

Running head: PATHOLOGICAL COMPUTER/VIDEO GAME/INTERNET USE

A Conceptual Review of Research on the
Pathological Use of Computers, Video Games, and the Internet

First submitted on March 22, 2010

Revised on November 18, 2011

Under review: Please do not cite or copy without permission.

Timothy Sim^a

Douglas A. Gentile^b

Francesco Bricolo^c

Giovanni Serpelloni^c

Farah Gulamoydeen^d

Affiliations: ^a Department of Applied Social Sciences, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China; ^b Department of Psychology, Iowa State University, Ames, IA, USA; ^c Dipartimento delle Dipendenze, Az. ULSS 20, Verona, Italy. ^d National Institute of Education, Nanyang Technological University, Singapore.

Correspondence concerning this manuscript should be addressed to Timothy Sim, The Hong Kong Polytechnic University, Department of Applied Social Sciences, Hung Hom, Kowloon, Hong Kong. Phone: [852] 2766-5015; Fax: [852] 2773-6558; E-mail: sstim@polyu.edu.hk

Abstract

Preliminary research studies suggest that some people who use computer, video games, and the Internet heavily develop dysfunctional symptoms, often referred to in the popular press as an “addiction.” Although several studies have measured various facets of this issue, there has been no common framework within which to view these studies. This paper aims to provide a conceptual framework of “impulse control disorders” and describe what is known currently based on a review of the international literature, and highlight what remains to be studied. We suggest the term “Pathological Technology Use” (PTU) rather than “internet addiction”, since there is robust construct validity (via convergent validity and comorbidity) for pathological computer, video game and Internet use, regardless of how individual researchers defined or measured it. Questions concerning diagnostic criteria are raised, and a common set of diagnostic criteria is proposed.

Keywords: addiction, pathological, computer, video games, internet, technology, impulse control disorders

A Conceptual Review of Research on the Pathological Use of Computer, Video Games, and Internet

INTRODUCTION

Fifteen years have passed since the brief but important debate over the “Internet and the future of psychiatry” (Huang & Alessi, 1996; Stein, 1997). Since that debate over the lack of research on pathological uses of computers/Internet, there have been several reports of psychopathological symptoms correlated with the use of digital technology (Bricolo & Serpelloni, 2002), including computer ‘addiction,’ and video game ‘addiction,’ and Internet ‘addiction,’ consequences of which affect individual’s occupational, interpersonal, psychological, and physical well-being (Murali & George, 2007). Increased time spent online may lead to social withdrawal, self-neglect, family and marital problems as well as sleep deprivation and fatigue resulting in poor educational and/or work performance and job loss.

Most of the early reports of pathological computer and Internet use were case studies (e.g., Soper & Miller, 1983; Keeper, 1990; Griffiths, 2000), but researchers have recently begun to demonstrate the psychometric properties of tests for diagnosing pathological computer-related behaviors, and have begun testing the construct validity of such diagnoses. However, without a common framework, the work has not been able to advance very far. Furthermore, there is still considerable debate about how to define addictions (e.g., Shaffer, Hall, & Vander Bilt, 2000; Shaffer & Kidman, 2003; Shaffer, LaPlante, LaBrie, Kidman, Donato, & Stanton, 2004). This debate is made more complex because the conceptual framework within which diagnoses are made is constantly changing (e.g., as we move from DSM III to IV to V). Therefore, the purpose of this paper is not to resolve that debate, but to provide a conceptual framework of pathological technology use (PTU) and discuss the reliability and validity of such a framework.

Definitions and terminology

Traditionally, the medical profession has defined addiction as a disease of the brain and has reviewed addiction from a neurobiological perspective (Cavacuti, 2011). The concept of “addiction” has initially been associated with psychoactive substances like alcohol, tobacco and other drugs. But behaviors which have been identified as being addictive include gambling, food, sex, viewing of pornography, use of computers, playing video games, use of the internet, work, exercise, etcetera emerged. However, disagreements remained about the exact nature of behavioral addiction or dependency (Goodman, 1990).

This debate is expected to continue as researchers continue to unravel this complex and multi-dimensional phenomenon.

Some researchers of Internet addiction have suggested that there are several distinct types of Internet addiction, including addiction to online sex and addiction to online gambling (Demmel, 2002; Griffiths, 2003; Davis, 2001; Putnam & Maheu, 2000). We feel that these issues are not the same as pathological Internet use, and would be better defined as other types of impulse control disorders, as the underlying disorder is about sex or gambling and the Internet is simply the delivery mechanism used. Treating a pathological gambler’s *computer use* is unlikely to resolve the underlying problem.

Several authors have noted that using the term “addiction” to discuss computer or video game behavior may be inappropriate. The term has been extended to take on a range of meanings in the popular media and in vernacular speech. This potential confusion has been mirrored in academic publications. For example, in one study of “cyber-game addiction,” the authors state that they use the terms “habit” and “addiction” as synonyms and use them interchangeably (Chou & Ting, 2003). In our opinion, however, the blurring of a line between habits and addictions seems unnecessary and unwise. The line has been blurred further by discussions of “positive addictions” (Shapira et al., 2003; Glasser, 1976; Griffiths, in press). Positive addictions have been defined as habitual behaviors that are considered good for the individual, rather than destructive. Some have gone so far as to suggest that perhaps addiction is a meaningless term, other than to serve pejorative aims. “The idea that people can generate their own internal addictive pharmacology can be applied to all sorts of behaviors other than gambling and drug-

taking, including such valued activities as playing the violin, walking to the North Pole, or becoming a Member of Parliament” (Davies, 1992, p. 73). It seems to us that for the term addiction to have any meaning, it must refer to something clinically significant and to be defined by dysfunction.

Currently, the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) (American Psychiatric Association [APA], 1994) carries a diagnosis for only one type of “addictive” behaviors, i.e., pathological gambling (Petry, 2006), which is classified as an impulse control disorder, based on substance use disorders. Since DSM III-R (American Psychiatric Association, 1987), all except one of the Pathological Gambling criteria were similar to those for Psychoactive Substance Dependence. The only unique criterion for pathological gambling was related to ‘chasing’ lost money (criterion 5). Some parallels between substance dependence disorders and pathological gambling remained in DSM-IV. Five of the seven dependence criteria have almost identical criteria in pathological gambling, but the others no longer have a parallel item. These include items related to escaping negative moods, chasing losses, lying to others, committing illegal acts and relying on others for bailouts (Petry, 2006). In a news release of the American Psychiatric Association on February 10, 2010 on the draft diagnostic criteria for DSM V, it has been announced that a new category of “behavioral addictions” has been created, in which gambling will remain as the sole disorder. Pathological Internet use, also known as “Internet addiction”, was considered for this category, but work group members decided there was insufficient research data to do so, so they recommended it be included in the manual’s appendix instead, with a goal of encouraging additional study (American Psychiatric Association, 2010).

The DSM-IV sets out 10 criteria that are indicative of pathological gambling. Together they comprise a bio-social-psychological perspective by including symptoms at several levels of analysis. They include:

- Cognitive preoccupation with gambling (cognitive salience)
- Need to gamble with increasing amounts of money in order to achieve the desired result (tolerance)
- Restless or irritable when attempting to cut down or stop (withdrawal symptoms)

- Gambles as a way of escaping from problems or of relieving a dysphoric mood (euphoria or mood modification)
- After losing money, often returns to get even (behavioral salience)
- Lies to family members or others about the extent of gambling (conflict: antisocial behavior that damages relationships)
- Commits illegal acts to finance gambling (conflict: antisocial behavior)
- Has jeopardized or lost a significant job, relationship, or educational or career opportunity because of gambling (conflict: damage to other important areas of life)
- Has repeated unsuccessful efforts to control, cut back, or stop gambling (relapse and reinstatement)
- Relies on others to provide money to relieve desperate financial situations (conflict: damage to relationships/codependency)

People are classified as pathological gamblers if they exhibit at least five of the ten symptoms. This approach to classification seems appropriate, as it involves fewer pejorative overtones than term “addiction,” but focuses instead on damage to healthy functioning in several areas of life (i.e., family, social, occupational, psychological). In addition, although pathological gamblers as a group show these symptoms, any individual is only likely to present a subset of them, and each individual may present a different subset.

Research has suggested similarities between video game playing and gambling (Brown, 1991; Fisher, 1994; Fisher & Griffiths, 1995). Wood, Gupta, Derevensky, Griffiths (2004) suggested that video games and gambling activities share common risk factors. For instance, they found a clear relationship between video game playing and gambling in adolescents, with problem gamblers being significantly more likely than non-problem gamblers or non-gamblers to spend excessive amounts of time playing video games. Many researchers attempting to define pathological computer, video game, Internet use have modified these DSM criteria. In general, although some researchers have added or subtracted

individual elements, most researchers have adapted the DSM pathological gambling criteria for it. One well-known modification is Young's (1996, 1997, & 1998) Diagnostic Questionnaire for Internet Addiction. People who answer "yes" to five or more of her eight items are classified as being addicted to the Internet. Young's (1998) comparison of excessive Internet use with pathological gambling suggests that this behavior may be better classified as an impulse control disorder rather than an addiction.

