogame research, as the line between the two is blurry. For example, in an investigation of adult online gamblers, 75% of participants utilized internet gambling videogames that did not involve gambling with money (McBride & Derevensky, 2009), which can yield similar problems to monetary gambling (Johansson & Götestam, 2004). Further, individuals can purchase or download casino games (e.g., blackjack, poker, etc.) as standalone videogames on their computers or game consoles (King, Delfabbro, & Griffiths, 2010). Some traditional videogames even include gambling-like activities in their retail package. King and colleagues (2010) note that games like *Fable 2* and *Grand Theft Auto: San Andreas* allow the in-game character to initiate gambling activities that win in-game currency to be used in other aspects of the game world. Since the publication of

that article, additional game releases with similar features demonstrate that gambling mini-games will likely continue to be included in future entertainment software. Thus, not only does the study of gambling provide insight into problematic videogame playing, the two may actually intersect in one software package.

Structural Characteristics of Gambling and Videogames

Based on the gambling literature highlighted above, it is clear that behavioral addictions have similar characteristics to substance use disorders, and models for these pathways set the stage for conjecture about how other behaviors may be similarly addictive. However, videogames are not simply another activity that can produce addictive behaviors, such as shopping (Hartston, 2012); instead, videogames directly share some characteristics with gambling. For example, Fisher and Griffiths (1995) highlight several overlaps which are succinctly recapped by Wood and colleagues (2004), including:

> the requirement of responses to stimuli that are predictable and governed by the software loop… the requirement of total concentration and hand-eye coordination… rapid span of play negotiable to some extent by the skill of the player… the provision of aural and visual rewards for a winning move… the provision of an incremental reward for a winning move (points or cash) that reinforces "correct" behavior… digitally displayed scores of "correct behavior"… [and] the opportunity for peer group attention and approval through competition. (Wood et al., 2004, p. 2)

Thus, videogames may operate in a similar fashion to electronic gambling using analogous reinforcement schedules (Griffiths, 2002), except with payouts of points or social recognition (Karlsen, 2011) instead of money. Additionally, using interview data with *World of Warcraft* players, Karlsen (2011) demonstrated that players succumbed to both entrapment and "near

miss" principles, which have been previously discussed in the gambling literature. Entrapment refers to "the point at which, despite mounting losses, players feel obliged to continue betting… through some internal sense that they have gone too far to give up now" (Rogers, 1998, p. 120). In *World of Warcraft*, players continued to "raid" with their companions for fear that particular items would appear without them present, especially given the amount of time already invested. A "near miss" refers to a situation in which the player has lost but interprets it as being close to a win (Griffiths, 1999b), prompting continued play. Karlsen (2011) provided several examples in which players continued to play far past their originally intended amount of time due to a win being perceived as imminent. One notable quote comes from an individual who indicated that he "struggled a bit" (p. 203) the night prior when referencing a gaming session that was extended by 4 hours.

In an attempt to identify the psycho-structural characteristics unique to videogame playing, Wood and colleagues (2004) designed a survey using the following techniques for item construction: reviewing the aforementioned gambling literature, speaking with gamers, inspecting the current empirical literature on videogames, and playing games firsthand. The primary categories assessed consisted of sound (sound effects, speaking characters, background music, narration), graphics (realistic graphics, cartoony graphics, full motion video), background and setting (based on an existing story, realistic or fantasy settings), duration of game (long, medium, or short), rate of play (absorption rate), advancement rate (how fast the game play advances), use of humor, control options (player adjustable difficulty, controls, etc.), game dynamics (exploration, quest fulfillment, collecting items, puzzle solving, etc.), winning and losing features (especially points), character development (customization options), brand assurance (brand loyalty), and multiplayer features (online vs. local, cooperative vs.

competitive). Results from online administration of the survey demonstrated that participants placed the highest importance on realistic sound, graphics, and setting. This suggests that for many gamers, realistic, high quality experiences are more attractive and potentially more addicting. Interestingly, when females were analyzed separately (due to their underrepresentation in the general sample), results indicated that women were more likely to prefer nonviolent, less competitive, gentler-paced, cartoon-style games that involve fantasy instead of realism. Thus, gender differences may also exist regarding what is valued most from a gaming experience.

King, Delfabbro, and Griffiths (2010) have since expanded upon Wood et al.'s (2004) taxonomy by addressing some of its limitations, such as refining variables that were difficult to operationalize and better incorporating gambling structural characteristics (e.g., Parke & Griffiths, 2007). Further, King and colleagues (2010) noted that their classifications were designed to help future researchers identify the factors that contribute to problematic videogame playing. This model consists of the following five features and their respective sub-features: Social Features (social utility features, social formation/institutional features, leader board features, support network features), Manipulation and Control Features (user input features, save features, player management features, non-controllable features), Narrative and Identity Features (avatar creation features, storytelling device features, theme and genre features), Reward and Punishment Features (general reward type features, punishment features, meta-game reward features, intermittent reward features, negative reward features, near miss features, event frequency features, event duration features, payout interval features), and Presentation Features (graphics and sound features, franchise features, explicit content features, in-game advertising

features). King et al. (2010) provide a detailed account of each category, including relevant literature, although no empirical study was conducted, nor was a specific measure included.

However, in a follow-up paper by the same authors, King Delfabbro, and Griffiths (2011) assessed videogame players recruited via online advertisements using what they named the Video Game Structural Characteristics Survey, a 37-item self-report measure based on the aforementioned taxonomy. Participants were asked to rate how much they enjoyed each feature, the overall importance of each feature, and how much that feature related to time playing games, yielding 111 different variables (37 items for each of the three structural characteristics). Results of *t*-test comparisons of problematic and non-problematic players (as measured by the Problematic Video Game Playing Test; King, Delfabbro, & Zajac, 2011) indicated 46 factors that significantly differed between the groups, although only the top 15 were explicitly discussed. However, it should be noted that Bonferroni corrections were not utilized to counteract this large number of comparisons. Problematic players appeared to have higher enjoyment of adult content, finding rare items, watching cut-scenes, and the tactile sensation of the controller. They further reported managing in-game resources, earning points, getting 100% in the game, and mastering the game as the most important aspects. Lastly, leveling up, earning meta-game rewards, and fast loading times had the greatest behavioral impact with regard to length of play.

Although the Video Game Structural Characteristics Survey requires psychometric validation and replication is sorely needed, this study represents one of the first attempts to determine which specific aspects of videogames may differentiate problematic players from normative videogamers. This is especially important with modern videogames that no longer mirror real-world "games" with opponents trying to beat each other and instead represent alternate realities in which players reside. Critics of the concept of videogame addiction have

specifically argued that these digital playgrounds are too complicated to manifest a simple behavioral addiction analogous to gambling. For example, when referencing his alcoholic mother, Castronova (2005) stated, "Now suppose she had been addicted to EverQuest. To me, that sentence, in comparison to alcohol addiction, sounds like someone suggesting: What if your mother was addicted to France instead of alcohol?" (p. 65). Thus, attempts at understanding which features relate to problematic play can help quell these concerns and aid in diagnostic understanding.

In addition to conceptualizing problematic videogame play as a homogenous entity, the taxonomy by King Delfabbro, and Griffiths (2010) was also used to identify subgroups of videogame players. Specifically, Westwood and Griffiths (2010) constructed a Q-sort that was completed by participants recruited via online forums. Results of a Q-factor analysis, which groups participants and not items, yielded six factors, labeled as the Story-driven Solo Gamer, the Social Gamer, the Solo Limited Gamer, the Hardcore Online Gamer, the Control/Identity Gamer, and the Casual Gamer. Each factor consisted of a cluster of items that comprised the latent class and helped to qualitatively describe group members. For example, the story-driven solo gamer preferred new HD graphical, story-driven, single-player games; whereas, the casual gamer played short games or mission-based games that could fit into their lives (only played when they had free time and did not return to the game quickly when interrupted). This categorization of individuals represents the other side of the taxonomic coin; in addition to specific features of games potentially leading to problematic usage, an interaction between the particular player and those features may actually better account for why some individuals develop pathological game playing behavior. For example, a social gamer who views gaming as his primary social activity and feels a sense of competition is likely to become engrossed in an

entirely different experience than a story-driven solo gamer who prefers to play alone for personal fulfillment and does not compare his/her progress with others. Although compelling, these categories warrant further investigation, not only to determine the validity of the classification system, but also to understand other personal characteristics of members within each group, such as comorbid issues, personality features, and other potentially distinguishing variables.

In addition to taxonomies developed by researchers, videogames are actually classified within particular genres by the industry, and gamers often use these categories to determine which titles to buy. However, only one study to date has investigated PVGP in terms of genre preference (Elliot et al., 2012). Specifically, the authors asked 3,380 participants to indicate which game they played the most in the past year. Using an existing online game database, all titles were categorized into one of fifteen genres for comparison purposes (see Table 1). Results demonstrated that the highest rates of PVGP were present in gamers who most played first-person shooter (FPS), action-adventure, massively multiplayer online role-playing game (MMORPG), or gambling games as compared to the other genres. Further, MMORPG players had the highest rates of PVGP, which is consistent with previous studies highlighting the addictive potential of such online worlds (Boellstorff, 2008; Griffiths, Davies, & Chappell, 2004; Taylor, 2006). Thus, while additional research is needed, Elliot and colleagues' findings (2012) suggest that particular types of games may lead to higher rates of PVGP. However, whether an interaction between personal characteristics and game genre exists is unknown.

Table 1

Primary videogame genres

MMORPGs	Players develop a character and interact collaboratively and competitively in a shared online world.
Other role playing	Games rich in narrative, with usually a single player. Success depends on developing and managing characters with skills suited to achieving objectives.
Action adventure	Games oriented toward combat and exploration, mostly in third-person perspective.
First-person shooter (FPS)	Kill-or-be-killed games from the player's eye view.
Other shooter	Shooting games in third-person perspective.
Sports general	Sports and workout games usually involving an interactive motion controller.
Sports other	All other sports games, mostly realistic simulations of team sports.
Rhythm	Music and dance games often involving a unique controller similar to a guitar or dance pad.
Driving	Primarily racing games.
Platformer	Games requiring precision movement and jumping.
Real-time strategy	Strategic combat-oriented games with no wait between moves.
Other strategy	Turn based (i.e., waiting on the player to act) and other forms of strategic simulation.
Puzzle	Games involving matching, logic, deductive reasoning, and other puzzles.
Board and card games	Simulations of primarily classic games without gambling.
Gambling	Primarily simulations of Poker, Black Jack, and slot machine gambling.
Other	All genres with fewer than 30 reported cases.

Reprinted from "Video Game Genre as a Predictor of Problem Use," by L. Elliot, A. Golub, G. Ream & E. Dunlap, 2012, *Cyberpsychology, Behavior, and Social Networking*, 15, p.156. Copyright 2012 by Mary Ann Liebert, Inc.

Assessing PVGP

As with any young area of study, early videogame researchers had to create their own measures in order to assess variables of interest (e.g., Chiu et al., 2004; Ng & Wiemer-Hastings, 2005). Thus, a variety of scales have been developed using the existing diagnostic criteria of

other disorders from the DSM (Fischer, 1994; Griffiths, 1997; Griffiths & Dancaster, 1995) or ICD-10 (Grüsser et al., 2007; Thalemann, Wolfing, & Grüsser, 2007). However, as the empirical landscape of PVGP has begun to flourish, several measures have surfaced as either the most frequently used or the most psychometrically validated. The steps that the authors took to construct each measure, their similarity to existing disorders of addiction, and extant psychometric data for the most significant scales will be discussed below.

Problematic Videogame Play (PVP). Developed by Salguero and Morán (2002), the PVP is the English-translated version of a 9-item Spanish self-report measure developed through the evaluation of the criteria for pathological gambling and substance dependence. Five of the items address tolerance, withdrawal, family/school disruption, and loss of control with regard to stopping or cutting back, which are jointly present for both pathological gambling and substance dependence. Additionally, one item assesses the level of preoccupation with videogames, similar to the first criterion for pathological gambling. This differs from substance dependence in that rather than examining how much time is spent performing the activity, the PVP preoccupation item solely pertains to thinking about games ("When I am not playing with… videogames, I keep thinking about them"). However, this more closely aligns with a criterion for SUD in DSM-5 related to cravings, considered to be a strong desire or urge to use the substance. Thus, preoccupation in pathological gambling may be analogous to craving in substance use disorder.

Another question captures the pathological gambling criterion related to using the behavior as an escape or mood regulator. An item pertaining to concealing videogame playing from others appears similar to the pathological gambling criterion assessing whether individuals lie to family members about their playing in order to conceal the level of involvement. However,

a different question examines the extent to which individuals disregard physical and psychological consequences, similar to SUD, except this PVP item also includes lying or stealing as examples. Thus, this question appears to jointly assess the pathological gambling criteria related to lying, as previously mentioned, as well as committing illegal acts. An individual who lies to friends in order to conceal his/her use, for example, may actually endorse two PVP questions ("Sometimes I conceal my video game playing to others…" and "In order to play video games I have skipped classes or work, or lied, or stolen, or had an argument or fight with someone") when meeting only one criteria for pathological gambling ("Lying to family members, therapist, or others to conceal the extent of involvement"). Further, this item is too broad, making it unclear if the individual has skipped classes, gotten into physical altercations, or just simply been untruthful with regard to time spent playing.

Worse yet is that the PVP is dichotomously scored as either "yes" or "no" (Salguero & Morán, 2002). Thus, any PVP item marked positively translates into that person meeting the criterion due to the brevity of the measure. Further, the dichotomous nature of the variables does not allow for any appreciation of the level of severity of a given individual, potentially providing diminished clinical utility. Despite these criticisms, the PVP appears to have high internal consistency with adolescents from Spain (Salguero & Morán, 2002), France (Parker et al., 2008), and the United States (Hart et al., 2009). Convergent validity with a measure of substance dependence, the Severity of Dependence Scale (SDS; Gossop et al., 1995), has also been demonstrated by the measure's authors (Salguero & Morán, 2002).

Video-Game Use (VGU). The VGU is an 11-item scale based on the DSM-IV criteria for pathological gambling (Gentile, 2009). However, several modifications have been made; for example, no item exists regarding chasing one's losses (represented in pathological gambling as

trying to get even after losing money). Further, the VGU separately assesses whether an individual has skipped household chores, skipped doing homework, or done poorly on a school assignment because of excessive play. This emphasis on particular activities related to chores and school clearly demonstrates that the VGU was designed with adolescents in mind. Further, while the author notes that the criteria "share core characteristics with other definitions of addictions, such as Brown's core facets of addition (Brown, 1991)" (Gentile, 2009, p. 595), this appears to relate more to the criteria of pathological gambling than the measure itself. Slightly improved over the PVP, each item is scored on a three-point scale ("yes," "no," or "maybe"). Having administered the measure to 1,178 adolescent Americans, Gentile (2009) reported internal consistency at $\alpha = .78$.

Game Addiction Scale for Adolescents. In an effort to avoid the commonly used method of simply adapting pathological gambling criteria for applicability to videogames, Lemmens, Valkenburg, and Peter (2009) instead focused on aspects of game addiction that have been outlined in the components model of addiction (Brown, 1991), including salience (importance of videogames in the person's life; includes preoccupation, cravings, and excessive behavior), tolerance, mood modification (either euphoria or escapism), withdrawal, relapse, conflict (including arguments or lies/deception), and problems (including intrapsychic conflict or external conflict, such as with school or socializing). Devising a 21-item measure rated on a 5-point Likert scale, the authors performed structural equation modeling (SEM) to test if the higher-order factor of "game addiction" could be explained by the aforementioned seven second-order factors. Results from a multiple-sample analysis (using two independent samples) suggested acceptable fit for both (CFI = .90, RMSEA = .08 and CFI = .90, RMSEA = .05). The internal consistencies were $\alpha = .94$ and $\alpha = .92$ respectively. Interestingly, the authors also

created a Short Version, consisting of only one item for each second-order factor (e.g., one item for salience, etc.). Results of an SEM yielded good model fit (CI = .97, RMSEA = .05) and internal consistency (α = .86). In order to determine convergent validity, the authors also correlated both the 21-item and 7-item versions with measures of time spent playing, loneliness, life satisfaction, social competence, and aggression (Lemmens, Valkenburg, & Peter, 2009). The long and short versions were strongly correlated with total time spent playing (*r*s = .58) and moderately correlated with the psychosocial variables (*r* = -.19 to .34 and *r* = .18 to .31 respectively). Overall, the results of this study suggest that the Game Addiction Scale for Adolescents potentially captures the unidimensional construct of videogame addiction more effectively than previously discussed questionnaires. However, further research is necessary to determine its applicability to adults.

Problem Video Game Playing Test (PVGT). When creating a new PVGP measure, King, Delfabbro, and Zajac (2011) examined the growing literature on internet addiction instead of pathological gambling, adapting the Internet Addiction Test (IAT; Young, 1998) to better fit the vernacular associated with videogames. Although internet addiction is also not classified in the DSM-IV-TR (APA, 2000) and thus will not be examined within this paper, diagnostic criteria have been outlined (Beard & Wolf, 2001) and conceptualizations for clinical practice developed (Young, 2004; Young, 2009). However, as with the PVGT literature, there are critics of the concept of internet usage as an addiction (Yellowlees & Marks, 2005). Regardless, the PVGT retains the 20-item, 5-point Likert responding format of the IAT, assessing individuals using the components model of addiction (Brown, 1991) discussed above (salience, mood modification, withdrawal, tolerance, relapse, and conflict). This more closely aligns with the diagnostic criteria for gambling addiction, except for the removal of engaging in criminal activity as a

criterion. In an effort to psychometrically validate the PVGT, King and colleagues (2011) examined two samples of individuals, obtaining high internal consistency values for both (α = .93 and .92). In sample one, PVGT scores were significantly correlated with total weekly time playing videogames (r = .45, p < .01), session length (r = .28, p < .01), and an adapted form of the DSM-IV criteria for pathological gambling (r = .40, p < .01). In sample two, the score distribution suggested that the IAT's cutoff of 40 (Young, 1998) to determine problematic usage is likely applicable to the PVGT. Further, construct validity was demonstrated with weekday time playing (r = .41, p < .01), weekend time playing (r = .44, p < .01), total playtime (r = .50, p < .01), as well as with the DASS subscales for depression (r = .18, p < .01), anxiety (r = .29, p < .01), and stress (r = .22, p < .01).

Additionally, an exploratory factor analysis (EFA) was conducted on the first sample, yielding a one-factor solution. A follow-up confirmatory factor analysis (CFA) tested this model, generating good model fit (TLI = .98, SRMR = .06). A similar CFA on the second sample generated comparable results (TLI = .96, SRMR = .07), suggesting that the PVGT is tapping into a unidimensional construct of PVGP that correlates with the symptoms of pathological gambling when adapted for videogames.

Problematic Video Game Play - Revised (PVGP-R) Scale. The PVGP-R (Tolchinsky, 2013) is an update to the PVGP scale created by Tolchinsky and Jefferson (2011). This original form of the measure was developed by modifying the aforementioned PVP scale (Salguero & Morán, 2002) to improve its characteristics while still retaining its convergence between substance dependence and pathological gambling. Specifically, the authors adopted a 5-point Likert scale for responding in place of the older dichotomous system. Further, double-barreled questions were modified to increase the interpretability of individual items. Lastly, items were

rephrased to ensure that videogame play served as the antecedent for all assessed effects. This is especially important, given that the PVP had included items that were written with game play as the response to other variables (e.g., "When I feel sad, I play more video games."). Phrased in this way, the item assesses videogame play as a reaction to feelings of sadness (which may suggest other symptomatology, such as social isolation). By rephrasing this question (Item 12: "When I play video games, it makes my sadness go away"), the alleviation of sadness is more clearly a consequence of the game play behavior.

An initial examination of the PVGP with college students yielded an internal consistency value of $\alpha = .92$. More recently, the primary author of the PVGP expanded upon the original measure to better capture symptom manifestation and associated features of PVGP (Tolchinsky, 2013). This revised version, known as the PVGP-R, consists of 27 items comprising 6 subscales (Psychological Dysfunction/Addiction Criteria, Mood Regulation, Physical Dysfunction, Concealing Behaviors, Failure to Limit Play, and Time Management Difficulties). Internal consistencies for each subscale ranged from $\alpha = .76$ to $\alpha = .85$.

Modifying PVGP Assessment

As indicated above, many of the primary measures of PVGP utilize pathological gambling symptomatology as a model for how to effectively assess behavioral addiction. However, none actually attempted to adapt an existing pathological gambling measure, which would allow for direct comparison between videogames and gambling, as well as provide some hypotheses about psychometric properties. Thus, the primary questionnaire for assessing pathological gambling will be discussed below in an effort to determine its possible utility with regard to PVGP. Further, the potential for using the DSM-5 criteria for substance use disorders as a model from which to adapt PVGP will also be explored.

South Oaks Gambling Screen (SOGS). The most commonly utilized measure in the literature, the SOGS (Lesieur & Blume, 1987) is a 20-item questionnaire based on the DSM-III (APA, 1980) criteria for addiction. However, the SOGS serves primarily as a screening tool and not as a diagnostic indicator. Specifically, dichotomous items (answered as "yes" or "no") assess whether the individual has gambled more than they intended to, been criticized for their betting, felt guilty about gambling, tried to stop but been unable, hidden signs of gambling, argued with people about money, borrowed money and not paid it back, or lost time due to betting. While these questions capture the diagnostic criteria, additional information is obtained via the SOGS that helps appreciate the full symptom presentation. For example, participants dichotomously indicate the source of borrowed money, which include spouses, relatives, loan sharks, bookies, and so forth. Further, the utilization of various gambling types (e.g., cards, horses, bingo, etc.) is rated as "not at all," "less than once a week," or "once a week or more." The largest amount gambled in one day, the people in the individual's life with a gambling problem, the frequency with which losses are chased, and dishonesty about losing are also assessed. Finally, participants respond as to whether they feel they have a gambling problem by indicating "no," "yes," or "yes, in the past, but not now." In terms of scoring, all 20 yes/no questions are rated as either a 0 or 1, making the maximum score a 20. Research has demonstrated that the SOGS is sensitive to changes over time and has excellent internal consistency ($\alpha = .97$) and adequate test-retest reliability (.71; Sylvain, Ladouceur, & Boisvert, 1997).

The extensive data gathered with the SOGS generates a large amount of useful information and could inform future videogame researchers about how to expand measures to assess more than just particular criteria. For example, questionnaires could include an item inquiring about the types of games played, similar to how the SOGS assesses gambling types.

However, the SOGS appears to rely heavily on interpersonal relationships, such as the items addressing criticisms or arguments with others, as well as hiding signs of gambling and/or borrowing money from important people in the individual's life. This contrasts with the substance dependence criteria of the DSM-IV that do not require input or interaction with an outside source. Specifically, an individual with a SUD may experience tolerance, withdrawal, take larger amounts than intended, unsuccessfully try to cut down, invest a great deal of time, give up social activities entirely, and continue using despite physical consequences. If avoiding interaction with others, there may be no need to be deceitful or have arguments, especially if relationships are with other substance users. Similarly, videogames represent a primarily solo experience. Players of MMOs, for example, may have limited contact with others outside of the digital medium, changing the symptom presentation from how the SOGS addresses gambling. Further, videogames do not require the substantial financial investment that gambling does, reducing the need to borrow money from others. It is doubtful that anyone with PVGP requires a loan shark, for example, to support his/her habit. Thus, the SOGS has surprisingly little applicability to the concepts of PVGP or videogame addiction.

Incorporating DSM-5 SUD Criteria. DSM-5 (APA, 2013), which is the most current edition, has condensed the former diagnoses of substance abuse and dependence into the singular substance use disorder (SUD). Thus, criteria from both disorders have been merged, with some level of modification. Table 2 provides the current diagnostic criteria. Interestingly, with the exception of criterion 8, which refers to engaging in physically hazardous activities, the rest of the symptomatology appear adaptable for use with PVGP. This incompatibility with criterion 8 occurs with other substances as well, such as nicotine, and thus does not represent a problem solely with PVGP. Further, the inclusion of criterion 4 (cravings) appears more in line with

pathological gambling's symptom of preoccupational thinking and may serve as a bridge between the two disorders.

However, despite the conceptual overlap between SUD and gambling disorder as both being potentially addictive disorders, the actual items used for assessment create divergence between them. For example, the Game Addiction Scale for Adolescents (Lemmens, Valkenburg, & Peter, 2009) assesses tolerance with the following three items: "Did you play longer than intended? Did you spend increasing amount of time on games? Were you unable to stop once you started playing?" (p. 95). However, these questions more accurately capture criteria 1 and 3 from SUD than criterion 10. Instead, tolerance refers to increased usage to *obtain the same desired effect*, which is absent from the wording of the aforementioned items. Similar problems emerge when trying to identify items assessing the SUD conceptualization of tolerance in other measures, such as the PVGT (King, Delfabbro, & Zajac, 2011). Of the primary videogame measures, only the VGU uses language that aligns with substance use; specifically, item 2 of the VGU asks individuals "Do you need to spend more and more time and/or money on video games in order to feel the same amount of excitement?" (Gentile, 2009, p. 598). The latter half of this question targets the underlying mechanism of the increased usage as a way to achieve the same level of excitement. Thus, in attempting to adapt SUD criteria for use in assessing PVGP, no single measure captures all the necessary symptoms, requiring specific items across measures to be combined. The process used to accomplish this as part of the current study will be described in the Methods section below.

Table 2

DSM-5 Criteria for Substance Use Disorder (SUD)

A problematic pattern of substance use leading to clinically significant impairment or distress, as manifested by at least 2 of the following, occurring at any time in the same 12-month period:

1. The substance is often taken in larger amounts or over a longer period than was intended.
2. There is a persistent desire or unsuccessful efforts to cut down or control substance use.
3. A great deal of time is spent in activities necessary to obtain, use or recover from use of the substance.
4. Craving, a strong desire or urge to use the substance.
5. Recurrent substance use resulting in a failure to fulfill major role obligations at work, school, or home (e.g., repeated absences or poor work performance; absences, suspensions, or expulsions from school; neglect of children or household).
6. Continued substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance (e.g., arguments with spouse about consequences of intoxication, parent punishment for use, loss of friends or partners).
7. Important social, occupational, or recreational activities are given up or reduced because of substance use.
8. Recurrent substance use in situations in which it is physically hazardous (e.g., driving an automobile or operating a machine when impaired by use).
9. Substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance.
10. Tolerance, as defined by either of the following:
    a. A need for markedly increased amounts of the substance to achieve intoxication or desired effect.
    b. Markedly diminished effect with continued use of the same amount of the substance.
11. Withdrawal, as manifested by either of the following:
    a. The characteristic withdrawal syndrome for the substance (refer to Criteria A and B of the criteria sets for Withdrawal)
    b. The same (or a closely related) substance is taken to relieve or avoid withdrawal symptoms.

Note. Adapted from the American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Copyright 2013 by American Psychiatric Association.

Overview of the Current Study

PVGP represents an increasingly prevalent problem in both adolescents (e.g., Gentile et al., 2011) and adults (Grüsser, Thalemann, & Griffiths, 2007), leading to a greater representation among patients seeking treatment (Young et al., 1999). Although typically conceptualized as a form of behavioral addiction similar to pathological gambling (Fisher & Griffiths, 1995; Wood et al., 2004), and measured using instruments adapted from pathological gambling diagnostic criteria (Gentile, 2009; Lemmens et al., 2009; King et al., 2011), a cursory examination of the

DSM-5 criteria for substance use disorder suggests a viable alternative for examining PVGP. Thus, current PVGP scales were adapted to better capture addiction as it is understood in the substance use literature in an effort to compare classification systems.

The particular aspects of videogames that may contribute to the onset of PVGP have received some attention in the literature. Specifically, King, Delfabbro, and Griffiths (2010) have developed a psycho-structural taxonomy of the features present in videogames and demonstrated that gamers' preference for and perception of certain features differentiates PVGP from normal use (2011). Dividing games by their respective genres has also suggested that certain types of games have higher rates of PVGP than others (Elliot et al., 2012). While many studies have examined PVGP as a homogeneous group, exploring the differences between players of different types of games may provide further insight into how PVGP could be best understood. Considering that the current edition of the DSM (APA, 2013) presents separate disorders based upon the substance ingested (e.g., Alcohol Use vs. Cannabis Use), the subclassification of PVGP based on game type does not seem unreasonable.

Further, PVGP is potentially associated with several notable psychological variables. For example, the neuropsychological literature suggests possible alterations in a variety of executive functioning abilities based upon game play (e.g., Barlett et al., 2009). Additionally, impulsivity has been associated with PVGP (Gentile et al., 2011) and the pathological gambling literature lends strong support for the presence of at least some form of impulsivity within behavioral addiction (e.g., Brewer & Potenza, 2008). This is notable, given that impulsivity (Conrod, Pihl, Stewart, & Dongier, 2000; Loxton & Dawe, 2001) and sensation-seeking (Conrod et al., 2000) have been associated with the onset of SUD. However, studies examining pathological gambling have yielded conflicting results, with some authors demonstrating self-reported impulsivity with

no elevations on neurocognitive tasks (Lawrence et al., 2009; Ledgerwood et al., 2009), and other authors showing differences in cognitive performance (e.g., Goudriaan et al., 2006). Thus, further examination of impulsivity with both a self-report and a performance measure is warranted.

Likewise, within the SUD literature, depression is linked to diagnosis (Conner, Pinquart, & Duberstein, 2008; McMahon, Malow, & Loewinger, 1999) and should similarly be examined within the context of PVGP, especially given that only one study thus far has examined the association between depression and problematic game play (Messias et al., 2011). Further, individuals with parents experiencing an alcohol use disorder are more likely to develop either an alcohol problem (Russell, Cooper, & Frone, 1990) or other substance use disorder (Sher, Walitzer, Wood, & Brent, 1991), suggesting potential familial impact with regard to onset of symptomatology. Exploring the addiction history of participants with PVGP may help determine if a family history of addiction (physiological or behavioral) can contribute to the development of a behavioral addiction. This mirrors a particular item on the SOGS (Lesieur & Blume, 1987) that inquires about "which of the following people in your life has (or had) a gambling problem." Additionally, self-consciousness appears to moderate the relationship between family history risk and alcohol use (Rogosch, Chassin, & Sher, 1990). Further, self-consciousness is also associated with higher physiological reactivity in individuals with an alcohol use disorder when exposed to alcohol cues (Bradizza et al., 1999) and patients with problematic drinking behavior have reported that alcohol helps to reduce their feelings of self-consciousness (Spada & Wells, 2006). Along the same lines, the inability to cope with stress also appears to uniquely contribute to adolescent substance abuse (Wagner, Myers, & McIninch, 1999), which is commensurate with the stress-coping model of substance use (Wills & Hirky, 1996) that posits individuals become

dependent on substances as a way to deal with life stressors. Similarly, several authors have suggested that particular coping strategies (e.g., escapist or relief-oriented coping) are specifically associated with substance use (Chen & Cunradi, 2008; Chiong, Bry, & Johnson, 2010; Courbasson et al., 2002; Wagner, 1993; Mohamad, 2009). Thus, individuals with particular coping styles may be more likely to turn to a substance to help manage their feelings than people who react to stressors differently. While the relationship between such variables and PVGP is relatively unknown, it is possible that gamers may similarly experience feelings of self-consciousness and utilize videogames as a way to cope with negative emotions, similar to the pathological gambling criterion of using the behavior as an escape. In an effort to explore the associations between these variables and PVGP, measures of impulsivity, executive functioning, depression, self-consciousness, coping skills, as well as family history, were included in the current study.

Hypotheses

1. It was hypothesized that the modified DSM-5 conceptualization of PVGP would have better internal consistency and a more robust factor analytic structure than traditional measures of PVGP.

In order to evaluate each measure, both exploratory and confirmatory factor analytic techniques were conducted on several measures of PVGP. Specifically, an exploratory model constructed using the Videogame Addiction Scale with a subset of data was evaluated with respect to which it fit data from a second subsample. Further, model fit indices for the aggregated scale were

predicted to be superior to those obtained from similar analyses conducted on existing measures of PVGP.

2. It was hypothesized that the modified DSM-5 conceptualization of PVGP would have greater criterion validity than traditional measures of PVGP. Specifically, the aggregated SUD-based score was expected to yield a stronger relationships with constructs associated with addiction than would scores on the PVGP-R and VGU.

Utilizing PVGP items across measures, a comprehensive evaluation of addiction-based criteria was expected to more closely align with the well-documented construct of SUD than the current pathological gambling-based conceptualization. Thus, variables that are associated with substance use, such as impulsivity, poor executive functioning, depression, and a family history of substance use, were anticipated to more strongly correlate with a SUD-based approach to assessing problematic play, relative to measures that do not systematically assess problematic play in accordance with SUD criteria.

3. Using whichever approach was determined to best capture the construct of PVGP (from Hypotheses 1 & 2), it was expected that PVGP would be more strongly associated with some genres of games than others. For example, higher rates of PVGP were expected among MMORPG players than other genres.

Although it was conjectured that the aggregated addiction-based measure would best capture the construct of PVGP, the entire PVGP-R and VGU questionnaires were included. Thus, direct

comparisons were be made and the superior measure was be utilized for subsequent analyses, as explained below. Gamers were then grouped based on their genre preference and the level of PVGP within each genre was compared. In line with the existing literature that suggests MMORPGs are highly addicting (Boellstorff, 2008; Elliot et al., 2012; Griffiths, Davies, & Chappell, 2004; Taylor, 2006), it was expected that individuals who identified MMORPGs as their favorite type of videogame would exhibit higher levels of PVGP as compared to other genres.

4. Similarly, it was hypothesized that the best measure of PVGP would also be strongly associated with particular structural characteristics of videogames. For example, it was expected that individuals with higher levels of PVGP would place greater value on leveling up, earning rewards, managing in-game resources, and developing mastery than players with lower ratings of PVGP.

As discussed earlier in this paper, only one study has evaluated the structural characteristics that differentiate problematic from non-problematic players (King, Delfabbro, & Griffiths, 2011). Thus, it was expected that the current study would yield similar results, albeit not likely a perfect replication

5. An interaction was hypothesized between game genre and structural characteristics such that PVGP players of certain genres would find features of those games more important, enjoyable, and impactful. For example, it was expected that MMORPG players would place a greater emphasis on social interaction, finding rare items, and leveling up,

whereas, FPS players would instead endorse high quality graphics, competitive aspects, and fast loading times.

Different genres of games likely appeal to individuals who value particular experiences from their videogames. As has been noted in the literature, MMORPGs offer a rich social environment that may lead to PVGP (Griffiths, Davies, & Chappell, 2004) in individuals seeking to fulfill social needs. However, an individual with PVGP who plays FPS games online may not choose to socially interact with others, instead selecting this genre for the fast-paced and visceral violence it provides. Thus, the FPS player endorsing PVGP may value realistic graphics and competitively killing opponents. Thus, an interaction likely exists, such that persons for whom certain game features affect their playing behaviors and who choose games that contain higher levels of those features were expected to be more at risk for developing PVGP.

6. When the scores obtained from a self-report measure and performance-based measure of impulsivity are compared, a greater disconnect was anticipated for those with high versus low levels of PVGP (using the measure determined from Hypotheses 1 & 2).

As indicated above, there are conflicting results with regard to impulsivity and pathological gambling, making it difficult to know if behavioral addictions are associated with greater neurocognitive impulsivity (e.g., Fuentes et al., 2006) or not (Ledgerwood et al., 2009). Further, empirical investigations of cognitive functioning have demonstrated improved abilities in videogame players across a variety of domains, although not impulsivity specifically (Barlett et al., 2009). Thus, it is also possible that frequent game play may actually be associated with less

impulsivity when measured with a performance-based task. In fact, many games reward carefully timed actions, forcing the player to inhibit him/herself until appropriate. However, as with pathological gambling, it is likely that individuals with PVGP will rate themselves as being highly impulsive, given that self-reports assess a different form of impulsivity than performance-based measures. For example, the BIS-11 (which will be discussed below) includes items such as "I buy things on impulse," "I am restless at the theater or lectures," and "I make up my mind quickly" that may be endorsed by gamers who are able to inhibit responses under particular task demands (e.g., while playing). Thus, it was expected that a greater disparity would exist between self-reported and performance-based impulsivity for individuals with higher levels of PVGP than non-problematic players, who may have more consistency between the two.

7. Results from a task of set shifting for individuals endorsing a high level of PVGP were not expected to significantly differ when compared to those from low PVGP individuals. Further, scores for problematic game players were hypothesized to be potentially higher than for non-problematic players.

The Wisconsin Card Sorting Test (WSCT; which will be described later) requires individuals to engage in problem solving, pattern recognition, and set shifting. However, this measure, especially when completed electronically, shares some similarities with game play features currently utilized in videogames. For example, many aspects of gaming require individuals to identify patterns and to adapt their problem-solving strategies, such as when finding the weakness of a boss in an action game or solving a puzzle in a strategy game. Thus, it was expected that individuals with PVGP would not exhibit impaired cognitive functioning in these

areas (problem solving, concept formation, set shifting) and may potentially even display improved abilities.

8. A structural model that captures the risk factors for gaming addiction was developed based on results from the previous hypotheses.

Utilizing the results of the previous hypotheses, the best fitting model of the aforementioned variables was constructed in order to determine the pathways to PVGP in videogame players. Specifically, structural equation modeling (SEM) was conducted in order to determine the most statistically appropriate way of conceptualizing the relationship between risk factors and their contribution to PVGP.

Methods

Participants

Participants for this study were recruited from Eastern Michigan University's (EMU) undergraduate student population. Specifically, the primary investigator sent emails to course instructors as well as spoke in various undergraduate classes that offered extra credit for research participation in an effort to raise awareness about the study. Specifically, the survey was available through the SONA system, an online research study database for EMU students. It was anticipated that students who self-identified as avid gamers would be more interested in participating once they were informed about the study, particularly when enrolled in classes that provide inherent benefits for doing so.

This sample of convenience consisted of 1,013 individuals who completed the online survey. The sample reflected a surprisingly equal percentage of both male (n = 459, 45.3%) and

female (*n* = 534, 52.7%) participants. Although the reported age of participants ranged from 18 to 66, the overall sample matched the typical college-age population (*M* = 21.36, *Mdn*= 20, *SD* = 4.44). Slightly over half of the sample reported as Caucasian (*n* = 587, *sd* = 57.9%), with almost another quarter reflecting African Americans (*n* = 223, *SD* = 22.0%). Additionally, individuals endorsed being Middle Eastern (*n* = 32, *SD* = 3.2%), Asian (*n* = 28, *SD* = 2.8%), Latino/a (*n* = 18, *sd* = 1.8%), Pacific Islander (*n* = 6, *SD* = 0.6%), American Indian (*n* = 4, *SD* = 0.4%), and Other (*n* = 11, *SD* = 1.1%). Given that participants had the option to choose more than one ethnicity, individuals who endorsed multiple answers were reclassified as multiracial, comprising of 9.3% of the sample (*n* = 94). Approximately half of the sample identified as single (*n* = 529, *SD* = 52.2%) and another third indicated they were in a non-cohabiting romantic relationship (*n* = 350, *SD* = 34.6%). Additionally, 64 participants reported being married (6.3%), 43 endorsed living with an opposite-sex partner (4.2%), 6 lived with a same-sex partner (0.6%), 5 were divorced (0.5%), 2 were separated (0.2%), 2 were remarried (0.2%), and 1 was widowed (0.1%). Participants played on average 4.34 hours of videogames on a week day (*SD* = 2.99) and 5.37 hours on a weekend day (*SD* = 3.16). Individuals were given the opportunity to optionally write in their major field of study, to which everyone responded; interestingly, only 169 participants (16.68%) listed psychology as their major. The other individuals constituted all other departments at EMU. Thus, despite participants primarily being recruited from undergraduate psychology courses, all major fields of study at EMU were at least partially represented.

Procedure

As indicated above, the initial component of the study, henceforth referred to as "phase one," consisted of an electronic survey available online via a survey-hosting website (i.e., Survey Monkey). Individuals interested in participating first read and digitally signed an informed

consent form preapproved by EMU Human Subjects Review Committee before being eligible to continue. Inclusionary criteria consisted of being at least 18 years old and playing videogames at least 1 hour a week. For entering the study, all participants were placed into a raffle with the possibility of winning one of two $50 gift cards for Amazon.com. Upon completion of the survey, eligible participants who were able to physically come to EMU were given the option of being considered for a follow-up study. Eligibility for the follow-up study was determined by PVGP-R scores that fell either above or below one standard deviation of the normative mean provided by Tolchinsky (2013), as this method of participant selection will help facilitate high versus low PVGP group comparisons. Specifically, at the end of the initial survey, participants were asked if they wished to engage in further research, confirming their interest by selecting "yes" and typing in their email address. Email was then used as the primary means of communication for follow up.

Based upon responses on the PVGP-R, eligible and consenting individuals were identified to participate in phase two. Prospective participants were invited to schedule an appointment with the principal investigator or a graduate assistant to complete the follow-up study, receiving $10 as compensation for their time. Participants who agreed to phase 2 were assigned ID numbers and their emails were no longer utilized for identification purposes. Upon arrival to the appointment, participants completed an additional consent form and engaged in two computerized tasks. These measures, described below, were minimally invasive and posed no known problems for participants. Upon completion of the two tasks, participants engaged in a brief discussion about their videogame play behavior with the principal investigator if time permitted. Participants were then thanked for their participation and excused.

Measures

Phase One Survey Measures.

Demographic Information. Demographic information was collected, including but not limited to age, gender, ethnicity, socioeconomic status, years of education, current marital status, current employment status, economic status of current household, and annual household income. Refer to Appendix A.

Videogame Addiction Scale. As highlighted earlier in this paper, no single measure of PVGP effectively captured the DSM-5 criteria for SUD. Thus, items were chosen from existing measures to develop a comprehensive questionnaire. Criterion 1, which references a substance being taken in larger amounts or over a longer period than was intended, was assessed by item 23 on the PVGP-R ("I play video games over a longer time period than I intended"). The second criterion, which highlights a persistent desire or unsuccessful effort to cut down or control substance use, was captured in the third item of the VGU ("Have you tried to play video games less often or for shorter periods of time, but are unsuccessful?"). Criterion 3 requires that a great deal of time is spent in obtaining, using, or recovering from substance use. Given that obtainment of and recovery from videogames are not nearly as problematic as for psychoactive substances, item 6 of the PVGP-R ("I spend an increasing amount of time playing video games") was deemed to assess the problematic amount of time invested. Criterion 4 from the DSM-5 assesses cravings, defined as a strong desire or urge to use the substance. In all measures of PVGP, items measuring preoccupation appeared to capture some aspect of craving, although many involve reflection upon past gaming sessions. In an effort to capture the future-oriented aspect of cravings (e.g., the preoccupation with wanting to use the substance again), item 11 on

the PVGP-R ("When I am not playing video games, I am often planning how I will play my next game") was chosen.

Criterion 5 refers to a failure to fulfill major role obligations at work, school, or home due to substance use. Interestingly, several measures of PVGP merge school/work problems with interpersonal problems, which represent separate criteria for SUD. Thus, item 25 of the PVGP-R ("In order to play video games, I have skipped class or work") was chosen as it does not include other functional impairments. Criterion 6 represents persistent or recurrent social or interpersonal problems and was captured via item 20 on the PVGP-R ("In order to play video games, I get into arguments with people"). Criterion 7 captures the reduction or giving up of social, occupational, or recreational activities and is reflected in item 2 of the PVGP-R ("Because of my video game playing, I have spent less time with my friends and family").

As indicated earlier, Criterion 8, which highlights physically hazardous situations related to substance use, was not assessed, as videogames do not have an obvious parallel. Criterion 9 assesses continued substance use despite physical or psychological problems. With the exception of the PVGP-R, no other measure explicitly captures the physical problems associated with problematic videogame playing. However, the PVGP-R includes items referencing neck pain (#7), wrist pain (#14), headaches (#22), hand pain (#24), and back pain (#33). Inclusion of physical effects from problematic playing allows for an extension beyond solely psychological effects and creates a closer analogue to SUD. Thus, affirmation of any of the aforementioned items on the PVGP-R was considered as endorsement of criterion 9.

Criterion 10 captures the concept of tolerance, defined as either a need for increased amounts to achieve the desired effect or as a diminished effect when using the same amount. Item 2 of the VGU ("Do you need to spend more and more time and/or money on video games in

order to feel the same amount of excitement?") alone captures the SUD conceptualization of tolerance and thus was included in this aggregation. Lastly, Criterion 11 refers to withdrawal, which includes either the characteristic withdrawal symptoms of a substance or the use of the substance to avoid these withdrawal symptoms. Given that pathological gambling literature has consistently shown that withdrawal from gambling typically includes restlessness and irritability (e.g., Toce-Gerstein et al., 2003), similar symptom markers were used to assess videogame withdrawal. Item 4 of the VGU ("Do you become restless or irritable when attempting to cut down or stop playing video games?") appeared to suitably capture the concept.

Merged together, these 10 items represented the 10 criteria for SUD measured in this study. However, the PVGP-R and VGU utilize different metrics for responding, with the former employing a 5-point Likert scale and the latter a 3-point scale. In order to correct for this, scores on VGU items were mapped onto a 5-point scale such that "no" becomes "never" (1), "maybe" becomes "sometimes" (3), and "yes" becomes "often" (5). Although another option would have been to mathematically transform the 3 anchors to fit on a 5-point scale (e.g., multiply each score by 1.667), this would place a negative response in between "never" and "sometimes" on the PVGP-R scale. Thus, individuals who have never experienced the symptom of a given item would have artificially inflated scores on the three items from the VGU as compared to the seven PVGP-R items. It should be noted that the complete PVGP-R and VGU measures were administered as part of the online questionnaire, negating the need to form a specific survey or to group items accordingly. This allowed for the evaluation of PVGP as intended by the scales' creators in addition to the examination of SUD-adapted criteria.

Problematic Video Game Play - Revised (PVGP-R) Scale. Described in more detail earlier in this paper, the PVGP-R is the newest version of the scale created by Tolchinsky and

Jefferson (2011). It originally consisted of 34 items rated on a 5-point Likert scale ranging from *Never* to *Often*. However, since the initiation of the current study, Tolchinsky revised the scale to 27 items, based on factor analytic techniques (2013); thus, the original 34 items were included in the study but not all were utilized in scoring the PVGP-R. Questions address the psychological, physical, and social consequences of problematic gameplay. Internal consistencies for each subscale ranged from $\alpha = .76$ to $\alpha = .85$ and construct validity was demonstrated using average number of hours spent playing (Tolchinsky, 2013). Refer to Appendix B.

Video-Game Use (VGU). Also described in more detail earlier in this paper, the VGU is an 11-item measure of PVGP created by Gentile (2009). Rated on a 3-point scale ("yes," "no," or "sometimes"), the VGU is adapted from the criteria for pathological gambling, although the wording of some items closely resembles SUD constructs. Internal consistency was reported at $\alpha = .78$. Refer to Appendix C.

Video Game Genre. An adapted version of Elliot and colleagues' (2012) method for determining game preference was utilized. Specifically, Elliot et al. (2012) asked participants to identify the videogame they played most often during the past year. Responses were categorized into the existing genres available via videogame industry websites (e.g., gamefaqs.com). The top 15 most endorsed genres were used for subsequent analyses (Elliot et al., 2012). In addition, the current study asked participants to indicate their *favorite* game as well. This was to help distinguish preference from frequency, given that individuals may potentially spend more time playing mobile games on their phone (e.g., while on public transportation, waiting in line, between classes), yet feel less connected and/or experience fewer symptoms related to these games than their console/PC counterparts. Lastly, participants were provided with a list of game

genres and asked to indicate all that they enjoy playing. This helped to identify the diversity of game types that particular individuals play. See Table 1 above for the primary genres identified by Elliot et al. (2012). Refer to Appendix D.

Brief Version of Video Game Structural Characteristics. The original survey (King, Delfabbro, & Griffiths, 2011) included 111 items assessing the taxonomy outlined by King, Delfabbro, and Griffiths (2010), which consisted of features related to social aspects, manipulation and control, narrative and identity, reward and punishment, as well as presentation. Specifically, 37 structural characteristics were rated on three items assessing enjoyment ("How much do you enjoy this feature of the video game?"), perceived importance ("How important do you believe this feature is to the playing experience?"), and behavioral impact ("What is the extent to which this feature contributes to longer playing times?"). Responses were scored on a 5-point Likert scale ranging from "Not at all" to "High importance." However, the manuscript by King and colleagues (2011) highlighted only the top 15 characteristics for each question, as the authors noted that these had the strongest statistical findings and the most utility. Thus, in an effort to increase the brevity of this measure, only the top 15 items on enjoyment, perceived importance, and behavioral impact were used for the current study. Thus, this brief version of the video game structural characteristics survey contained 45 total items. Refer to Appendix E for more details.

Modified AUDIT. The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, & de la Fuente, 1993) is generally considered one of the best screening tools for assessing a range of alcohol problems (Fiellin, Carrington, & O'Connor, 2000). Further, the scales within the AUDIT can easily be adapted to examine the frequency of using other substances (e.g., Ivezaj, 2011) or engagement in addictive behaviors. For the sake of brevity, the

full AUDIT, expanded to cover all possible substances, was not administered, but frequency of use was used as an indicator of problematic substance use. Specifically, the first AUDIT item was used to query how often participants use cocaine/crack, other stimulants, heroin or other opiates, marijuana, tranquilizers, hallucinogens, or caffeine, as well as their frequency of engaging in gambling activities. Responses were rated on a 10-point Likert scale ranging from "Not at all" to "Daily heavy use." Refer to Appendix F.

Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ). The B-YAACQ (Kahler, Strong, & Read, 2005) is a 24-item measure of problematic drinking specifically for use in college students. The original YAACQ (Read et al., 2004) was a 48-item measure of eight domains of problematic drinking (social-interpersonal consequences, impaired control, self-perception, self-care, risk behaviors, academic/occupational consequences, excessive drinking, and physiological dependence) with adequate internal consistency ($\alpha = .89$). However, results of a Rasch model analysis suggested that 24 of these items fit a unidimensional model well, had good Rasch model person reliability (.82), generated a normally distributed distribution, correlated highly with the original YAACQ (total score $r(340) = .95$), and had high internal consistency ($\alpha = .83$). These 24 items thus comprise the brief version of the measure, which has since been shown to have high internal consistency, minimal item redundancy, reliability over time, sensitivity to change, and does not yield floor or ceiling effects (Kahler et al., 2008). The B-YAACQ was included in this study to provide a comprehensive examination of SUD severity for at least one substance, and given the prevalence of problematic drinking in college samples, alcohol was chosen to examine in more detail. Refer to Appendix G.

Family History of Addiction. One item from the SOGS (Lesieur & Blume, 1987) assessing "Which of the following people in your life has (or had) a gambling problem" was

adapted for the current study. Specifically, participants completed this question with regard to SUDs, gambling, and videogame playing. As with the SOGS, respondents checked the applicable individuals from the following choices: father, mother, brother/sister, spouse/partner, children, another relative, or a friend/someone important. However, participants also filled in how many people fit into categories potentially encapsulated more than one person (e.g., brother/sister) in an effort to more accurately assess the amount of addiction in the individual's familial network. Refer to Appendix H.

Patient Health Questionnaire – Depression Scale (PHQ-9). The PHQ-9 (Kroenke, Spitzer, & Williams, 2001) is a nine-item depression subscale of the PHQ, a measure originally designed to assess mental disorders in primary care patients (Spitzer, Kroenke, & Williams, 1999). However, Martin and colleagues (2006) have validated the PHQ-9's use in the general population, suggesting its appropriateness for the current study. The PHQ-9 assesses the level of depression over the past two weeks using a 4-point Likert scale ranging from "Not at all" to "Nearly every day." Total scores range from 0 to 27, which are categorized into the following groupings of depression severity: 0-4 (none), 5-9 (mild), 10-14 (moderate), 15 -19 (moderately severe), and 20-27 (severe). Psychometric investigations of the PHQ-9 have suggested high internal consistency ($\alpha = .86$; Pinto-Meza et al., 2005) and test-rest reliability (Intraclass correlation (ICC) values ranging from .81 to .96; Löwe et al., 2004), as well as good sensitivity and specificity for diagnosing Major Depressive Disorder (Sensitivity = .73, 95% CI: .59-.87; Specificity = .98, 95% CI: .96-.100; Spitzer et al., 1999). Further, the PHQ-9 is highly correlated with the Beck Depression Inventory (*r*s = .79 - .95), the most commonly utilized self-report measure for depression. Refer to Appendix I.

Barratt Impulsiveness Scale, Version 11 (BIS-11). The BIS-11 (Patton, Stanford, & Barratt, 1995) is considered the most commonly utilized measure of impulsivity (Spinella, 2007). Consisting of 30 items rated on a 4-point Likert scale (ranging from "Rarely/Never" to "Almost always/Always"), the BIS-11 comprises three subscales: motor impulsivity, which assesses action without thought, non-planning impulsivity, which highlights a lack of future orientation, and cognitive impulsivity, which captures poor attention and concentration (Patton et al., 1995). Internal consistency was reported by the authors of the measure as $\alpha = .82$. Refer to Appendix J.

Self-Consciousness Scale (SCS). The SCS (Fenigstein, Scheier, & Buss, 1975) measures self-consciousness in three domains: private self-consciousness, or attending to inner thoughts and feelings, public self-consciousness, or general awareness of the self in a social context, and social anxiety, or the experience of discomfort in the presence of others. The measure consists of 23 items rated on a 5-point Likert scale, ranging from "Extremely Uncharacteristic" to "Extremely Characteristic." Adequate test-retest reliability has been demonstrated (*r*s = .84 for public, .79 for private, .73 for social anxiety), as has convergent validity with each subscale (Turner, Scheier, Carver, & Ickes, 1978). Specifically, private self-consciousness was significantly correlated (*r* = .48) with the Guilford-Zimmerman Thoughtfulness Scale (Guilford & Zimmerman, 1949), public self-consciousness related (*r* = -.26) to the Self-Esteem Scale by Morse and Gergen (1970), and social anxiety correlated (*r* = .31) with the EASI III Temperament Survey (Buss & Plomin, 1975). Further, discriminant validity with a measure assessing need for achievement (Edwards Personal Preference Schedule; Edwards, 1959) has been documented as well (*r* = .16 for private, *r* = .09 for private, *r* = .07 for social anxiety). Refer to Appendix K.

Brief Coping Orientation for Problems Experienced (COPE) Inventory. The Brief COPE (Carver, 1997) is a measure of the way in which individuals cope with stress. Adapted from the original 60-item COPE (Carver, Scheier, & Weintraub, 1989), the author of the revised scale extracted the strongest items to diminish redundancy and overall length, resulting in a 28-item measure containing 14 subscales. These include active coping, planning, positive reframing, acceptance, humor, religion, using emotional support, using instrumental support, self-distraction, denial, venting, substance use, behavioral disengagement, and self-blame. Adequate internal consistency was demonstrated in a sample of survivors of hurricane Andrew (Carver, 1997), with alpha reliabilities ranging from .50 (venting) to .90 (substance use), with a mean of $\alpha = .68$. Further, the Brief COPE has been translated into a variety of languages and used heavily in international research (Badr, 2004; Fogel, 2004; Meyer, 2001; Muller & Spitz, 2003; Olley et al., 2004, 2005; Perczek et al., 2000). Refer to Appendix L.

Phase Two Performance Measures.

Continuous Performance Test II (CPT-II). The CPT-II (Conners & MHS Staff, 2000) is a neuropsychological measure designed to assess "impulsivity, inattention, signal detection efficiency, response consistency, and perseveration" (Erdodi, Lajiness-O'Neill, & Saules, 2009, p. 44). Specifically, participants are instructed to watch a computer monitor and press the space bar whenever any letter except for X flashes on the screen. Letters appear for 250 milliseconds in six blocks; "within each block are three 20 trial sub-blocks with different inter-stimulus-intervals (ISIs) of 1, 2, or 4 seconds" (Kirlin, 2003, p. 56). The CPT-II assesses the speed and consistency of responses by recording omission errors (not hitting the space bar when appropriate), commission errors (hitting the space bar on an X), and response time (Conners, 2000). Specifically, this study utilized the percent of commission responses (Commission %),

the mean response time for all target responses (Hit Reaction Time), and the percent of responses occurring immediately after the previous response (< 100 milliseconds; Perseverations %), given that high numbers of commission errors, fast reaction times, and preservative responding cumulatively indicate impulsivity. With respect to scoring, results were converted into *t*-scores and percentiles that are based on a general population sample of 1,920 participants. The CPT-II takes about 14 minutes to administer and is administered via and scored by the computer software.

Wisconsin Card Sorting Test (WCST). The WCST (Heaton, 1981; Heaton et al., 1993) is a measure of executive functioning, including problem solving, concept formation, and set shifting. Participants are presented with two decks of cards, each containing 64 cards with various shapes (triangles, circles, crosses, stars), colors (blue, red, green, yellow), and quantities (one, two, three, or four). The instructions indicate that each card should be matched with one of four key cards, although participants are not instructed what constitutes a right answer. As each individual places a card, he/she is told whether the match was correct or incorrect. After ten consecutive correct answers, the pattern is changed without warning, forcing the individual to determine the new sorting principle. After six sets of correct answers (10 cards each) or running out of cards, the task is stopped. Thus, participants are expected to recognize the sorting rule (e.g., by color, by shape, or by number of shapes), yet adapt when correct answers inexplicably become incorrect. Although originally designed using physical cards, the WCST has since been adapted into a computerized version (Heaton & PAR Staff, 2003) in which participants click and drag cards to the desired key cards. This not only decreases the time needed, ensures standardized administration, and replaces hand scoring, but also provides a better analogue of experience for videogame players. Specifically, gamers are familiar with manipulating objects

via digital input and the computerized version of the WCST is similar to a videogame in which the player is seeking "correct" answers. For the purposes of this study, three scores were utilized in data analysis: total errors, perseverative errors, and conceptual level responses. While total errors refer to the number of responses that are incorrect, perseverative errors refer specifically to when the individual "persists in responding to a stimulus characteristic that is incorrect" using previous a sorting rule (Heaton et al., 1993, p. 8), thus exhibiting an inability to adapt to the new pattern. Conceptual level responses include the total number of at least three consecutive correct responses.

Data Analysis

In order to test Hypothesis 1, the sample of phase one participants was subdivided into two samples that did not meaningfully differ on PVGP-related variables or demographic characteristics (henceforth referred to as the validation and cross-validation samples). Exploratory factor analyses were then conducted on the validation sample and these models subsequently tested via confirmatory factor analyses with the cross-validation sample. Specifically, three separate analyses were conducted for the PVGP-R, the VGU, and the Videogame Addiction Scale. Further, internal consistency was examined using Cronbach's alpha. Factor analyses were conducted using Mplus© 5.21 (Muthén & Muthén, 2008), and involved current standards for factor analytic evaluation, including parallel analysis as well as determining the significance of factor loadings by examining the standard errors of loadings using a z-statistic.

As stated above, Hypothesis 2 involved the comparison of the relationships between various measures of PVGP and related constructs. In order to determine the utility of a SUD-based scoring system, correlation matrices were calculated using SPSS 17.0 (SPSS, 2008) for

each measure of PVGP (aggregated SUD-based score, PVGP-R, and VGU) and the BIS-11, CPT-II, PHQ-9, B-YAACQ, and family history of addiction. Correlation matrices were then compared using Fisher's transformation (Bond, 2004), which converted *r* values into *z*-scores. Thus, the strength of these relationships was statistically compared in order to determine if one scoring method yielded significantly stronger correlations with associated variables.

Hypothesis 3 conjectured that individuals who prefer particular genres of games will have higher rates of PVGP than other types of games. Specifically, it was expected that players of MMORPGs and shooter gamers would have exhibited the most elevated levels in the following pattern: MMORPG > (FPS > Third-person shooter) > All others. In order to test this, a one-way ANOVA was conducted in order to examine this Genre (MMORPG, FPS, TPS, Other) and PVGP relationship using SPSS 20.0 (IBM Corp., 2011). Additionally, a second ANOVA was conducted in which individual genres were analyzed and consolidated appropriately based on the data obtained without an a priori model. For example, if FPS and Third-person shooter players did not statistically differ, they would have been aggregated for the second ANOVA. This would also allow genres that may exhibit higher-than-anticipated PVGP scores to have been included. Further, grouping genres together enabled accurate analysis without overly diminishing statistical power.

Hypothesis 4 involved an examination of the relationship between the videogame structural characteristics and scores of PVGP. As an initial investigation, PVGP ratings were correlated with structural characteristics in order to examine the relationship between variables using the entire sample. This helped determine if ratings increase linearly with severity or if specific breakpoints exist at which endorsement of specific structural characteristics occur. Next, *t*-tests were conducted for the structural characteristics found to be most important, in

order to compare high PVGP individuals with low PVGP participants. This allowed for group comparison using only a subset of the sample, similar to analyses run by King Delfabbro, and Griffiths (2011). However, unlike these authors, the present study utilized only the most relevant characteristics in an effort to decrease the number of analyses, and thus, minimize alpha inflation.

Hypothesis 5 examined the interaction between structural characteristics and game genres. In order to test this, two-way ANOVAs were conducted to determine the Genre X Characteristic relationship. Both genres and structural characteristics were consolidated based on obtained data in order to allow for appropriate analysis. Post hoc analyses should help determine which specific characteristics and genres were statistically significantly related.

Hypothesis 6 involved the comparison of scores on the BIS-11 and CPT-II for the two groups brought into the lab as part of phase 2 of this study. Thus, the three subscales of the BIS-11 (motor, non-planning, and cognitive impulsivity) were correlated with the three primary outputs of the CPT-II (comissions %, hit reaction time, and perseverations %) for both the high PVGP group and the low PVGP group. The correlations for each group were then compared using Fisher's *r*-to-*z* transformation in order to determine if the PVGP groups statistically significantly differed. Hypothesis 7 posited that low and high PVGP groups would not differ statistically on the WCST, and if differences did emerge, they would be in favor of the latter. In order to test this hypothesis, a MANOVA was conducted with the independent variable consisting of group (high vs. low) and the dependent variables comprising the primary outputs of the WCST (total errors, perseverative errors, and conceptual level responses). This would allow direct comparison of the PVGP groups without the need for multiple analyses (e.g., one for each

dependent variable). Post hoc analyses were intended to be used in the event of statistical significance to determine which group was exhibiting higher scores on the WCST.

Lastly, Hypothesis 8 involved the use of SEM in order to develop a model that accurately described the relationship between the previous variables. Modeling was conducted using Mplus© 5.21 (Muthén & Muthén, 2008). Prior to data collection, it was difficult to develop hypotheses about how the specific variables would interact, although model fit was examined to determine the best arrangement of variables. Specifically, the current study used the root mean square error of approximation (RMSEA; Steiger, 1990; Steiger & Lind, 1980) and the comparative fit index (CFI; Bentler, 1990). For the RMSEA, a cutoff of .06 is generally used to determine good model fit, with a lower score representing greater fit (Hu & Bentler, 1999). However, RMSEA values of .08 to .10 are considered "mediocre" by some authors and are acceptable (MacCallum et al., 1996). It should be noted that Chen and colleagues (2008) suggest that little empirical support exists for any universal cutoff score; thus, results of the SEM were intended to be examined even if the RMSEA fell within the mediocre range. Regarding the CFI, scores greater than .95 are generally considered acceptable for continuous variables (Hu & Bentler, 1999; Yu, 2002). In order to address any missing data, the SEM used the full information maximum likelihood (FIML) method, which allows Mplus to estimate the missing values. Essentially, FIML finds patterns of missing data and estimates the variances and covariances for these patterns (Robins, Fraley, & Krueger, 2007).

Sample Size

The recommended number of participants for factor analytic techniques varies widely between authors, with numbers ranging from 5 participants per variable (Bryant & Yarnold, 1995) to 20 (Hair, Anderson, Tatham, & Black, 1995). MacCallum, Widaman, Zhang, and Hong

(1999) suggest that any rule of thumb is not valid for determining sample size when conducting factor analyses. Conversely, Gorsuch (1983) indicates that 200 participants are adequate irrespective of the number of variables included. Most parsimoniously, Tabachnick and Fidell's suggest that "it is comforting to have at least 300 cases for factor analysis" (2001, p. 588). Thus, a minimum of 300 individuals for the validation and cross-validation groups was considered sufficient.

For Hypotheses 2 through 5, it was anticipated that the largest analysis that would be needed would be a 5X5 ANOVA when determining the relationship between videogame genre and structural characteristics (Hypothesis 6). Thus, a power analysis for an ANOVA was conducted using G*Power© 3.1.5 (Heine, 2012) in an effort to determine the minimum number of participants needed. When the effect size was set to medium ($f = .25$), the error probability (α) at .05, and power ($1-\beta$) at .80, results indicated that a sample size of 270 participants was required to conduct a 5X5 ANOVA. Given that Hypothesis 5 utilized only data obtained via the online survey, this indicated that 270 participants were required as part of phase 1 of the current study. Thus, recruitment was planned to continue until a minimum of 270 online participants completed the survey.

Hypotheses 6 and 7 utilized data collected during phase 2 of this study. In order to determine the number of participants that needed to be brought into the lab, a power analysis was conducted using the power tables provided by Cohen (1988, 1992). The number of participants needed for an alpha of .05, effect size of .80, and power of .80 was 26 individuals per group (Cohen, 1992; Kazdin, 2003). Thus, for two-group comparisons (high PVGP vs. low PVGP), a total sample of 52 individuals was required. Although less preferred, a large effect size (.80) was chosen due to the fact that the current study's methodology attempted to yield a large separation

between groups (e.g., using individuals with the highest and lowest PVGP scores only) as well as because of practical limitations. Specifically, while a medium effect size (.50) would have been preferred, the 128 individuals required (64 per group) was beyond the financial scope of this study (e.g., compensating each participant $10 would require $1,280 to complete phase 2). However, it was expected that 52 individuals would be sufficient to detect an effect if one was present. As noted in the Discussion section below, it was not possible to recruit 52 participants for phase 2 by the termination of the data collection period.

Results

Hypothesis One

In order to evaluate the factor structures of each model, all participant data for Phase 1 of the study was divided into two subsamples. This allowed for an exploratory factor analysis (EFA) to be conducted in one sample of participants and then tested via confirmatory factor analysis (CFA) in a second sample. To accomplish this task, participants were numbered and split into odd and even groups. Groups were compared on both demographic and relevant videogame-related variables to ensure that groups did not meaningfully differ from each other. Specifically, no significant differences were observed for ethnicity, χ^2 (8) = 8.48, p = .39, gender, χ^2 (2) = 1.08, p = .58, age, t(945) = .73, p = .47, hours of videogames played on an average weekday, t(1011) = -.79, p = .43, hours of videogames played on an average weekend day, t(1011) = -.47, p = .64, PVGP-R total score, t(971) = .90, p = .37, VGU total score, t(938) = -.69, p = .49, or the Videogame Addiction Scale, t(938) = -.14, p = .89. Henceforth, the first subsample is referred to as the validation sample and the second subsample is referred to as the cross-validation sample.

Factor analyses were conducted using Mplus© 5.21 (Muthén & Muthén, 2008). Initial exploratory factor analysis (EFA) using geomin rotation was performed on the validation sample to examine the factor structure of the data without the restriction of an *a priori* model. Considering the resulting factors were presumed to be oblique, the geomin rotation method, which is the default for Mplus© 5.21, was appropriate. Given that responses to all the measures are scored on a Likert-scale, it was assumed that items were continuous variables (Flora & Curran, 2004; Joreskog & Moustaki, 2001), enabling model parameters to be estimated with the maximum likelihood method.

When determining the number of factors to retain, previous researchers have suggested that several methodological approaches and theoretical rationale should be used in the decision-making process (Fabrigar et. al, 1999; Henson & Roberts, 2006; Thompson & Daniel, 1996). Factor inclusion was determined using the following techniques: the scree test (Cattell, 1966), which involves an examination of the scree plot, the Kaiser-Guttman rule, in which factors with eigenvalues greater than 1 are included in the model (Kaiser, 1960), and parallel analysis, for which each factor's eigenvalue is compared with those obtained from a random data matrix (Horn, 1965). It was decided before data analysis that if these guidelines yielded several solutions that appeared statistically valid, theoretically grounded reasoning would be used to determine which model to examine.

Once sufficient results had been achieved with the EFA, a confirmatory factor analysis (CFA) was conducted on the cross-validation sample. The fit of the CFA model to the cross-validation data was determined using the root mean square error of approximation (*RMSEA*; Steiger, 1990; Steiger & Lind, 1980) and the comparative fit index (*CFI*; Bentler, 1990). For the RMSEA, a cutoff of .06 is generally used to determine good model fit, with a lower score

representing greater model fit (Hu & Bentler, 1999). However, RMSEA values of .08 to .10 are considered "mediocre" by some authors and are acceptable (MacCallum et al., 1996). It should be noted that Chen, Curran, Bollen, Kirby, and Paxton (2008) suggest that little empirical support exists for any universal cutoff score; thus, results of the CFA would have been examined even if the RMSEA fell within the mediocre range. Regarding the CFI, scores greater than .95 are generally considered acceptable for continuous variables (Hu & Bentler, 1999; Yu, 2002). In order to address any missing data, the CFA used the full information maximum likelihood (FIML) method, which allowed Mplus to estimate the missing values. Essentially, FIML finds patterns of missing data and estimates the variances and covariances for these patterns (Robins, Fraley, & Krueger, 2007). Since factor analyses require only the variance-covariance matrix and not the actual raw data for computation, FIML can estimate missing information better than methods designed to impute item responses.