Although Young based her criteria on pathological gambling, she excludes two diagnostic areas (i.e., criterion six, after losing money gambling, often returned another day to get even, and criterion eight, has committed illegal acts such as forgery, fraud, theft, or embezzlement to finance gambling). There is no explanation of why these criteria were not modified to coincide with her other Internet addiction diagnostic criteria (Beard & Wolf, 2001).

But, this approach is not without problems. According to a study by Dowling and Quirk (2009), Young's criteria revealed that those who were in the "at-risk" category of Internet dependence had the same internet behavior and psychological profiles as those who were classified as Internet dependent. The implication of this is that both populations displayed psychological problems serious enough to warrant psychological intervention. Although there may be other approaches one could take in defining the morphology of pathological computer, video game, or Internet use, this approach of considering pathological use of computer, video game and Internet as a subtype of impulse control disorder has been most widely endorsed by researchers (e.g., Young, 1996, 2004; Chou & Hsiao, 2000; Beard & Wolf, 2001; Gentile, 2009; Johansson and Gotestam, 2004a; Cao et al., 2007).

We suggest the term "Pathological Technology Use" (PTU) rather than addiction, based on the principle that the technology is not in itself "bad" or "good" in the way that some substances are physically harmful. Instead, the problem is attributed to the *use*. If we take this approach, one additional definitional issue can be resolved. If PTU is a unique problem, then it would fit under the Axis I category 'impulse-control disorders not elsewhere classified.' Understanding such a disorder as an impulse control disorder appears to be beneficial for understanding the nature of the problem, and suggests potential

avenues for treatment. This will be explored further in the Research Evidence of PTU section further below.

Prevalence of computer, video game and Internet use

There is no one standard practice of measuring the prevalence of pathological computer, video game and the Internet use, or pathological technology use (PTU) as we suggested, as yet. However there are a few measurement instruments that have reported to have sufficient reliability, which will be discussed further in the test reliability section further below. Most measurement instruments used in the following studies to assess prevalence of pathological computer, video game and the internet use were based on and adapted from the DSM criteria for pathological gambling. These various studies have provided different estimates of the prevalence of pathological computer and/or video game use in different parts of the world, ranging between 1% and 20%, with the most recent numbers seeming to converge between 7% and 12%.

Early studies (e.g., Greenfield, 1999) estimated that nearly 6% of Internet users in the U.S. suffered from PTU. Studies with US college students yield prevalence estimates of 8.1% having four or more symptoms on pathological Internet use (Morahan-Martin and Schumacher, 2000)). The most comprehensive study to date in the US used a national sample of over 1,100 youth aged 8 to 18, in which 8.5% of video game players were classified as pathological, based upon a pathological gaming scale adapted from the DSM-IV criteria for pathological gambling (Gentile, 2009).

In Europe, Grüsser et al. (2007) reported that 11.9% of 7,069 computer gamers fulfilled diagnostic criteria of pathological Internet use based upon key symptoms of a dependence syndrome from the International Classification of Diseases. An early study of 387 British adolescents video gamers between 12 and 16 years of age found 20% to be considered pathological gamers when assessed based upon the DSM-III criteria of pathological gambling (Griffiths & Hunt, 1998). A Norwegian study using Young's Diagnostic Questionnaire for Internet Addiction involved 3,237 adolescents between 12 and 18 years old reported the pathological Internet use rate to be 4%, with an additional 18% showing at-risk use

(Johansson & Götestam, 2004a). In the same sample, the prevalence of pathological video game use among video game players was 4%, with an additional 15.5% showing at-risk use (Johansson, & Götestam, 2004b). In Spain, a national survey conducted on media use including the internet, found no excessive Internet use in a sample of 35,234 Spanish adults, but excessive use was defined only in terms of time (>30 hours/week), and not in terms of damage to functioning as is probably most appropriate (Estallo, 2001).

In Asia, the rates of pathological use are not less alarming. A recent Chinese study reported a prevalence rate of 10.32% among 503 college students in mainland China who were pathological video game players (Peng & Li, 2009). Choo et al (2011) reported that the prevalence of pathological gaming of elementary and secondary school students in Singapore was similar to that in other countries (8.7%). The prevalence of pathological Internet use according to Young's Internet Addiction test among 752 South Korean 4th-6th graders was 1%, with an additional 14% showing at-risk use (Yoo et al, 2004), while Yang and colleagues (2005) reported that 4.9% of Korean senior high school students as Internet excessive users using the same test by Young.

Although the majority of these studies yield prevalence estimates within a few percentage points of each other, some of the differences may be due to the fact that these studies have not used a common methodology or definition as well as potentially having sampling biases, as many of these samples (though not all) use convenient samples. We recommend that each estimate of prevalence be considered to be preliminary.

RESEARCH EVIDENCE OF PATHOLOGICAL TECHNOLOGY USE (PTU)

It is important first to determine whether there is scientific evidence that PTU satisfies several basic criteria. Three issues relevant to this question have been addressed in the scientific literature: (1) the reliability of tests for pathological use, (2) the construct validity of pathological use, and (3) comorbidity with pathological use.

We conducted a review by searching the Psych Info, Medline, and Google Scholar databases to find articles that matched keywords (“video game*,” “computer” or “Internet”) *and* (“addiction” or “pathological” or “compulsive”). The identified articles were required to include empirical data in order to be selected.

Research on test reliability

Researchers have measured PTU in several ways, and most have shown sufficient reliability. Two studies reported scales based on DSM-III-R pathological gambling criteria, with moderate success. Griffiths & Hunt (1998) created an eight-item dichotomous (yes/no) scale with 387 adolescents. Although the authors provided no reliability information, the scale did appear to work appropriately. Several studies have independently created 9-item scales based on the DSM-IV pathological gambling criteria, and each reported acceptable reliability values. In one of the first studies of pathological video game use, Fisher (1994) reported acceptable reliability ($\alpha = .71$) of his scale, DSM-IV-JV. In addition, factor analyses revealed two factors: one defined as need to play and the second defined as negative feelings and behaviors resulting from pathological playing. Other researchers using a similar scale conducted a principal components factor analysis of the items, and found only one factor, suggesting that the nine items measure a single underlying construct ($\alpha = .69$) (Tejeiro Salguero, Bersabé Morán, 2002). A third study found sufficient reliability ($\alpha = .73$), and the authors also reported high test-retest reliability for a subsample of 47 adults ($r = .80, p < .001$ for the number of symptoms reported) (Gentile et al., 2010). Nichols & Nicki (2004) created a 36-item scale (Nichols Internet Addiction Scale, NIAS) for Internet “addiction” also based on DSM-IV pathological gambling criteria, which achieved high ($\alpha = .95$) reliability after deleting 5 items. One could, however, raise a legitimate concern about whether Cronbach’s alpha is an appropriate statistic for this type of scale. As mentioned earlier, most diagnosed substance or gambling addicts do *not* present all the possible symptoms, but only a subset. Therefore, unlike trying to predict a general trait such as IQ, one would not predict that the DSM’s checklist

approach to diagnosis would result in high alpha values. Surprisingly, almost all of the other studies using this approach *do* report high reliabilities.

Several other studies have used 8- to 10-item scales based on Brown's six criteria of addiction (which are similar to DSM criteria, described above), and each reported sufficient reliability. Chou and Ting (2003) created two groupings of items *a priori*, one defined as addiction based on 5 of Brown's six criteria ($\alpha = .90$) and one based on salience (4 items; $\alpha = .88$). In a representative sample of 3,237 Norwegian adolescents, Johansson & Göttestam (2004a) report sufficient reliability ($\alpha = .71$) and also a single factor underlying their 8-item scale. Charlton (2002) attempted to discover whether pathological computer use was distinct from computer engagement and computer anxiety. Using a 10-item scale based on Brown's criteria which he termed the Engagement-Addiction scale, he found that most of the items did indeed load onto a single "addiction" factor, but that three (cognitive salience, euphoria, and tolerance) also loaded onto the computer engagement factor.

Other studies have used Young's 20-item scale, the Internet Addiction Test (IAT), on which respondents provide answers on a 5-point Likert scale (Rarely to Always), yielding a continuous total score (ranging from 20 to 100) (Young, 1998). Although one study of 535 Korean elementary school children reports a high reliability ($\alpha = .92$) (Yoo et al, 2004), the second conducted a factor analysis of the data from 86 adults and found that the 20 items cluster into six distinct factors (Widyanto, & McMurrin, 2004).

In summary, despite the methodological differences in construct measurement and the wide differences in populations (both in terms of age and culture), almost all studies displayed high reliability and unidimensionality of the "addiction" construct. The most consistent results appear to be displayed by those studies using a checklist approach based on DSM criteria (including Brown's summary of DSM criteria).

Research on construct validity: Convergent validity

If PTU is a valid construct, it should show construct validity in several salient domains, such as showing convergent validity with several other indicators. For example, the DSM diagnostic criteria focus on aspects of tolerance, withdrawal, damage to ability to function in social and occupational lives, but they do not ask how *much* one plays. This is appropriate, as regular or even heavy use is not a necessary indicator of addiction (McMurrin, 1994). However, if pathological gamers did *not* play for more time than non-addicted gamers it would appear to be evidence for a lack of validity in the construct. Several behaviors can be hypothesized to co-occur with pathological use that would show (or fail to show) convergent validity. These include, but not limited to: large amounts of time playing VGs, an awareness of feeling “addicted,” attempts to control the amount of play, increasing numbers of games purchased, gaming as a way to control stress, and having more emotional reactivity to games. Apart from that, the criteria is also not sufficient in differentiating the at-risk users from the pathological users as mentioned before in the study done by Dowling and Quirk (2009), where populations of these two groups displayed similar internet behaviors.