VGU. Given that the VGU (Gentile, 2009) is scored by summing all eleven items, an initial CFA was conducted using the validation sample to determine if a one-factor solution adequately fit the data. If good fit was achieved, this would suggest that the entire measure encapsulates a single, unified construct and warrants a single total score. However, the results suggested poor fit using the CFI (.72) and RMSEA (.12) fit indices, $\chi^2 (44) = 345.71$, $p < .001$. This suggests that the 11 items of the VGU likely represent more than one latent construct and would likely load onto several factors.

Thus, an EFA was conducted on the VGU items for participants in the validation sample. In order to determine the factors to retain, several methods were evaluated. Regarding the Kaiser-Guttman rule (Kaiser, 1960), the eigenvalues for the resultant data suggested a three factor solution, given that the values for the first three factors were above one. For the scree test

(Cattel, 1966), a graph of eigenvalues for every factor (scree plot) was examined to determine the point at which the "elbowed" or flattened out. Although this process is largely subjective, the scree plot appeared to suggest that the third factor represented the "break point" of the graph, warranting the retention of a three factor solution. For the parallel analysis (Horn, 1965), the comparison data matrix was created using syntax code for SPSS 17.0 (SPSS, 2008). These data consisted of 1,000 datasets of random responses containing the same number of variables and "participants" as the validation sample and served as the level of chance responding. The eigenvalues from this simulated analysis were compared with the EFA results to determine the point at which the latter fell below the former and thus were below chance. Results of the parallel analysis suggested that a two-factor solution was best.

Given the discrepancy between the parallel analysis and other factor retention methods, the CFI and RMSEA fit indices were examined as well. Results of the two-factor EFA yielded a CFI of .94 and an RMSEA of .06, $\chi^2(34) = 99.98$, $p < .001$; whereas, the three-factor solution generated a CFI of .98 and an RMSEA of .04, $\chi^2(25) = 44.75$, $p = .01$. A chi-square model comparison suggested that these models were statistically different from one another, $\Delta\chi^2(9) = 55.23$, $p < .01$. However, the above indices suggest that both models had good fit. The specific loadings for each item on the resulting factors were statistically evaluated to determine how items grouped across factors for the two models. In order to make this determination, the standard errors of the factor loadings were used to examine fit by determining significance using the *z*-statistic. The two-tailed Bonferroni critical value was calculated at $\alpha = .05$ by accounting for the number of factors and items to adjust for alpha inflation (Cudeck & O'Dell, 1994), yielding a critical *z*-statistic of 3.02 for the 2-factor and 3.10 for the 3-factor solutions. Thus, all estimated/standard error values for the item loadings that exceeded the respective number loaded

significantly on that factor, regardless of the loading value itself. This is superior to the previous convention of using cutoffs (Cudeck & O'Dell, 1994). Results of the two-factor solution suggested that 10 items of the VGU significantly loaded on only one factor and one item loaded on two factors; whereas, for the three factor solution, two items cross-loaded. Overall, the three-factor solution generated good fit indices, appeared to have a better fit based on a chi-square model comparison, and seemed most appropriate based on the Kaiser-Guttman rule as well as visual examination of the scree plot. Thus, the three-factor solution, which accounted for 54.99% of the variance, was chosen to represent the data. For the rotated factor loadings and item significance, see Table 3.

Table 3

Exploratory Factor Structure of the VGU

	Factor 1	Factor 2	Factor 3
1) Spending more time thinking about games	**.53**	.28	.01
2) Need to spend more time playing to feel same excitement	**.28**	**.35**	.02
3) Unsuccessfully tried to play less	.18	**.32**	.10
4) Become restless/irritable when cutting down	.24	**.58**	-.06
5) Played as a way to escape problems or bad feelings	.17	-.01	**.38**
6) Lied to family/friends about how much you play	-.03	**.51**	.17
7) Stolen a videogame or stolen money to buy a videogame	-.24	**.71**	-.01
8) Skip household chores to spend more time playing	.01	-.02	**.75**
9) Skip homework to spend more time playing	-.25	.01	**.88**
10) Done poorly on assignment/test because of playing	.02	.20	**.50**
11) Needed friends/family to give you extra money	.01	**.62**	.08

Bold loadings *represent $p < .05$.*

In order to determine if this model accurately reflected the data, a CFA of the aforementioned three-factor model was conducted on the cross-validation sample. Results suggested mediocre fit using both CFI (.91) and RMSEA (.07), χ^2 (40) = 128.39, $p < .001$. The internal consistency of the VGU was calculated across the entire sample (validation and cross-validation combined) and yielded a Cronbach's alpha of .77, which is similar to the value provided by the measure's author ($\alpha = .78$; Gentile, 2009).

PVGP-R. An initial CFA was conducted on the PVGP-R items within the validation sample using the 6-factor solution provided by Tolchinsky (2013). This yielded inadequate fit, as measured by the CFI (.88) and RMSEA (.07), χ^2 (309) = 1124.35, $p < .001$. Thus, an EFA was conducted on the 27 items of the PVGP-R and the aforementioned factor retention methods analyzed. Specifically, the Kaiser-Guttman rule (Kaiser, 1960) advocated that a 6-factor solution was best, the scree plot (Cattel, 1966) was suggestive of a 4-factor solution, and the parallel analysis (Horn, 1965) indicated a 4-factor solution kept eigenvalues above chance values. To aid in clarification, the fit indices of both the 4-factor and 6-factor solutions were compared. Specifically, the 4-factor solution resulted in poor fit (CFI = .88, RMSEA = .08, χ^2 (249) = 1029.81, $p < .001$) and the 6-factor solution generated better fit (CFI = .93, RMSEA = .07, χ^2 (226) = 702.56, $p < .001$). A chi-square model comparison suggested that the 6-factor solution may better represent the data, $\Delta\chi^2$ (23) = 327.25, $p < .001$, and was chosen for further examination.

The resulting 6-factor solution accounted for 64.93% of the variance. Loadings were evaluated using an adjusted two-tailed Bonferroni critical value converted into a critical z-statistic of 3.55. All items significantly loaded on at least one factor, though five items significantly loaded on more than one factor. See Table 4 for further details.

In order to determine if this model accurately reflected the data, a CFA of the aforementioned six-factor model was conducted on the cross-validation sample. Results suggested poor fit using CFI (.88) and mediocre fit using RMSEA (.07), χ_2 (304) = 1074.41, $p <$ .001. The internal consistency of the PVGP-R was calculated across the entire sample (validation and cross-validation combined) and yielded a Cronbach's alpha of .92.

Table 4

Exploratory Factor Structure of the PVGP-R

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Keep thinking about videogames	**.64**	.03	-.10	.01	**.39**	-.10
Get irritable when stop	.27	-.03	-.04	.02	**.57**	.04
Keep playing until achieve	**.62**	-.01	.06	.03	.10	-.12
Nervousness goes away	.20	**.55**	-.01	-.03	.13	-.10
Increasing amount of time	**.54**	.11	.03	-.04	**.40**	.01
Neck hurts	.18	-.05	**.46**	.10	.10	.10
Tried to stop	-.10	.02	.08	**.70**	.13	-.01
Anger goes away	.02	**.66**	-.01	.05	-.03	.04
Planning how to play	**.41**	.02	.11	-.06	**.51**	-.01
Sadness goes away	-.01	**.84**	.03	.06	.03	.01
Conceal playing from sig. others	-.01	.03	.05	**.22**	**.55**	-.01
Wrists hurt	-.05	.04	**.83**	.03	.05	-.06
Worries go away	.02	**.82**	.01	-.02	-.02	.04
Tried to cut back	.12	.01	-.01	**.80**	-.01	-.02
Gone to bed late	**.74**	.03	.03	-.03	-.01	.11
Conceal playing from friends	-.14	-.02	.13	.16	**.51**	.11
Experience headaches	.04	.01	**.65**	-.03	.01	.22
Play longer than intended	**.67**	-.01	.07	.05	-.07	.18
Hands hurt	.11	-.02	**.82**	.02	-.04	-.07
Tried to control amount	.06	.01	-.04	**.61**	-.01	.13
Have lied to play	.01	.01	.02	.02	**.46**	.38
Experience migraines	-.13	.04	**.45**	-.04	.20	.30
Get restless when cannot play	.01	.03	-.04	.03	**.54**	**.42**
Trouble falling asleep	.15	.01	.14	.03	.22	**.43**
Neglected homework/schoolwork	.39	-.01	.01	.01	.03	**.48**
Back hurts	.02	.07	**.59**	.04	-.02	.20
Play until reach goal	**.62**	.10	-.02	.13	-.09	.09

Bold loadings *represent* $p < .05$.

Videogame Addiction Scale. Given that the aggregated scale was created for the purposes of the current study and no *a priori* model exists, an EFA was conducted on the 10 items taken from the PVGP-R and VGU to construct the measure. While the Kaiser-Guttman rule (Kaiser, 1960) suggested that two factors would be appropriate, the third factor generated an eigenvalue of 0.99, which is just below the cutoff. Further, the scree test (Cattel, 1966) and the parallel analysis (Horn, 1965) seemed to corroborate the two-factor solution as most appropriate. Interestingly, when examining the fit indices for the two-factor (CFI = .96, RMSEA = .07, χ^2 (26) = 80.29, $p < .001$) and three-factor (CFI = .99, RMSEA = .03, χ^2 (18) = 26.36, $p = .09$) solutions, the chi-square test of model fit yielded non-significant results for the three-factor solution. Non-significance denotes that the sample covariance matrix does not differ from the population covariance matrix (null hypothesis), which is the desired result. While chi-square is typically sensitive to sample size and can generate significant results even in good models that utilize a large number of participants (Bentler & Bonnet, 1980; Jöreskog & Sörbom, 1993), the aforementioned non-significance speaks to the three-factor solution's strength. A chi-square model comparison was conducted to compare the two solutions, the results of which suggested that they statistically differed from one another, $\Delta \chi^2$ (8) = 53.93, $p < .001$.

Given that the three-factor solution generated robust fit indices, it was selected for subsequent analyses. Specifically, this model accounted for 61.0% of the variance. Given that the three items of the VGU are scored on a three-point Likert scale, the model was reevaluated with Criteria 2, 10, and 11 set as categorical variables. It has been noted that scales with less than four response options may violate the parametric assumption of the maximum likelihood estimator (Flora & Curran, 2004; Joreskog & Moustaki, 2001), requiring alternative techniques to be used. Further, the difference in scoring method between the PVGP-R and the VGU could

potentially create false covariance relationships. Thus, the three items taken from the VGU were set to use the robust weighted least-squares with mean and variance adjustment (WLSMV) estimator, which is optimal for nonparametric data, while the other seven items were estimated with maximum likelihood. This method allows for more accurate item loadings on the presented factors. Loadings were evaluated using the critical z-statistic of 3.12. All items significantly loaded on at least one factor; however, one item loaded on two factors. See Table 5 for the rotated factor loadings as well as their significance.

Table 5

Exploratory Factor Structure of the Videogame Addiction Scale

	Factor 1	Factor 2	Factor 3
1) Play for longer period than intended	.01	**.73**	-.20
2) Unsuccessfully tried to play for less time	**.79**	-.01	-.26
3) Spend increasing amount of time playing	-.04	**.85**	-.01
4) Planning how I will play my next game	-.01	**.57**	**.31**
5) Skipped class/work to play	.21	.10	**.44**
6) In order to play, I get into arguments with people	.26	-.01	**.62**
7) Spent less time with family/friends	.16	**.59**	.01
8) Experienced neck, wrist, hand, or back pain or headaches	.14	**.42**	.17
9) Spend more time/money to feel same excitement	**.39**	.10	.12
10) Become restless/irritable when cutting down	**.83**	-.01	.01

Bold loadings *represent* $p < .05$.

As with the previous models, a CFA of the three-factor solution was conducted on the cross-validation sample (see Figure 1). Results suggested good model fit, based on the CFI (.96) and RMSEA (.06), χ^2 (30) = 83.43, $p < .001$. This suggests that the model generated as part of the EFA was accurately representing the data in CFA when loadings were constrained to the *a priori* relationship. The internal consistency of the aggregated model was $\alpha = .81$.

Examination of the item loadings within the model suggests that the first factor may capture underlying mechanisms of tolerance and withdrawal as well as the associated lack of control when trying to stop. The second factor seems to highlight issues related to the amount of time spent playing as well as physical pain. Lastly, the third factor may address both social problems as well as a failure to fulfill role obligations.

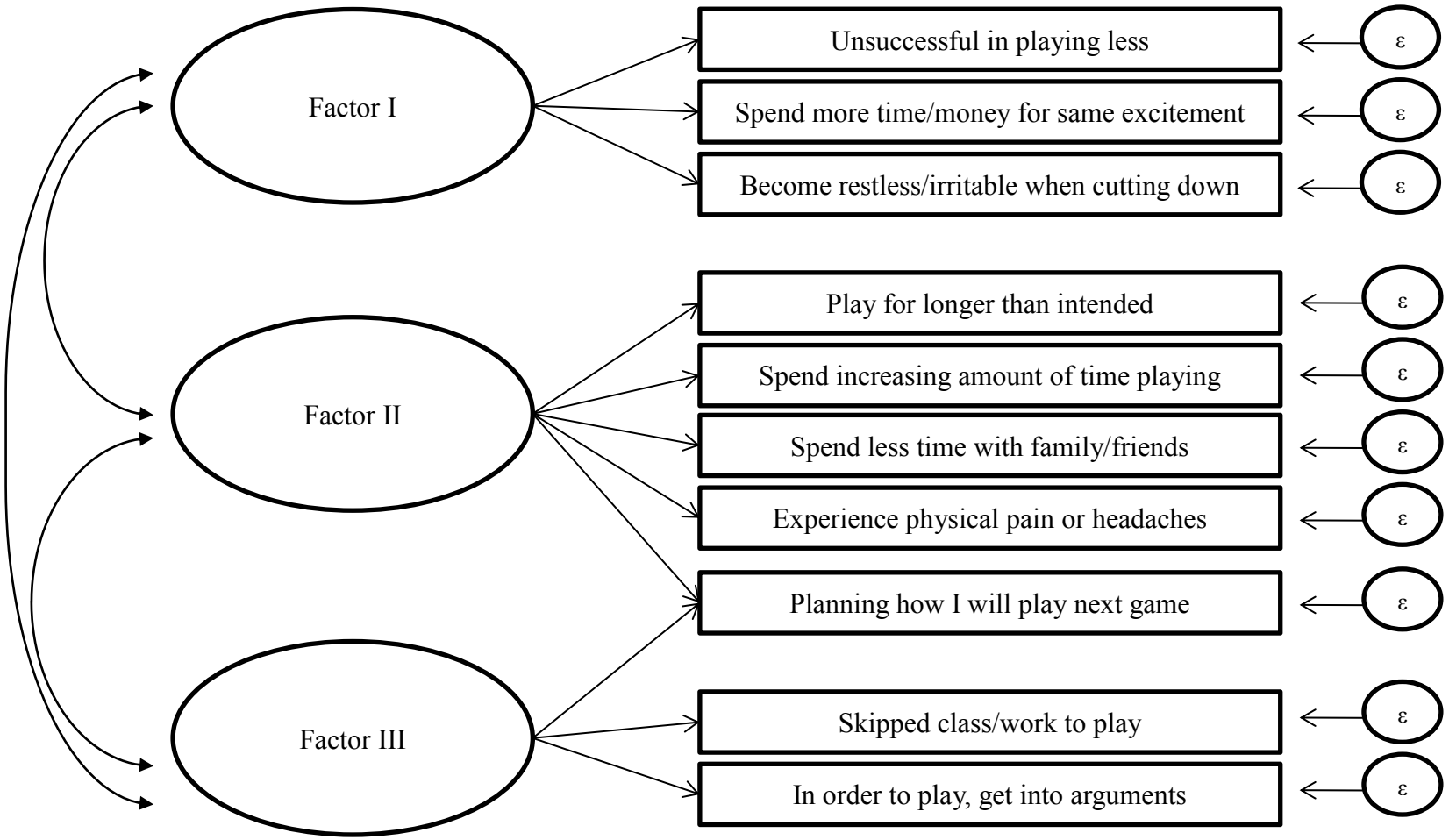

Figure 1. CFA model of the EFA factor structure.

Hypothesis Two

In order to evaluate the criterion validity of the three measures of PVGP, each measure was correlated with the BIS-11, PHQ-9, B-YAACQ, modified AUDIT, COPE, SCS, and family history of addiction. Specifically, the BIS-11 items were subdivided into the three second order factors outlined by Patton and colleagues (1995), labeled as cognitive impulsivity, motor impulsivity, and non-planning impulsivity. The PHQ-9 consisted of one total score for the first nine items (Kroenke et al., 2001). Similarly, the B-YAACQ items were unidimensionally scored as well (Kahler et al., 2008; Kahler, Strong, & Read, 2005. The modified AUDIT total score was calculated by summing Likert-scale responses for items inquiring into the use of caffeine, cocaine, other stimulants, marijuana, as well as gambling. The 28 items of the Brief COPE were paired into 14 subscales (Carver, 1997) that assess active coping, planning, positive reframing, acceptance, humor, religion, using emotional support, using instrumental support, self-distraction, denial, venting, substance use, behavioral disengagement, and self-blame. The Self-Consciousness Scale (Fenigstein et al., 1975) items were divided into three subscales assessing private self-consciousness, public self-consciousness, and social anxiety. Lastly, the number of persons within an individual's family who were reported to have a substance, gambling, or videogame problem were tallied. In order to calculate this variable, endorsement of a father, mother, or spouse with each respective issue was coded as a single individual and summed. The number of brothers/sisters, children, other relatives, or friends/important people with the aforementioned problems were also tallied and added into the total number. Thus, three variables were constructed: total individuals suffering from a gambling problem, total number with an alcohol or other drug (AOD) problem, and total number with a videogame problem.

Altogether, the aforementioned scales totaled 26 variables that were correlated with the scores of the PVGP-R, the VGU, and the Videogame Addiction Scale. See Table 6 for results.

Table 6

Correlation Coefficients for Measures of PVGP and Criterion Variables

	PVGP-R	VGU	Videogame Addiction Scale
Total Score for the PVGP-R			
Total Score for the VGU	.61**		
Total Score for the Videogame Addiction Scale	.86**	.74**	
Cognitive/Attentional Subscale of the BIS-11 Scale	.28**	.29**	.30**
Motor Subscale of the BIS-11	.22**	.25**	.26**
Non-planning Subscale of the BIS-11	.07	.20**	.16**
Total Score for PHQ-9	.37**	.36**	.37**
Active Coping Subscale of the COPE	.02	-.11**	-.08*
Planning Subscale of the COPE	.02	-.07*	-.04
Positive Reframing Subscale of the COPE	.07*	-.03	.01
Acceptance Subscale of the COPE	.09**	-.02	.01
Humor Subscale of the COPE	.20**	.14**	.16**
Religion Subscale of the COPE	-.03	-.05	.02
Using Emotional Support Subscale of the COPE	.02	-.04	-.04
Using Instrumental Support Subscale of the COPE	.04	-.02	-.01
Self-Distraction Subscale of the COPE	.23**	.15**	.13**
Denial Subscale of the COPE	.23**	.19**	.27**
Venting Subscale of the COPE	.19**	.14**	.18**
Substance Use Subscale of the COPE	.19**	.18**	.21**
Behavioral Disengagement Subscale of the COPE	.29**	.24**	.32**
Self-Blame Subscale of the COPE	.23**	.20**	.21**
Private Self-Consciousness Subscale of the SCS	.15**	.03	.06
Public Self-Consciousness Subscale of the SCS	.17**	.04	.10**
Social Anxiety Subscale of the SCS	.18**	.10**	.14**
Total Score for the B-YAACQ	.14**	.17**	.18**
Total score for AUDIT Items	.15**	.15**	.14**
Total # of People in Life that have Gambling Problem	.05	.07*	.06
Total # of People in Life that have AOD Problem	.07*	.05	.06
Total # of People in Life that have Videogame Problem	.16**	.14**	.15**

NOTE: * $p < .05$; ** $p < .01$

Examination of the correlation coefficients yielded expected relationships with related variables, including inattention, particular methods of coping, self-consciousness, substance use, and acquaintances/peers suffering from videogame-related issues. However, in order to compare the strengths of the relationships between the three measures of PVGP and associated criterion variables, Fisher's *r*-to-*z* transformation analyses were computed (Bond, 2004). This method involves transforming *r* values into normally-distributed, standardized z-scores by accounting for sample size. Two z-values can then be statistically compared in order to obtain a p-value and determine if they significantly differ from each other. Further, the positive or negative value of the z-score can help determine the direction of the correlation, ensuring that relationships are manifested in expected ways. Thus, three calculations were computed for each criterion variable: a comparison of PVGP-R to VGU, PVGP-R to the Videogame Addiction Scale, and VGU to the Videogame Addiction Scale score. The Z-critical values for $p < .05$ and $p < .01$ are 1.96 and 2.58 respectively. See Table 7 for results.

Table 7

Z-scores for Comparisons of the Three PVGP Measures

	PVGP-R & VGU	PVGP-R & Addiction Scale	VGU & Addiction Scale
Cognitive/Attentional Subscale of the BIS-11 Scale	-0.23	-0.37	-0.14
Motor Subscale of the BIS-11	-0.78	-1.03	-0.25
Non-planning Subscale of the BIS-11	-3.00**	-1.95	1.05
Total Score for PHQ-9	0.24	0.02	-0.22
Active Coping Subscale of the COPE	2.77**	2.10*	-0.66
Planning Subscale of the COPE	1.88	1.32	-0.56
Positive Reframing Subscale of the COPE	2.08*	1.49	-0.59
Acceptance Subscale of the COPE	2.44*	1.71	-0.73
Humor Subscale of the COPE	1.29	0.97	-0.33
Religion Subscale of the COPE	0.38	-1.17	-1.55
Using Emotional Support Subscale of the COPE	1.34	1.28	-0.06
Using Instrumental Support Subscale of the COPE	1.30	1.06	-0.23
Self-Distraction Subscale of the COPE	1.81	2.07*	0.26
Denial Subscale of the COPE	0.90	-0.90	-1.80
Venting Subscale of the COPE	1.02	0.29	-0.74
Substance Use Subscale of the COPE	0.20	-0.46	-0.66
Behavioral Disengagement Subscale of the COPE	1.18	-0.84	-2.03*
Self-Blame Subscale of the COPE	0.67	0.38	-0.29
Private Self-Consciousness Subscale of the SCS	2.45*	1.95	-0.50
Public Self-Consciousness Subscale of the SCS	2.68**	1.59	-1.09
Social Anxiety Subscale of the SCS	1.66	0.82	-0.83
Total Score for the B-YAACQ	-0.73	-0.97	-0.23
Total score for AUDIT Items	-0.04	0.28	0.32
Total # of People in Life that have Gambling Problem	-0.26	-0.13	0.13
Total # of People in Life that have AOD Problem	0.50	0.26	-0.24
Total # of People in Life that have Videogame Problem	0.56	0.22	-0.33

NOTE: * $p < .05$; ** $p < .01$

These results indicate that the PVGP-R generated significantly stronger correlations than the VGU for the following variables: Positive Reframing COPE subscale, $z = 2.08$, $p < .05$, Acceptance COPE subscale, $z = 2.44$, $p < .05$, Private Self-Consciousness SCS subscale, $z = 2.45$, $p < .05$, and Public Self-Consciousness subscale, $z = 2.68$, $p < .01$. Interestingly, the VGU yielded significantly higher correlations than the PVGP-R for the Non-planning BIS-11 subscale,

z = -3.00, p < .01, and the Active COPE subscale, z = 2.77, p < .01. Further, the PVGP-R generated a significantly stronger correlation than the Aggregated Score for the Self-Distraction COPE subscale, z = 2.07, p < .05; the inverse was true for the Active COPE subscale, z = 2.10, p < .05. Lastly, only one difference emerged between the VGU and Aggregated Score for the Behavioral Disengagement COPE subscale, z = -2.03, p < .05, suggesting that the latter was more strongly associated with higher scores of disengagement.

An examination of the aforementioned results yields several observations. First, the Videogame Addiction Scale score differs from both the PVGP-R and VGU on just three items (two for the former and one for the latter), only one of which is in favor of the other measure (Self-Distraction COPE subscale). Further, these observed differences make conceptual sense in light of *a priori* assumptions about the connection between these particular variables and PVGP. For example, the Aggregated score is negatively correlated with Active Coping, $r(900)$ = -.08, p < .05, which assesses active efforts to improve the individual's current situation by taking action. This relationship makes sense, given that individuals problematically playing games may not be actively seeking to change difficult situations. However, this result is in contrast to the PVGP-R's nonsignificant relationship to this variable.

Additionally, the Videogame Addiction Scale score does *not* differ from other relationships in expected ways as well. For example, the PVGP-R more strongly relates to the Public Self-Consciousness subscale than the VGU does (z = 2.68, p < .01) primarily because the PVGP-R is significantly related, $r(868)$ = .17, p < .01, and the VGU is not, $r(868)$ = ..04, p = .21. While the Videogame Addiction Scale does not statistically significantly differ from the other two measures, it is also significantly related to public self-consciousness, $r(868)$ = .10, p < .01. This suggests that the Videogame Addiction Scale is observing this relationship about as well as

the PVGP-R from a statistical perspective. Thus, a nonsignificant Z-comparison result is not necessarily a bad thing; it just highlights that the two measures are yielding similar correlations with criterion variables.

Taken together, these results appear to suggest that the Videogame Addiction Scale exhibits good criterion validity when compared to measures of impulsivity, depression, less adaptive coping strategies (e.g., denial, substance use, behavioral disengagement, self-blame), self-consciousness and social anxiety when in public, and alcohol use. Further, the results of the previous hypothesis also indicate that the factor analytic structure of the Aggregated measure is excellent (CFI = .99, RMSEA = .03, χ^2 (18) = 26.36, p = .09) and accurately represents the data from a separate sample (CFI = .96, RMSEA = .06, χ^2 (30) = 83.43, p < .001). Lastly, the Aggregated Scale has good internal consistency, as measured by Cronbach's Alpha (α = .81; George & Mallery, 2003). Thus, the Videogame Addiction Scale score will be utilized for subsequent hypotheses within the current study. The acronym used henceforth for this variable is VGAS.

Hypothesis Three

The genres of videogames that individuals played were assessed via two strategies. First, participants were able to select the genres that they play from a list, choosing as many as they felt were appropriate. This allowed participants to highlight the various types of games they enjoy, even if they are not specifically playing one of these games currently. However, this method is predicated upon the assumption that participants are able to accurately reflect the genre into which their videogame choices fit, which can sometimes be more difficult than initially assumed. For example, playing a "Mario" game could refer to Super Mario Brothers, which is a platformer, Mario Kart, which is a driving game, Mario Tennis/Golf, which would be

classified as a sports game, or Paper Mario, which would be a roleplaying game. Thus, while the games selected by participants illuminate potential characteristics of the sample, it should be recognized that such data come from self-report. See Table 8 for the number of participants who selected each genre as well as the VGAS means and standard deviations for each genre.

Table 8

Videogame Genres Endorsed by Participants

	Number of Participants[1]	Percentage of Sample[2]	VGAS Mean	VGAS Standard Deviation
Action-Adventure	674	68.4	20.89	6.94
First-person Shooter	538	54.0	20.67	6.62
Sports	443	44.7	20.15	7.17
Driving/Racing	437	44.6	20.15	7.12
Roleplaying Game	393	39.6	21.66	6.76
Fighting	381	38.6	21.27	7.20
Puzzle	373	38.2	20.00	6.71
Music/Dance/Rhythm	355	35.9	20.21	7.47
Board/Card Games	325	33.4	19.97	6.94
Sports/Workout (Motion Controls)	269	27.2	19.36	6.76
Third-person Shooter	262	26.7	21.48	6.55
Simulation	252	26.0	21.35	7.21
Real-Time Strategy	251	25.5	21.87	6.63
Turn-Based Strategy	173	17.6	21.74	6.83
Gambling	162	16.7	20.58	7.37
Platformer	154	15.7	21.74	6.48
MMORPG	147	14.9	22.74	6.63

NOTE: *1 = Number of participants who endorsed genre and completed VGAS items*
2 = Percent of individuals who endorsed genre out of total sample (even if no VGAS score)

The other method utilized to obtain genre information consisted of two qualitative questions that assessed the videogame played most often during the past year as well as participants' favorite videogame. Individuals wrote in their responses, which were then coded using the gamefaqs.com database available online. The results of the quantification are represented in Table 9.

Table 9

Genres of Videogames Reported as Being Played Most Often as well as Favorite Videogame

	Videogame Played Most Often		Favorite Videogame	
	Number of Participants	Percentage of Sample	Number of Participants	Percentage of Sample
First-person Shooter	257	25.4	188	18.6
Action-Adventure	164	16.2	180	17.8
Sports	147	14.5	127	12.5
Roleplaying Game	73	7.2	97	9.6
Simulation	53	5.2	45	4.4
Real-Time Strategy	36	3.6	18	1.8
Music/Dance/Rhythm	35	3.5	31	3.1
MMORPG	33	3.3	18	1.8
Platformer	29	2.9	120	11.8
Driving/Racing	27	2.7	42	4.1
Fighting	20	2.0	23	2.3
Board/Card Games	19	1.9	18	1.8
Sports/Workout (Motion Controls)	17	1.7	17	1.7
Puzzle	13	1.3	12	1.2
Turn-Based Strategy	9	0.9	5	0.5
Third-person Shooter	2	0.2	11	1.1
Gambling	2	0.2	1	0.1
Other	8	0.8	3	0.3
Cannot Code	25	2.5	13	1.3

In order to test the hypothesis that MMORPG players had higher scores of problematic videogame playing than shooters, which in turn had higher values than other game types, the genres for games played most often were recoded into groups. The most played game within the past year was chosen as it likely captures the particular videogame that is contributing to the elevations listed on the VGAS. For example, while 44.6% of participants endorsed playing driving games, only 2.7% listed a driving-based game as their most played videogame within the past year. Thus, while particular genres may be popular, the videogames within these genres may not contribute to the current VGAS scores obtained. The initial analysis was planned to consist of the following series of relationships: MMORPG > (FPS > Third-person shooter) > All others. However, there were surprisingly only two individuals who listed third-person shooters as their most played game. Thus, both subtypes of shooters were aggregated into a single variable (n = 256; VGAS scores: M = 21.17, SD = 7.33). MMORPG players constituted another group (n = 32; VGAS scores: M = 25.25, SD = 7.12). Other genres that were neither Shooters nor MMORPGs were classified together as "Other" (n = 620; VGAS scores: M = 19.84, SD = 6.92) and a one-way ANOVA was conducted. Results of the analysis suggested a statistically significant difference between groups, $F(2,905) = 11.05$, $p < .001$. A Tukey post-hoc test further revealed that VGAS scores were significantly higher for Shooters than for Other genres (mean difference = 1.33, $p < .03$). Similarly, VGAS scores for MMORPGs were significantly higher than for Shooters (mean difference = 4.08, $p < .01$). Thus, the expected relationship of MMORPG > Shooter > All others was observed.

A second ANOVA was conducted based on the VGAS scores obtained within the current sample and without an *a priori* model. Thus, VGAS scores for each genre were compared in order to determine which had the highest elevations. See Table 10 for details. Based on these

data, the top five genres were MMORPG, roleplaying, real-time strategy, simulation/virtual life, and first-person shooter. Thus, the second one-way ANOVA consisted of these five groups as well as an "Other" group (n = 474; VGAS scores: M = 19.19, SD = 6.75).

Table 10

VGAS Scores for Genres Based on Most Played Videogame

	N	Mean	Std. Deviation
MMORPG	32	25.25	7.12
Roleplaying Game	71	21.94	6.43
Real-Time Strategy	35	21.80	6.48
Simulation/Virtual Life	50	21.70	8.16
First-person Shooter	254	21.19	7.35
Action-Adventure	157	20.80	6.82
Other	8	20.38	6.55
Turn-based Strategy	8	20.25	6.23
Sports	142	19.25	6.71
Third-person Shooter	2	19.00	5.66
Platformer	29	18.79	6.46
Fighting	20	18.00	6.84
Music/Dance/Rhythm	33	17.52	6.87
Puzzle	11	17.45	6.49
Sports/Workout (Motion Controls)	17	17.24	6.58
Driving/Racing	27	16.78	6.40
Board/Card Games	19	15.74	5.50
Gambling	1	15.00	N/A

Results of the analysis suggested a statistically significant difference between groups, $F(5,910) = 7.89$, $p < .001$. Examination of the post-hoc Tukey test suggested that unsurprisingly, VGAS scores for MMORPG players were significantly higher than for FPS ($M_{diff} = 4.06$, $p = .02$) and Other genres ($M_{diff} = 6.06$, $p < .01$). Individuals who indicated a Roleplaying game also had higher VGAS scores than individuals categorized in the Other genres category ($M_{diff} = 2.75$, $p = .03$). FPS VGAS scores were also statistically significantly higher than Other genre scores ($M_{diff} = 1.99$, $p < .001$). No other differences were observed between genres and both Real-Time Strategy and Simulation were nonsignificant with respect to all groups. Thus, roleplaying games (whether single-player or massively multiplayer online) and first-person shooters seemed most related to problematic videogame playing.

Hypothesis Four

As noted earlier, the structural characteristics of videogames were assessed using a modified version of the measure created by King and colleagues (2011). However, given that the original measure was exceedingly long (111 items), only the top 15 structural characteristics for each section were utilized, totaling 45 items. These 45 items were correlated with the Videogame Addiction Scale score, yielding significant results for all items. Specifically, for the enjoyment of each feature, results ranged from $r(938) = .12$ (competitive aspects, $p < .001$) to $r(938) = .29$ (customizing in-game features, $p < .001$). See Table 11 for the correlation matrix. Regarding the perceived importance of each feature, results ranged from $r(938) = .13$ (cooperation, $p < .001$) to $r(938) = .30$ (emotional investment in an in-game character, $p < .001$). Table 12 provides all of the correlation coefficients. Lastly, items addressing the extent to which each feature contributes to longer playing times ranged from $r(938) = .10$ (getting 100% completion, $p = .003$) to $r(938) = .26$ (emotional investment in character, $p < .001$). Refer to

Table 13 for the full list of correlations. Thus, all of the structural characteristics were positively associated with level of videogame playing “addiction”.

Table 11

Correlation Matrix for Structural Characteristics That Are Most Enjoyable

	VGAS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
VGAS Score															
1) Social Interaction	.13														
2) Competitive Aspects	.12	.52													
3) Cooperation	.13	.55	.50												
4) Customizing Features	.29	.34	.31	.44											
5) Cut-Scenes	.26	.26	.12	.34	.51										
6) Complex Story	.26	.45	.13	.36	.45	.69									
7) Different Story Outcomes	.20	.32	.23	.41	.50	.55	.69								
8) Leveling Up	.15	.31	.33	.40	.42	.33	.40	.57							
9) Earning XP	.17	.35	.32	.42	.38	.30	.33	.47	.72						
10) Unique Items	.21	.34	.30	.37	.43	.35	.37	.51	.67	.74					
11) 100% Completion	.12	.25	.30	.28	.25	.22	.23	.36	.45	.51	.55				
12) Meta-Game Rewards	.14	.27	.32	.27	.31	.24	.20	.32	.47	.56	.56	.64			
13) Fast Loading	.17	.34	.34	.39	.35	.35	.35	.50	.55	.53	.51	.44	.47		
14) Visual Aspects	.17	.31	.31	.35	.40	.35	.43	.52	.48	.45	.44	.37	.39	.60	
15) Sound	.17	.29	.25	.32	.42	.41	.43	.47	.41	.39	.38	.34	.33	.45	.69

NOTE: All correlations are significant, $p < .001$.

Table 12

Correlation Matrix for Structural Characteristics That are Perceived as Important

	VGAS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
VGAS Score															
1) Cooperation	.13														
2) Correct Mistakes	.15	.43													
3) Customizing Features	.24	.38	.49												
4) Emotional Investment	.30	.28	.41	.52											
5) Cut-Scenes	.27	.31	.37	.48	.62										
6) Complex Story	.23	.34	.38	.37	.59	.68									
7) Different Story Outcomes	.21	.34	.42	.42	.49	.53	.62								
8) Leveling Up	.14	.39	.43	.40	.37	.37	.39	.53							
9) Earning XP	.16	.40	.41	.35	.32	.29	.32	.44	.72						
10) Unique Items	.18	.35	.39	.35	.34	.31	.33	.44	.63	.72					
11) Difficult Sections	.18	.31	.35	.32	.35	.30	.37	.46	.45	.45	.55				
12) Hardest Difficulty	.18	.24	.21	.20	.23	.15	.19	.27	.30	.31	.40	.64			
13) Fast Loading	.16	.34	.45	.34	.29	.30	.33	.42	.52	.49	.46	.41	.35		
14) Visual Aspects	.20	.30	.40	.37	.34	.37	.39	.44	.43	.42	.40	.38	.28	.57	
15) Sound	.17	.31	.36	.42	.42	.44	.43	.43	.37	.34	.34	.35	.27	.42	.67

NOTE: All correlations are significant, $p < .001$.

Table 13

Correlation Matrix for Structural Characteristics That Contribute to Longer Playing Times

	VGAS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
VGAS Score															
1) Social Interaction	.12														
2) Cooperation	.15	.73													
3) Correct Mistakes	.19	.34	.35												
4) Emotional Investment	.26	.26	.31	.40											
5) Complex Game Story	.25	.27	.29	.42	.67										
6) Different Story Outcomes	.23	.24	.26	.45	.55	.71									
7) Leveling Up	.16	.32	.36	.39	.41	.39	.47								
8) Earning XP	.18	.37	.40	.39	.38	.34	.42	.71							
9) Rare Items	.17	.35	.36	.41	.41	.39	.44	.64	.77						
10) 100% Completion	.10	.31	.29	.37	.26	.30	.35	.47	.54	.55					
11) Meta-Game Rewards	.16	.35	.33	.37	.27	.27	.37	.53	.61	.61	.64				
12) Difficult Sections	.14	.34	.31	.41	.34	.42	.41	.46	.46	.50	.50	.50			
13) Fast Loading	.13	.32	.30	.45	.28	.25	.31	.43	.39	.38	.30	.37	.32		
14) Visual Aspects	.21	.23	.28	.34	.29	.29	.35	.31	.34	.32	.26	.33	.28	.60	
15) Sound	.21	.20	.25	.29	.29	.27	.29	.25	.28	.27	.22	.25	.23	.49	.81

NOTE: All correlations are significant, $p < .001$.

T-tests were then conducted in order to compare participants with low and high levels of videogame addiction on the aforementioned structural characteristics. Specifically, participants were divided into two groups via a mean-split, based on the Videogame Addiction Scale score (M = 20.32, SD = 7.15). Thus, the Low VGAS group consisted of individuals with scores of 19 or below (n = 497, M = 14.90, SD = 2.95); whereas, the High VGAS group contained participants with scores of 20 or above (n = 443, M = 26.41, SD = 5.34). Additionally, a Bonferroni adjustment for alpha inflation due to multiple comparisons was utilized. Thus, values of p = .003 were considered statistically significant within each domain (e.g., enjoyment, importance, behavioral impact).

Results of t-tests indicated that the high group had significantly greater enjoyment of videogames than the low group with regard to the following structural characteristics: customizing in-game features, $t(938) = -6.64$, $p < .001$, cut-scenes, $t(938) = -5.89$, $p < .001$, complex game story, $t(938) = -6.10$, $p < .001$, different story outcomes based on player action, $t(938) = -4.59$, $p < .001$, leveling up a game character, $t(938) = -3.95$, $p < .001$, earning points/XP, $t(938) = -3.87$, $p < .001$, being rewarded with rare/unique items, $t(938) = -4.97$, $p < .001$, unlocking meta-game rewards, $t(938) = -4.25$, $p < .001$, faster loading/respawning, $t(938) = -3.80$, $p < .001$, visual aspects, $t(938) = 3.57$, $p < .001$, and sound, $t(938) = -3.26$, $p = .001$. Cooperation was the only characteristic not significantly different between high and low groups before the Bonferroni adjustment and the following approached the adjusted alpha: social interaction, $t(938) = -2.92$, $p = .004$, competitive aspects, $t(938) = -2.59$, $p = .01$, and getting 100% completion, $t(938) = -2.14$, $p = .03$.

Regarding the structural characteristics associated with perceived importance, the high VGAS group was significantly higher on the following: customizing in-game features, $t(938) = -$

5.42, $p < .001$, emotional investment in an in-game character, $t(938) = -8.36$, $p < .001$, cut-scenes, $t(938) = -6.54$, $p < .001$, complex game story, $t(938) = -5.36$, $p < .001$, different story outcomes based on player action, $t(938) = -5.14$, $p < .001$, leveling up a game character, $t(938) = -4.12$, $p < .001$, earning points/XP, $t(938) = -4.65$, $p < .001$, being rewarded with rare/unique items, $t(938) = -5.06$, $p < .001$, very difficult sections of the game, $t(938) = -3.86$, $p < .001$, playing a game on the hardest difficulty, $t(938) = -4.26$, $p < .001$, faster loading/respawning, $t(938) = -3.45$, $p = .001$, visual aspects, $t(938) = -4.73$, $p < .001$, and sound, $t(938) = -3.56$, $p < .001$. Again, cooperation was not significantly different between groups; in addition, being able to correct mistakes by reloading a save file approached the adjusted alpha, $t(938) = -2.87$, $p = .004$.

The structural characteristics associated with longer playing times were analyzed and the following differed between the two groups, with higher scores manifesting for the high VGAS group: being able to correct mistakes by reloading a save file, $t(938) = -4.00$, $p < .001$, emotional investment in an in-game character, $t(938) = -7.03$, $p < .001$, complex game story, $t(938) = -5.45$, $p < .001$, different story outcomes based on player actions, $t(938) = -5.10$, $p < .001$, leveling up a character, $t(938) = -4.76$, $p < .001$, earning points/XP, $t(938) = -4.95$, $p < .001$, being rewarded with rare/unique items, $t(938) = -3.97$, $p < .001$, unlocking meta-game achievements, $t(938) = -3.96$, $p < .001$, faster loading/respawning, $t(938) = -2.99$, $p = .003$, visual aspects, $t(938) = -5.01$, $p < .001$, and sound, $t(938) = -4.94$, $p < .001$. The following did not meet the Bonferroni adjusted alpha: social interaction, $t(938) = -2.19$, $p = .03$, cooperation, $t(938) = -2.77$, $p = .006$, getting 100% completion, $t(938) = -2.40$, $p = .02$, and very difficult sections of the game, $t(938) = -2.73$, $p = .006$.

Taken together, these results suggest that more highly addicted videogame players are likely to place greater emphasis on earning rewards, having more input into the game world (either via the storyline or character construction), complex plotlines and emotional investment in characters, graphical fidelity, as well as high-quality music/sound effects. Furthermore, many of the aforementioned characteristics seem linked to subjective enjoyment as well as to the amount of time actually playing the videogame. Interestingly, cooperative play (e.g., individuals working together to accomplish goals) did not seem to differentiate high and low PVGAS groups for any of the three domains. This makes intuitive sense, given the notable emphasis on the storylines of games. Typically, games that provide the richest narrative experiences tend to be single-player experiences and thus do not feature cooperative elements. As such, these structural characteristics are in some ways mutually exclusive; that is, games with cooperative elements may not offer the complex stories this sample greatly valued.

Hypothesis Five

The interaction between genres and structural characteristics was examined via a series of two-way ANOVAs. Specifically, responses for each structural characteristic were divided into "high" and "low" response groups and compared to the aforementioned genre groups from the previous one-way ANOVA (e.g., Shooters, MMORPG, Other genres). Regarding characteristics most related to enjoyment, the 11 structural characteristics that yielded statistical significance in the previous hypothesis were included. The frequency distribution of each item was evaluated in an effort to subdivide the sample in half. However, given that characteristics were scored on a 5-point Likert scale, it was not always possible to generate two groups that each contained 50% of participants. Thus, the following variables were divided based on a cutpoint of scores from 1 to 3 representing the low group and scores of 4 or 5 constituting the high: customizing in-game

features (low n = 519; high n = 441), cut-scenes (low n = 556; high n = 393), complex game story (low n = 453; high n = 506), and unlocking meta-game rewards (low n = 405; high n = 554). For the next set of variables, scores of 1 to 4 represented the low group and a response of 5 was classified as the high group: different story outcomes (low n = 603; high n = 441), leveling up (low n = 585; high n = 374), earning points/XP (low n = 577; high n = 382), rewarded with rare items (low n = 568; high n = 391), fast loading times (low n = 584; high n = 375), visual aspects (low n = 566; high n = 393), and sound (low n = 618; high n = 341).

Two-way 3x2 ANOVAs were conducted for each of these 11 structural characteristics, the results of which are represented in Table 14. Specifically, all F-values were significant, ranging from $F(5,902) = 6.38$, $p < .001$ (meta-game rewards) to $F(5,902) = 16.46$, $p < .001$ (customizing features). Further, an examination of the main effect for genre highlighted statistical significance for all structural characteristics. Interestingly, the main effect for characteristics was less universal, with significant results manifesting only for the following: customizing features, $F(1,902) = 22.08$, $p < .001$, fast loading, $F(1,902) = 6.86$, $p = .01$, cut-scenes, $F(1,902) = 6.04$, $p = .01$, complex story, $F(1,902) = 5.02$, $p = .03$, different story outcomes, $F(1,902) = 4.23$, $p = .04$, visual aspects, $F(1,902) = 5.06$, $p = .03$, and sound, $F(1,902) = 22.08$, $p = .04$. The only genre-by-characteristic interaction effect that manifested was for leveling up, though the results were modest, $F(2,902) = 3.12$, $p = .05$. Specifically, individuals who placed higher value on leveling up had higher VGAS scores with respect to shooters and other genres. Inversely, higher enjoyment about leveling up was associated with lower scores on VGAS within the MMORPG players.

Table 14

F-values for Structural Characteristic x VGAS ANOVA regarding Enjoyment

	Full Model (5,902)	Genre Main Effect (2,902)	Characteristic Main Effect (1,902)	Interaction (2,902)
3) Customizing Features	16.46**	11.21**	22.08**	1.57
5) Cut-Scenes	10.09**	10.92**	6.04*	0.07
6) Complex Story	11.37**	9.29**	5.02*	0.18
7) Diff. Story Outcomes	7.01**	11.13**	4.23*	0.04
8) Leveling Up	7.40**	10.48**	0.28	3.12*
9) Earning XP	6.96**	10.14**	0.90	0.71
10) Unique Items	9.16**	9.99**	2.83	0.51
12) Meta-Game Rewards	6.38**	10.10**	0.31	1.16
13) Fast Loading	7.10**	9.95**	6.86**	0.49
14) Visual Aspects	7.46**	10.16**	5.06*	0.68
15) Sound	7.17**	10.29**	4.40*	0.27

Note: * $p < .05$, ** $p < .01$

A similar process was conducted for the 13 structural characteristics deemed significant in Hypothesis Four (see Table 15). Again, all F-values were significant, ranging from $F(5,902) = 7.12$, $p < .001$ (different story outcomes, fast loading) to $F(5,902) = 19.53$, $p < .001$ (emotional investment). Similarly, all of the genre main effects were significant as well, ranging from $F(2,902) = 7.61$, $p < .001$ (sound) to $F(2,902) = 14.14$, $p < .001$ (emotional investment); post-hoc Tukey tests indicated that MMORPGs were significantly higher than Shooters, which were significantly higher than Other genres. Only six structural characteristic main effects were significant, with the high VGAS group having higher scores, including: customizing features, $F(1,902) = 10.45$, $p = .001$, emotional investment, $F(1,902) = 9.95$, $p = .002$, very difficult

sections, $F(1,902) = 6.54$, $p = .01$, playing the hardest difficulty, $F(1,902) = 8.03$, $p = .005$, fast loading, $F(1,902) = 9.68$, $p = .002$, and visual aspects, $F(1,902) = 5.17$, $p = .02$. No genre x characteristic interactions were present.

Table 15

F-values for Structural Characteristic x VGAS ANOVA regarding Importance

	Full Model (5,902)	Genre Main Effect (2,902)	Characteristic Main Effect (1,902)	Interaction (2,902)
3) Customizing Features	10.61**	11.46**	10.45**	1.40
4) Emotional Investment	19.53**	14.14**	9.95**	1.62
5) Cut-Scenes	12.19**	10.63**	2.38	1.70
6) Complex Story	10.39**	12.54**	1.02	1.65
7) Diff. Story Outcomes	7.12**	11.03**	2.14	0.11
8) Leveling Up	8.40**	8.82**	0.31	1.87
9) Earning XP	7.53**	9.39**	2.89	0.16
10) Unique Items	8.25**	10.44**	1.92	0.79
11) Difficult Sections	9.05**	9.12**	6.54**	.41
12) Hardest Difficulty	9.96**	10.28**	8.03**	0.81
13) Fast Loading	7.12**	8.92**	9.68**	1.97
14) Visual Aspects	10.90**	8.76**	5.17*	0.38
15) Sound	8.22**	7.61**	1.75	0.26

Note: * $p < .05$, ** $p < .01$

Lastly, the structural characteristics that were deemed to contribute to longer playing times were analyzed in the same fashion (see Table 16). Specifically, 11 items were evaluated via 3x2 ANOVAs, which were all significant and ranged from $F(5,902) = 7.39$, $p < .001$ (different story outcomes) to $F(5,902) = 14.71$, $p < .001$ (emotional investment in a character).

Further, all genre main effects were significant as well in the same pattern as previous analyses (e.g., MMORPG > Shooter > Other). Only three structural characteristics yielded significance, including ability to correct mistakes by reloading a save file, $F(1,902) = 4.04$, $p = .05$, emotional investment in a character, $F(1,902) = 9.57$, $p = .002$, and sound, $F(1,902) = 9.00$, $p = .003$. Post-hoc analyses confirmed that great endorsement of items was associated with the high VGAS group. There were no significant interactions.

Table 16

F-values for Structural Characteristic x VGAS ANOVA regarding Longer Playtimes

	Full Model (5,902)	Genre Main Effect (2,902)	Characteristic Main Effect (1,902)	Interaction (2,902)
3) Correct Mistakes	9.37**	11.51**	4.04*	1.65
4) Emotional Investment	14.71**	13.71**	9.57**	1.43
5) Complex Game Story	9.55**	9.58**	2.73	0.63
6) Diff. Story Outcomes	7.39**	9.54**	2.28	0.18
7) Leveling Up	8.26**	9.98**	0.07	2.35
8) Earning XP	8.43**	8.98**	0.58	2.44
9) Rare Items	8.58**	10.20**	0.05	2.42
11) Meta-Game Rewards	7.65**	8.23**	0.50	1.09
13) Fast Loading	6.28**	10.73**	3.39	0.06
14) Visual Aspects	11.62**	9.36**	1.10	2.23
15) Sound	12.68**	10.88**	9.00**	1.54

Note: * $p < .05$, ** $p < .01$

In summation, it appears that an interaction between game genre and structural characteristics did not manifest as expected. As an example, the results of a variable that was hypothesized to have yielded significant effects are displayed below to highlight a trend found in

most variables. However, while significant main effects existed for both genre ($F(2,902) = 9.95$, $p < .01$) and value on loading ($F(1,902) = 6.86$, $p = .01$), no significant interaction terms materialized. See Figure 2 for a visual representation of the data. Thus, it appears that individuals who derive greater enjoyment from shorter interruptions to gameplay have higher VGAS scores across all genres than their lower scoring peers.

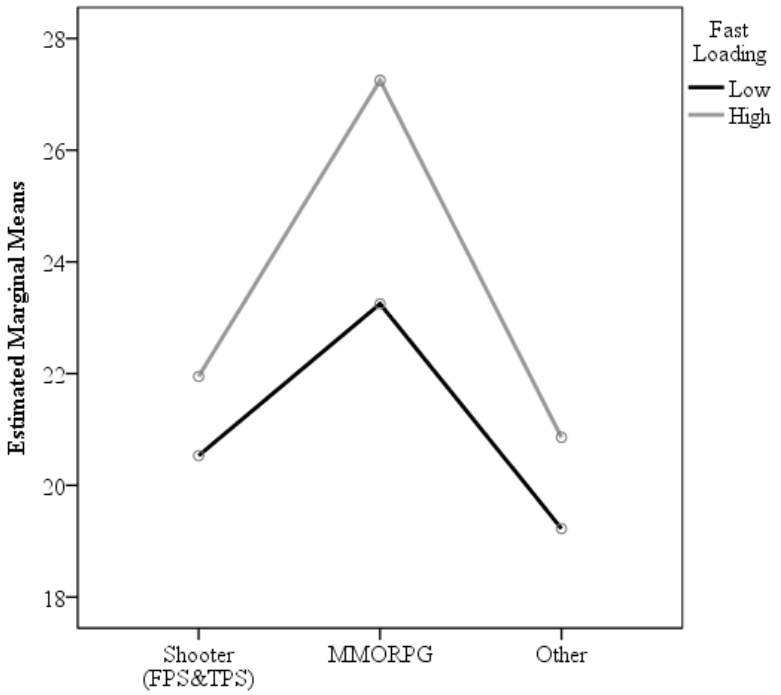

Figure 2. Results for loading structural characteristic as related to videogame enjoyment.

Hypothesis 6

As noted earlier, the intention of the sixth hypothesis was to evaluate the relationship between self-reported and performance-based impulsivity in relation to low versus high VGAS groups. In order to conduct this evaluation, Phase 2 data would be utilized, as the CPT-II was only administered during the second phase of the study. Power analyses had concluded that 26 participants per group (56 total) would be necessary in order to test hypothesis six. However,

only 29 participants were successfully recruited (17 High, 12 Low) during the 12 months of data collection. Thus, there were not enough participants to yield adequate power for the proposed analyses.

Regardless, analyses were conducted with what was available. Specifically, the three BIS-11 subscales were correlated with the three primary CPT scales for both the high and low VGAS groups. Data are presented in Table 17. Unsurprisingly, no correlations were statistically significant. Fisher's *r*-to-*z* transformation analyses were then computed to determine if the correlations significantly differed between the low and high VGAS groups. Again, results were all nonsignificant (see Table 18).

Table 17

Correlation Matrices for CPT and BIS Scores

	Low VGAS			High VGAS		
	Attentional Subscale (BIS-11)	Motor Subscale (BIS-11)	Non-planning Subscale (BIS-11)	Attentional Subscale (BIS-11)	Motor Subscale (BIS-11)	Non-planning Subscale (BIS-11)
CPT Com. %	.10	.19	.20	-.41	-.26	.08
CPT Hit RT	.07	-.17	.08	.33	.16	-.12
CPT Persev. %	.10	-.07	.31	-.07	-.01	.10

Table 18

Z-values for Fisher's R-to-Z Comparisons between High and Low VGAS

	Attentional Subscale (BIS-11)	Motor Subscale (BIS-11)	Non-planning Subscale (BIS-11)
CPT Com. %	1.27	1.09	0.26
CPT Hit RT	-0.65	0.79	0.42
CPT Persev. %	0.41	0.14	0.46

In order to evaluate the existing Phase 2 data, t-tests were conducted on high and low VGAS groups for all CPT-II variables (12 total). Results showed no significance for any variable. Specifically, results ranged from $t(28) = 1.29$, $p = .21$ (for Percent of Omissions) to $t(28) = -.09$, $p = .93$ (for Hit Reaction Time Standard Error). Please see Table 19 for t-test results for all variables. Given that this sample has not reached adequate power, participant data was doubled (e.g., each participant was entered into the dataset twice) to simulate potential findings if an additional 29 individuals were recruited with identical scores. Results of t-tests still demonstrated no significance on any variable, even before implementing a Bonferroni adjustment for alpha inflation due to multiple comparisons. Thus, it appeared that significant differences may not have manifested even with the desired sample.

Table 19

Results of T-tests Comparing High and Low VGAS Groups on CPT-II Variables

	T-tests of Current Data	T-tests of Duplicated Data
Omissions %	*t*(28) = 1.29, p = .21	*t*(58) = 1.86, p = .07
Commissions %	*t*(28) = -.29, p = .77	*t*(58) = -.41, p = .68
Hit RT	*t*(28) = .13, p = .89	*t*(58) = .19, p = .85
Hit RT Std Error	*t*(28) = -.09, p = .93	*t*(58) = -.14, p = .89
Variability	*t*(28) = -.43, p = .67	*t*(58) = -.62, p = .54
Detectability	*t*(28) = -.87, p = .39	*t*(58) = -1.26, p = .21
Response Style	*t*(28) = .75, p = .46	*t*(58) = 1.08, p = .28
Perseverations %	*t*(28) = .39, p = .70	*t*(58) = .56, p = .58
Hit RT Block Δ	*t*(28) = -.18, p = .86	*t*(58) = -.26, p = .80
Hit SE Block Δ	*t*(28) = -.63, p = .53	*t*(58) = -.91, p = .37
Hit RT ISI Δ	*t*(28) = -.21, p = .71	*t*(58) = -.30, p = .76
Hit SE ISI Δ	*t*(28) = -.62, p = .54	*t*(58) = -.89, p = .38

Hypothesis Seven

In order to examine the differences between the high and low VGAS groups for the WCST, a MANOVA was conducted. Specifically, the individual variable consisted of VGAS group (high and low) and the dependent variables were the following variables from the WCST: total errors, perseverative errors, and conceptual level. However, as with the previous hypothesis, it should be noted that not enough participants were obtained for Phase 2 of the study to make meaningful conclusions about results. Regardless, the MANOVA was run. Results

suggested no significant difference between groups, $F(3,26) = 0.19$, $p = .90$; Wilk's $\Lambda = 0..98$, partial $\eta^2 = .02$.

As with the CPT-II, t-tests were conducted for the six scores obtained for the WCST. Again, participants were duplicated within the database to simulate results if twice as many participants had been collected with similar scores. In both cases, t-tests yielded no significant differences (see Table 20). Thus, it appears that low and high VGAS groups may not meaningfully differ on the WCST. However, any interpretations of the current data should be made with extreme caution, given the notably small sample size.

Table 20

Results of T-tests Comparing High and Low VGAS Groups on WCST Variables

	T-tests of Current Data	T-tests of Duplicated Data
Raw Score	$t(28) = .66$, p = .52	$t(58) = .94$, p = .35
Total Errors	$t(28) = .62$, p = .54	$t(58) = .89$, p = .38
Persev Resp	$t(28) = .70$, p = .49	$t(58) = 1.01$, p = .32
Persev Errors	$t(28) = .62$, p = .54	$t(58) = .89$, p = .38
Nonpersev Errors	$t(28) = .93$, p = .36	$t(58) = 1.34$, p = .19
Conceptual Lvl	$t(28) = .53$, p = .60	$t(58) = .77$, p = .45

Hypothesis Eight

In order to evaluate how the variables from the previous hypotheses related, several models were tested. Specifically, the aforementioned variables were conceptualized as constituting three domains: self-characteristics, game features, and exposure to videogames. Self-characteristics captured aspects of an individual's experience independent of the videogame playing behavior. This included how coping style, depression, and impulsivity. Impulsivity was assessed by summing the three subscales of the BIS-11 (motor, non-planning, and cognitive impulsivity) to generate a total BIS-11 score. Depression was measured via the PHQ-9 total score. Coping was assessed in various methods, including individual subscales as well as a total score. Game features represented the structural characteristics of a videogame. Specifically, the characteristics that generated main effects in the previously conducted ANOVAs were summed into single values for each subscale of the measure: enjoyment, importance, and playtime. While each variable was tested separately within the models highlighted below, the summed characteristics associated with longer playtime fit notably better each time; thus, descriptions of the following models all refer to the total of the structural characteristics rated as most related to playing longer. Specifically, these were the ability to correct mistakes by reloading a save file, emotional investment in a game character, and sound. Lastly, exposure to videogames was assessed via two items from the survey that inquired into the average hours spent playing videogames on a weekday and on a weekend day. In order to estimate the average weekly time spent playing videogames, the weekday value was multiplied by five and summed with the doubled weekend day value. Thus, exposure was conceptualized as actual time spent interacting with videogames each week.

The aforementioned variables were evaluated via structural equation modeling using Mplus© 5.21 (Muthén & Muthén, 2008). The initial model consisted of personal characteristics predicting structural characteristics, which in turn predicted playtime, and finally, predicting problematic videogame addiction. Specifically, the three most related subscales of the COPE (Behavioral Disengagement, Denial, and Self-Blame) were utilized, as was the PHQ-9 total score and BIS-11 total. The Substance Use COPE subscale was not included, as using illicit substances was hypothesized to be a correlate of problematic videogame playing and not a prerequisite. However, this model yielded poor fit. Thus, the three COPE scales were summed to create a maladaptive coping score and the model reanalyzed. Again, poor fit was obtained. Next, personal characteristics and structural characteristics were clustered together, jointly predicting playtime, which predicted VGAS scores. However, this also did not yield good fit. The model was reconceptualized such that maladaptive coping no longer predicted playtime and instead directly related to videogame addiction. Similarly, the structural characteristics were allowed to correlate with playtime but no longer predicted it. This appeared to make more sense, given that playtime likely represents just one aspect of addiction and not the channel through which all other variables relate to addiction. The model approached adequate fit but was still poorly defined. Lastly, the model was run again, but with depression removed.

Specifically, the last model hypothesized that scores on the Videogame Addiction Scale would be predicted by the measures of playtime, impulsivity, and coping strategies. Further, weekly playtime and the structural characteristics were allowed to correlate. Lastly, playtime was assumed to be predicted by impulsivity. This model is visually represented in Figure 3. Results of the analysis yielded good model fit based on the CFI (.97) and nearly good fit using the RMSEA (.07), χ_2 (2) = 11.79, p = .003. This suggests that impulsivity likely leads to longer

playtime, which in turn relates to the videogame characteristics that players' value. Lastly, maladaptive coping strategies, weekly playtime, and valued structural characteristics all predict VGAS scores.

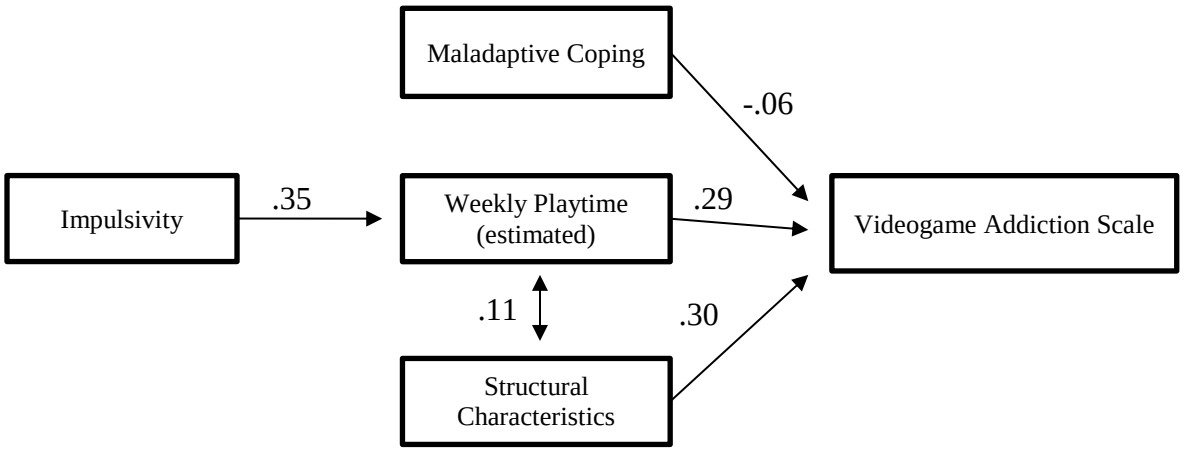

Figure 3. Structural equation model of videogame playing addiction and associated variables

Discussion

The current study sought to explore the concept of problematic videogame playing (PVGP), which is a relatively new field of study within the empirical literature. Specifically, the hypotheses addressed in this paper focused on the particular components of videogames that may relate to PVGP, including genre and structural characteristics, as well as the personal characteristics of gamers exhibiting problematic play. Further, the most notable PVGP measures within the literature were compared to each other in order to determine the best instrument for the aforementioned analyses. The large sample recruited for the current study allowed for a variety of statistical analyses to be conducted, including modeling on subsamples that require hundreds of individuals. Thus, this paper represents one of the first systematic attempts to directly compare measures of PVGP on their factor analytic structure, and it is the first to explicitly address the extent to which PVGP fits with an addiction model akin to that applied to substance use disorders.

Specifically, the PVGP-R, VGU, and Videogame Addiction Scale (VGAS) were compared. Results of exploratory factor analyses suggested that the scale generated from adapting the substance use disorder (SUD) criteria of the DSM-5 (APA, 2013) had the best overall model fit. Further, when models were constructed via confirmatory methods in a second subsample, only the aggregated scale yielded good fit. Thus, the addiction model of problematic videogame playing seems to represent the current data well. Examination of the factor structure of the Videogame Addiction Scale highlighted that the first factor captured items assessing unsuccessful efforts to play less (criterion 2), spending more time/money for the same excitement (criterion 10), and becoming restless/irritable when cutting down (criterion 11). Thus, this factor appears to capture the underlying mechanisms of tolerance and withdrawal as

well as the associated lack of control when trying to stop. The second factor encapsulated playing for longer than intended (criterion 1), spending increasing amounts of time playing (criterion 3), spending less time with family/friends (criterion 7), experiencing physical pain (criterion 9), and planning future games when not playing (criterion 4). Thus, the second factor consisted of the items addressing time playing and not doing other activities as well as playing games to the point of experiencing physical pain. Collectively, these items seem to capture the narrow reinforcement menu that is common to other forms of addiction, wherein the primary source of reward and motivation comes from substance/activity to which one is "addicted," to the exclusion of other available reinforcers. Lastly, the third factor also consisted of preoccupation with how to play future games, as well as skipping class/work to play (criterion 5) and getting into arguments with others (criterion 6). Thus, the last factor captured primarily psychosocial problems associated with game play. Interestingly, it was the item addressing craving/preoccupation that cross-loaded, suggesting that elements of having a strong desire to play videogames when not actually playing may relate to time spent playing as well as psychosocial difficulties. The VGAS is available in Appendix M.

While this factor structure appears to fit the current data, it does not match the factor analytic investigations of substance use disorders. Although less research is available on the current criteria for SUD within DSM-5 (APA, 2013), several studies have combined the abuse and dependence criteria from DSM-IV-TR (APA, 2000), which collectively align with the current conceptualization of SUD. Thus, when combining the DSM-IV abuse and dependence criteria together, Saha et al. (2012) yielded one-factor solutions for amphetamines, cocaine, prescription drugs, tranquilizers, and opioids (CFIs = .97 to .99, RMSEAs = .03 to .05). Similar results were found by Fulkerson, Harrison, and Beebe (1999) across two samples (Goodness-of-

Fit = .99, RMSEA = .05 for both). Additionally, undimensional models were presented by Rounsaville and colleagues (1993), factor loadings = .70 to 1.03 (no fit indices provided), and Nelson et al. (1999), loadings = .80 to 1.00. Only one paper has suggested two-factor solutions better capture the data for alcohol, cannabis, cocaine, opiates, sedatives, and stimulants (Beseler et al., 2006), though the particular criteria that loaded on the factors differed for each substance. Taken together, this suggests that while videogame addiction may be best assessed using the same criteria as substance use disorders, the relationships between these criteria differ. That is, the results within the current study did not support the unidimensional model proposed in the SUD literature.

Regardless, the recently published DSM-5 (APA, 2013) includes Internet Gaming Disorder (IGD) under the "Conditions for Further Study" section and further exemplifies that gaming may represent an addiction. Specifically, the DSM-5 highlights that videogaming shares similarities with substance use disorders and even notes that the Chinese government has labeled internet gaming as an addiction. IGD is characterized as "a pattern of excessive and prolonged Internet gaming that results in a cluster of cognitive and behavioral symptoms, including progressive loss of control over gaming, tolerance, and withdrawal symptoms, analogous to the symptoms of substance use disorders" (APA, 2013, p. 796). See Table 21 for the specific criteria from DSM-5, which seem to mirror the subcomponents of SUD. While only one study to date has evaluated the diagnostic accuracy of IGD specifically (Ko et al., 2014), other studies have highlighted the addictive quality of videogames (e.g., Festl, Scharkow, & Quandt, 2013; van Rooij et al., 2011). Further, a recent review of the neuroscience literature highlights that "Internet gaming addiction appears similar to other addictions, including substance-related addictions, at the molecular, neurocircuitry, and behavioral levels" (Kuss, 2013, p. 130). Thus,

increasing evidence for an addiction model of videogame playing has been materializing. However, it has been noted that one of the main issues that prevented the proposed disorder from being classified within the DSM-5 was the lack of standardized diagnostic criteria across the current literature (Petry & O'Brien, 2013). Additionally, concern has been raised that inclusion of the disorder will eventually lead the term "addiction" to be used for any excessive behavior that causes problems (Starcevic, 2013).