As is shown in Table 1, there is robust convergent validity with pathological use, regardless of the method of measurement or the particular medium studied (i.e., computer, video games, or Internet). As would be predicted, pathological users spend more time with their medium, they are more heavily engaged with it (they know more about it, they use it more extensively, etc.), they show some evidence of tolerance (at least with regard to violent content), they use it as a stress-coping tool, and they and others are likely to feel concerned about their own use.

Research on Construct Validity: Comorbidity

Another domain in which Pathological Technology Use (PTU) should show construct validity is correlations with other problems. If PTU is similar to other addictions, individuals with PTU should show patterns of correlations and comorbidity similar to other addictions. As is shown in Table 2, there is fairly robust convergent validity with pathological use, again regardless of the method of measurement or

the particular medium studied (i.e., computer, video games, Internet). As predicted, pathological users show patterns of correlations and comorbidity similar to those found in other addictions. Some researchers have measured other clinical disorders and have found that pathological technology users often show comorbidity with psychiatric disorders (Black, Belsare, & Schlosser, 1990; Shapira et al., 2000). Shapira and his colleagues (2003) summarized those studies and noted that the most typical comorbid or primary disorders were mood disorders, substance use disorders, anxiety disorders, impulse control disorders, and personality disorders. Consistent with that, a study by Dowling and Brown (2010) examined the relationship between problem gambling and PTU among university students. They found that there was no overlap between the two populations but both disorders were associated with similar psychological profiles, and both disorders were associated with anxiety, loneliness, and student stressors. Dowling and Quirk (2009), too, found that both the at-risk or pathological Internet users had comorbid psychological problems such as anxiety, depression, and stress. A recent study by Gentile et al. (2011) also found that depression, anxiety, social phobias, and lower school performance seemed to act as outcomes of pathological gaming among Asian children and secondary schools students. .

Several personality factors are correlated with PTU, most notably higher trait hostility or animosity (Table 2). Surprisingly, although Type A personality is typically correlated with addictions, Griffiths and Dancaster (1995) did not find a statistically significant difference between college students who were or were not “addicted” to video games based on a checklist” adapted from the DSM-III-R for pathological gambling. However, they reported that twice as many Type A as Type B respondents reported being “addicted” to video games at some point in their lives. It should be noted that their sample was very small ($N = 24$), and there was low statistical power, but this is worth mentioning as there are not many studies in this area as of yet. Perhaps studies in future may explore this area further.

Several studies find that pathological technology users show higher rates of aggressive and antisocial behaviors, a pattern that is also found in other addictions. Similarly, there are a range of risk factors and demographics that are correlated with pathological use, such as poorer family function and lower maternal education. Although it is not represented in the table, almost every study finds that males

are more likely than females to show pathological use (again, similar to other addictions). Finally, most studies that have looked at potential outcomes of pathological use have found significant problems, such as poorer school performance and more relationship problems.

It should be noted that these are correlation studies and it is equally possible that these problems preceded the pathological use. At a broader level of analysis, the presence of comorbid pathologies is not, by itself, strong evidence that PTU is a unique taxon. It may be that the behavioral phenotypical expressions of PTU are a manifestation of one of these other underlying disorders (Shaffer et al., 2004), or that one disorder leads to another as a complication, or that they arise because of common antecedents (Shaffer, 2004). Further research is needed to provide evidence to help us to interpret comorbidity in this domain. At this time, however, it seems reasonable to view the pattern of correlations and comorbidity (in conjunction with other evidence of reliability and validity) as similar to the patterns shown in other addictions.

Correlates of PTU

Since the etiology of pathological computer and/or video game use is currently unknown, although some authors have speculated about it, this section shall review some correlates of PTU. LaRose and colleagues (2001) described a social-cognitive approach to understanding Internet usage. Within that context, Internet usage can be predicted from expected positive outcomes, expected negative outcomes, perceived self-efficacy, and self-regulatory mechanisms; pathological use would be due to deficient self-regulation, and perhaps distortions of expectations. In a short-term longitudinal study of Internet and computer game use by adolescents, Willoughby (2008) found that being male significantly predicted both computer gaming and Internet use, and trends in favor of higher friendship quality and less positive parental relationships predicted higher frequency of Internet use. Also, it was found that moderate use of the Internet was associated with a more positive academic orientation than nonuse or high level of use. The direction of effect, however, is not clear from these studies. From a cognitive-behavioral perspective, Davis (2001) posits that pathological Internet use stems from “problematic” cognitions together with

behaviors are what intensify or maintain the “maladaptive responses.” Young’s (1999) cognitive theory of Internet addicts includes high worry and anxiety with catastrophic thinking leading to pathological use of Internet as a “psychological escape mechanism,” and negative core beliefs about self, drawing one to the anonymous interactive capabilities the Internet provides in order to “overcome their perceived inadequacies.” Based on this theory, Young has used the CBT approach to treat pathological Internet use. This will be discussed further in the treatment section.

Biologically there are not many studies examining this area of PTU. Only one study has examined online gaming addicts via fMRI scanning thus far with their results suggesting there is a shared neurobiological mechanism in the craving for games online gaming and the craving for drugs (Ko et al. 2009). Based on the findings of Ko et al (2009), Han et al (2011) hypothesized that there was a similarity in pathological video gamers, drug addicts and pathological gamblers due to their weak inhibition of dopamine and norepinephrine reuptake. They developed a drug-based treatment which shall be further elaborated on in the treatment section. However, it is unclear if there are any biological underpinnings that may predispose or be a risk factor for one to engage in PTU, therefore it is suggested that this area be further looked into in future.

The framework for addiction etiology proposed by the National Institute of Drug Abuse describes the balance between *risk* and *protective* Factors. The essential feature of this model is that the “weights” of risk and protective factors are always changing during life, and the “vulnerability” profile is defined within a particular window of time. Following this model, there is a need to measure the balance between risk and protective factors (Pickens, & Svikis, 1989; United Nations, 2003). Yet, it is unclear at this time what those factors may be in PTU.

Yoo and his colleagues (2004) suggest that ADHD may be a necessary factor, or at least is a risk factor, for developing pathological Internet use because the Internet fits their cognitive styles, and may compensate for poor social skills, interpersonal difficulties, and the lack of pleasure in other daily activities. Gentile (2009) found that youths who would be classified as pathological video gamers were significantly more likely to have been diagnosed with ADHD. Grüsser et al (2007) highlighted the

possibility that gaming has an addictive potential that is also mirrored by addiction-related cognitive components like significantly stronger positive outcome expectancies. This demonstrates a potential problem that currently exists with definitions and interpretation – in this example, it is unclear whether PTU and ADHD would be independent but comorbid, or whether one is a risk or predictive factor for the other. Perhaps this area needs to be looked into with more depth.

Chiu and colleagues (2004) suggest that addiction may be predicted by several individual difference and family variables, such as hostility, sensation-seeking, boredom, and family functioning. Gentile and his colleagues found that greater amounts of gaming, lower social competence, and greater impulsivity seemed to act as risk factors for children and adolescents to become pathological gamers,

Other risk factors for the etiology of PTU include the positive emotional experience of “flow” (Chou & Ting, 2003) (the experience of time distortion and feeling of being *in* the game), having prior underlying disorders (Young, 1996), being a new user (Young, 1997; Widyanto, & McMurrin, 2004), or the “intense” connection possible between human and machine because the machine does not have a self-organizing function (Wassenaar, Van Doorn, & Dierssen, 1998), or even greater activation and functional connectivity in the mesocorticolimbic (neural) systems (Hoeft et al., 2007)

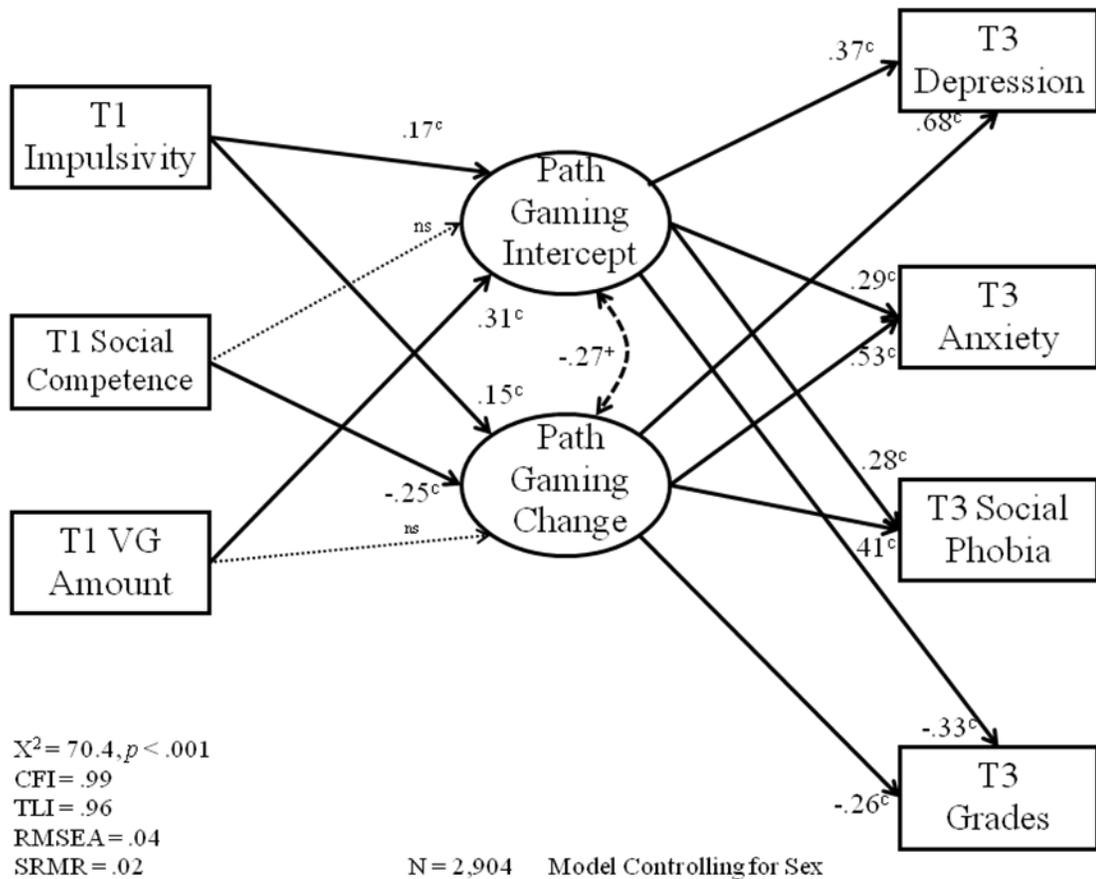
Griffiths has discussed the differences between structural and situational variables that affect gambling addiction, and how the structural characteristics of video game and Internet technology may work to enhance the problem related to PTU (Griffiths, 2003; Griffiths & Wood, 2000). For example, immediate feedback, continuous play, and accessibility are all made easier through computer technology. It is possible that these situational and structural characteristics will need to be accounted for when measuring the etiology of PTU, as different types of activities vary widely in them. However, as Griffiths noted, although there is evidence that both gambling and the Internet can be addictive, “there is no evidence (to date) that Internet gambling is ‘doubly addictive’ (Griffiths, 2003), for instance, gambling on the internet is not any more pathological than gambling without using the Internet.

Johansson, & Götestam (2004a; 2004b) postulated that the amount of time spent on the Internet and video games leads to pathological use. While reported literature consistently point to the usage time demonstrated important indicators to Internet and video game pathological use, it is difficult to say if the high usage time represents the cause or the effect (Ferraro, Caci, D'Amico & Di Blasi, 2007). Moreover, we would take issue with amount of time being a cause of pathology. Although some amount of time using interactive media is obviously necessary, it alone should not be sufficient. For example, in defining substance addictions and pathological gambling, amount of usage or time spent gambling is *not* one of the symptoms in the DSM-IV. The problem is not amount *per se*, but instead focuses on damage to functioning (including occupational, social, family, psychological functioning). This appears to be a valid approach to defining pathology. For example, some people can consume a lot of alcohol and not damage their functioning, whereas others could drink rarely but when they do it causes such disruption to their lives that it is pathological. Although time probably should not be used to diagnose pathological computer, video game and Internet use, if pathological users did not generally spend large amounts of time, this would be evidence of a lack of validity for the construct. Studies generally do find pathological users spending much more time than non-pathological users.

At the time of this writing, little is known about the course of PTU. To date, only two longitudinal studies have been published. One studied 881 Chinese adolescents between 13 and 16, using Young's 20-item Internet addiction scale (Lam & Peng, 2010). Adolescents were surveyed twice nine months apart. Pathological Internet use predicted increased risk of depression (but not general anxiety) nine months later, after controlling for several potential confounding factors (e.g., sex, age, family dissatisfaction, illness, etc.). A two-year study of 3034 Singaporean children and adolescents provided some of the first clear evidence of whether variables such as depression and poor school performance are predictors of or predicted by pathological video gaming (Gentile et al., 2011). Because of the large sample size, the researchers were able to classify gamers into four types: those who never were pathological across the two years, those who became pathological gamers, those who were pathological at the start but stopped being pathological, and those who were and stayed pathological gamers. Depression

became worse if youth became pathological gamers, similar to the results found by Lam & Peng (2010). Furthermore, anxiety, social phobia, and school performance also became worse after becoming a pathological gamer. Additionally, if children stopped being pathological gamers, their depression, anxiety, social phobia, and school performance all improved. This pattern suggests that these are likely to be outcomes of pathological technology use rather than predictors of it. At a minimum, it suggests that these issues are truly co-morbid, such that they can influence each other.

Several factors predicted who became pathological gamers across the two years. These included high impulsivity, low social competence, and poorer emotion regulation. In a longitudinal latent growth curve model, impulsivity, social competence, and amount of video game play predicted the number of pathological symptoms reported both initially and changes in them, which in turn predicted depression, anxiety, social phobias, and school performance two years later (Figure 1).



Gentile et al. (2011) found that 84% of those who would be classified as pathological video game players at the start of the study still would be classified as pathological two years later. Therefore, the problem does not seem to resolve itself for most youth. It may be that it resolves itself in some cases (but perhaps not before significant damage has been done). These issue need to be studied with additional longitudinal samples of pathological users.

Diagnosis of PTU

There is a need for specific diagnostic criteria for clinical use and to direct future research efforts. Charlton (2002) surveyed 404 undergraduates on several facets of computer use, including 10 items he created based on Brown's six facets of addiction. He factor analyzed 47 variables, finding three factors. The first factor he defined as computer "engagement," a non-pathological interest in and frequent use of computers. The second factor was an "addiction" factor, and the third was "comfort" factor (how comfortable participants were using computers). Of particular interest was the fact that three of the addiction items measuring salience, euphoria, and tolerance loaded more heavily on the engagement factor than on the addiction factor (although they also loaded on the addiction factor). His interpretation was that these features may either not be discriminatory for pathological use, or that perhaps they indicate early symptoms in the etiology of pathological use. Although more research is necessary to test both of these hypotheses, we believe that his approach to measurement of these issues may not be sufficient. For example, his items were worded gently rather than strictly: "I tend to want to spend increasing amounts of time using computers" rather than "I need to spend more and more time and/or money on computers in order to achieve the desired excitement." He also measured his items on a 5-point Likert scale (strongly agree-strongly disagree), rather than the dichotomous yes/no approach suggested by DSM symptom checklists. Furthermore, "euphoria," or positive feelings associated with the behavior (measured by Charlton as "I often experience a buzz of excitement while computing") are not used by the DSM-IV for either pathological gambling or substance related disorders. It is likely that there are positive feelings about *any* repeated behavior, making this facet unlikely to be discriminatory for clinical use.

It is currently unclear whether it is more appropriate to define pathological computer/video game use as a continuous or discontinuous variable. There are two facets to this issue. The first is whether to measure in a dichotomous (e.g., yes/no), trichotomous (e.g., yes/no/sometimes), or continuous fashion (e.g., strongly agree, agree, neither agree nor disagree, disagree, strongly disagree). At the very least, this issue is critical for identifying prevalence rates. The second facet is whether pathological use itself is better defined as a dichotomous state (a patient either has or does not have the disorder), or as a place on a continuum (a patient shows fewer or more symptoms, suggesting extent of disorder). Both of these approaches have been used by different researchers with success, and there is not clear evidence of one approach being better.

We propose the 10 items listed in Appendix A for clinical use, although further studies should be conducted on them as well as other possible wordings of them. These items are not intended to be used to make self-diagnoses, but to help define the issue for future studies. There are several potential additional symptoms that we feel are not good diagnostic criteria. For example, some researchers have suggested that there is a time distortion effect (Diskin & Hodgins, 1999). Chou & Ting (2003) directly measured this with video games, asking whether players played longer than they intended to. In our experience, this is such a typical experience for video game players and computer users that it would not discriminate pathological users from healthy users. Apart from that, it is also not a criterion in the DSM currently. Therefore it might be beneficial not to consider this in the diagnostic criteria of PTU.

Our preliminary recommendation is that perhaps three groups should be defined based on the number of symptoms they present: a pathological group (at least 5 symptoms based on the 9 items in Appendix A), an at-risk group (at least 3 symptoms), and a normal group (< 3 symptoms). This approach has been used successfully by other researchers (Yoo et al., 2004; Johansson & Götestam, 2004b), although it remains to be tested with the items presented here. It is important to note that we do not mean to imply that this categorical approach is necessarily the best way to define PTU, as found by Dowling and Quirk (2009) where the at-risk and pathological group displayed similar internet behavior and psychological problems. We recommend it simply because it has the most empirical evidence at this

time. Furthermore, although the DSM-IV tends to use a symptom-counting approach to diagnosis, in practice, clinicians tend to evaluate problems based on relative severity. Therefore, these definitions should be considered and revised in relation to the broader psychological and psychiatric debate regarding the merits of defining psychopathologies in categorical, dimensional, or multi-axial terms (e.g., Shaffer, 2004). Further studies of clinical use of these criteria are needed, particularly to determine whether the criteria are appropriate for both adult and child populations. Some behaviors are normal in childhood and pathological in adulthood. It may be that the criteria should be different for different ages.