Table 21

DSM-5 Criteria for Internet Gaming Disorder

Persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress as indicated by five (or more) of the following in a 12-month period:
1. Preoccupation with Internet games. (The individual thinks about previous gaming activity or anticipates playing the next game; Internet gaming becomes the dominant activity in daily life).
Note: This disorder is distinct from Internet gambling, which is included under gambling disorder.
2. Withdrawal symptoms when Internet gaming is taken away. (These symptoms are typically described as irritability, anxiety, or sadness, but there are no physical signs of pharmacological withdrawal).
3. Tolerance – the need to spend increasing amounts of time engaged in Internet games.
4. Unsuccessful attempts to control the participation in Internet games.
5. Loss of interests in previous hobbies and entertainment as a result of, or with the exception of, Internet games.
6. Continued excessive use of Internet games despite knowledge of psychosocial problems.
7. Has deceived family members, therapists, or others regarding the amount of Internet gaming.
8. Use of Internet games to escape or relieve a negative mood (e.g., feelings of helplessness, guilt, anxiety).
9. Has jeopardized or lost a significant relationship, job, or educational or career opportunity because of participation in Internet games.

One issue with the current conceptualization of videogame addiction in DSM-5 is that it emphasizes the internet as a functional component of the playing process. As King and Delfabbro (2012) highlight, this "confuses two different delivery mechanisms (i.e., the internet and a video-game) within a single classification" (p. 21). Similarly, Baer, Saran, and Green (2012) report high correlations between measures assessing online and offline videogame use

and further highlight that videogame playing (regardless of online status) "is consistently correlated with emotional and functional problems in youth across multiple measures of addiction and impairment as well as multiple informants" (p. 430). Thus, the aforementioned research may be focusing too narrowly on one subtype of videogames (i.e., those played online).

Within the current study, the three assessed measures of PVGP were also compared regarding their relationship with several criterion variables, including impulsivity, coping strategies, self-consciousness, alcohol and other drug use, and family/peer history of addiction. Coping via self-distraction was the only scale that was more significantly related to another measure (PVGP-R), relative to its association with the Videogame Addiction Scale. Further, the aggregated scale score was actually more strongly related to active coping than was the PVGP-R, and to behavioral disengagement than was the VGU. Thus, the aggregated VGAS measure related to criterion variables in expected ways. However, it should be noted that few variables were differentiated by measures of PVGP, as only six variables statistically differed between the PVGP-R and VGU. Thus, it seemed that all three measures were highlighting at least some of the expected associations with related variables. Further examination into which variables were associated with the Videogame Addiction Scale revealed significantly positive correlations with impulsivity, depression, self-consciousness in public, social anxiety, alcohol and other drug use, number of family/friends with videogame-related problems, as well as coping via humor, self-distraction, denial, venting, substance use, behavioral disengagement, and self-blame. The aggregated scale was also negatively associated with active coping, highlighting that individuals with higher videogame "addiction" are less likely to concentrate their efforts on taking action to change negative situations.

The connection between PVGP and impulsivity, which was found for all measures in the current study, has been demonstrated elsewhere in the literature (Bioulac, Arfi, & Bouvard, 2008; Chan & Rabinowitz, 2006; Swing et al., 2010). However, Gentile, Swing, Lim, and Khoo (2012) outline four potential hypotheses for how electronic media may relate to attention problems. Specifically, the excitement hypothesis posits that videogames make other activities seem less interesting by changing the desired level of stimulation over time. The displacement hypothesis conjectures that individuals may be playing games instead of engaging in activities that would have taught them impulse control. The attraction hypothesis speculates that individuals with premorbid attentional problems actually seek out videogames specifically, potentially due to a lack of self-control. Lastly, the third-variable hypothesis postulates that the connection between digital media and attentional difficulties is better accounted for by a third variable that is mediating the connection between the two.

While it is unclear exactly what the positive correlation between PVGP and impulsivity in the current study represents, the age and stage of life of college students may suggest that any combination of these theories are at work. Specifically, individuals currently 20 years of age (the median for the current study) have essentially never existed in a world where home consoles were not a mainstream piece of technology. For example, the Super Nintendo Entertainment System, which was released in 1991, and the Sega Genesis, which was released in 1989, sold a cumulative total of 89.1 million units in their lifespan (Imagine Publishing, 2013). Thus, these individuals may have grown up with a higher expectation regarding stimulation than their elder counterparts. Further, playing videogames may possibly inhibit an individual's ability to develop appropriate study habits or impulse control. This is particularly salient with college

students, who are likely experiencing their first taste of unsupervised, unstructured free time as well as less academic monitoring than in high school.

The strong positive association between PVGP and depression (as demonstrated in the current study for all three videogame measures) is interesting, as it differs from Sammis' (2008) finding that college students who played videogames did not experience higher levels of depression. Further, Valadez and Ferguson (2012) reported that time spent playing videogames was also not related to depression. Thus, it is unclear why individuals with higher levels of VGAS in the current sample were reporting elevated levels of depression. However, Ferguson et al. (2011) suggested that personality traits (e.g., high neuroticism; low conscientiousness and extraversion) actually mediate the relationship between videogame violence exposure and depression. According to the five-factor model (Costa & McCrae, 2008), high extraversion is associated with a preference for the company of others, an interest in others, and a higher level of activity. Higher levels of neuroticism capture feelings of self-consciousness and impulsivity. Conscientiousness partially relates to the capacity to follow through on tasks and a belief in one's own self-efficacy. Given that in the current study, the VGAS was positively associated with behavioral disengagement, public self-consciousness, social anxiety, and impulsivity as well as negatively associated with active coping, it seems plausible that some of the aforementioned personality characteristics may be present in participants. Specifically, these features seem related to the aforementioned personality traits noted in Ferguson and colleagues (2011).

In addition to evaluating specific measures of problematic videogame playing, the current study also examined the various game features that related to game preference, including genre as well as structural characteristics. Regarding genre choice, multiple methods were utilized to

evaluate the genres that individuals played. Specifically, participants indicated the particular genres they prefer as well as reported their most-played game within the past year and their favorite game of all time. Regarding the game played most often and genre preference, the top five of both included FPS, Action-Adventure, Roleplaying, and Sports. Thus, these represented the most popular genres in the current sample. This is largely unsurprising, given both the sales (e.g., *Call of Duty: Ghosts*, a FPS released in November, 2013 generated one billion dollars in sales in a single day; Griffiths, 2013) and frequency (e.g., most sports franchises are released annually) with which these games release. By comparison, Floros and Siomos (2012) reported the top five most-preferred genres for boys as follows: Sports, Combat Simulation (which contained FPS games), Adventure, Driving, and Strategy. Interestingly, of the aforementioned popular genres in this study, only Roleplaying and FPS were listed in the top five highest genres based on VGAS scores. Instead, MMORPG, Real-Time Strategy, and Simulation/Virtual Life represented the other genres with the highest scores on the Videogame Addiction Scale. Relatedly, Elliott and colleagues (2012) listed their top five genres most associated with PVGP as follows: MMORPG, Roleplaying, Action-Adventure, FPS, and Other Shooter. Thus, while many individuals report playing other genres, such as Sports, these games do not seem as associated with symptoms of addiction as videogames that represent strategy, simulation, roleplaying (offline and MMO), and shooter genres. The findings of the current study also suggest that while some of the aforementioned genres may be less popular (e.g., MMORPG constituted 3.3% of individuals' most played game), individuals that play these games are potentially more at risk for problematic videogame playing.

Given the VGAS elevations for both MMORPGs and Shooters, it was conjectured that these genres would be statistically higher on scores of "addiction" than all other genres. As

expected, players of MMORPGs exhibited higher levels of videogame "addiction" as compared to Shooters, which in turn were significantly higher than players of other genres. As noted elsewhere in this paper, the incidence of PVGP within MMORPG players has been documented in the literature (Boellstorff, 2008; Griffiths, Davies, & Chappell, 2004; Taylor, 2006). This likely relates to the level of immersion (Floros & Siomos, 2012; Kuss, Louws, & Wiers, 2012) found within MMORPGs, which provide players a notable level of escapism from their current difficulties and an opportunity to alter their identity. Similarly, Hagström and Kaldo (2014) highlight the negative reinforcement value of MMORPGs, as playing can allow for avoidance from daily hassles and distress. Additionally, MMORPGs encourage the formation of organized groups of players (known as "guilds" or "clans") that potentially add social pressure to play regularly and for long periods of time (Hsu et al., 2009). Further, Billieux and colleagues (2013) suggest that while cross-sectional data indicate that game progression and mechanics are primary motivators for play, longitudinal data show that guild affiliation and other social aspects become more important over time. While the addiction characteristics of shooters are less well-documented, studies have demonstrated that players of FPS games have elevated PVGP in relation to other genres (see Elliott, Ream, McGinsky, & Dunlap, 2012). Additionally, Metcalf and Pammer (2014a) suggest that the relationship between impulsivity and excessive play may be unique to FPS games and that increased play may actually improve decision-making ability.

Interestingly, FPS players identified as "addicted" based on the Addiction-Engagement Questionnaire (Charlton & Danforth, 2007) experienced significant increases in blood pressure while gaming; whereas, "addicted" MMORPG players exhibited a decrease in blood pressure (Metcalf & Pammer, 2014b). While this suggests there may be notable differences between the two genres, other aspects seem more alike than different. For example, both the MMORPG and

FPS genres are primarily played online, lending further support for the proposed Internet Gaming Disorder (APA, 2013) that captures both genres. In fact, recently released shooter games offer only online, competitive multiplayer modes (e.g., Titanfall, Counterstrike: Global Offensive, etc.). Further, both genres appear to include variable reinforcement schedules that are similar to those involved in gambling (National Research Council, 1999), and they lack any sort of ending (in contrast to linear, narrative-focused, action-adventure games). In fact, it has increasingly become the standard for online FPS games to feature "RPG elements" that have existed in MMORPGs since the inception of the genre (e.g., leveling up, unlocking rare items, etc.).

The specific videogame features that players value, known as structural characteristics, were assessed on three domains: enjoyment of each feature, the overall importance of each feature, and how much that feature related to time playing games. Across all domains, every structural characteristic included from the measure by King, Delfabbro, and Griffiths (2011) was statistically correlated with videogame playing "addiction", as assessed by the VGAS. Follow-up t-tests comparing high and low VGAS players indicated that self-reported enjoyment of a videogame was largely related to storyline elements, earning rewards, character customization, and audio/graphical aspects. Regarding the perceived importance of particular characteristics, similar patterns emerged, though with the inclusion of increased difficulty within the game (e.g., playing on the hardest setting, very difficult sections of the game). Thus, having a suitable challenge appeared important to individuals endorsing high VGAS. Lastly, attributes noted to increase playtime also addressed narrative facets, rewards, and audiovisual fidelity, as well as the ability to correct mistakes by reloading a save file. Thus, given the ability to replay a section over again, high VGAS individuals indicated they were likely to play longer.

Only one study evaluating structural characteristics has evaluated videogame enjoyment within the context of PVGP (King, Delfabbro, & Griffiths, 2011). Specifically, this study reported significant differences on enjoyment between high and low PVGP groups for the following: violent content, finding rare items, tactile sensation of playing, and story cut-scenes. Regarding importance, differences emerged regarding competitive elements, earning points, gaining a sense of mastery (e.g., control, 100% completion of game), and managing game resources. Lastly, increased playtime included the following: sharing tips/strategies, cooperative elements, earning rewards, and graphics. Although these results do not align with the current investigation, it should be noted that not all of the aforementioned characteristics were assessed in this study. In addition, the present study used a measure specifically designed to tap characteristics of videogame addiction, in contrast to measures of PVGP more generally.

As of this writing, no other authors have evaluated enjoyment and problematic videogame playing, though several papers have examined characteristics of enjoyment in gamers more generally. In an effort to determine the motivations of adolescents that play videogames, Ferguson and Olson (2013) evaluated seventh and eighth graders and noted that individuals largely played due to a belief that games can be fun, may reduce stress, offer social interaction with others, as well as fill time and avoid boredom. However, as highlighted by Whitbourne, Ellenberg, and Akimoto (2013), the age of the participant may relate to the structural characteristics associated with enjoyment. Specifically, Whitbourne et al.(2013) examined casual video game players (who played videogames integrated into social networking websites) and found that individuals18 to 29 years-old most often played for the social benefits, gamers age 30 to 59 cited stress relief as their primary motivator, and adults age 60 and up desired a challenge. Thus, the age of participants may have an impact on study results. In an examination

of college students, Shafer (2013) evaluated FPS players on predictors of enjoyment. Results suggested that overall videogame enjoyment was predicted by interactivity (the ability to affect the form and content of the game), perceived reality (the degree of correspondence between the visual presentation and real-world content), spatial presence (perception of virtual objects as actual objects), and skill (ability to manipulate circumstances to one's benefit). Lastly, in a longitudinal study, Wirth and colleagues (2013) noted that playing over several sessions led to an increase in overall enjoyment. Further, videogame enjoyment appeared related to exploration within the game, spatial presence, a sense of competence, and simulated experiences of life, which included narrative content. Taken together, it appears that videogame players may choose this medium as a way to engage socially with others, experience catharsis, develop a sense of mastery, overcome obstacles and earn rewards, as well as experience an enjoyable narrative.

The interaction between game genre and structural characteristics was evaluated next. Interestingly, only one significant interaction manifested with regard to the enjoyment of leveling up. Specifically, players of shooters and other genres with high VGAS scores reported greater enjoyment from leveling up than their low VGAS counterparts; however, the inverse was true for MMORPG players. No other structural characteristics exhibited interaction effects, demonstrating that regardless of genre, individuals with elevated VGAS levels reported higher enjoyment, greater importance, and increased playtime of aforementioned characteristics than persons with lower scores of VGAS. This was an unanticipated finding, as *a priori* hypotheses had been generated about additional interactions. For example, it was conjectured that players of videogames within the shooter genre with high VGAS scores would derive greater enjoyment from short load times, given that shooters require players to wait to respawn after dying. Inversely, MMORPG players high on the VGAS were anticipated to be less concerned about

loading than their lower scoring counterparts, given that such downtime provides space for social interaction with "clan members" or to strategize about future battles. In fact, it is not uncommon to see players in MMORPGs sitting idly as they rifle through a digital inventory of items or chat with peers. However, this did not materialize, as higher VGAS players of all genres derived more enjoyment from faster loading than lower VGAS players. Thus, while unexpected, the lack of interaction highlights that the VGAS likely captures a unified construct of addiction, regardless of the specific type of game. This is not unlike substance use disorders, which feature the same criteria regardless of the substance being ingested (APA, 2013).

Model of Videogame Addiction

Utilizing the results obtained from the previous analyses, a model of videogame addiction was constructed to help determine if the association between variables followed expected patterns, based on the substance use disorder literature. Specifically, the following variables were included in the model: impulsivity, maladaptive coping, weekly playtime, and the structural characteristics associated with longer playtime. A brief overview of the literature with regard to analogous substance-related variables is presented below.

Elevated impulsivity, as measured by self-report, has been demonstrated among those who experience substance-related disorders involving psychostimulants (Coffey et al., 2003; Leland & Paulus, 2005; Moeller et al., 2004), opiates (Ersche et al., 2006; Kirby et al., 1999; Madden et al., 1997; Verdejo-Garcia & Perez-Garcia, 2007), alcohol (Mitchell et al., 2005; Whiteside & Lynam, 2003), and ecstasy (Butler & Montgomery, 2004; Morgan, 1998; Parrott et al., 2000). Additionally, elevated BIS scores have been observed among those with pathological gambling (Carlton & Manowitz, 1994; Fuentes et al., 2006; Petry, 2001, Rodrigues-Jimenez et al., 2006). Further, negative correlations have been observed between BIS scores and first

cocaine use (Moeller et al., 2002), which is "consistent with a vulnerability pathway where high impulsivity predispose early recreational drug-taking" (Verdejo-Garcia, Lawrence, & Clark, 2008, p. 782). While some researchers have posited that changes in the frontal cortex due to drug use actually cause the previously observed impulsivity (Bechara, 2003; Goldstein & Volkow, 2002; Porrino & Lyons, 2000), another possibility is that impulsivity precedes drug use and actually serves as a risk factor (Verdejo-Garcia et al., 2008). Further, impulsivity has been demonstrated in populations that are considered high-risk for substance use disorders, such as adolescents (Wagner & Anthony, 2002). Specifically, adolescents simultaneously possess immature frontal cortical control systems and mature striatal systems that process reward (Chambers et al., 2003; Ernst et al., 2006; Eshel et al., 2007). Thus, adolescents may be more likely to engage in pleasurable activities without an ability for self-control. Taken together, these results suggest that impulsivity ties into the use of substances and should be included in an adapted model of addiction for videogames. Specifically, scores on the BIS-11 were utilized.

When examining the literature regarding coping mechanisms, different coping strategies are generally classified into one of two categories: active coping, which often involve problem-solving, planning, and help-seeking behaviors; and avoidant/negative coping, which includes denial, self-distraction, behavioral disengagement, and substance use (Lee & Liu, 2001). Negative coping strategies have been associated with or predicted substance use in a variety of individuals, including homeless adults (Galaif, Nyamathi, & Stein, 1999; Stein, Dixon, & Nyamathi, 2008), incarcerated individuals (Eftekhari, Turner, & Larimer, 2004; El-Bassel et al., 1996), manufacturing workers (Mohamad, 2009), working professionals (Nowack & Pentkowski, 1994), adolescents (Frone & Windle, 1997; Simons & Robertson, 1989), abuse victims (Min, Farkas, Minnes, & Singer, 2007), and so on. Thus, it appears that across a variety

of demographic characteristics, engaging in maladaptive coping behaviors may lead to or at least be associated with substance use. Interestingly, the coping strategies most related to VGAS in the current study were the following: behavioral disengagement, denial, self-blame, and substance use. All of these constitute avoidant/negative coping strategies, making the current findings commensurate with the substance use disorder literature. Thus, the final model of videogame addiction predicted that maladaptive coping would relate to higher scores on the Videogame Addiction Scale.

In order to generate a measure of weekly playtime, reported daily usage for weekdays and weekend days was used to calculate an estimation of hours typically played. For the purposes of evaluating an addictions model within the current study, weekly playtime was conceptualized as a measure of "exposure." This made conceptual sense, given that playtime is a direct measure of the amount of hours one is exposed to the desired stimulus; in this case videogames. Further, given that playtime is not necessarily indicative of problematic videogame play (van Rooij et al., 2010), it was deemed appropriate to conceptually separate playtime from scores of videogame addiction. In order to further elucidate the literature on substance exposure, two main areas were examined: dose-response research and the gateway theory.

Within the substance use literature, exposure is often represented as a dose-response curve, which is a graphical representation of data in which the X-axis represents the concentration of a particular substance and the Y-axis highlights the associated response (Golan, Tashjian, Armstrong, & Armstrong, 2011). The specific response being measured differs by study, but can comprise a variety of behaviors or physiological responses. Dose-response curves typically manifest such that for low doses, the increase in response is more gradual, and for high doses, a plateau effect materializes in which additional substance yields little or no increased

response. However, in between those two extremes, an increase in the administration of substance leads to greater responses.

Many studies suggest an "inverted U-shaped" dose-response function for substances, such that after a certain point, higher doses of a substance will yield diminishing response rates (e.g., Hahn, Mohammed, & Stolerman, 2011; Horiguchi et al., 2013; King, Xiong, & Ellinwood, 1997; Peffer-Smith, Smith, & Byrd, 1983). As an example, in a study by Morgan and colleagues (2004), participants were given an 80-minute infusion of either a high or low dose of ketamine and asked about their subjective enjoyment/desire of the drug. Results indicated that while the higher dose group unsurprisingly felt the effects more strongly, it was the lower dose group that rated higher enjoyment and subsequently stronger desire for the drug than their higher dosage counterparts. However, these parabolic relationships across studies may relate to a lessening in the physiologically reinforcing effects of a substance (Meisch & Lemaire, 1993), its effects on operant behavior, or substance satiation. When a drug has been administered only once per session (Corrigall & Coen, 1989; Goldberg & Tang, 1977) or the first injection was measured separately (Arroyo et al., 1998), a linear relationship between drug dose and response rate manifested (Everitt & Robbins, 2000). For example, in a study of etonitazene, a particular type of opioid, Gomez and Meisch (2004) examined behaviors prior to drug administration to enable examination of rats in a "drug-free state" (Gomez & Meisch, 2004, p. 266). Results suggested that the reinforcing effect of the drug increased as a function of drug dose in a linear fashion. Thus, if the physiological effect of the drug is removed from the investigation, the reinforcing value of increasing dosages may similarly increase. Further, research evaluating intravenous self-administration of cocaine by rhesus monkeys demonstrated that as the dosage of drug-per-injection was increased, the response rate also increased (Flory & Woods, 2003). This suggests

that satiety was not the underlying factor, as the opposite relationship would be expected if the animals were becoming satiated with higher drug-per-injection levels. The aforementioned results are notable, given that videogames do not lead to the same physiological responses at "high doses" as substances do. Interestingly, within the current study, a linear relationship manifested when playtime was conceptualized as the "dose" and level of problematic videogame play as the "response" (see Figure 4). Thus, increased exposure to videogames generated higher symptom endorsement.

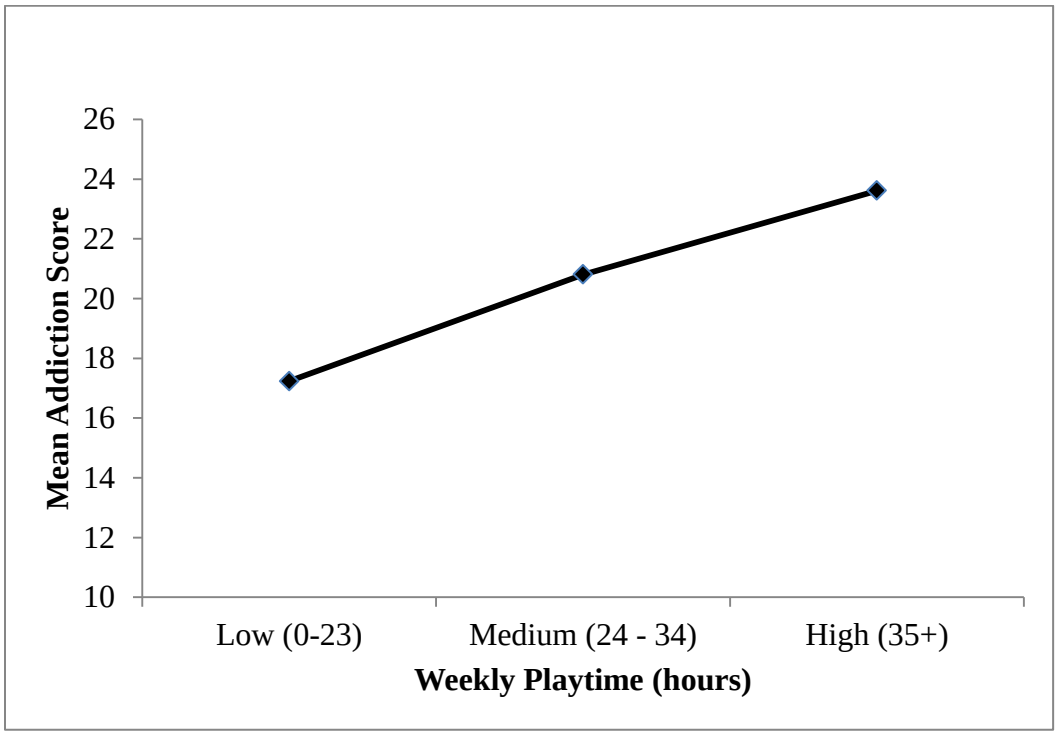

Figure 4. Addiction scores based on playtime.

The gateway theory posits that drug use undergoes a hierarchical sequence in which individuals start by using legal drugs (e.g., tobacco, alcohol) and eventually transition into increasingly damaging illicit substances (e.g., begin with marijuana and later try cocaine and/or

heroin; Chen et al., 2002; Kandel, 2002; Kandel & Yamaguchi, 1993; Werch & Anzalone, 1995). As an example, Kane and Yacoubian (1999) evaluated arrestees on their previous use of substances, yielding results that corroborated the aforementioned pattern of drug escalation. Thus, individuals that switch substances pass some form of threshold that leads them to transition to a different class of drugs. Risk factors have been identified, such as the initial age of use as well as the degree of involvement of a prior drug (Kandel & Jessor, 2002; Kandel & Yamaguchi, 2002). Thus, increased exposure may contribute to the transition into "harder" drugs. The gateway theory is beneficial in that it helps to make sense of why some individuals develop more problematic usage, whereas most do not transition beyond legal drugs. In fact, some level of substance use is normative within the United States, as 83.6% of individuals report having used alcohol, 73.3% tobacco, and 33.7% marijuana (Anthony & Arria, 1999). Similarly, videogame play is normative within modern society as well, with approximately 58% of Americans endorsing some form of play (Entertainment Software Association, 2012). This number jumps to 88% when only examining American youth between the ages of 8 and 18 (Gentile, 2009). Thus, incorporating the gateway theory into videogame playing, it could be conjectured that those individuals within the current sample that endorsed high levels of videogame addiction may have initially started with "normative" levels of play, and that subsequent exposure to games (and possibly transitioning to other genres, such as MMORPGs) could have led to current impairments. Thus, within a model of videogame addiction, weekly playtime should partially predict problematic videogame playing.

Lastly, the structural characteristics were included in the overall model. Specifically, these were the aspects of videogames reported to be most related to playing longer, which included the ability to correct mistakes by reloading a save file, emotional investment in a game

character, and sound design. Given that these structural characteristics essentially address the user experience of a game as well as the way in which the user interacts with the game, the literature regarding substance delivery was examined. Specifically, Hatsukami and Fischman (1996) highlight that while cocaine hydrochloride and crack cocaine have similar pharmacokinetics once absorbed, the two forms are different in their addiction level, primarily because of the rate of onset as well as the intensity and duration of the effect. Further, many users of crack cocaine actually began with intranasally-administered cocaine hydrochloride and shifted delivery mechanisms to smoking crack (Brower, Hierholzer, & Maddahian, 1986; Khalsa, Anglin, & Paredes, 1993; Miller & Gold, 1994; Pottieger et al., 1995). Thus, while the two types of cocaine are chemically the same, the characteristics of the type of administration do seem to play a role. Similarly, games that allow players to correct their mistakes, feel connected to their game characters, and experience more immersive sound may also exhibit a higher addictive potential.

Relatedly, Klein and colleagues (2008) examined the use of flavored cigarettes (e.g., fruit-flavored) among smokers and determined that use was inversely related to age, such that 17 to 19 year olds were most likely to try flavored tobacco. Further, the packaging and marketing of these cigarettes also appealed to younger smokers (Carpenter et al., 2005; Cummings et al., 2002; Lewis & Wackowski, 2006; Wayne & Connolly, 2002). In fact, the sale of flavored cigarettes was banned since the publication of the aforementioned research (Hartman, 2009), due to concern that such features increased the appeal of tobacco to younger individuals. In a similar fashion, the structural characteristics of videogames may draw younger, more susceptible individuals to gaming or entice potential players that may not have otherwise been interested. For example, the increasingly complex characters and immersive worlds of modern games could

appeal to some individuals who did not previously play, thus leading to increased playtime and potential addiction symptomatology.

All of the aforementioned variables were evaluated via structural equation modeling in order to determine the best-fitting model. The overall model highlighted that impulsivity appears to predict weekly playtime; thus, individuals with higher self-reported impulsivity tend to play more throughout the week. Playtime was correlated with the structural characteristics associated with longer playtime, which makes intuitive sense. Specifically, individuals that report that these characteristics impact their playtime are thus likely to play longer. Lastly, avoidant/negative coping, weekly playtime, and the structural characteristics all predicted videogame addiction. The relationships of these variables is commensurate with what would be expected based on the previously discussed substance use disorder literature. Thus, similar underlying mechanisms may ultimately contribute to the manifestation of addiction symptomatology for both videogames and substances.

Phase Two

A series of hypotheses were generated based on the second phase of the study, during which individuals were tasked with completing computer-based measures of impulsivity and executive functioning. However, within the one year of recruitment of the current study, only 29 participants completed the tasks of phase 2, representing 55.77% of the necessary sample for adequate power. These 29 phase 2 participants collected from the sample of 1,013 phase 1 participants represented a ratio of 2.86%. At that rate, it was projected that another 804 participants would have needed to be recruited in order to obtain the necessary phase 2 data. At the observed collection rate of approximately 84 participants per month (1013 / 12 months), this would have taken additional 9.5 months of data collection. Further, it was noted that data

collection actually slowed as the year progressed, given that only individuals who had not previously taken the study were eligible. Specifically, 51.5% of participants completed the survey within the first 2.5 months of recruitment (and the remaining 48.5% were collected over 9.5 months). Thus, it was possible that data collection for an additional 804 individuals could have taken well over another year.

Furthermore, 145 individuals from phase 1 were contacted for participation in phase 2 via email. Additional reminder emails were sent out to each participant at a later point to recruit individuals too busy to respond at the first contact. Each participant was given a weekly schedule of available times, making appointment selection simple and efficient. Further, appointment times were offered by both the principal investigator as well as a trained GA, generating a large window of availability throughout the week. For individuals who set up an appointment, reminder emails or texts were sent to aid in retention. However, despite this extra step, there were considerable no-shows from interested parties. Thus, despite ongoing efforts to actively engage potential participants, recruitment was not successful. It is unclear what made this aspect of the methodology so difficult, but it raises important considerations for future empirical endeavors. Specifically, researchers may need to anticipate a longer period of time for lab-based recruitment. Further, generating less rigorous inclusionary criteria for lab-based participation as well as utilizing statistical analyses that require fewer participants may also aid in obtaining an adequate number of individuals. Lastly, it is possible that ten dollars was not an adequate incentive for current college students.

Although results could not be obtained within the current study, only one previous study has assessed self-report impulsivity (using the BIS-11) and performance-based impulsivity (via the CPT-II; Metcalf & Pammer, 2014a). Although this study focused solely on FPS players,

results indicated that individuals identified as "addicted" via the Addiction-Engagement Questionnaire (Charlton & Danforth, 2007) had significantly higher levels of performance-based impulsivity than controls. Further, addiction was positively correlated with BIS-11 scale scores. The CPT-II results highlighted that addicted FPS gamers exhibited "greater disinhibition and higher levels of inattention… compared to controls, whereas highly engaged FPS gamers had no differences compared to controls" (Metcalf & Pammer, 2014a, p. 150). This suggests that individuals that are highly engaged in videogames but do not endorse addiction symptomatology are not likely to exhibit the same level of impulsivity as those with more impairment. Further, Metcalf and Pammer (2014a) demonstrate commensurate findings for both types of impulsivity, which is different than what was expected in the current study. Specifically, it was hypothesized that a greater disconnect would materialize between the BIS-11 and CPT-II for more addicted gamers than for less addicted individuals. Thus, in light of findings from this new report, it may well be that the expected result would not have materialized even if an adequate sample size had been obtained.

Interestingly, only one study has examined individuals with problematic videogame playing using the WCST (Han, Lyoo, & Renshaw, 2012). Specifically, non-addicted individuals that professionally played StarCraft for the Korea eSports Association were found to require fewer trials and exhibited less total errors than participants that met criteria for online game addiction (based on criteria outlined by Han et al., 2010) or videogame playing controls. The addicted gamers and controls did not differ on these variables. However, the addicted gamers had more perseverative errors as compared to both the professional players and controls. Thus, only one parameter of the WCST differentiated addicted players from their counterparts. It had been conjectured in the current study that high and low VGAS groups would either not differ on

the WCST variables or that the higher group may actually have improved performance. This latter part was conjectured based on the assumption that gameplay may train individuals to be more skillful in problem solving, pattern recognition, and set shifting, which is consistent with the neuropsychological literature (e.g., Bergstrom, Howard, & Howard, 2012; Cain, Landau, & Shimamura, 2012; Clark, Fleck, & Mitroff, 2011). However, the study by Han, Lyoo and Renshaw (2012) highlights that while skillful playing of a real-time strategy game may be associated with improved performance, this connection was not present for individuals with game-addiction. Further, the aforementioned neuropsychological literature did not differentiate problematic play from normative play. Thus, it is possible that cognitive improvements may not materialize within individuals who meet addiction criteria; further, worse performance may actually manifest. However, further research is needed to disentangle these relationships.

Limitations

The current study has several notable limitations. First, given that the survey was open to all undergraduate students at Eastern Michigan University (EMU) via the SONA research participant recruitment system, it is not possible to calculate response rates. Further, it is unclear if individuals that completed the survey represent a specific subsample of eligible individuals or if results are generalizable to the student population of EMU. In order to prevent a restricted range of responses (e.g., only problematic videogame players completing the survey), the principal investigator visited undergraduate psychology courses in order to educate individuals about the inclusionary criteria as well as to encourage casual videogame players to participate. The wide range of VGAS scores suggest that recruitment was successful in obtaining individuals across the spectrum of videogame playing. However, further investigations would help to better calculate prevalence rates of videogame addiction on college campuses.

Additionally, given that not all items on the survey required a response in order to submit the data, there were missing data throughout the sample. Specifically, questionnaires related to problematic videogame playing required that all items be answered; however, subsequent measures removed this restriction. Thus, for all analyses other than the structural equation modeling, listwise deletion was utilized to account for missing data. This ensured that only participants that completed the specific measures within each analysis were included; however, it created the possibility that unintended biases could manifest. Thus, it was unclear if there were meaningful differences between participants that completed a given measure and those that did not. However, with a sample size of over a thousand participants, it was conjectured that a pattern of systematic bias was unlikely, as the sheer number of participants would likely counteract any emerging patterns of bias.

Lastly, as indicated above, all participants were currently enrolled in college at the time of survey completion. Thus, results may not generalize to other populations of addicted gamers, such as children, older adults, or non-degree-seeking peers. As noted earlier, the age of videogame players may shape the reported reasons for playing (Whitbourne, Ellenberg, & Akimoto, 2013), even if all individuals are playing the same game. Thus, the results of this study may only capture the characteristics of videogame addiction as well as the relationship of associated variables within a Midwestern college population. However, given the ubiquity of videogame play among college students as well as the possibility for addiction to negatively impact students' academic/career trajectories, this is still a population worth investigating. Thus, while not necessarily generalizable, the current findings are important.

Conclusion

To date, many measures of problematic videogame play have been utilized in the literature without any systematic investigation of which is the most appropriate/accurate or if common variables exist across measures. This lack of a standardized definition was cited as one of the major reasons for classifying Internet Gaming Disorder (IGD) as a "condition for further study" within DSM-5 and not as a diagnosable disorder (Petry & O'Brien, 2013). Further, while the term "addiction" is used loosely across studies, few researchers have sought to adapt the substance use disorder criteria for use in videogame research, which would allow direct comparisons between drug addiction and behavioral addiction. Thus, this study represents the first to compare primary measures of problematic videogame playing as well as to combine items across measures to map onto the current criteria for substance use disorder. As expected, the aggregated questionnaire, known as the Videogame Addiction Scale (VGAS), was the most compelling measure of videogame-related impairment, based on both psychometric analysis as well as criterion validity. These results partially support the criteria of Internet Gaming Disorder as outlined in the DSM-5; however, IGD appears to adapt the Gambling Disorder criteria and vernacular as opposed to utilizing a substance use conceptualization. Thus, additional research is needed to reproduce the current findings and to lend further support for an addictions model of problematic videogaming.

Interestingly, while IGD confuses two delivery mechanisms (i.e., the internet and videogames) into a single diagnosis, the current study suggests there may be some validity to emphasizing online games. Specifically, players of MMORPGS and shooters were found to have higher levels of videogame addiction than players of all other genres. This is notable, given that shooters are almost exclusively played online and MMORPGs are online-only. Thus, the

highest rates of videogame addiction do seem to appear within the online realm. However, the concern with IGD relates to individuals that meet all criteria for the disorder, but instead choose single-player titles or engage in offline experiences. This is further complicated by passive online components in modern games, such as asynchronous multiplayer games. As an example, Forza 5, a recently released simulation racing game, uses data obtained from real players in order to procedurally generate artificially intelligent opponents. Thus, a player is racing against downloaded approximations of other human players via the internet but is still engaging in an offline, single-player experience (e.g., not actually racing other humans in real-time). Thus, in some ways, the current technology has already surpassed the diagnostic distinction of IGD.

Additionally, the results of the current study suggested that while the value of many structural characteristics differentiated high and low addiction groups, these relationships were consistent across genres. Further, of 45 calculations, only one genre-by-characteristic interaction materialized. This suggests that while the prevalence of addiction may differ across genres, the underlying mechanisms are likely similar. Further, when a structural equation model of addiction was calculated, genre was not entered into the model; however, results still suggested adequate model fit across the entire sample. Thus, it appears that videogame addiction is a unified construct, irrespective of the game chosen by the player. This finding lends further support to the perspective that IGD is limited in its scope, as the criteria are no less likely to capture pathology within non-internet experiences. Future research focusing on addicted gamers that play offline videogames may help corroborate this point.

Although the current study has generated several important conclusions, future empirical endeavors can help solidify an addictions-based perspective of problematic videogame play. Specifically, validation of the VGAS within a clinical sample would help ensure that the current

conceptualization of addiction is reflected in individuals seeking treatment for their impairment. Further, evaluation of a clinical sample would help determine if the VGAS is sensitive to clinical change. It would be anticipated that scores on the VGAS would drop in response to treatment or diminishment of symptomatology. Lastly, future research could determine if certain groups of individuals are more vulnerable to videogame addiction. It is possible that variables not measured within the current study could help determine meaningful differences between individuals within the high and low VGAS groups, particularly with regard to at-risk genres (e.g., MMORPGs).

References

Adachi, P. J. C., & Willoughby, T. (2011). The effect of violent video games on aggression: Is it more than just the violence? *Aggression and Violent Behavior*, *16*(1), 55–62.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Anderson, C.A., & Carnagey, N. L. (2009). Causal effects of violent sports video games on aggression: Is it competitiveness or violent content? *Journal of Experimental Social Psychology, 45*, 731-739.

Anderson, C. A., Funk, J. B., & Griffiths, M. D. (2004). Contemporary issues in adolescent video game playing: Brief overview and introduction to the special issue. *Journal of Adolescence, 27*(1), 1-3.

Anderson, C. A., Sakamoto, A., Gentile, D. A., Ihori, N., Shibuya, A., Yukawa, S., Naito, M., & Kobayashi, K. (2008). Longitudinal effects of violent video games on aggression in Japan and the United States. *Pediatrics, 122*(5), e1067-e1072.

Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., Sakamoto, A., Rothstein, H. R., & Saleem, M. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in eastern and western countries: A meta-analytic review. *Psychological Bulletin, 136*(2), 151-173.

Anthony, J. & Arria, A. (1999). Epidemiology of substance abuse in adulthood. In P. Ott, R. Tarter, & R. Ammerman (Eds.). *Sourcebook on substance abuse* (pp. 32-49). Boston, MA: Allyn & Bacon.

Arroyo, M., Markou, A., Robbins, T. W., & Everitt, B. J. (1998). Acquisition and maintenance of intravenous cocaine self-administration under a second-order schedule of reinforcement in rats: Effects of conditioned cues and continuous access to cocaine. *Psychopharmacology, 140*, 331-344.

Badr, H. (2004). Coping in marital dyads: A contextual perspective on the role of gender and health. *Personal Relationships, 11*(2), 197-211.

Baer, S., Saran, K., & Green, D. A. (2012). Computer/gaming station use in youth: Correlations among use, addiction and functional impairment. *Paediatr Child Health, 17*(8), 427-431.

Bailey, K., West, R., & Anderson, C. A. (2010). A negative association between video game experience and proactive cognitive control. *Psychophysiology, 47*(1), 34-42.

Ballard, M., Gray, M., Reilly, J., & Noggle, M. (2009). Eating behaviors correlates of video game screen time among males : Body mass, physical activity, and other media use. *Eating Behaviors, 10*(3), 161-167.

Ballard, M. E., & West, J. R. (1996). Mortal kombat ™: The effects of violent videogame play on males' hostility and cardiovascular responding. *Journal of Applied Social Psychology, 26*(8), 717-730.

Barlett, C., Branch, O., Rodeheffer, C., & Harris, R. (2009). How long do the short-term violent video game effects last? *Aggressive behavior, 35*(3), 225–236.

Barlett, C. P., Harris, R. J., & Bruey, C. (2008). The effect of the amount of blood in a violent video game on aggression, hostility, and arousal. *Journal of Experimental Social Psychology, 44*, 539-546.

Barlett, C. P., Vowels, C. L., Shanteau, J., Crow, J., & Miller, T. (2009). The effect of violent and non-violent computer games on cognitive performance. *Computers in Human Behavior, 25*(1), 96–102.

Bartholow, B. D., Sestir, M. A., & Davis, E. B. (2005). Correlates and consequences of exposure to video game violence: Hostile personality, empathy, and aggressive behavior. *Personality and Social Psychology Bulletin, 31*(11), 1573-1586.

Basak, C., Boot, W. R., Voss, M. W., & Kramer, A. F. (2008). Can training in a real-time strategy video game attenuate cognitive decline in older adults? *Psychology and aging, 23*(4), 765–777.

Bastian, B., Jetten, J., & Radke, H. R. M. (2012). Cyber-dehumanization: Violent video game play diminishes our humanity. *Journal of Experimental Social Psychology, 48*, 486-491.

Beard, K. W., & Wolf, E. M. (2001). Modification in the proposed diagnostic criteria for internet addiction. *CyberPsychology & Behavior, 4*(3), 377-383.

Bechara, A. (2003). Risky business: Emotion, decision-making, and addiction. *Journal of Gambling Studies, 19*, 23-51.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238-246.

Bentler, P.M., & Bonnet, D.C. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*(3), 588-606.

Bergstrom, J. C. R., Howard, J. H., & Howard, D. V. (2012). Enhanced implicit sequence learning in college-age video game players and musicians. *Applied Cognitive Psychology, 26*(1), 91-96.

Beseler, C., Jacobson, K. C., Kremen, W. S., Lyons, M. J., Glatt, S. J., Faraone, S. V., … Tsuang, M. T. (2006). Is there heterogeneity among syndromes of substance use disorder for illicit drugs? *Addictive Behaviors, 31*, 929-947.

Beullens, K., Roe, K., & Van den Bulck, J. (2011). Excellent gamer, excellent driver? The impact of adolescents' video game playing on driving behavior: a two-wave panel study. *Accident Analysis and Prevention, 43*(1), 58-65.

Bialystok, E. (2006). Effect of bilingualism and computer video game experience on the Simon task. *Canadian Journal of Experimental Psychology, 60*(1), 68-79.

Billieux, J., Van der Linden, M., Achab, S., Khazaal, Y., Paraskevopoulos, L., Zullino, D., & Thorens, G. (2013). Why do you play World of Warcraft? An in-depth exploration of self-reported motivations to play online and in-game behaviours in the virtual world of Azeroth. *Computers in Human Behavior, 29*, 103-109.

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

Black, D. W., McNeilly, D. P., Burke, W. J., Shaw, M. C., & Allen, J. (2011). An open-label trial of acamprosate in the treatment of pathological gambling. *Ann Clin Psychiatry, 23*(4), 250-256.

Blaszczynski, A. (2008). Commentary: A response to "Problems with the concept of video game "addiction": Some case study examples. *International Journal of Mental Health and Addiction, 6*, 179-181.

Blaszczynski, A., Sharpe, L., & Walker, M. (2001). *The assessment of the impact of the reconfiguration on electronic gaming machines as harm minimization strategies for problem gambling.* Report for the gaming industry operators group. Access August 1st, 2012. Available at: http://www.psych.usyd.edu.au/gambling/GIO_report.pdf.

Blaszczynski, A., Walker, M., Sharpe, L., & Nower, L. (2008). Withdrawal and tolerance phenomenon in problem gambling. *International Gambling Studies, 8*(2), 179-192.

Bluemke, M., Friedrich, M., & Zumbach, J. (2010). The influence of violent and nonviolent computer games on implicit measures of aggressiveness. *Aggressive Behavior, 36*(1), 1-13.

Boellstorff, T. (2008). *Coming of age in second life: An anthropologist explores the virtually human.* Princeton, NJ: Princeton University Press.

Bond, C. F., & Richardson, K. (2004). Seeing the Fischer Z-formation. *Psychometrika, 69*(2), 291-303.

Boot, W. R., Kramer, A. F., Simons, D. J., Fabiani, M., & Gratton, G. (2008). The effects of video game playing on attention, memory, and executive control. *Acta psychologica, 129*(3), 387–398.

Borusiak, P., Bouikidis, A., Liersch, R., & Russell, J. B. (2008). Cardiovascular effects in adolescents while they are playing video games: a potential health risk factor? *Psychophysiology, 45*(2), 327-332.

Boyle, J. M. (1998). Centrally controlled government regulated gaming machine programs. In G. Coman, B. Evans, & R. Wooton (Eds.), *Responsible gambling: A future winner.*

Proceedings of the 8th conference of the national association for gambling studies (pp. 21-26). Adelaide: national Association for Gambling Studies.

Bozarth, M. A. (1990). Drug addiction as a psychobiological process. In D. M. Warburton (Ed.), *Addiction Controversies* (pp. 112-113). London, England: Harwood Academic Publishers.

Bradizza, C. M., Gulliver, S. B., Stasiewicz., P. R., Torrisi, R., Rohsenow, D. J., & Monti, P. M. (1999). Alcohol cue reactivity and private self-consciousness among male alcoholics. *Addictive Behaviors, 24*(4), 543-549.

Breen, R. B., & Zimmerman, M. (2002). Rapid onset of pathological gambling in machine gamblers. *Journal of Gambling Studies, 18*, 31-43.

Brewer, J. A., & Potenza, M. N. (2008). The neurobiology and genetics of impulse control disorders: Relationships to drug addictions. *Biochem Pharmacol, 75*, 63-75.

Brower, K. J., Hierholzer, R., & Maddahian, E. (1986). Recent trends in cocaine abuse in a VA psychiatric population. *Hospital & Community Psychiatry, 37*(12), 1229-1234.

Brown, R. I. F. (1991).Gaming, gambling and other addictive play. In J. H. Kerr & M. J. Apter (Eds.), *Adult place: A reversal theory approach* (pp. 101-118). Amsterdam: Swets & Zeitlinger.

Brown, T. A., & Barlow, D. H. (1995). Long-term outcome in cognitive-behavioural treatment of panic disorder: Clinical predictors and alternative strategies for assessment. *Journal of Consulting and Clinical Psychology, 63*(5), 754-765.

Brown, T. A., Campbell, L. A., Lehman, C. L., Grisham, J. R., Mancill, R. B. (2001). Current and lifetime comorbidity of the DSM-IV anxiety and mood disorders in a large clinical sample. *Journal of Abnormal Psychology, 110*(4), 585-599.

Bryant, F. B., & Yarnold, P. R. (1995). Principal-components analysis and exploratory and confirmatory factor analysis. In L. G. Grimm & P. R. Yarnold (Eds.), *Reading and understanding multivariate statistics* (1st ed., pp. 99 –136). Washington, DC: American Psychological Association.

Buckholtz, J. W., Treadway, M. T., Cowan, R. L., Woodward, N. D., Li, R., Ansari, M. S., … Zald, D. H. (2010). Dopaminergic network differences in human impulsivity. *Science, 329*, 532.

Bushman, B. J., & Anderson, C. A. (2009). Comfortably numb: Desensitizing effects of violent media on helping others. *Psychological Science, 20*, 273-277.

Buss, A. H., & Plomin, R. (1975). *A temperament theory of personality development*. Oxford, England: Wiley-Interscience.

Butler, G. K., & Montgomery, A. M. (2004). Impulsivity, risk taking, and recreational 'ecstasy' (MDMA) use. *Drug and Alcohol Dependence, 76*, 55-62.

Cain, M. S., Landau, A. N., & Shimamura, A. P. (2012). Action video game experience reduces the cost of switching tasks. *Attention, Perception & Psychophysics, 74*(4), 641-647.

Campbell-Meiklejohn, D., Wakeley, J., Herbert, V., Cook, J., Scollo, P., Ray, M. K., … Rogers, R. D. (2011). Serotonin and dopamine play complementary roles in gambling to recover losses. *Neuropsychopharmacology, 36*(2), 402-410.

Caplovitz, G. P., & Kastner, S. (2009). Carrot sticks or joysticks: Video games improve vision. *Nature Neuroscience, 12*(5), 527-528.

Carlton, P. L., & Manowitz, P. (1994). Factors determining the severity of pathological gambling in males. *Journal of Gambling Studies, 10*, 147.

Carpenter, C. M., Wayne, G. F., Pauly, J. L., Koh, H. K., & Connolly, G. N. (2005). New cigarette brands with flavors that appeal to youth: Tobacco marketing strategies. *Health Affairs (Project Hope), 24*(6), 1601–1610.

Carver, C. S. (1997). You want to measure coping but your protocol's too long: Consider the Brief COPE. *International Journal of Behavioral* Medicine, 4, 92-100.

Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of Personality and Social Psychology*, *56*(2), 267-283.

Castel, A. D., Pratt, J., & Drummond, E. (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*(2), 217-230.

Castranova, E. (2005). *Synthetic worlds: The business and culture of online games.* Chicago, IL: University of Chicago Press.

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*(2), 245-276.

Chambers, J. H., & Ascione, F. R. (1987). The effects of prosocial and aggressive videogames on children's donating and helping. *The Journal of Genetic Psychology: Research and Theory on Human Development, 148*(4), 499-505.

Chambers, R. A., Taylor, J. R., & Potenza, M. N. (2003). Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability. *American Journal of Psychiatry, 160,* 1041-1052.

Chan, P. A, & Rabinowitz, T. (2006). A cross-sectional analysis of video games and attention deficit hyperactivity disorder symptoms in adolescents. *Annals of General Psychiatry, 5,* 16-26.

Charlton, J. P., & Danforth, I. D. W. (2007). Distinguishing addiction and high engagement in the context of online game playing. *Computers in Human Behavior, 23*, 1531-1548.

Chappell, D., Eatough, V., Davies, M. N. O., & Griffiths, M. (2006). EverQuest—It's just a computer game right? An interpretative phenomenological analysis of online gaming addiction. *International Journal of Mental Health and Addiction*, *4*(3), 205-216.

Chen, M.-J., & Cunradi, C. (2008). Job stress, burnout and substance use among urban transit operators: The potential mediating role of coping behaviour. *Work & Stress, 22*(4), 327-340.

Chen, F., Curan, P. J., Bollen, K. A., Kirby, J., & Paxton, P. (2008). An empirical evaluation of the use of fixed cutoff points in RMSEA test statistic in structural equation models. *Sociol Methods Res, 36*(4), 462-494.

Chen, X., Unger, J. B., Palmer, P., Weiner, M. D., Johnson, C. A., Wong, M. M., & Austin, G. (2002). Prior cigarette smoking initiation predicting current alcohol use: Evidence for a gateway drug effect among California adolescents from eleven ethnic groups. *Addictive Behaviors, 27,* 799-817.

Chiong, A. S., Bry, B. H., & Johnson, V. L. (2010). Mediators between coping styles and substance use/intentions in urban, high school freshman. *Addictive Behaviors, 35*(1), 57-59.

Chisholm, J. D., Hickey, C., Theeuwes, J., & Kingstone, A. (2010). Reduced attentional capture in action video game players. *Perception & Psychophysics, 72*(3), 667-671.

Cho, M. J., Hahm, B. J., Suh, T., Suh, G. H., Cho, S. J., & Lee, C. K. (2002). Comorbid mental disorders among the patients with alcohol abuse and dependence in Korea. *J Korean Med Sci, 17*(2), 236-241.

Chui, S.-I., Lee, J.-Z., & Huang, D.-H. (2004). Video game addiction in children and teenagers in Taiwan. *CyberPsychology & Behavior, 7*, 571-581.

Clark, K., Fleck, M. S., & Mitroff, S. R. (2011). Enhanced change detection performance reveals improved strategy use in avid action video game players. *Acta Psychologica, 136*(1), 67-72.

Coffey, S. F., Gudleski, G. D., Saladin, M. E., & Brady, K. T. (2003). Impulsivity and rapid discounting of delayed hypothetical rewards in cocaine-dependent individuals. *Experimental and Clinical Psychopharmacology, 11*, 18-25.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, J. (1992). Quantitative methods in psychology: A power primer. *Psychological Bulletin, 112*(1), 155-159.

Conner, K. R., Pinquart, M., & Duberstein, P. R. (2008). Meta-analysis of depression and substance use and impairment among intravenous drug users (IDUs). *Addiction, 103*(4), 524-534.

Conners, C. K., & MHS Staff (Eds.) (2000). *Conners' continuous performance test II: Computer program for windows technical guide and software manual.* North Tonawanda, NY: Multi-Health Systems.

Conrod, P. J., Pihl, R. O., Stewart, S. H., & Maurice, D. (2000). Validation of a system of classifying female substance abusers on the basis of personality and motivational risk factors of substance abuse. *Psychology of Addictive Behaviors, 14*(3), 243-256.

Corrigall, W. A., & Coen, K. M. (1989). Fixed-interval schedules for drug self-administration in the rat. *Psychopharmacology, 99*, 136-139.

Costa, P., & McCrae, R. (2008). The revised NEO personality inventory (NEO-PI-R). In G. Boyle, G. Matthews, & D. Saklofske (Eds.), *The SAGE handbook of personality theory and assessment: Volume 2 — Personality measurement and testing.* (pp. 179-199). London: SAGE Publications Ltd.

Courbasson, C. M. A., Endler, N. S., & Kocovski, N. L. (2002). Coping and psychological distress for men with substance use disorders. *Current Psychology: A Journal of Diverse Perspectives on Diverse Psychological Issues, 21*(1), 35-49.

Cummings, K. M., Morley, C. P., Horan, J. K., Steger, C., & Leavell, N. (2002). Marketing to America's youth: Evidence from corporate documents. *Tobacco Control, 11*(Suppl I), i5–i17.

Delfabbro, P. H., & Winefield, A. H. (1997). Community gambling patterns: Findings from the 1996 statewide study of the prevalence of gambling-related problems in South Australia. In B. Tolchard (Ed.), *Towards 2000: The future of gambling. Proceeds of the 7th conference of the national association for gambling studies* (pp. 151-162). Adelaide: National Association for Gambling Studies.

Dickerson, M. G. (1993). Internal and external determinants of persistent gambling: Problems in generalising from one form of gambling to another. *Journal of Gambling Studies, 9*, 225-245.

Dickerson, M. G. (1996). Why ‘slots’ equals ‘grind’ in any language: The cross-cultural popularity of the slot machine. In J. McMillen (Ed.), *Gambling Cultures: Studies in History and Interpretation* (pp. 152-166). London, England: Routledge.

Digital Buzz (2012). *Infographic: Social gaming demographics 2012*. Retrieved July 20th, 2012, from http://www.digitalbuzzblog.com/infographic-social-gaming-demographics-statistics-2012/

Dill, K. E., & Dill, J. C. (1998). Video game violence: A review of the empirical literature. *Aggression and Violent Behavior, 3*(4), 407-428.

Donohue, S. E., Woldorff, M. G., Mitroff, S. R. (2010). Video game players show more precise multisensory temporal processing abilities. *Attention, Perception, & Psychophysics, 72*(4), 1120-1129.

Doughney, J. R. (2002). *The poker machine state: Dilemmas in ethics, economics, and governance.* Altona, Victoria: Common Ground Publishing.

Dowling, N., Smith, D., & Thomas, T. (2005). Electronic gaming machines : Are they the “crack-cocaine ” of gambling ? *Addiction,* 100, 33-45.

Durlach, P. J., Kring, J. P., & Bowens, L. D. (2009). Effects of action video game experience on change detection. *Military Psychology, 21*(1), 24-39.

Echeburúa, E., Báez, C., & Fernández-Montalvo, J. (1996). Comparative effectiveness of three therapeutic modalities in the psychological treatment of pathological gambling: Long-term outcome. *Behavioural and Cognitive Psychotherapy, 24*, 51-72.

Edwards, A. L. (1959). *Edwards personal preference schedule* (2nd ed.). Oxford, England: Psychological Corp.

Elia, C., & Jacons, D. F. (1993). The incidence of pathological gambling among Native Americans treated for alcohol dependence. *International Journal of the Addictions, 28,* 659-666.

Elliott, L., Golub, A., Ream, G., & Dunlap, E. (2012). Video game genre as a predictor of problem use. *Cyberpsychology, Behavior and Social Networking*, *15*(3), 155–161.

Elliott, L., Ream, G., McGinsky, E., & Dunlap, E. (2012). The contribution of game genre and other use patterns to problem video game play among adult video gamers. *International Journal of Mental Health and Addiction, 10*(6), 948-969.

Engelhardt, C. R., Bartholow, B. D., Kerr, G. T., & Bushman, B. J. (2011). This is your brain on violent video games: Neural desensitization to violence predicts increased aggression following video game exposure. *Journal of Experimental Social Psychology, 47*, 1033-1036.

Entertainment Software Association. (2012). *Industry Facts*. Retrieved July 10th, 2012, from http://www.theesa.com/facts/index.asp

Erdodi, L. A., Lajiness-O'Neill, R., & Saules, K. K. (2009). Order of Conners' CPT-II administration within a cognitive test battery influences ADHD indices. *J Atten Disord, 14*(1), 43-51.

Ernst, M., Luckenbaugh, D. A., Moolchan, E. T., Leff, M. K., Allen, R., Eschel, N., … Kimes, A. (2006). Behavioral predictors of substance-use initiation in adolescents with and without attention-deficit/hyperactivity disorder. *Pediatrics, 117*, 2030-2039.

Ersche, K. D., Clark, L., London, M., Robins, T. W., Sahakian, B. J. (2006). Profile of executive and memory function associated with amphetamine and opiate dependence. *Neuropsychopharmacology, 31,* 1036-1047.

Eshel, N., Nelson, E. E., Blair, R. J., Pine, D. S., & Ernst, M. (2007). Neural substrates of choice selection in adults and adolescents: Development of the ventrolateral prefrontal and anterior cingulate cortices. *Neuropsychologia, 45*, 1270-1279.

Everitt, B. J., & Robbins, T. W. (2000). Second-order schedules of drug reinforcement in rats and monkeys: Measurement of reinforcing efficacy and drug- seeking behaviour. *Psychopharmacology, 153,* 17-30.

Everitt, B. J., & Robbins, T. W. (2005). Neural systems of reinforcement for drug addiction: From actions to habits to compulsion. *Nat Neurosci, 8*, 1481-1489.

Fabian, T. (1995). Pathological gambling: A comparison of gambling at German-style slot machines and 'classical' gambling. *Journal of Gambling Studies, 11,* 249-263.

Fabrigar, L. R., Wegener, D. T., MacCallum, R.C., & Strahan, E. J. (1999). Evaluating the use of factor analysis in psychological research. *Psychological Methods, 4,* 272-299.

Feingold, A., & Rounsaville, B. (1995). Construct validity of the dependence syndrome as measured by DSM-IV for different psychoactive substances. *Addiction, 90,* 1661-1669.

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

Fenigstein, A., Scheier, M. F., & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology, 43*(4), 522-527.

Ferguson, C. J. (2010). Blazing angels or resident evil? Can violent video games be a force for good? *Review of General Psychology*, *14*(2), 68–81.

Ferguson, C. J. (2011a). Video games and youth violence: A prospective analysis in adolescents. *Journal of youth and adolescence*, *40*(4), 377–391.

Ferguson, C. J. (2011b). The influence of television and video game use on attention and school problems: a multivariate analysis with other risk factors controlled. *Journal of psychiatric research, 45*(6), 808-13.

Ferguson, D. J., Colwell, J., Mlačić, B., Milas, G., & Mikloušić, I. (2011). Personality and media influences on violence and depression in a cross-national sample of young adults: Data from Mexican-Americans, English and Croatians. *Computers in Human Behavior, 27*, 1195-1200.

Ferguson, C. J., & Kilburn, J. (2010). Much ado about nothing: The misestimation and overinterpretation of violent video game effects in eastern and western nations: Comment on Anderson et al. (2010). *Psychological bulletin, 136*(2), 174–178.

Ferguson, C. J., & Olson, C. K. (2013). Friends, fun, frustration, and fantasy: Child motivations for video game play. *Motivation and Emotion, 37*(1), 154-164.

Ferguson, C. J., & Rueda, S. M. (2010). The Hitman Study. *European Psychologist, 15*(2), 99–108.

Ferguson, C. J., Rueda, S. M., Cruz, A. M., Ferguson, D. E., Fritz, S., & Smith, S. M. (2008). Violent video games and aggression: Causal relationship or byproduct of family violence and intrinsic violence motivation? *Criminal Justice and Behavior, 35*(3), 311–332.

Ferguson, C. J., San Miguel, C., Garza, A., & Jerabeck, J. M. (2012). A longitudinal test of video game violence influences on dating and aggression: A 3-year longitudinal study of adolescents. *Journal of psychiatric research, 46*(2), 141–146.

Festl, R., Scharkow, M., & Quandt, T. (2013). Problematic computer game use among adolescents, younger and older adults. *Addiction, 108*, 592-599.

Fiellin D.A., Carrington, R., O'Connor, P.G. (2000). Screening for alcohol problems in primary care: a systematic review, *Arch Intern Med, 160*, 1977–*1989.*

Fillmore, M. T., & Rush, C. R. (2002). Impaired inhibitory control of behavior in chronic cocaine users. *Drug Alcohol Dependence, 66*, 265-273.

Fineberg, N. A., Potenza, M. N., Chamberlain, S. R., Berlin, H. A., Menzies, L., Bechara, A., … Hollander, E. (2010). Probing compulsive and impulsive behaviors, from animal models to endophenotypes: A narrative review. *Neuropsychopharmacology, 35*, 591-604.

Fischer, P., Greitemeyer, T., Morton, T., Kastenmüller, A., Postmes, T., Frey, D., … Odenwälder, J. (2009). The racing-game effect: Why do video racing games increase risk-taking inclinations? *Personality & Social Psychology Bulletin*, *35*(10), 1395-1409.

Fischer, P., Kastenmüller, A., & Greitemeyer, T. (2010). Media violence and the self: The impact of personalized gaming characters in aggressive video games on aggressive behavior. *Journal of Experimental Social Psychology*, *46*(1), 192-195.

Fisher, S. (1994). Identifying video game addiction in children and adolescents. *Addictive Behaviors, 19*, 545-553.

Fisher, S., & Griffiths, M. (1995). Current trends in slot machine gambling: Research and policy issues. *Journal of Gambling Studies, 11*, 239-247.

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods, 9*, 466-491.

Floros, G., & Siomos, K. (2012). Patterns of cohices on video game genres and internet addiction. *Cyberpsychology, Behavior, and Social Networking, 15*(8), 417-424.

Flory, G. S., & Woods, J. H. (2003). The ascending limb of the cocaine dose-response curve for reinforcing effect in rhesus monkeys. *Psychopharmacology, 166*, 91-94.

Fogel, J. (2004). Internet breast health information use and coping among women with breast cancer. *CyberPsychology & Behavior, 7*(1), 59-63.

Foti, K. E., Eaton, D. K., Lowry, R., & McKnight-Ely, L. R. (2011). Sufficient sleep, physical activity, and sedentary behaviors. *American Journal of Preventive Medicine, 41*(6), 596-602.

Fraser, A. M., Padilla-Walker, L. M., Coyne, S. M., Nelson, L. J., & Stockdale, L. a. (2012). Associations Between Violent Video Gaming, Empathic Concern, and Prosocial Behavior Toward Strangers, Friends, and Family Members. *Journal of youth and adolescence*, 636–649.

Fuentes, D., Tavares, H., Artes, R., & Gorenstein, C. (2006). Self-reported and neuropsychological measures of impulsivity in pathological gambling. *Journal of the International Neuropsychological Society, 12*(6), 907-912.

Fulkerson, J. A., Harrison, P. A., & Beebe, T. J. (1999). DSM-IV substance abuse and dependence: Are there really two dimensions of substance use disorders in adolescents? *Addiction, 94*(4), 495-506.

Gainsbury, S., Wood, R., Russell, A., Hing, N., & Blaszczynski, A. (2012). A digital revolution: Comparison of demographic profiles, attitudes and gambling behavior of internet and non-internet gamblers. *Computers in Human Behavior, 28*(4), 1388–1398.

Gentile, D. (2009). Pathological video-game use among youth ages 8 to 18: A national study. *Psychological Science, 20*(5), 594-602.

Gentile, D. A, Anderson, C. A, Yukawa, S., Ihori, N., Saleem, M., Ming, L. K., Shibuya, A., et al. (2009). The effects of prosocial video games on prosocial behaviors: International evidence from correlational, longitudinal, and experimental studies. *Personality & Social Psychology Bulletin*, *35*(6), 752–763.

Gentile, D. A, Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics*, *127*(2), e319-e329.

Gentile, D. A., Lynch, P. J., Linder, J. R., & Walsh, D. A. (2004). The effects of violent video game habits on adolescent hostility, aggressive behaviors, and school performance. *Journal of Adolescence, 27*, 5-22.

Gentile, D. A., Swing, E. L., Lim, C. G., & Khoo, A. (2012). Video game playing, attention problems, and impulsiveness: Evidence of bidirectional causality. *Psychology of Popular Media Culture, 1*(1), 62-70.

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference* (4th ed.). Boston, MA: Allyn & Bacon.

Golan, D. E., Tashjian, A. H., Armstrong, E. J., & Armstrong, A. W. (2011). *Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy* (3rd ed.). Philadelphia, PA: Lippincott, Williams, & Wilkins.

Goldberg, S. R., & Tang A. H. (1977). Behavior maintained under second-order schedules of intravenous morphine injection in squirrel and rhesus monkeys. *Psychopharmacology, 51*, 235-242.

Goldstein, R. Z., & Volkow, N. D. (2002). Drug addiction and its underlying neurobiological basis: Neuroimaging evidence for the involvement of the frontal cortex. *The American Journal of Psychiatry, 159*(10), 1642-1652.

Gorsuch, R. L. (1983). *Factor Analysis*. Hillsdale, NJ: Lawrence Erlbaum.

Gossop, M., Darke, S., Griffiths, P., & Hando, J. (1995). The severity of dependence scale (SDS): Psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction, 90*(5), 607-614.

Goudriaan, A. E., Oosterlaan, J., de Beurs, E., & van den Brink, W. (2005). Decision making in pathological gambling: A comparison between pathological gamblers, alcohol dependents, persons with Tourette syndrome, and normal controls. *Brain Research. Cognitive Brain Research, 23*(1), 137-151.

Goudriaan, A. E., Oosterlaan, J., de Beurs, E., & van den Brink, W. (2006). Psychophysiological determinants and concomitants of deficient decision making in pathological gamblers. *Drug and Alcohol Dependence, 84*(3), 231-239.

Grant, J. E., Kim, S. W., & Odlaug, B. L. (2007). *N*-acetyl cysteine, a glutamate-modulating agent, in the treatment of pathological gambling: A pilot study. *Biol Psychiatry, 62*, 652-657.

Grant, J. E., Potenza, M. N., Weinstein, A., & Gorelick, D. A. (2010). Introduction to behavioral addictions. *American Journal of Drug and Alcohol Abuse, 36*(5), 233-241.

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

Green, C. S., & Bavelier, D. (2006a). Effect of action video games on the spatial distribution of visuospatial attention. *Journal of Experimental Psychology: Human Perception and Performance, 32*(6), 1465-1478.

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

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

Green, C. S., Sugarman, M. A, Medford, K., Klobusicky, E., & Bavelier, D. (2012). The effect of action video game experience on task-switching. *Computers in Human Behavior*, *28*(3), 984-994.

Greenfield, P. M., deWinstanley, P., Kilpatrick, H., & Kaye, D. (1994). Action video games and informal education: Effects on strategies for dividing visual attention. *Journal of Applied Developmental Psychology*, *15*, 105-123.

Greitemeyer, T., Agthe, M., Turner, R., & Gschwendtner, C. (2012). Acting prosocially reduces retaliation: Effects of prosocial video games on aggressive behavior. *European Journal of Social Psychology*, *42*(2), 235–242.

Greitemeyer, T., & McLatchie, N. (2011). Denying humanness to others: A newly discovered mechanism by which violent video games increase aggressive behavior. *Psychological Science*, *22*(5), 659-665.

Greitemeyer, T., & Osswald, S. (2009). Prosocial video games reduce aggressive cognitions. *Journal of Experimental Social Psychology*, *45*(4), 896–900.

Greitemeyer, T., & Osswald, S. (2010). Effects of prosocial video games on prosocial behavior. *Journal of Personality and Social Psychology*, *98*(2), 211–221.

Greitemeyer, T., Osswald, S., & Brauer, M. (2010). Playing prosocial video games increases empathy and decreases schadenfreude. *Emotion, 10*(6), 796–802.

Griffiths, D. N. (2013, November 6th). Activision boasts $1 billion 'Call of Duty: Ghosts' day one sales. *Forbes.* Retrieved March 24, 2014 from http://www.forbes.com/sites/danielnyegriffiths/2013/11/06/activision-boasts-1-billion-call-of-duty-ghosts-day-one-sales/.

Griffiths, M. D. (1990). The cognitive psychology of gambling. *Journal of Gambling Studies, 6*(1), 31-42.

Griffiths, M. D. (1993). Fruit machine gambling: The importance of structural characteristics. *Journal of gambling Studies, 9,* 101-120.

Griffiths, M. D. (1995). The role of subjective mood states in the maintenance of fruit machine gambling behavior. *Journal of Gambling Studies, 11*(2), 123-135.

Griffiths, M. D. (1997). Video games and children's behaviour. In T. Charlton & K. David (Eds.), *Elusive links: Television, video games, cinema and children's behaviour* (pp. 66-93). Gloucester: GCED/Park.

Griffiths, M. D. (1999a). Gambling technologies: Prospects for problem gambling. *Journal of Gambling Studies, 15,* 265-283.