Treatment of PTU

Studies are beginning to be published on the treatment of PTU. Two early case reports suggested that it is treatable. For one 12-year-old male, residential treatment with family therapy over six months was reported to help the adolescent in abstaining from video game after the resolutions of the parental conflicts (Keepers, 1990). For another 18-year-old college student, a cognitive-behavioral approach combining relaxation training, in vivo exposure, and response prevention was reported to have demonstrated a 90 percent reduction in video game playing (Kuczmierczyk, Walley, & Calhoun, 1987).

Grüsser et al (2007) proposed that cognitive-behavioral interventions which focus on developing self-observation skills with regard to the function of gaming as an inadequate stress coping strategy (e.g., “playing the hurt away”) and outcome expectancies seem to be appropriate in treating excessive gamers. Du, Jiang and Vance (2010) compared a group of Chinese adolescents with pathological internet use receiving an eight session multimodal school-based CBT intervention with another group receiving no intervention. Although internet use decreased for both groups, the group receiving CBT group intervention demonstrated better time management skills and improved emotional, cognitive and behavioral symptoms.

Young (2007) conducted one of the first studies using cognitive behavioral therapy to treat 114 clients who suffered from pathological Internet use. Preliminary analyses indicated that most clients were able to manage their presenting complaints by the eighth session, and symptom management was

sustained upon a 6-month follow-up. Young (1998) observes that the greatest difficulty in treating people with pathological Internet use is breaking through their denial of the addiction itself. However, the current and probably most urgent need is well-defined criteria to diagnosis PTU. Without this it is highly likely that the cart is placed before the horse, and possibly resulting more harm than help if assessment is not adequately carried out.

Kuntz and colleagues (2001) reported that virtual reality (VR) technology might be beneficial for reducing cue reactivity, similar to how it has been used for systematic desensitization of phobias. Some clinicians are beginning to develop methods of providing behavioral health care partly through computer and Internet technologies (Putnam & Maheu, 2000; Morganti, 2004). An interesting study by Han, Hwang, and Renshaw (2011), saw them using sustained-release bupropion with Internet video game addicts. Bupropion has been widely used to treat drug addicts and pathological gamblers. After a six-week use of bupropion on 11 male students, there was decreased craving and total game play time, as well as decrease in cue-induced brain activity in these students. Han and colleagues suggested this treatment was similar to that of the treatment of those with drug dependence.

CONCLUSION AND IMPLICATIONS

We stated that before we could consider computer, video game, and Internet use to be pathological, we would want to answer three questions. The first question is whether tests for pathological use are reliable. Although researchers have defined and measured the disorder in many different ways, almost all have been reliable, demonstrating strong robustness to measurement differences. In general, however, those that conform more closely to the DSM-IV pathological gambling criteria appear to be the most reliable.

The second question is whether the construct of pathological computer/video game use, or PTU, shows construct validity. Researchers have provided evidence for construct validity in two ways: convergent validity and comorbidity. Again, although researchers have defined the problem differently,

there is robust evidence that pathological use shows high convergent validity with other theoretically relevant variables.

The third question is whether construct validity of PTU is shown in patterns of correlations and comorbidity similar to those shown in other addictions. Although there are fewer studies, again there is robust evidence in support of this hypothesis.

Therefore, we conclude that there is sufficient evidence to consider the concerns and implications for (1) developing standardized diagnostic criteria defining PTU, (2) measuring the prevalence of PTU, and (3) defining the etiology, course, and treatment of PTU. Although research in each of these areas is still immature, some preliminary conclusions can be drawn.

We recommend that PTU be considered as different manifestations of the same underlying disorder. This is similar to the approach for pathological gambling. In a review of pathological gambling, Dowling, Smith, & Thomas (2005) found that not all types of pathological gambling were the same: “the weight of recent research evidence [indicates] that different gambling activities are heterogeneous in nature and that gamblers and problem gamblers engaging in these various gambling activities comprise heterogeneous populations” (p. 36). That is, a person who has a problem gambling on horses may not have a problem gambling on slot machines, and vice versa. Thus, although playing video games is not identical to the Internet use, the data reviewed here suggest that pathological use of each appears to show the same types of symptoms. Until further research is conducted clearly demonstrating that these different technology activities discriminate wholly separate taxons, it is more parsimonious to consider them to be the same type of disorder. This is currently the same in substance use disorder, where different drugs are not taken into consideration.

Although there is little evidence about the stages of change and treatment (Connors, Donovan, & Di Clemente, 2001) in people with PTU, the psychological and psychiatric communities will need to consider the questions raised here for at least three reasons. First, clearly some people are already suffering from problems. Without consensus in the field, many will go untreated with consequent disruptions to their jobs, relationships, finances, and mental health. Second, with each year, higher

percentages of children and adults gain access to digital technologies, and children are beginning to use computers and to play video games at younger ages. Therefore, more people will have greater opportunities to access and use computers, video games, and the Internet, which may result in higher numbers of people experiencing problems. Finally, as the technologies improve, they will become more interactive and pervasive. Indeed, the next generation of technologies is already being created, called “*pervasive games*, stressing the pervasive and ubiquitous nature of these games: Pervasive games are no longer confined to the virtual domain of the computer, but integrate the physical and social aspects of the real world” (Magerkurth, Cheok, Mandryk, & Nilsen, 2005, p. 2). These features may increase the likelihood of pathological use. Therefore, it is time to conduct studies that will allow us to properly define, diagnose, and treat PTU.

References

- American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., revised). Washington, DC: American Psychiatric Association.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- American Psychiatric Association. (2010, February 10). APA Announces Draft Diagnostic Criteria for DSM-5 [Press release]. Retrieved from <http://www.dsm5.org/Newsroom/Documents/Diag%20%20Criteria%20General%20FINAL%20.05.pdf>
- Beard, K. W., & Wolf, E. M. (2001). Modification in the proposed diagnostic criteria for Internet addiction. *CyberPsychology & Behavior*, 4(3), 377-383.
- Black, D.W., Belsare, G., & Schlosser, S. (1990). Clinical features, psychiatric comorbidity, and health-related quality of life in persons reporting compulsive computer use behavior. *Journal of Clinical Psychiatry*, 60(12), 839-844.
- Bricolo, F., Marconi, P.L., Conte, G.L., di Giannantonio, M., & De Risio, S., (1997). Internet addiction disorder: una nuova dipendenza? Studio di un campione di giovani utenti. *Società Italiana di Psichiatria Bollettino Scientifico e di Informazione*, n. 1-2, anno IV, marzo-luglio, 38-44.
- Bricolo, F., & Serpelloni, G., (2002). Efectos del uso de la tecnología digital en el cerebro y en el psique: Análisis de las evidencias y de propuestas. *Adicciones*, 14(1), 107-116.
- 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.
- Cao, F. L., Su, L. Y., Liu, T. Q., & Gao, X. P. (2007). The relationship between impulsivity and Internet addiction in a sample of Chinese adolescents. *European Psychiatry*, 22, 466-471.
- Cavacuiti, C. A. (2011). *Principles of addiction medicine: The essentials*. Philadelphia: Wolters Kluwer.
- Charlton, J.P. (2002). A factor-analytic investigation of computer 'addiction' and engagement. *British Journal of Psychology*, 93(Part 3), 329-344.

- Childress, A.R., McLellan, A.T., & O'Brien, C.P. (1986). Abstinent opiate abusers exhibit conditioned craving, conditioned withdrawal and reductions in both through extinction. *British Journal of Addiction, 81*(5), 655-660.
- Chiu, S.I., Lee, J.Z., & Huang, D.H. (2004). Video game addiction in children and teenagers in Taiwan. *CyberPsychology & Behavior, 7*(5), 571-581.
- Chou, C., & Hsiao, M. C. (2000). Internet addiction, usage, gratifications, and pleasure experience—The Taiwan college students' case. *Computer Education, 35*(1), 65–80.
- Chou, T.J. & Ting, C.C. (2003). The role of flow experience in cyber-game addiction. *CyberPsychology & Behavior, 6*(6), 663-675.
- Connors, G.J., Donovan, D.M., & Di Clemente, C.C. (2001). *Substance abuse treatment and stages of change*. New York: The Guilford Press.
- Davies, J.B. (1992). *The myth of addiction*. Chur, Switzerland: Harwood Academic Publishers.
- Davis, R.A. (2001). A cognitive-behavioral model of pathological internet use. *Computers in Human Behavior, 17*, 187-195.
- Demmel, R. (2002). Internet addiction: Ein literaturüberblick. *Sucht: Zeitschrift für Wissenschaft und Praxis, 48*, 29-46.
- Diskin, K.M. & Hodgins, D.C. (1999). Narrowing of attention and dissociation in pathological video lottery gamblers. *Journal of Gambling Studies, 15*(1), 17-28.
- Dowling, N.A. & Brown, M. (2010). Commonalities in the psychological factors associated with problem gambling and Internet dependence. *Cyberpsychology, Behavior, and Social Networking, 13*(4), 437-441.
- Dowling, N.A. & Quirk, K. (2009). Screening for Internet dependence: Do proposed diagnostic criteria differentiate normal from dependent Internet use? *Cyberpsychology and Behavior, 12*(1), 21-27.
- Dowling, N., Smith, D., & Thomas, T. (2005). Electronic gaming machines: Are they the 'crack-cocaine' of gambling? *Addiction, 100*(1), 33-45.

- Du, Y., Jiang, W., & Vance, A. (2010). Longer term effect of randomized, controlled group cognitive behavioural therapy for internet addiction in adolescent students in Shanghai. *Australian and New Zealand Journal of Psychiatry*, 44(2), 129-134.
- Estallo, J.A. (2001). Usos y abusos de internet. *Anuario de Psicología*, 32, 95-108.
- Feng, Y., Yan, X., & Guo, X. (2003). Behavior problem and family environment of children with video games dependence. *Chinese Mental Health Journal*, 17(Part 6), 367-368.
- Ferraro, G., Caci, B., D'Amico, A., & Di Blasi, M. (2007). Internet addiction disorder: An Italian study. *Cyberpsychology & Behavior*, 10(2), 170-175.
- Fisher, S. (1994). Identifying video game addiction in children and adolescents. *Addictive Behaviors*, 19(5), 545-553.
- Fisher, S., & Griffiths, M. (1995). Current trends in slot machine gambling: Research and policy issues. *Journal of Gambling Studies*, 11(3), 239-247.
- Gentile, D. (2009). Pathological video-game use among youth ages 8 to 18: A national study. *Psychological Science*, 20(6), 594-602.
- Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological Video Game Use among Youth: A Two-Year Longitudinal Study. *Pediatrics*. 127(2), e319-e329
- Gentile, D.A., Tapscott, R.L., & Lynch, P.J. (2010) Construct validity and predictive validity of pathological video game use. Manuscript under review.
- Glasser, W. (1976). *Positive addiction*. New York: Harper and Row.
- Goodman, A. (1990). "Addiction: definition and implications". *British Journal of Addiction*, 85(11), 1403-1408.
- Greenfield, D. (1999). *Virtual addiction: Help for netheads, cyberfreaks, and those who love them*. Oakland, CA: New Harginger.
- Griffiths, M. (2000) Does internet and computer "addiction" exist? Some case study evidence. *CyberPsychology & Behavior*, 3(2), 211-218.

- Griffiths, M. (2003). Internet gambling: Issues, concerns, and recommendations. *CyberPsychology & Behavior*, 6(6), 557-568.
- Griffiths, M. (In press). The role of context in online gaming excess and addiction: Some case study evidence. *International Journal of Mental Health and Addiction*.
- Griffiths, M.D., & Dancaster, I. (1995). The effect of type A personality on physiological arousal while playing computer games. *Addictive Behaviors*, 20(4), 543-548.
- Griffiths, M.D., Davies, M.N., & Chappell, D. (2004a). Demographic factors and playing variables in online computer gaming. *CyberPsychology & Behavior*, 7(4), 479-487.
- Griffiths, M.D., Davies, M.N., & Chappell, D., (2004b) Online computer gaming: A comparison of adolescent and adult gamers. *Journal of Adolescence*, 27(1), 87-96.
- Griffiths, M.D. & Hunt, N. (1998). Dependence on computer games by adolescents. *Psychological Reports*, 82(2), 475-480.
- Griffiths, M. Wood, R.T.A. (2000). Risk factors in adolescence: The case of gambling, video game playing, and the internet. *Journal of Gambling Studies*, 16, 199-225.
- Grüsser, S.M. Thalemann, R., Albrecht, U., & Thalemann, C.N. (2005). Exzessive computernutzung im Kindesalter – Ergebnisse einer psychometrischem Erhebung. *Wiener Klinische Wochenschrift*, 117, 188-195.
- Grüsser, S.M. Thalemann, R., & Griffiths, M. D. (2007). Excessive computer game playing: Evidence for addiction and aggression? *CyberPsychology & Behavior*, 10(2), 290-292.
- Gupta, R., & Derevensky, J.L. (1996). The relationship between gambling and video-game playing behavior in children and adolescents. *Journal of Gambling Studies*, 12(4), 375-394.
- Han, D. H., Hwang, J. W., & Renshaw, P. F. (2011). Bupropion sustained release treatment decreases craving for video games and cue-induced brain activity in patients with Internet video game addiction. *Psychology of Popular Media Culture*, 1(S), 108-117.

- Handelman, D. (Writer), & Barsh, A. (Director). (2005). Video game addiction. [Television Series Episode]. In M. Weisman (Executive Producer), *The Jane Pauley Show*. Burbank, CA: NBC Studios.
- Hoefl, F., Watson, C. L., Kesler, S. R., Bettinge, K. E., & Reiss, A. L. (2007). Gender differences in the mesocorticolimbic system during computer game-play. *Journal of Psychiatric Research*, 42, 253-258.
- Huang, M.P. & Alessi, N.E. (1996). The internet and the future of psychiatry. *American Journal of Psychiatry*, 153(7), 861-869.
- Johansson, A., & Götestam, K.G. (2004a). Internet addiction: Characteristics of a questionnaire and prevalence in Norwegian youth. *Scandinavian Journal of Psychology*, 45(3), 223-229.
- Johansson, A. & Götestam, K.G. (2004b). Problems with computer games with monetary reward: Similarity to pathological gambling. *Psychological Reports*, 95(2), 641-650.
- Keepers, G.A. (1990). Pathological preoccupation with video games. *Journal of the American Academy of Child and Adolescent Psychiatry*, 29(1), 49-50.
- Kipnis, D. (1997). Ghosts, taxonomies, and social psychology. *American Psychologist*, 52, 205-211.
- Ko, C. H., Yen, J. Y., Yen, C. F., Lin, H. C., & Yang, M. J. (2007). Factors predictive for incidence and remission of Internet addiction in young adolescents: A prospective study. *CyberPsychology & Behavior*, 10(4), 545-551.
- Ko, C. H., Liu, G. C., Hsiao, S., Yen, J. Y., Yang, M. J., Lin, W. C., Yen, C. F., & Chen, C. S. (2009). Brain activities associated with gaming urge of online gaming addiction. *Journal of Psychiatric Research*, 43(7), 739-747.
- Koepp, M. J., Gunn, R. N., Lawrence, A. D., Cunningham, V. J., Dagher, A., Jones, T., Brooks, D. J., Bench, C. J., Grasby, P. M. (1998). Evidence for striatal dopamine release during a video game. *Nature*, 393, 266-268.

- Kronenberger, W.O., Mathews, V.P., Dunn, D.W., Wang, Y., Wood, E.A., Giaque, A.L., et al. (2005). Media violence exposure and executive functioning in aggressive and control adolescents. *Journal of Clinical Psychology, 61*, 715-737.
- Kuczmierczyk, A.R., Walley, P.B., & Calhoun, K.W. (1987). Relaxation training, in vivo exposure and response-prevention in the treatment of compulsive video-game playing. *Scandinavian Journal of Behavior Therapy, 16*, 185-190.
- Kuntze, M.F., Stoermer, R., Mager, R., Roessler, A., Mueller-Spahn, F., Bullinger, A.H. (2001). Immersive virtual environments in cue exposure. *CyberPsychology & Behavior, 4*, 497-501.
- LaRose, R., Mastro, D., & Eastin, M.S. (2001). Understanding internet usage: A social-cognitive approach to uses and gratifications. *Social Science Computer Review, 19*, 395-413.
- Magerkurth, C., Cheok, A.D., Mandryk, R.L., & Nilsen, T. (2005). Pervasive games: Bringing computer entertainment back to the real world. *ACM Computers in Entertainment, 3*, 1-19.
- McMurrin, M. (1994). *The psychology of addiction*. London: Taylor and Francis.
- Meyer, G., Schwertfeger, J., Exton, M.S., Jansen, O.E., Knapp, W., Stadler, M.A., et al. (2004). Neuroendocrine response to casino gambling in problem gamblers. *Psychoneuroendocrinology, 29*(10), 1272 – 1280.
- Miller, S.A. (2002). Death of a game addict. *Milwaukee Journal Sentinel*. Retrieved April 2, 2002 from JS Online: <http://www.jsonline.com/news/State/mar02/31536.asp>
- Morahan-Martin, J., & Schumacher, P. (2000). Incidence and correlates of pathological internet use among college students. *Computers in Human Behavior, 16*(1), 13-29.
- Morganti, F. (2004). Virtual interaction in cognitive neuropsychology. In G. Riva, C. Botella, P. Légeron, & G. Optale (Eds.), *Cybertherapy*. Amsterdam: IOS Press.
- Murali, V. & George, S. (2007) Lost online: an overview of Internet addiction. *Advances in Psychiatric Treatment 2007, 13*, 24-30.
- Nichols, L. A. & Nicki, R. (2004). Development of a psychometrically sound Internet addiction scale: A preliminary step. *Psychology of Addictive Behaviors, 18*, 381-384.