Griffiths, M. D. (1999b). The psychology of near miss (revisited): A comment on Delfabbro and Winefield. *British Journal of Psychology, 90*, 441-445.

Griffiths, M. D. (2000). Does internet and computer "addiction" exist? Some case study evidence. *CyberPsychology and Behavior, 3,* 211-218.

Griffiths, M. (2003). Internet gambling: Issues, concerns, and recommendations. *CyberPsychology & Behavior, 6,* 557-568.

Griffiths, M. D., & Dancaster, I. (1995). The effect of type A personality on physiological arousal while playing computer games. *Addictive Behaviors, 20,* 543-548.

Griffiths, M. D., Davies, M. N. O., & Chappell, D. (2004). Demographic factors and playing variables in online computer gaming. *CyberPsychology & Behavior, 7*(4), 479-487.

Griffiths, M. D., & Hunt, N. (1998). Dependence on computer games by adolescents. *Psychological Reports, 82*(2), 475-480.

Griffiths, M. D., & Meredith, A. (2009). Videogame addiction and its treatment. *Journal of Contemporary Psychotherapy, 39*(4), 247-253.

Griffiths, M. D., & Parke, J. (2002). The social impact of internet gambling. *Social Science Computer Review, 20*(3), 312-320.

Grüsser, S. M., Thalemann, R., & Griffiths, M. D. (2007). Excessive computer game playing: Evidence for addiction and aggression? *CyberPsychology & Behavior, 10*(2), 290-292.

Guilford, J. P., & Zimmerman, W. S. (1949). *The Guilford-Zimmerman temperament survey.* Oxford, England: Sheridan Supply Co.

Gunter, W. D., & Daly, K. (2012). Causal or spurious: Using propensity score matching to detangle the relationship between violent video games and violent behavior. *Computers in Human Behavior, 28*(4), 1348–1355.

Hagström, D., & Kaldo, V. (2014). Escapism among players of MMORPGs – conceptual clarifications, its relation to mental health factors, and development of a new measure. *Cyberpsychol Behav Soc Netw, 17*(1), 19-25.

Hahn, B., Mohammed, S., & Stolerman, I. P. (2011). Selective nicotinic receptor antagonists: Effects on attention and nicotine-induced attentional enhancement. *Psychopharmacology, 217*(1), 75-82.

Hair, J. E., Anderson, R. E., Tatham, R. L., & Black W. C. (1998). *Multivariate data analysis.* (5th ed.). Upper Saddle River, NJ: Prentice-Hall.

Hall, G. W., Carriero, N. J., Takushi, R. Y. Montoya, I. D., Preston, K. L., & Gorelick, D. A. (2000). Pathological gambling among cocaine-dependent outpatients. *American Journal of Psychiatry, 157*(7), 1127-1133.

Han, D. H., Lyoo, I. K., & Renshaw, P. F. (2012). Differential regional gray matter volumes in patients with on-line game addiction and professional gamers. *Journal of Psychiatric Research, 46*, 507-515.

Hart, G. M., Johnson, B., Stamm, B., Angers, N., Robinson, A., Lally, T., & Fagley, W. H. (2009). Effects of video games on adolescents and adults. *CyberPsychology & Behavior, 12*(1), 63-65.

Hartman, B. (2009, September 22). New law bans flavored cigarettes. *ABC News.* Retrieved April 13, 2014, from http://abcnews.go.com/Health/QuitToLive/law-bans-sale-flavored-cigarettes/story?id=8640262.

Hartmann, T., Toz, E., & Brandon, M. (2010). Just a game? Unjustified virtual violence produces guilt in empathetic players. *Media Psychology, 13*(4), 339–363.

Hartston, H. (2012). The case for compulsive shopping as an addiction. *Journal of Psychoactive Drugs, 44*(1), 64-67.

Hatsukami, D. K., & Fischman, M. W. (1996). Crack cocaine and cocaine hydrochloride: Are the differences myth or reality? *JAMA, 276*(19), 1580-1588.

Heaton, R. K. (1981). *Wisconsin card sort test manual.* Odessa, FL: Psychological Assessment Resources, Inc.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtis, G. (1993). *Wisconsin card sort test (WCST) manual, revised and expanded.* Odessa, FL: Psychological Assessment Resources, Inc.

Heaton, R. K., & PAR Staff (2003). *Wisconsin card sorting test: Computer version 4, research edition (WCST: CV4).* Odessa, FL: Psychological Assessment Resources, Inc.

Heine, H. (2012). *User guide: Analyses by design.* Accessed August 10th, 2012. Available at: http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/

Henson, R. K., & Roberts, J. K. (2006). Exploratory factor analysis reporting practices in published psychological research: Common errors and some comment on improved practice. *Educational and Psychological Measurement, 66*(3), 393-416.

Holmes, W. L. (1985). Video games: Concepts and latest influences. In W. R. Eadington (Ed.), *The Gambling Studies. Proceedings of the 6th National Conference on Gambling and Risk Taking* (pp. 191-208). Reno, NV: University of Nevada.

Horiguchi, M., Hannaway, K. E., Adelekun, A. E., Huang, M., Jayathilake, K., & Meltzer, H. Y. (2013). D_1 receptor agonists reverse the subchronic phencyclidine (PCP)-induced novel object recognition (NOR) deficit in female rats. *Behavioural Brain Research, 238,* 36-43.

Horn J. L. (1965). A rationale and a test for the number of factors in factor analysis. *Psychometrika, 30*, 179–185.

Hsu, S. H., Wen, M. H., & Wu, M. C. (2009). Exploring user experiences as predictors of MMORPG addiction. *Computers in Education, 53*, 990–999.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Hubert-Wallander, B., Green, C. S., Sugarman, M., & Bavelier, D. (2011). Changes in search rate but not in the dynamics of exogenous attention in action videogame players. *Attention, Perception & Psychophysics, 73*(8), 2399-2412.

Hummer, T. A., Wang, Y., Kronenberger, W. G., Mosier, K. M., Kalnin, A. J., Dunn, D. W., & Mathews, V. P. (2010). Short-term violent video game play by adolescents alters prefrontal activity during cognitive inhibition. *Media Psychology, 13*(2), 136-154.

Hussain, Z., & Griffiths, M. D. (2009). Excessive use of massively multi-player online role-playing games: A pilot study. *International Journal of Mental Health and Addiction, 7*(4), 563-571.

Ibáñez, A., Blanco, C., Donahue, E., Lesieur, H. R., Pérez de Castro, I., Fernández-Piqueras, J., & Sáiz-Ruiz, J. (2001). Psychiatric comorbidity in pathological gamblers seeking treatment. *Am J Psychiatry, 158*(10), 1733-1735.

IBM Corp. (2011). *IBM SPSS Statistics for Windows, Version 20.0.* Armonk, NY: IBM Corporation.

Imagine Publishing (2013). *The Mega Drive/SNES Book*. Bournemouth, UK: Imagine Publishing.

Ip, Barry. (2011a). Narrative structures in computer and video games: Part 1: Context, definitions, and initial findings. *Games and Culture: A Journal of Interactive Media, 6*(2), 103-134.

Ip, Barry. (2011b). Narrative structures in computer and video games: Part 2: Emotions, structures, and archetypes. *Games and Culture: A Journal of Interactive Media, 6*(2), 203-244.

Irwin, A. R., & Gross, A. M. (1995). Cognitive tempo, violent video games, and aggressive behavior in young boys. *Journal of Family Violence, 10*(3), 337-350.

Ivezaj, V. (2011). *An examination of psychological risk factors for the development of substance abuse among post-bariatric surgery patients*. Unpublished doctoral dissertation; publication is pending in Dissertation Abstracts.

Jackson, L. A., von Eye, A., Fitzgerald, H. E., Witt, E. A., & Zhao, Y. (2011). Internet use, videogame playing and cell phone use as predictors of children's body mass index (BMI), body weight, academic performance, and social and overall self-esteem. *Computers in Human Behavior, 27*(1), 599-604.

Jaffe, J. H. (1990). Trivialising dependence [Commentary]. *British Journal of Addiction, 85*, 1425-1427.

Jentsch, J. D., & Taylor, J. R. (1999). Impulsivity resulting from frontostriatal dysfunction in drug abuse: Implications for the control of behavior by reward-related stimuli. *Psychopharmacology, 146*(4), 373-390.

Johansson, A., & Götestam, K. G. (2004). Problems with computer games without monetary reward: Similarity to pathological gambling. *Psychological Reports, 95*, 641-650.

Joinson, A. (1998). Causes and implications of disinhibited behavior on the internet. In J. Gackenbach (Ed.), *Psychology and the internet: Intrapersonal, interpersonal, and transpersonal implications* (pp. 43-60). San Diego, CA: Academic Press.

Jöreskog, K., & Moustaki, I. (2001). Factor analysis for ordinal variables: A comparison of three approaches. *Multivariate Behavioural Research, 36*, 347-387.

Jöreskog, K., & Sörbom, D. (1993). *LISREL 8: Structural equation modeling with the SIMPLIS command language.* Chicago, IL: Scientific Software International Inc.

Kahler, C. W., Hustad, J., Barnett, N. P., Strong, D. R., & Borsari, B. (2008). Validation of the 30-day version of the brief young adult alcohol consequences questionnaire for use in longitudinal studies. *Journal of Studies on Alcohol and Drugs, 69*(4), 611-615.

Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The brief young adult alcohol consequences questionnaire. *Alcoholism: Clinical and Experimental Research, 29*(7), 1180-1189.

Kairouz, S., Paradis, C., & Nadeau, L. (2012). Are online gamblers more at risk than offline gamblers? *Cyberpsychology, Behavior, and Social Networking, 15*(3), 175-180.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20*, 141-151.

Kalivas, P. W. (2009). The glutamate homeostasis hypothesis of addiction. *Nat Rev Neurosci, 10*, 561-572.

Kamarajan, C., Porjesz, B., Jones, K. A., Choi, K., Chorlian, D. B. Padmanabhapillai, A., … Begleiter, H. (2005). Alcoholism is a disinhibitory disorder: Neurophysiological evidence from a go/no-go task. *Biol Psychiatry, 69*, 353-373.

Kandel, D. B. (2002). Examining the gateway hypothesis: Stages and pathways of drug involvement. In D. B. Kandel (Ed.), *Stages and pathways of drug involvement: Examining the gateway hypothesis* (pp. 3-15). New York, NY: Cambridge University Press.

Kandel, D. B., & Jessor, R. (2002). The gateway hypothesis revisited. In D. B. Kandel (Ed.), *Stages and pathways of drug involvement: Examining the gateway hypothesis* (pp. 365-372). New York, NY: Cambridge University Press.

Kandel, D., & Yamaguchi, K. (1993). From beer to crack: Developmental patterns of drug involvement. *American Journal of Public Health, 83*, 851-855.

Kandel, D. B., & Yamaguchi, K. (2002). Stages of drug involvement in the U.S. population. In D. B. Kandel (Ed.), *Stages and pathways of drug involvement: Examining the gateway hypothesis* (pp. 65-89). New York, NY: Cambridge University Press.

Kane, R. J., & Yacoubian, G. S., Jr. (1999). Patterns of drug escalation among Philadelphia arrestees: An assessment of the gateway theory. *Journal of Drug Issues, 29*(1), 107-120.

Karle, J. W., Watter, S., & Shedden, J. M. (2010). Task switching in video game players: Benefits of selective attention but not resistance to proactive interference. *Acta Psychologica, 134*(1), 70-78.

Karlsen, F. (2010). Entrapment and near miss: A comparative analysis of psycho-structural elements in gambling games and massively multiplayer online role-playing games. *International Journal of Mental Health and Addiction, 9*(2), 193–207.

Khalsa, H. K., Anglin, M. D., Paredes, A., Potepan, P., & Potter, C. (1993). Pretreatment natural history of cocaine addiction: Preliminary 1-year followup results. In F. M. Tims & C. G. Leukefeld (Eds.), *Cocaine treatment research and clinical perspectives* (pp. 218-235). Rockville, MD: US Dept. of Health and Human Services.

King, D., & Delfabbro, P. (2009). The general health status of heavy video game players: Comparisons with Australian normative data. *Journal of CyberTherapy and Rehabilitation, 2*(1), 17-26.

King, D. L., & Delfabbro, P. H. (2012). Issues for DSM-5: Video-gaming disorder? *Australian & New Zealand Journal of Psychiatry, 47*(1), 20-22.

King, D., Delfabbro, P., & Griffiths, M. (2010). The convergence of gambling and digital media: Implications for gambling in young people. *Journal of Gambling Studies, 26*(2), 175–187.

King, D. L., Delfabbro, P. H., & Griffiths, M. D. (2011). The role of structural characteristics in problematic video game play: An empirical study. *International Journal of Mental Health and Addiction, 9*(3), 320–333.

King, D. L., Delfabbro, P. H., & Zajac, I. T. (2011). Preliminary validation of a new clinical tool for identifying problem video game playing. *International Journal of Mental Health and Addiction, 9*(1), 72–87.

King, G. R., Xiong, Z., & Ellinwood, E. H., Jr. (1997). Blockade of cocaine sensitization and tolerance by the co-administration of odansetron, a 5-HT3 receptor antagonist, and cocaine. *Psychopharmacology, 130*(2), 159-165.

Kirby, K. N., Petry, N. M., & Bickel, W.K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology General, 128*, 78-87.

Kirlin, K. A. (2003). *Inattentive and impulsive profiles of the CPT-II and their relationship with DSM-IV ADHD subtypes.* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (Accession Order No. AAI3062632)

Klein, S. M., Giovino, G. A., Barker, D. C., Tworek, C., Cummings, K. M., & O'Connor, R. J. (2008). Use of flavored cigarettes among older adolescent and adult smokers: United States, 2004 – 2005. *Nicotine & Tobacco Research, 10*(7), 1209-1214.

Klimmt, C., & Vorderer, P. (2003). Media Psychology "is not there yet": Introducing theories on media entertainment to the present debate. *Presence, 12*(4), 346-359.

Ko, C-H., Yen, J-Y., Chen, S-H., Wang, P-W., Chen, C-S, & Yen, C-F. (2014). Evaluation of the diagnostic criteria of Internet gaming disorder in the DSM-5 among young adults in Taiwan. *Journal of Psychiatric Research.* Advance online publication. Doi: 10.1016/j.jpsychires.2014.02.008.

Korn, D. A., & Shaffer, H. J. (1999). Gambling and the health of the public: Adopting a public health perspective. *Journal of Gambling Studies, 15,* 289-365.

Krcmar, M., & Farrar, K. (2009). Retaliatory aggression and the effects of point of view and blood in violent video games. *Mass Communication and Society, 12,* 115-138.

Krcmar, M., Farrar, K., & McGloin, R. (2011). The effects of video game realism on attention, retention and aggressive outcomes. *Computers in Human Behavior, 27*(1), 432–439.

Krcmar, M., & Lachlan, K. (2009). Aggressive Outcomes and Videogame Play: The Role of Length of Play and the Mechanisms at Work. *Media Psychology*, *12*(3), 249–267.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16,* 606-613.

Kronenberger, W. G., Mathews, V. P., Dunn, D. W., Wang, Y., Wood, E. A., Giauque, A. L., … Li, T.-Q. (2005). Media violence exposure and executive functioning in aggressive and control adolescents. *Journal of Clinical Psychology, 61*(6), 725-737.

Kuss, D. J. (2013). Internet gaming addiction: Current perspectives. *Psychology Research and Behavior Management, 6*, 125-137.

Kuss, D. J., Louws, J., & Wiers, R. W. (2012). Online gaming addiction? Motives predict addictive play behavior in massively multiplayer online role-playing games. *Cyberpsychology, Behavior, and Social Networking, 15*(9), 480-485.

Ladd, G. T., & Petry, N. M. (2002). Disordered gambling among university-based medical and dental patients: A focus on internet gambling. *Psychology of Addictive Behaviors, 16*(1), 76-79.

Ladd, G. T., & Petry, N. M. (2003). A comparison of pathological gamblers with and without substance abuse treatment histories. *Experimental & Clinical Psychopharmacology, 11*(3), 202-209.

Lawrence, A. J., Luty, J., Bogdan, N. A., Sahakian, B. J., & Clark, L. (2009). Impulsivity and response inhibition in alcohol dependence and problem gambling. *Psychopharmacology, 207*, 163-172.

Ledgerwood, D. M., Alessi, S. M., Phoenix, N., & Petry, N. M. (2009). Behavioral assessment of impulsivity in pathological gamblers with and without substance use disorder histories versus healthy controls. *Drug and Alcohol Dependence, 105*(1-2), 89-96.

Ledgerwood, D. M., & Downey, K. K. (2002). Relationship between problem gambling and substance use in a methadone maintenance population. *Addictive Behaviors, 27*, 483-491.

Lee, K. M., Peng, W., & Klein, J. (2010). Will the experience of playing a violent video game influence people's judgments of violent crimes? *Computers in Human Behavior, 26*, 1019-1023.

Leland, D. S., & Paulus, M. P. (2005). Increased risk-taking decision-making but not altered response to punishment in stimulant-using young adults. *Drug and Alcohol Dependence, 78*, 83-90.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2009). Development and validation of a game addiction scale for adolescents. *Media Psychology*, *12*(1), 77–95.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). The effects of pathological gaming on aggressive behavior. *Journal of Youth and Adolescence, 40*(1), 38-47.

Lesieur, H.R., & Blume, S.B. (1987). The South Oaks Gambling Screen (The SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry, 144*, 1184-1188.

Lesieur, H. R., Blume, S. B., & Zoppa, R. M. (1986). Alcoholism, drug abuse, and gambling. *Alcoholis: Clinical and experimental Research, 10*, 33-38.

Lewis, M. J., & Wackowski, O. (2006). Dealing with an innovative industry: A look at flavored cigarettes promoted by mainstream brands. *American Journal of Public Health, 96*(2), 244–251.

Li, C. S., Milivojevic, V., Kemp, K., Hong, K., & Sinha, R. (2006). Performance monitoring and stop signal inhibition in abstinent patients with cocaine dependence. *Drug Alcohol Depen, 85*, 205-212.

Lin, S.-F. (2011). Effect of opponent type on moral emotions and responses to video game play. *Cyberpsychology, Behavior and Social Networking*, *14*(11), 695–698.

Lipman, R. S., Covi, L., & Shapiro, A. K. (1979). The Hopkins symptoms checklist (HSCL): Factors derived from the HSCL-90. *Journal of Affective Disorders, 1*, 9-24.

Loba, P., Stewart, S. H., Klein, R. M., & Blackburn, J. R. (2001). Manipulations of the features of standard video lottery terminal (VLT) games: Effects in pathological and non-pathological gamblers. *Journal of Gambling Studies, 17*, 297-320.

Löwe B, Unützer J, Callahan C, Perkins A, Kroenke K. (2004). Monitoring depression treatment outcomes with the patient health questionnare-9. *Medical Care, 42*,1194-1201.

Loxton, N. J., & Dawe, S. (2001). Alcohol abuse and dysfunctional eating in adolescent girls: The influence of individual differences in sensitivity to reward and punishment. *International Journal of Eating Disorders, 29*, 455-462.

Lyons, E. J., Tate, D. F., & Ward, D. S. (2013). The better the story, the bigger the serving: Narrative transportation increases snacking during screen time in a randomized trial. *The International Journal of Behavioral Nutrition and Physical Activity, 10*, 60-65.

MacCallum, R. C., Browne, M. W., & Cai, L. (2006). Testing differences between nested covariance structure models: Power analysis and null hypotheses. *Psychological Methods, 11*, 19-35.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods*, *4*, 84-99.

Madden, G. J., Petry, N. M., Badger, G. J., & Bickel, W. K. (1997). Impulsive and self-control choices in opioid-dependent patients and non-drug-using control participants: Drug and monetary rewards. *Experimental and Clinical Psychopharmacology, 5*, 256-262.

Martin, A., Rief, W., Klaiberg, A., & Braehler, E. (2006). Validity of the brief patient health questionnaire mood scale (PHQ-9) in the general population. *General Hospital Psychiatry, 28*(1), 71-77.

McBride, J. & Derensky, J. (2009). Internet gambling behaviour in a sample of online gamblers. *International Journal of Mental Health and Addiction, 7*, 149-167.

McMahon, R. C., Malow, R., & Loewinger, L. (1999). Substance abuse history predicts depression and relapse status among cocaine abusers. *The American Journal of Addictions, 8*(1), 1-8.

Meisch, R. A., & Lemaire, G. A. (1993). Drug self-administration. In: F. Van Haaren (Ed.), *Methods in behavioral pharmacology* (pp. 257-300). Amsterdam: Elsevier.

Mellecker, R. R., Lanningham-Foster, L., Levine, J. A, & McManus, A. M. (2010). Energy intake during activity enhanced video game play. *Appetite*, *55*(2), 343-347.

Mentzoni, R. A., Brunborg, G. S., Molde, H., Myrseth, H., Skouverøe, K. J. M., Hetland, J., & Pallesen, S. (2011). Problematic video game use: Estimated prevalence and associations with mental and physical health. *Cyberpsychology, Behavior and Social Networking*, *14*(10), 591-596.

Messias, E., Castro, J., Saini, A., Usman, M., & Peeples, D. (2011). Sadness, suicide, and their association with video game and internet overuse among teens: Results from the youth risk behavior survey 2007 and 2009. *Suicide & Life-Threatening Behavior*, *41*(3), 307-315.

Metcalf, O., & Pammer, K. (2014a). Impulsivity and related neuropsychological features in regular and addictive first person shooter gaming. *Cyberpsychol Behav Soc Netw*, *17*(3), 147-152.

Metcalf, O., & Pammer, K. (2014b). Physiological arousal deficits in addicted gamers differ based on preferred game genre. *Eur Addict Res*, *20*(1), 23-32.

Meyer, B. (2001). Coping with severe mental illness: Relations and the brief COPE with symptoms, functioning, and well-being. *Journal of Psychopathology and Behavioral Assessment, 23*(4), 265-277.

Miller, N. S., & Gold, M. S. (1994). Criminal activity and crack addiction. *Journal of the Addictions, 29*(8), 1069-1078.

Mishra, J., Zinni, M., Bavelier, D., & Hillyard, S. A. (2011). Neural basis of superior performance of action videogame players in an attention-demanding task. *The Journal of Neuroscience : The Official Journal of the Society for Neuroscience*, *31*(3), 992-998.

Mitchell, J. M., Fields, H. L., D'Esposito, M., & Boettiger, C. A. (2005). Impulsive responding in alcoholics. *Alcoholism-Clinical and Experimental Research, 29*, 2158-2169.

Moeller, F. G., Barratt, E. S., Fischer, C. J., Dougherty, D. M., Reilly, E. L., Mathias, C. W., & Swann, A. C. (2004). P300 event-related potential amplitude and impulsivity in cocaine-dependent subjects. *Neuropsychobiology, 50*, 167-173.

Moeller, F. G., Dougherty, D. M., Barratt, E. S., Oderinde, V., Mathias, C. W., Harper, R. A., & Swann, A. C. (2002). Increased impulsivity in cocaine dependence subjects independent of antisocial personality disorder and aggression. *Drug and Alcohol Dependence, 68*, 105-111.

Mohamad, M. S. (2009). Daily hassles, coping strategies, and substance use among Egyptian manufacturing workers. *Journal of Muslim Mental Health, 4*(1), 17-29.

Möller, I., & Krahé, B. (2009). Exposure to violent video games and aggression in German adolescents: A longitudinal analysis. *Aggressive Behavior*, *35*(1), 75-89.

Montag, C., Weber, B., Trautner, P., Newport, B., Markett, S., Walter, N. T., Felten, A., & Reuter, M. (2012). Does excessive play of violent first-person-shooter-video-games dampen brain activity in response to emotional stimuli? *Biological Psychology*, *89*, 107-111.

Monterosso, J. R., Aron, A. R., Cordova, X., Xu, J., & London, E. D. (2005). Deficits in response inhibition associated with chronic methamphetamine abuse. *Drug Alcohol Depend*, *79*, 273-277.

Moreyra, P., Ibáñez, A., Liebowitz, M. R., Sáiz-Ruiz, J., & Blanco, C. (2002). Pathological gambling: Addiction or obsession? *Psychiatric Annals, 32*(3), 161-166.

Morgan, C. J. A., Mofeez, A., Brandner, B., Bromley, L., & Curran, H. V. (2004). Ketamine impairs response inhibition and is positively reinforcing in healthy volunteers: A dose-response study. *Psychopharmacology, 172*, 298-308.

Morgan, M. J. (1998). Recreational use of "ecstasy" (MDMA) is associated with elevated impulsivity. *Neuropsychopharmacology, 19*, 252-264.

Morse, S., & Gergen, K. J. (1970). Social comparison, self-consistency, and the concept of self. *Journal of Personality and Social Psychology*, *16*(1), 148-156.

Muller, L., & Spitz, E. (2003). Évaluation multidimensionnelle du coping: Validation du Brief COPE sur une population française. *Revue de psychiatrie clinique biologique et thérapeutique, 29*(6), 507-518.

Muthén, L. K., & Muthén, B. O. (2008). *Mplus user's guide*. Los Angeles, CA: Author.

Nelson, C. B., Rehm, Ustun, T. B., Grant, B., & Chatterji, S. (1999). Factor structures for DSM-IV substance disorder criteria endorsed by alcohol, cannabis, cocaine and opiate users: Results from the WHO reliability and validity study. *Addiction, 94*(6), 843-855.

Ng, B. D., & Wiemer-Hastings, P. (2005). Addiction to the internet and online gaming. *CyberPsychology & Behavior, 8*, 110-113.

Nower, L., & Blaszczynski, A. (2006). Impulsivity and pathological gambling: A descriptive model. *International Gambling Studies, 6*(1), 61-75.

Nouchi, R., Taki, Y., Takeuchi, H., Hashizume, H., Akitsuki, Y., Shigemune, Y., Sekiguchi, A., et al. (2012). Brain training game improves executive functions and processing speed in the elderly: a randomized controlled trial. *PloS one, 7*(1), 1-9.

O'Brien, C. (2011). Addiction and dependence in DSM-V. *Addiction, 106*(5), 866-867.

Olley, B. O., Seedat, S., Nei, D. G., & Stein, D. J. (2004). Predictors of major depression in recently diagnosed patients with HIV/AIDS in South Africa. *AIDS Patient Care and STDS, 18*(8), 481-487.

Olley, B. O., Zeier, M. D., Seedat, S., & Stein, D. J. (2005). Post-traumatic stress disorder among recently diagnosed patients with HIV/AIDS in South Africa. *AIDS Care, 17*(5), 550-557.

Olson, C. K., Kutner, L. A., Baer, L., Beresin, E. V., Warner, D. E. & Nicholi, A. M. (2009). M-rated video games and aggressive or problem behavior among young adolescents. *Applied Developmental Science, 13*(4), 188-198.

Orford, J., Morison, V., & Somers, M. (1996). Drinking and gambling: A comparison with implications for theories of addiction. *Drug and Alcohol Review, 15*(1), 47-56.

Padilla-Walker, L. M., Nelson, L. J., Carroll, J. S., & Jensen, A. C. (2010). More than a just a game: Video game and internet use during emerging adulthood. *Journal of Youth and Adolescence, 39*(2), 103-113.

Parke, J., & Griffiths, M. D. (2007). The role of structural characteristics in gambling. In D. Smith, D. Hodgins, & R. Williams (Eds.), *Research and measurement issues in gambling studies* (pp. 211-243). New York, NY: Elsevier.

Parker, J. D. A., Taylor, R. N., Eastabrook, J. M., Schell, S. L., & Wood, L. M. (2008). Problem gambling in adolescence: Relationships with internet misuse, gaming abuse and emotional intelligence. *Personality and Individual Differences, 45*(2), 174-180.

Parrott, A. C., Sisk, E., & Turner, J. J. (2000). Psychobiological problems in heavy 'ecstasy' use (MDMA) polydrug users. *Drug and Alcohol Dependence, 60*, 105-110.

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. *Journal of Clinical Psychology, 51*(6), 768-774.

Peffer-Smith, P. G., Smith, E. O., & Byrd, L. D. (1983). Effects of d-amphetamine on self-aggression and posturing in stumptail macaques. *Journal of the Experimental Analysis of Behavior, 40*(3), 313-320.

Perczek, R., Carver, C. S., Price, A. A., & Pozo-Kaderman, C. (2000). Coping, mood, and aspects of personality in Spanish translation and evidence of convergence with English versions. *Journal of Personality Assessment, 74*(1), 63-87.

Petry, N. M. (2001). Substance abuse, pathological gambling, and impulsiveness. *Drug and Alcohol Dependence, 63*(1), 29-38.

Petry, N. M. (2010). Pathological gambling and the DSM-V. *International Gambling Studies, 10*(2), 113-115.

Petry, N. M., & O'Brien, C. P. (2013). Internet gaming disorder and the DSM-5. *Addition, 108*(7), 1186-1187.

Petry, N. M., & Oncken, C. (2002). Cigarette smoking is associated with increased severity of gambling problems in treatment-seeking gamblers. *Addiction, 97*(6), 745-753.

Petry, N. M.,Stinson, F. S., & Grant, B. F. (2005). Co-morbidity of DSM-IV pathological gambling and other psychiatric disorders: Results from the National Epidemiologic Survey on alcohol and related conditions. *Journal of Clinical Psychiatry, 66*, 564-574.

Pinto-Meza, A., Serrano-Bianco, A., Peñarrubia, M. T., Blanco, E., & Haro, J. M. (2005). Assessing depression in primary care with the PHQ-9: Can it be carried out over the telephone? *Journal of General Internal Medicine, 20*(8), 738-742.

Polman, H., de Castro, B. O., & van Aken, M. a G. (2008). Experimental study of the differential effects of playing versus watching violent video games on children's aggressive behavior. *Aggressive behavior*, *34*(3), 256–264.

Porrino, L. J., & Lyons, D. (2000). Orbital and medial prefrontal cortex and psychostimulant abuse: Studies in animal models. *Cerebral Cortex, 10*, 326-333.

Potenza, M. N. (2009). Non-substance and substance addictions. *Addiction, 104*(6), 1016-1017.

Pottieger, A. E., Tressell, P. A., Surratt, H. L., Inciardi, J. A., & Citwood, D. D. (1995). Drug use patterns of adult crack users in street versus residential treatment samples. *Journal of Psychoactive Drugs, 27*(1), 27-38.

Read, J. R., Kahler, C. W., Strong, D. R., & Colder, C. R. (2004). Development and preliminary validation of the young adult alcohol consequences questionnaire. *Presented at the 27th Annual Meeting of the Research Society on Alcoholism, Vancouver, Canada*.

Richardson, A. E., Powers, M. E., & Bousquet, L. G. (2011). Video game experience predicts virtual, but not real navigation performance. *Computers in Human Behavior*, *27*(1), 552-560.

Robins, R. W., Fraley, R. C., & Krueger, R. F. (Eds.) (2007). *Handbook of research methods in personality psychology*. New York, NY: Guilford.

Rodriguez-Jimenez, R., Avila, C., Jimenez-Arriero, M. A., Ponce, G., Monasor, R., Jimenez, M., … Palomo, T. (2006). Impulsivity and sustained attention in pathological gamblers: Influence of childhood ADHD history. *Journal of Gambling Studies, 22*, 451-461.

Rogers, P. (1998). The cognitive psychology of lottery gambling: A theoretical review. *Journal of Gambling Studies, 14*, 111-134.

Rogosch, F., Chassin, L., & Sher, K. J. (1990). Personality variables as mediators of family history risk for alcoholism: Conceptual and methodological issues. *Journal of Studies on Alcohol, 51*(4), 310-318.

Rounsaville, B. J., Bryant, K., Babor, T., Kranzler, H., & Kadden, R. (1993). Cross system agreement for substance use disorders: DSM-III-R, DSM-IV, and ICD-10. *Addiction, 88,* 337-348.

Russell, M., Cooper, M. L., & Frone, M. R. (1990). The influence of sociodemographic characteristics on familial alcohol problems: Data from a community sample. *Alcoholism: Clinical and Experimental Research, 14*(2), 221-226.

Saha, T. D., Compton, W. M., Chou, S. P., Smith, S., Ruan, W. J., Huang, B., … Grant, B. F. (2012). Analyses related to the development of DSM-5 criteria for substance use related disorders. 1. Toward amphetamine, cocaine and prescription drug use disorder continua using item response theory. *Drug and Alcohol Dependence, 122,* 38-46.

Salguero, R. A. T., & Morán, R. M. B. (2002). Measuring problem video game playing in adolescents. *Addiction, 97*(12), 1601-1606.

Sammis, J. (2008). *Video game addiction & depression rates among online video game players* Doctoral Dissertation). Retrieved from ProQuest Dissertations (Accession Order No. AAT 3318657).

Sanchez, C. A. (2012). Enhancing visuospatial performance through video game training to increase learning in visuospatial science domains. *Psychonomic Bulletin & Review, 19*(1), 58-65.

Saunders, J. B., Aasland, O. G., Babor, T. F., & de la Fuente, J. R. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption: II. *Addiction, 88*(6), 791-804.

Schultz, W. (2011). Potential vulnerabilities of neuronal reward, risk, and decision mechanisms to addictive drugs. *Neuron, 69*, 603-617.

Sestir, M. A., & Bartholow, B. D. (2010). Violent and nonviolent video games produce opposing effects on aggressive and prosocial outcomes. *Journal of Experimental Social Psychology*, *46*(6), 934–942.

Shafer, D. M. (2013). An integrative model of predictors of enjoyment in console versus mobile video games. *PsychNology, 11*(2), 137-157.

Shaffer, H. J., Hall, M. N, & Vander Bilt, J. (2000). "Computer addiction": A critical consideration. *American Journal of Orthopsychiatry*, *70*(2), 162-168.

Shaffer, H. J., LaPlante, D. a, LaBrie, R. a, Kidman, R. C., Donato, A. N., & Stanton, M. V. (2004). Toward a syndrome model of addiction: multiple expressions, common etiology. *Harvard Review of Psychiatry, 12*(6), 367-374.

Sharpe, L., Tarrier, N., Schotte, D., & Spence, S. (1995). The role of autonomic arousal in problem gambling. *Addiction, 90*, 1529-1540.

Sheese, B. E., & Graziano, W. G. (2005). Deciding to defect: The effects of video-game violence on cooperative behavior. *Psychological Science, 16*(5), 354-357.

Sher, K. J., Walitzer, K. S., Wood, P. K., & Brent, E. E. (1991). Characteristics of children of alcoholics: Putative risk factors, substance use and abuse, and psychopathology. *Journal of Abnormal Psychology, 100*(4), 427-448.

Sherry, J. L. (2007). Violent video games and aggression: Why can't we find effects? In R. W. Preiss, B. M. Gayle, M. Burrell, M. Allen, & J. Bryants (Eds.), *Mass media effects research: Advances through meta-analysis* (pp. 245-262). Mahwah, NJ: Erlbaum.