- Peng, Li. H., & Li, X. (2009). A survey of Chinese college students addicted to video games. *China Education Innovation Herald*, 28, 111-112.
- Petry, N. M. (2006). Should the scope of addictive behaviors be broadened to include pathological gambling? *Addiction*, 101(Supplement s1), 152–160.
- Pickens, R.W., & Svikis, D.S. (1989). *Biological Vulnerability to Drug Abuse (NIDA Research Monograph, Number89)*. Rockville, MD: Department of Health of Human Services.
- Pomerleau, O.F., Fertig, J., Baker, L., & Cooney, N. (1983). Reactivity to alcohol cues in alcoholics and non-alcoholics: Implications for a stimulus control analysis of drinking. *Addictive Behaviors*, 8(1), 1-10.
- Porter, G., Starcevic, V., Berle, D., & Fenech, P. (2010). Recognizing problem video game use. *Australia and New Zealand Journal of Psychiatry*, 44(2), 120-128.
- Putnam, D.F. & Maheu, M.M. (2000). Online sexual addiction and compulsivity: Integrating web resources and behavioral telehealth in treatment. *Sexual Addiction & Compulsivity*, 7, 91-112.
- Reuters News Service. (2005a). Asia tackles online game addiction. Retrieved November 27, 2005 from the MSNBC website: <http://www.msnbc.msn.com/id/9340038/>
- Reuters News Service. (2005b). South Korean man dies after 50 hours of computer games. Retrieved November 26, 2005 from the MSNBC website: <http://www.msnbc.msn.com/id/8888579/>
- Robinson, T.E. & Berridge, K.C. (2003). Addiction. *Annual Review of Psychology*, 54, 25-53.
- Shaffer, D. (2004). Concepts of diagnostic classification. In J. M. Wiener & M. I. Dulcan (Eds.), *The American psychiatric publishing textbook of child and adolescent psychiatry*. Washington, DC: American Psychiatric Press, pp. 77-85.
- Shaffer, H. J. (1996). Understanding the means and objects of addiction: Technology, the Internet, and gambling. *Journal of Gambling Studies*, 12, 461-469.
- Shaffer, H. J., Hall, M. N., & Vander Bilt, J. (2000). “Computer addiction”: A critical consideration. *American Journal of Orthopsychiatry*, 70, 162-168.

- Shaffer, H. J. & Kidman, R. (2003). Shifting perspectives on gambling and addiction. *Journal of Gambling Studies, 19*, 1-6.
- 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*, 367-374.
- Shapira, N.A., Goldsmith, T.D., Keck, P.E., Khosla, U.M., & McElroy, S.L. (2000) Psychiatric features of individuals with problematic internet use. *Journal of Affective Disorders, 57*(1-3), 267-272.
- Shapira, N.A., Lessig, M.C., Goldsmith, T.D., Szabo, S.T., Lazoritz, M., Gold, M.S., et al. (2003). Problematic internet use: Proposed classification and diagnostic criteria. *Depression and Anxiety, 17*(4), 207-216.
- Soper, W.B. & Miller, M.J. (1983). Junk-time junkies: An emerging addiction among students. *The School Counselor, 31*(1), 40-43.
- Stein, D.J. (1997). Internet addiction, internet psychotherapy. *American Journal of Psychiatry, 154*(6), 890.
- Stern, S.E. (1999). Addiction to technologies: A social psychological perspective of internet addiction. *CyberPsychology & Behavior, 2*, 419-424.
- Tejeiro Salguero, R.A., & Bersabé Morán, R.M. (2002). Measuring problem video game playing in adolescents. *Addiction, 97*(12), 1601-1606.
- Tisserand, I.N. (2000). New risks of addiction for new populations: the example of hackers. *Annales de Medecine Interne. 151*, Suppl B, B49-52
- United Nations. (2003). Adolescent substance use: Risk and protection. New York: United Nations.
- Wassenaar, J.S., Van Doorn, A.B.D., & Dierssen, A.H.J. (1998). The human-computer interface: Autonomy and addiction—a neuro-cognitive study. *CyberPsychology & Behavior, 1*, 353-360.
- West, M. I. (1988). *Children, culture, & controversy*. Hamden, CT: Archon Books.
- Widyanto, L., & McMurrin, M. (2004). The psychometric properties of the internet addiction test. *CyberPsychology & Behavior, 7*(4), 443-450.

- Willoughby, T. (2008). A short-term longitudinal study of internet and computer game use by adolescent boys and girls: Prevalence, frequency of use, and psychosocial predictors. *Developmental Psychology, 44*(1), 195-204.
- Wood, R.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*, 77-100.
- Yang, C. K., Choe, B. M., Baity, M., Lee, J. H. & Cho, J. S. (2005). SCL-90-R and 16PF profiles of senior high school students with excessive internet use. *Canadian Journal of Psychiatry, 50*, 407-414.
- Yee, N. (2001). *The Norrathian Scrolls: A Study of EverQuest (Version 2.5)*. Retrieved November 28, 2005, from Nick Yee's Homepage: <http://www.nickyee.com/eqt>
- Yee, N. (2002). *Ariadne: Understanding MMORPG Addiction*. Retrieved November 28, 2005, from Nick Yee's Homepage: <http://www.nickyee.com/hub/addiction/home.html>
- Young, K.S. (1996) Psychology of computer use: XL. Addictive use of the internet: A case that breaks the stereotype. *Psychological Reports, 79*(3 Pt 1), 899-902.
- Young, K.S. (1997). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior, 1*, 237-244.
- Young, K.S. (1998). *Caught in the net*. New York: John Wiley & Sons.
- Young, K.S. (1999). The evaluation and treatment of Internet addiction. In: VandeCreek L. & Jackson, T., eds. *Innovations in clinical practice: a source book*. Sarasota, FL: Professional Resource Press, pp.19-31.
- Young, K. (2004). Internet addiction: A new clinical phenomenon and its consequences. *American Behavioral Scientist, 48*(4), 402-415.
- Young, K. (2007). Cognitive-behavioral therapy with internet addicts: Treatment outcomes and implications. *Cyberpsychology & Behavior, 10*, 671-679.
- Yoo, H.J., Cho S.C., Ha, J., Yune, S.K., Kim, S.J., Hwang, J., et al. (2004). Attention deficit hyperactivity symptoms and internet addiction. *Psychiatry and Clinical Neurosciences, 58*(5), 487-494.

Table 1: Measures of Convergent Validity with Pathological Computer/Video Game Use by Study

<i>Frequency of Use/Play</i>		
<i>Study</i>	<i>Frequency of Use/Play Variable</i>	<i>Significant?</i>
Chou & Ting (2003)	Amount of MMORPG play	Y
Fisher (1994)	Frequency of arcade VG play	Y
	Duration of arcade VG play	Y
Ferraro et al (2007)	Duration of Internet time usage	Y
Gentile (2009)	Frequency of VG play	Y
	Number of years play	Y
Gentile et al (Study 1)(2010)	Frequency of VG play	Y
	Familiarity with VGs	Y
	Years playing VGs	Y
	Length of play at single sitting	Y
	Weekly amount of play	Y
	Frequency of playing 3 favorite games	Y
	Frequency of buying/renting new games	Y
	Likelihood to own VGs	Y
Gentile et al (Study 2)(2010)	Frequency of VG play	Y
	Years playing VGs	Y
	Weekly amount of play	Y
	Frequency of playing 3 favorite games	Y
	Likelihood to own VGs	Y
	Likelihood of playing VGs in High School	Y
Griffiths & Hunt (1998)	Frequency of VG play	Y
	Amount of VG play per sitting	Y
	Longest single VG playing time	Y
Grüsser et al (2007)	Frequency of VG play	Y
Ko et al (2007)	Frequency of Internet Use	Y
Johansson & Göttestam (2004a)	Amount of Internet Use	Y
	Frequency of Internet Use	Y
Johansson & Göttestam (2004b)	Amount of VG play	Y
	Frequency of VG play	Y
LaRose et al.(2001)	Frequency of Internet use	Y
Porter et al. (2010)	Frequency VG play	Y

Tejeiro Salguero et al. (2002)	Frequency of VG play	Y
	Mean duration of VG play	Y
	Longest time of playing session	Y
Widyanto & McMurrin (2004)	Amount of personal Internet use	Y
	Amount of general Internet use	Y
	Amount of professional Internet use	N
Yoo et al (2004)	Amount of Internet Use	Y
Young (1997)	Weekly amount of Internet use	Y

Table 1 continued

Engagement with Computers/Video Games

Study	<i>Engagement with Computers/VG Variable</i>	<i>Significant?</i>
Fisher (1994)	Amount of money spent on arcade VG play	Y
Gentile (2009)	Has a VG system in the bedroom	Y
	Has friends who are “addicted” to VGs	Y
Gentile et al (Study 1)(2010)	Frequency of customizing VGs	Y
	Frequency of using “cheat codes”	Y
	Frequency of visiting game sites on Internet	Y
	Frequency of playing games over the Internet	Y
	Video game violence exposure	Y
	Knowledge of VG ratings	Y
	Frequency of downloading VGs from Internet	Y
	More emotionally responsive to VGs	Y
Gentile et al. (Study 2)(2010)	Video game violence exposure	Y
Griffiths & Hunt (1998)	Beginning age of play (“dependent” group younger)	Y
	High emotions (pos & neg) before, during, after play	Y
Grüsser et al.(2005)	Use of computers for games	Y
Johansson & Göttestam (2004a)	Has home Internet access	Y
	Participate in Internet discussion groups	Y
	Uses Internet for email	Y
	Uses Internet to buy goods/services	Y
	Uses Internet to play games	Y
	Uses Internet to read newspapers/magazines	Y
Johansson & Göttestam (2004b)	Types of games played	Y
LaRose et al. (2001)	Perceived Internet self-efficacy	Y
Morahan-Martin & Schumacher (2000)	Frequency of visiting game sites as well as technologically sophisticated sites	Y
Porter et al. (2010)	Play certain online role-playing game	Y
Yoo et al (2004)	Uses Internet to play games	Y