Silvern, S. B., & Williamson, P. A. (1987). The effects of video game play on young children's aggression, fantasy, and prosocial behavior. *J Appl Dev Psychol, 8*, 453-462.

Smith, G. J., & Wynne, H. J. (2004). *VLT gambling in Alberta: A preliminary analysis*. Accessed July 12th, 2012. Available at: http://www.abgaminginstitute.ualberta.ca/documents/research/VLT_Gambling_Alberta.pdf.

Spada, M. M., & Wells, A. (2006). Metacognitions about alcohol use in problem drinkers. *Clinical Psychology & Psychotherapy, 13*(2), 138-143.

Spinella, M. (2007). Normative data and a short form of the Barratt Impulsiveness Scale. *International Journal of Neuroscience, 117*(3), 359-368.

Spitzer, R. L., Kroenke, K., & Williams, J. B. W. (1999). Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. *JAMA, 282*(18), 1737-1744.

SPSS (2008). *SPSS Base 17.0 for Windows User's Guide*. Chicago, IL: Author.

Spunt, S. M., Lesieur, H., Hunt, D., & Cahill, L. (1995). Gambling among methadone patients. *International Journal of the Addictions, 30*, 929-962.

Starcevic, V. (2013). Video-gaming disorder and behavioural addictions. *Australian & New Zealand Journal of Psychiatry, 47*(3), 285-286.

Starcevic, V., Berle, D., Porter, G., & Fenech, P. (2011). Problem video game use and dimensions of psychopathology. *International Journal of Mental Health and Addiction, 9*(3), 248-256.

Steiger, J. H. (1990). Structural model evaluation and modification. *Multivariate Behavioral Research, 25*, 214-212.

Steiger, J. H., & Lind, J. C. (1980, May). *Statistically-based tests for the number of common factors*. Paper presented at the annual Spring Meeting of the Psychometric Society in Iowa City.

Steinberg, M. A., Kosten, T. R., & Rounsaville, B. J. (1992). Cocaine abuse and pathological gambling. *American Journal on Addictions, 1,* 121-132.

Stockwell., T., Hodgson, R., Edwards, G., Taylor, C., & Rankin, H. (1979). The development of a questionnaire to measure severity of alcohol dependence. *British Journal of Addiction, 74*, 79-87.

Sungur, H., & Boduroglu, A. (2012). Action video game players form more detailed representation of objects. *Acta Psychologica, 139*(2), 327-334.

Swing, E. L., Gentile, D. A., Anderson, C. A., & Walsh, D. A. (2010). Television and video game exposure and the development of attention problems. *Pediatrics, 126,* 214 –221.

Sylvain, C., & Ladouceur, R. (1992). Cognitive correction and practices of play in players of video poker. *Revue Canadienne des Sciences du Comportement, 24,* 479-489.

Tabachnick, B.G., & Fidell, L.S. (2001). *Using multivariate statistics* (4th ed.). Needham Heights, MA: Allyn & Bacon.

Taylor, T. L. (2006). *Play between worlds: Exploring online game culture.* Cambridge, MA: MIT Press.

Thalemann, R., Wolfing, K., & Grüsser, S. M. (2007). Specific cue reactivity on computer game-related cues in excessive gamers. *Behavioral Neuroscience, 21,* 614-618.

Thetechlabs.com (2011). *It's time to take mobile gaming seriously.* Retrieved July 21st, 2012, from http://www.thetechlabz.com/tech-news/its-time-to-take-mobile-gaming-seriously/

Thomas, N., & Martin, F. H. (2010). Video-arcade game, computer game and internet activities of Australian students: Participation habits and prevalence of addiction. *Australian Journal of Psychology*, *62*(2), 59-66.

Thompson, B., & Daniel, L. G. (1996). Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement*, *56*, 197-208.

Toce-Gerstein, M., Gerstein, D. R., & Volberg, R. A. (2003). A hierarchy of gambling disorders in the community. *Addiction*, *98*(12), 1661-1672.

Tolchinsky, A. (2013). *The development of a self-report questionnaire to measure problematic video game play and its relationship to other psychological phenomena.* Unpublished Dissertation, Eastern Michigan University, Ypsilanti, MI.

Tolchinsky, A., & Jefferson, S. D. (2011). Problematic video game play in a college sample and its relationship to time management skills and attention-deficit/hyperactivity disorder symptomology. *CyberPsychology, Behavior, & Social Networking*, *14*(9), 489-496.

Toneatto, T., & Brennan, J. (2002). Pathological gambling in treatment-seeking substance abusers. *Addictive Behavior, 27*, 465-469.

Trick, L. M., Jaspers-Fayer, F., & Sethi, N. (2005). Multiple-object tracking in children: The "Catch the Spies" task. *Cognitive Development*, *20*(3), 373-387.

Tsitsika, A., Critselis, E., Janikian, M., Kormas, G., & Kafetzis, D. A. (2011). Association between internet gambling and problematic internet use among adolescents. *Journal of Gambling Studies*, *27*(3), 389–400.

Turner, N., & Horbay, R. (2004). How do slot machines and other electronic gambling machines actually work? *Electronic Journal of Gambling Issues, 11*. Accessed July 27th, 2012. Available at: http://www.camh.net/egambling/issue11.

Turner, R. G., Scheier, M. F., Carver, C. S., & Ickes, W. (1978). Correlates of self-consciousness. *Journal of Personality Assessment, 42*(3), 285-289.

Valadez, J. J., & Ferguson, C. J. (2012). Just a game after all: Violent video game exposure and time spent playing effects on hostile feelings, depression, and visuospatial cognition. *Computers in Human Behavior, 28*(2), 608–616.

van Rooij, A. J., Meerkerk, G., Schoenmakers, T. M., Griffiths, M., & van de Mheen, D. (2010). Video game addiction and social responsibility. *Addiction Research and Theory, 18*(5), 489-493.

Van Rooij, A. J., Schoenmakers, T. M., Vermulst, A. A., Van den Eijinden, R. J., & Van de Mhen, D. (2011). Online video game addiction: Identification of addicted adolescent gamers. *Addiction, 106*(1), 205-212.

Verdejo-García, A., Lawrence, A. J., & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience and Biobehavioral Reviews, 32*(4), 777-810.

Verdejo-Garcia, A., & Perez-Garcia, M. (2007). Profile of executive deficits in cocaine and heroin polysubstance users: Common and differential effects on separate executive components. *Psychopharmacology, 190,* 517-530.

Vitaro, F., Ferland, F., Jacques, C., & Ladouceur, R. (1998). Gambling, substance use, and impulsivity during adolescence. *Psychology of Addictive Behaviors, 12*(3), 185-194.

Volberg, R. A. (1997). *Gambling and problem gambling in Oregon.* Report to the Oregon gambling addiction treatment foundation. Accessed June 20th, 2012. Available at: http://www.gamblingaddiction.org/oregonreport/OregonReportPrint.htm.

Volkow, N. D. (2010). Opioid-dopamine interactions: Implications for substance use disorders and their treatment. *Biol Psychiatry, 68*, 685-686.

Volkow, N. D., Wang, G. J., Telang, F., Fowler, J. S., Logan, J., Jayne, M., … Wong, C. (2007). Profound decreases in dopamine release in striatum in detoxified alcoholics: Possible orbitofrontal involvement. *J Neurosci, 27*, 12700-12706.

Wack, E., & Tantleff-Dunn, S. (2009). Relationships between electronic game play, obesity , and psychosocial functioning in young men, *12*(2), 2-5.

Wagner, E. F. (1993). Delay of gratification, coping with stress, and substance use in adolescence. *Experimental and Clinical Psychopharmacology, 1*, 1-4.

Wagner, E. F., Myers, M. G., & McIninch, J. L. (1999). Stress-coping and temptation-coping as predictors of adolescent substance use. *Addictive Behaviors, 24*(6), 769-779.

Wagner, F. A., & Anthony, J. C. (2002). From first drug use to drug dependence; developmental periods of risk for dependence upon marijuana, cocaine, and alcohol. *Neuropsychopharmacology, 26*, 479-488.

Wang, Y., Mathews, V. P., Kalnin, A. J., Mosier, K. M., Dunn, D. W., Saykin, A. J., & Kronenberger, W. G. (2009). Short term exposure to a violent video game induces changes in frontolimbic circuitry in adolescents. *Brain Imaging and Behavior, 3*, 38-50.

Wareham, J. D., & Potenza, M. (2010). Pathological gambling and substance use disorders. *The American Journal of Drug Alcohol Abuse, 36*, 242-247.

Wayne, G. F., & Connolly, G. N. (2002). How cigarette design can affect youth initiation into smoking: Camel cigarettes 1983–1993. *Tobacco Control, 11*(Suppl I), i32–i39.

Welte, J. W., Barnes, G. M., Wieczorek, W. F., Tidwell, M. O., & Parker, J. C. (2004). Risk factors for pathological gambling. *Addictive Behaviours, 29*, 323-335.

Werch, C. E., & Anzalone, D. (1995). Stage theory and research on tobacco, alcohol, and other drug use. *Journal of Drug Education, 25*(2), 81-98.

Westwood, D., & Griffiths, M. (2010). The role of structural characteristics in video-game play motivation: A Q-methodology study. *CyberPsychology, Behavior and Social Networking, 13*(5), 581-585.

Whitaker, J. L., & Bushman, B. J. (2011). "Remain calm. Be kind." Effects of relaxing video games on aggressive and prosocial behavior. *Social Psychological and Personality Science, 3*(1), 88–92.

Whitbourne, S. K., Ellenberg, S., & Akimoto, K. (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.

Whiteside, S. P., & Lynam, D. R. (2003). Understanding the role of impulsivity and externalizing psychopathology in alcohol abuse: Application of the UPPS impulsive behavior scale. *Experimental and Clinical Psychopharmacology, 11*, 210-217.

Wiegman, O., & van Schie, E. G. (1998). Video game playing and its relation with aggression and prosocial behavior. *British Journal of Social Psychology, 37*, 367-378.

Williams, D. (2006). A brief social history of game play. In D. Williams (Ed.), *Playing video games: Motives, responses, and consequences* (pp. 197-212). Mahwah, NJ: Lawrence Erlbaum Associates.

Williams, D., Kennedy, T. L. M., & Moore, R. J. (2011). Behind the avatar: The patterns, practices, and functions of role playing in MMOs. *Games and Culture: A Journal of Interactive Media, 6*(2), 171-200.

Wills, T. A., & Hirky, A. E. (1996). Coping and substance abuse: A theoretical model and review of the evidence. In T. A. Wills & A. Hirky (Eds.), *Handbook of coping: Theory, research, applications* (pp. 279-302). Oxford, England: John Wiley & Sons.

Wirth, W., Ryffel, F., von Pape, T., & Karnowski, V. (2013). The development of video game enjoyment in a role playing game. *Cyberpsychology, Behavior, and Social Networking, 16*(4), 260-264.

Wood, R. T. A. (2008). Problems with the concept of video game "Addiction": Some case study examples. *International Journal of Mental Health and Addiction, 6*(2), 169-178.

Wood, R. T. A., Gupta, R., Derevensky, J. L., & Griffiths, M. (2004). Video game playing and gambling in adolescents: Common risk factors. *Journal of Child & Adolescent Substance Abuse, 14*(1), 77-100.

Wood, R. T., & Williams, R. J. (2007). Problem gambling on the internet: Implications for internet gambling policy in North America. *New Media & Society, 9*, 540-542.

Wood, R. T., & Williams, R. J. (2009). *Internet gambling: Prevalence, patterns, problems, and policy options.* Final report prepared for the Ontario problem gambling research centre. Guelph, Ontario.

Wood, R. T., & Williams, R. J. (2011). A comparative profile of the internet gambler: Demographic characteristics, game-play patterns, and problem gambling status. *New Media & Society*, *13*(7), 1123–1141.

World Health Organization. (1993). WHO expert committee on drug dependence, 28th report. *Technical Report Series 836*. Geneva, Switzerland: Author.

Wu, L-T., Blazer, D. G., Woody, G. E., Burchett, B., Yang, C., Pan, J-J., & Ling, W. (2012). Alcohol and drug dependence syndrome items as brief screeners for substance use disorders: Results from the clinical trials network. *Journal of Psychiatric Research, 46*, 360-369.

Wynne, H. (2002). *Gambling and problem gambling in Saskatchewan.* Accessed July 20th, 2012. Available at: http://www.health.gov.sk.ca/ps_final_report_on_the_prevalence_of_problem _gambling.pdf.

Yellowlees, P. M., & Marks, S. (2007). Problematic internet use or internet addiction? *Computers in Human Behavior, 23*(3), 1447–1453.

Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior, 1*, 237-244.

Young, K. S. (2004). Internet addiction: A new clinical phenomenon and its consequence. *American Behavioral Scientist, 48*(4), 402-415.

Young, K. S. (2009). Internet addiction: Diagnosis and treatment considerations. *Journal of Contemporary Psychotherapy, 39*(4), 241-246.

Young, K., Pistner, P. D. M., O'Mara, J., & Buchanan, J. (1999). Cyber disorders: The mental health concern for the new millennium. *CyberPsychology & Behavior*, *2*(5), 475-479.

Yu, C.-Y. (2002). *Evaluation of model fit indices for latent variable models with categorical and continuous outcomes.* Unpublished dissertation. Retrieved February 8, 2010, from Mplus website http://www.statmodel.com/download/Yudissertation.pdf

Appendix A

Demographics Questionnaire

1) Some people identify themselves as belonging to one or more racial or ethnic groups. Please check the box(es) below which correspond to group(s) you belong to:

White or Caucasian ☐
Black or African-American ☐
Hispanic or Latino ☐
American Native ☐
Alaskan Native ☐
Asian ☐
Pacific Islander ☐
Middle Eastern ☐
Do you consider yourself to be of any other race or ethnic group?
If so, what is it? _____

2) Sex (Check one):
Female _____
Male _____
Transgender _____

3) How old are you?
_____

Marital status: (Check One Answer)
☐Single
☐ In a Romantic Relationship (more serious than casual dating)
☐Married
☐Divorced
☐Remarried
☐Widowed
☐Separated
☐Living with partner
Same Sex _____ Opposite Sex _____

4) Optional: If you are a student, what is your major field(s) of study?
_____

5) Optional: If you are a student, what is your overall GPA?
_____

6) Type of residence:
Living with Parents/Relatives _____
Renting with Roommates _____
Renting with Romantic Partner _____
Renting Alone _____
Own house/condo _____

7) How many hours on an average **weekday** do you typically play videogames?

_____

8) How many hours on an average **weekend day** do you typically play videogames?

_____

9) On **how many occasions** have you had alcoholic beverages to drink?
a) in your lifetime? _____
b) during the last 12 months? _____
c) during the last 30 days? _____

10) In the **past 30 days**, when you drank alcohol, how many drinks per occasion did you usually have? (Choose one answer.)

1 drink ___, 2 drinks ___, 3 drinks ___, 4 drinks ___, 5 drinks ___,

6 drinks ___, 7 drinks___, 8 drinks ___, 9 or more drinks_____

MALES:
Think back over the **LAST Thirty Days**.
How many times have you had **5** or more drinks in a row? (A "drink" is a 4 oz. glass of wine, a 12-oz. bottle of beer, a wine cooler, a shot glass of liquor, or a mixed drink.)

_____ times

FEMALES:
Think back over the **LAST Thirty Days**.
How many times have you had **4** or more drinks in a row? (A "drink" is a 4 oz. glass of wine, a 12-oz. bottle of beer, a wine cooler, a shot glass of liquor, or a mixed drink.)

_____ times

Appendix B

Problematic Video Game Play – Revised

	Never		Sometimes		Often
1)When I am not playing video games, I keep thinking about games I have played	1	2	3	4	5
2) Because of my video game playing, I have spent less time with my friends and family	1	2	3	4	5
3) When I can't play video games, I get irritable	1	2	3	4	5
4) When I have not obtained the desired results while playing, I need to play again to achieve my target	1	2	3	4	5
5) When I play video games, it makes my nervousness go away	1	2	3	4	5
6) I spend an increasing amount of time playing video games	1	2	3	4	5
7) Because of my video game playing, my neck hurts	1	2	3	4	5
8) I have tried to stop playing video games	1	2	3	4	5
9) When I play video games, it makes my anger go away	1	2	3	4	5
10) Because of my video game playing, I have missed meals	1	2	3	4	5
11) When I am not playing video games, I am often planning how I will play my next game	1	2	3	4	5
12) When I play video games, it makes my sadness go away	1	2	3	4	5
13) I conceal my video game playing from my significant others	1	2	3	4	5
14) Because of my video game playing, my wrist(s) hurt	1	2	3	4	5
15) When I play video games, it makes my worries go away	1	2	3	4	5

16) I have tried to cut back playing video games	1	2	3	4	5
17) In order to play video games I have stolen	1	2	3	4	5
18) Because of video game playing, I have gone to bed late	1	2	3	4	5
19) I conceal my video game playing from my parents	1	2	3	4	5
20) In order to play video games I get into arguments with people	1	2	3	4	5
21) I conceal my video game playing from my friends	1	2	3	4	5
22) Because of my video game playing, I experience headaches	1	2	3	4	5
23) I play video games over a longer time period than I intended	1	2	3	4	5
24) Because of my video game playing, my hand(s) hurt	1	2	3	4	5
25) In order to play video games I have skipped class or work	1	2	3	4	5
26) I have tried to control how much I play video games	1	2	3	4	5
27) Because of my video game playing, my eyes hurt or feel strained	1	2	3	4	5
28) In order to play video games I have lied	1	2	3	4	5
29) Because of my video game playing, I experience migraines	1	2	3	4	5
30) When I can’t play video games, I get restless	1	2	3	4	5
31) Because of my video game playing, I have trouble falling asleep	1	2	3	4	5
32) Because of video game playing, I have neglected my homework/schoolwork	1	2	3	4	5
33) Because of my video game playing, my back hurts	1	2	3	4	5

34) When I play video games, I play until I have reached my goal (for example, defeated a boss, finished a chapter, gained a level, acquired a special item) instead of setting a time limit	1	2	3	4	5

Appendix C

Video-Game Use

	Yes	No	Sometimes
1. Over time, have you been spending much more time thinking about playing video games, learning about video-game playing, or planning the next opportunity to play?			
2. Do you need to spend more and more time and/or money on video games in order to feel the same amount of excitement?			
3. Have you tried to play video games less often or for shorter periods of time, but are unsuccessful?			
4. Do you become restless or irritable when attempting to cut down or stop playing video games?			
5. Have you played video games as a way of escaping from problems or bad feelings?			
6. Have you ever lied to family or friends about how much you play video games?			
7. Have you ever stolen a video game from a store or a friend, or have you ever stolen money in order to buy a video game?			
8. Do you sometimes skip household chores in order to spend more time playing video games?			
9. Do you sometimes skip doing homework in order to spend more time playing video games?			
10. Have you ever done poorly on a school assignment or test because you spent too much time playing video games?			
11. Have you ever needed friends or family to give you extra money because you spent too much money on video game equipment, software, or game/Internet fees?			

Appendix D

Video Game Genre

1. Please identify the videogame you played **most often** during the past year:

_____

2. Please identify your **favorite** videogame (does not need to be current):

_____

3. Please indicate all game genres you enjoy playing (check all that apply):

- ☐ Action-adventure ☐ First-person Shooter (FPS) ☐ Third-person Shooter
- ☐ Fighting (General) ☐ RPG (single-player) ☐ MMORPG
- ☐ Platformer ☐ Simulation ☐ Sports
- ☐ Driving/Racing ☐ Real-time Strategy (RTS) ☐ Turn-based Strategy
- ☐ Music/Dance /Rhythm ☐ Sports or workout games using motion controls
- ☐ Puzzle ☐ Board or Card games (Magic, Monopoly)
- ☐ Gambling (Poker, Black Jack)
- ☐ Other (Please specify) _____

Appendix E

Video Game Structural Characteristics

How much do you **enjoy** this feature of the video game?

	Not Enjoyable At All				High Enjoyment
1. Social interaction, communicating with other players	1	2	3	4	5
2. Competitive aspects, playing against other people, leaderboard rankings	1	2	3	4	5
3. Cooperation, working together to reach goals	1	2	3	4	5
4. Customizing in-game features, such as controls, rules, etc.	1	2	3	4	5
5. Cut-scenes, extra non-playable story content	1	2	3	4	5
6. A complex game story, involving dialogue and narration	1	2	3	4	5
7. Different story outcomes based on your player actions	1	2	3	4	5
8. “Leveling up” a game character (including non-human characters, like a racing car)	1	2	3	4	5
9. Earning points, XP or other rewards	1	2	3	4	5
10. Being rewarded with rare, unique items for skillful play or playing for a long time	1	2	3	4	5
11. Getting 100% completion in the game	1	2	3	4	5
12. Unlocking meta-game rewards, like “Achievements” or “Trophies”	1	2	3	4	5
13. Fast loading times between levels or multiplayer matches, and instant respawning when your character dies	1	2	3	4	5
14. Visual aspects, such as high-resolution textures and lighting effects	1	2	3	4	5
15. Sound, including music and audio effects	1	2	3	4	5

How **important** do you believe this feature is to the playing experience?

	Not Important At All				High Importance
1. Cooperation, working together to reach goals	1	2	3	4	5
2. Being able to correct mistakes by reloading a save file	1	2	3	4	5
3. Customizing in-game features, such as controls, rules, etc.	1	2	3	4	5
4. An emotional investment in an in-game character	1	2	3	4	5
5. Cut-scenes, extra non-playable story content	1	2	3	4	5
6. A complex game story, involving dialogue and narration	1	2	3	4	5
7. Different story outcomes based on your player actions	1	2	3	4	5
8. "Leveling up" a game character (including non-human characters, like a racing car)	1	2	3	4	5
9. Earning points, XP or other rewards	1	2	3	4	5
10. Being rewarded with rare, unique items for skillful play or playing for a long time	1	2	3	4	5
11. Sections of the game that are very difficult and require sustained effort with few mistakes	1	2	3	4	5
12. Playing the game on the hardest difficulty, facing very difficult challenges	1	2	3	4	5
13. Fast loading times between levels or multiplayer matches, and instant respawning when your character dies	1	2	3	4	5
14. Visual aspects, such as high-resolution textures and lighting effects	1	2	3	4	5
15. Sound, including music and audio effects	1	2	3	4	5

What is the extent to which this feature contributes to **longer playing times**?

	Not Impactful At All				Highly Impactful
1. Social interaction, communicating with other players	1	2	3	4	5
2. Cooperation, working together to reach goals	1	2	3	4	5
3. Being able to correct mistakes by reloading a save file	1	2	3	4	5
4. An emotional investment in an in-game character	1	2	3	4	5
5. A complex game story, involving dialogue and narration	1	2	3	4	5
6. Different story outcomes based on your player actions	1	2	3	4	5
7. "Leveling up" a game character (including non-human characters, like a racing car)	1	2	3	4	5
8. Earning points, XP or other rewards	1	2	3	4	5
9. Being rewarded with rare, unique items for skillful play or playing for a long time	1	2	3	4	5
10. Getting 100% completion in the game	1	2	3	4	5
11. Unlocking meta-game rewards, like "Achievements" or "Trophies"	1	2	3	4	5
12. Sections of the game that are very difficult and require sustained effort with few mistakes	1	2	3	4	5
13. Fast loading times between levels or multiplayer matches, and instant respawning when your character dies	1	2	3	4	5
14. Visual aspects, such as high-resolution textures and lighting effects	1	2	3	4	5
15. Sound, including music and audio effects	1	2	3	4	5

Appendix F

Modified AUDIT

How often do you do any of the following:

	Not at all	Monthly	Weekly	Twice per week	Three times per week	Four times per week	Five times per week	Six times per week	Daily Moderate Use	Daily Heavy Use
Alcohol	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cocaine/crack	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other Stimulants (Ritalin, Amphetamine, Adderall, Methamphetamine, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Heroin or other opiates (Vicodin, Darvon, Codeine, OxyContin, Fentanyl, Methadone, LAAM, BUprenorphine, Suboxone, Oxycodone, Oxycontin, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Marijuana (Weed, Blunts, Hash)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tranquilizers (Xanax, Klonopin, Valium, GHB, Roofies, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hallucinogens (LSD, Ecstasy, Mushrooms, Ketamine, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Caffeine (pop, soda, tea, coffee, etc.)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Gambling (any type)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix G

Brief Young Adult Alcohol Consequences Questionnaire

Below is a list of things that sometimes happen to people either during, or after, the have been drinking alcohol. Next to each item below, please mark an "X" in either the YES or NO column to indicate whether that items describes something that has happened to you IN THE PAST MONTH.

In the past month…

		NO	YES
1.	While drinking, I Have said or done embarrassing things.		
2.	I have had a hangover (headache, sick stomach) the morning after I had been drinking.		
3.	I have felt very sick to my stomach or thrown up after drinking.		
4.	I often have ended up drinking on nights when I had planned not to drink.		
5.	I have taken foolish risks when I have been drinking.		
6.	I have passed out from drinking.		
7.	I have found that I needed larger amounts of alcohol to feel any effect, or that I could no longer get high or drunk on the amount that used to get me high or drunk.		
8.	When drinking, I have done impulsive things that I regretted later.		
9.	I've not been able to remember large stretches of time while drinking heavily.		
10.	I have driven a car when I knew I had too much to drink to drive safely.		
11.	I have not gone to work or missed classes at school because of drinking, a hangover, or illness caused by drinking.		
12.	My drinking has gotten me into sexual situations I later regretted.		
13.	I have often found it difficult to limit how much I drink.		
14.	I have become very rude, obnoxious or insulting after drinking.		
15.	I have woken up in an unexpected place after heavy drinking.		
16.	I have felt badly about myself because of my drinking.		
17.	I have had less energy or felt tired because of my drinking.		
18.	The quality of my work or schoolwork has suffered because of my drinking.		
19.	I have spent too much time drinking.		
20.	I have neglected my obligations to family, work, or school because of drinking.		
21.	My drinking has created problems between myself and my boyfriend/girlfriend/spouse, parents, or other near relatives.		
22.	I have been overweight because of drinking.		
23.	My physical appearance has been harmed by my drinking.		
24.	I have felt like I needed a drink after I'd gotten up (that is, before breakfast).		

Appendix H

Family History of Addiction

1. Has anyone you know had a **substance/drug problem**?
_____ Yes
_____ No

If YES, check which of the following people in your life has (or had) a **substance/drug problem?

_____ Father
_____ Mother
_____ Brothers/Sisters
How many siblings do you have? _____ How many have a substance problem? _____
_____ My Spouse/Partner
_____ My child(ren)
How many children do you have? _____ How many have a substance problem? _____
_____Another Relative
How many relatives do you know well? _____ How many have a substance problem? _____
_____ A friend or Someone Important in My Life
How many people are you close to? _____ How many have a substance problem? ____

2. Has anyone you know had a **gambling** problem?
_____ Yes
_____ No

If YES, check which of the following people in your life has (or had) a **gambling problem?

_____ Father
_____ Mother
_____ Brothers/Sisters
How many siblings do you have? _____ How many have a gambling problem? _____
_____ My Spouse/Partner
_____ My child(ren)
How many children do you have? _____ How many have a gambling problem? _____
_____Another Relative
How many relatives do you know well? _____ How many have a gambling problem? _____
_____ A friend or Someone Important in My Life
How many people are you close to? _____ How many have a substance problem? ____

3. Has anyone you know had a **videogame playing** problem?
_____ Yes
_____ No

** If YES, check which of the following people in your life has (or had) a **videogame playing**

problem?

_____ Father
_____ Mother
_____ Brothers/Sisters
How many siblings do you have? _____ How many have a videogme problem? _____
_____ My Spouse/Partner
_____ My child(ren)
How many children do you have? _____ How many have a videogame problem? _____
_____Another Relative
How many relatives do you know well? _____ How many have a videogame problem? _____
_____ A friend or Someone Important in My Life
How many people are you close to? _____ How many have a videogame problem? ____

Appendix I

Patient Health Questionnaire – Depression Scale

Over the last 2 weeks, how often have you been bothered by the following problems?	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	☐	☐	☐	☐
2. Feeling down, depressed, or hopeless	☐	☐	☐	☐
3. Trouble falling or staying asleep, or sleeping too much	☐	☐	☐	☐
4. Feeling tired or having little energy	☐	☐	☐	☐
5. Poor appetite or overeating	☐	☐	☐	☐
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	☐	☐	☐	☐
7. Trouble concentrating on things, such as reading the newspaper or watching television	☐	☐	☐	☐
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	☐	☐	☐	☐
9. Thoughts that you would be better off dead or of hurting yourself in some way	☐	☐	☐	☐

If you checked off any problems above, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	**Somewhat difficult**	**Very difficult**	**Extremely difficult**
☐	☐	☐	☐

Appendix J

Barratt Impulsiveness Scale, Version 11

	Rarely/ Never	Occasionally	Often	Almost always/ Always
1) I plan tasks carefully	1	2	3	4
2) I do things without thinking	1	2	3	4
3) I make up my mind quickly	1	2	3	4
4) I am happy-go-lucky	1	2	3	4
5) I don't "pay attention"	1	2	3	4
6) I have "racing" thoughts	1	2	3	4
7) I plan trips well ahead of time	1	2	3	4
8) I am self-controlled	1	2	3	4
9) I concentrate easily	1	2	3	4
10) I save regularly	1	2	3	4
11) I "squirm" at plays or lectures	1	2	3	4
12) I am a careful thinker	1	2	3	4
13) I plan for job security	1	2	3	4
14) I say things without thinking	1	2	3	4
15) I like to think about complex problems	1	2	3	4
16) I change jobs	1	2	3	4
17) I act "on impulse"	1	2	3	4
18) I get bored easily when solving thought problems	1	2	3	4
19) I act on the spur of the moment	1	2	3	4
20) I am a steady thinker	1	2	3	4
21) I change residences	1	2	3	4
22) I buy things on impulse	1	2	3	4
23) I can only think about one problem at a time	1	2	3	4
24) I change hobbies	1	2	3	4
25) I spend or charge more than I earn	1	2	3	4
26) I often have extraneous thoughts when thinking	1	2	3	4
27) I am more interested in the present than the future	1	2	3	4
28) I am restless at the theater or lectures	1	2	3	4
29) I like puzzles	1	2	3	4
30) I am future oriented	1	2	3	4

Appendix K

Self-Consciousness Scale

Below are twenty-three statements that may or may not be characteristic of the way you see yourself as a person. Read each one carefully and rate whether the statement is characteristic of uncharacteristic or you using the rating scale below. Select your answer after each question from one of the options provided.

1. I'm always trying to figure myself out.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

2. I'm concerned about my style of doing things.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

3. Generally, I'm not very aware of myself.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

4. It takes me time to overcome my shyness in new situations.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

5. I reflect about myself a lot.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

6. I’m concerned about the way I present myself.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

7. I’m often the subject of my own fantasies.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

8. I have trouble working when someone is watching me.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

9. I never scrutinize myself.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

10. I get embarrassed very easily.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

11. I’m self-conscious about the way I look.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

12. I don't find it hard to talk to strangers.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

13. I’m generally attentive to my inner feelings.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

14. I usually worry about making a good impression.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

15. I’m constantly examining my motives.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

16. I feel anxious when I speak in front of a group.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

17. One of the last things I do before I leave the house is look in the mirror.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

18. I sometimes have the feeling that I'm off somewhere watching myself.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

19. I'm concerned about what other people think of me.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

20. I'm alert to changes in my mood.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

21. I'm usually aware of my appearance.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

22. I'm aware of the way my mind works when I work through a problem.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

23. Large groups make me nervous.

- Extremely uncharacteristic
- Generally uncharacteristic
- Equally characteristic and uncharacteristic
- Generally characteristic
- Extremely characteristic

Appendix L

Brief Coping Orientation for Problems Experienced Inventory

We are interested in how people respond when they confront difficult or stressful events in their lives. There are lots of ways to try to deal with stress. This questionnaire asks you to indicate what you generally do and feel, when you experience stressful events. Obviously, different events bring out somewhat different responses, but think about what you usually do when you are under a lot of stress.

Then respond to each of the following items by circling one number on your answer sheet for each, using the response choices listed just below. Please try to respond to each item separately in your mind from each other item. Choose your answers thoughtfully, and make your answers as true FOR YOU as you can. Please answer every item. There are no "right" or "wrong" answers, so choose the most accurate answer for YOU--not what you think "most people" would say or do. Indicate what YOU usually do when YOU experience a stressful event.

1 = I haven't been doing this at all
2 = I've been doing this a little bit
3 = I've been doing this a medium amount
4 = I've been doing this a lot

1. I turn to work or other activities to take my mind off things.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

2. I concentrate my efforts on doing something about the situation I'm in.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

3. I say to myself "this isn't real."

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

4. I use alcohol or other drugs to make myself feel better.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

5. I get emotional support from others.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

6. I give up trying to deal with it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

7 I take action to try to make the situation better.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

8. I refuse to believe that it has happened.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

9. I say things to let my unpleasant feelings escape.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

10. I get help and advice from other people.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

11. I use alcohol or other drugs to help me get through it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

12. I try to see it in a different light, to make it seem more positive.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

13. I criticize myself.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

14. I try to come up with a strategy about what to do.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

15. I get comfort and understanding from someone.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

16. I give up the attempt to cope.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

17. I look for something good in what is happening.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

18. I make jokes about it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

19. I do something to think about it less, such as going to movies, watching TV, reading, daydreaming, sleeping, or shopping.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

20. I accept the reality of the fact that it has happened.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

21. I express my negative feelings.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

22. I try to find comfort in my religion or spiritual beliefs.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

23. I try to get advice or help from other people about what to do.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

24. I learn to live with it.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

25. I think hard about what steps to take.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

26. I blame myself for things that happened.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

27. I pray or meditate.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

28. I make fun of the situation.

I haven't been doing this at all	I've been doing this a little bit	I've been doing this a medium amount	I've been doing this a lot
1	2	3	4

Appendix M

Videogame Addiction Scale (VGAS)

	Never		Sometimes		Often
1) I play video games over a longer time period than I intended	1	2	3	4	5
2) I have tried to play video games less often or for shorter periods of time, but was unsuccessful	1	2	3	4	5
3) I spend an increasing amount of time playing video games	1	2	3	4	5
4) When I am not playing video games, I am often planning how I will play my next game	1	2	3	4	5
5) In order to play video games, I have skipped class or work	1	2	3	4	5
6) In order to play video games, I get into arguments with people	1	2	3	4	5
7) Because of my video game playing, I have spent less time with my friends and family	1	2	3	4	5
8) Because of my video game playing, I have experienced headaches or my neck, wrist, hand(s), or back hurt	1	2	3	4	5
9) I need to spend more and more time and/or money on video games in order to feel the same amount of excitement	1	2	3	4	5
10) I become restless or irritable when attempting to cut down or stop playing video games	1	2	3	4	5