Table 1 continued

Other Markers of Computer/Video Game Use

<i>Study</i>	<i>Other Markers</i>	<i>Significant?</i>
Bricolo et al (1997)	Low performance at school	N
Ferraro et al (2007)	Compromised quality of life	Y
Fisher (1994)	Worried they played VGs “too much”	Y
	Borrow money to play arcade VGs	Y
	Frequency of borrowing money to play arcade VGs	Y
	Sell possessions to fund playing arcade VGs	Y
Gentile (2009)	Skipping household chores to play VGs	Y
	Play VGs to escape from problems	Y
	Skipped homework to play VGs	Y
	VGs have high cognitive salience	Y
	Done poorly on schoolwork because of VGs	Y
	Needed extra money because of VGs	Y
	Lied to family and friends because of VGs	Y
	Felt “addicted” to VGs	Y
Gentile et al (Study 1)(2010)	Preferred greater amount of violence in VGs	Y
	Prefer more violence now than 2-3 years ago	Y
	Parents say they play VGs too much	Y
	Have games parents wouldn’t approve of	N
	Play VGs to release anger	Y
	Have felt like they were addicted	Y
Gentile et al (Study 2)(2010)	Preferred greater amount of violence in	Y
	Prefer more violence now than 2-3 years ago	Y
	Play VGs to release anger	Y
	Have felt like they were addicted	Y
Gentile et al (2011)	Lower socioeconomic level	Y
Griffiths & Hunt (1998)	Play VGs because there is “nothing else to do”	Y
Grüsser et al (2005)	Use games as a stress coping strategy	Y
Grüsser et al (2007)	Higher craving	Y
	Higher expected relief of withdrawal symptoms	Y
Ko et al (2007)	High exploratory excitability	Y
	Low self-esteem	Y
	Low family functioning	Y

Porter et al. (2010)	Found it easier to meet people online	Y
	Had fewer friends in real life	Y
	Excessive caffeine consumption	Y
Tejeiro Salguero et al.(2002)	Think they play VGs too much	Y
	Parents worried they play VGs too much	Y
	Think they have a problem with their VG playing	Y

Table 2: Measures of Comorbidity with Pathological Computer/Video Game Use (by Study)

<i>Other Disorders</i>		
<i>Study</i>	<i>Other disorders</i>	<i>Significant?</i>
Black, Belsare, & Schlosser (1990)	Compulsive computer users show several comorbid disorders, including substance use disorders (38%), mood disorders (33%), anxiety disorders (19%), and psychotic disorders (14%)	*
	Compulsive computer users also show other impulse control disorders, including compulsive buying (19%), pathological gambling (10%), pyromania (10%), compulsive sexual behavior (10%), kleptomania (5%), etc.	*
	Compulsive computer users also show personality disorders, including borderline (24%), narcissistic (19%), anti-social personality (19%), and others	*
Feng, Yan, & Guo (2003)	VG “dependents” show more anxiety/depression	Y
Gentile (2009)	Diagnosed with an attention problem	Y
Gentile et al (2011)	Depression, anxiety and social phobia	Y
Shapira et al (2000)	All 20 pathological Internet users evaluated had other diagnosable psychiatric disorders	Y
Tejeiro Salguero et al.(2002)	Problem VG players score higher on general Severity of Dependence scale	Y
Wood et al.(2004)	Problem gamblers play “excessive” amount VGs	Y
Yoo et al.(2004)	Internet “addicts” more likely to have ADHD	Y
	Internet “addicts” more likely to have past history of other addictive behaviors, esp. video games	Y
	Internet “addicts” show more anxiety/depression	Y
		Y

Table 2 continued

<i>Personality Factors</i>		
<i>Study</i>	<i>Personality Factor Variables</i>	<i>Significant?</i>
Chiu et al. (2004)	Higher sensation seeking	Y
	Higher boredom inclination	Y
	Higher trait animosity	Y
Feng, Yan, & Guo (2003)	VG “dependents” higher on psychoticism	Y
	VG “dependents” higher on trait lying	Y
Gentile et al (Study 1)(2010)	Pathological VG users have higher hostile attribution bias	Y
	Pathological VG users have higher trait hostility	Y
Gentile et al (Study 2)(2010)	Pathological VG users have higher trait hostility	Y
Gentile et al (2011)	Higher impulsivity	Y
Griffiths & Dancaster (1994)	Computer “addicted” more likely to be Type A	N
	Internet “addicts” more boredom prone	Y
Nichols & Nicki (2004)	Internet “addicts” higher on family loneliness	Y
	Internet “addicts” higher on emotional loneliness	N
	Internet “addicts” higher on social loneliness	Y
Yee (2002)	Self-esteem correlated with feeling “addicted” to MMORPG	Y
Yoo et al.(2004)	Internet “addicts” are more withdrawn	Y
	Internet “addicts” show more internalizing problems	Y

Table 2 continued

Antisocial and Aggressive Behaviors

<i>Study</i>	<i>Antisocial/Aggressive Behavior Variables</i>	<i>Significant?</i>
Feng, Yan, & Guo (2003)	VG “dependents” show more delinquent behavior	Y
	VG “dependents” show more externalizing problems	Y
	VG “dependents” show more social problems	Y
Gentile et al (Study 1)(2010)	Pathological VG users have more arguments with friends	Y
Gentile et al (Study 2)(2010)	Pathological VGers show more proactive physical aggression	Y
	Pathological VGers show more reactive physical aggression	N
	Pathological VGers show more proactive relational aggression	Y
	Pathological VGers show more reactive relational aggression	Y
	Pathological VGers show more cross-sex relational aggression	Y
	Pathological VGers show less prosocial behavior	N
Griffiths & Hunt (1998)	VG “dependents” higher aggressive feelings after playing	Y
	VG “dependents” truant from school	N
	VG “dependents” steal to buy games	N
Yoo et al. (2004)	Internet “addicts” show more aggressive behavior	Y
	Internet “addicts” show more delinquent behavior	Y
	Internet “addicts” show more externalizing problems	Y
	Internet “addicts” show more internalizing problems	Y
	Internet “addicts” show more social problems	Y
	Internet “addicts” show less social competence	N

Table 2 continued

<i>Other Risk Factors and Demographics</i>		
<i>Study</i>	<i>Other Risk Factor Variables</i>	<i>Significant?</i>
Chiu et al.(2004)	Poorer family functioning	Y
Feng, Yan, & Guo (2003)	VG “dependents” have lower family intimacy	Y
	VG “dependents” have lower family expressiveness	Y
	VG “dependents” have higher family conflict	Y
Gentile et al (Study 1)(2010)	Pathological VG users watch more TV	Y
	Pathological VG users go to church less	Y
	Pathological VG users have fathers with less education	N
	VG “addicts” have mothers with less education	Y
Gentile et al (Study 2)(2010)	Pathological VG users watch more TV	Y
	Pathological VG users have mothers with less education	Y
Grüsser et al. (2005)	Problem computer users more likely to smoke	N
	Problem computer users more likely to drink alcohol	N
	Problem computer users more likely to use cannabis	N
<i>Potential Outcomes/Risk Factors Associated with Computer/Video Game Use</i>		
<i>Study</i>	<i>Potential Outcome Variables</i>	<i>Significant?</i>
Chiu et al. (2004)	Poorer school grades	Y
Gentile et al (Study 1)(2010)	Poorer school grades	Y
Gentile et al (Study 2)(2010)	Poorer school grades	N
Young (1997)	Poorer academic performance	Y
	Increased relationship problems	Y
	Increased financial problems	Y
	Poorer occupational functioning	Y
	Increased physical problems	Y

* Statistical testing not appropriate due to no comparison group

Appendix A: Suggested Pathological Computer/Video Game Use Questionnaire Items for Adults
(Recommended scale: Yes/No/Sometimes)

Persistent and recurrent maladaptive use of computers, video games, the Internet, or other digital technologies, as indicated by five (or more) of the following:

1. During the past year, have you become more preoccupied with playing video games, studying video game playing, or planning the next opportunity to play?
2. In the past year, do you need to spend more and more time and/or money on video games in order to achieve the desired excitement? (Y/N/S)
3. In the past year, have you sometimes tried to limit your own playing? (Y/N) If yes, are you successful in limiting yourself? (Y/N/S)
4. In the past year, have you become restless or irritable when attempting to cut down or stop playing video games? (Y/N/S)
5. In the past year, have you played video games as a way of escaping from problems or bad feelings? (Y/N/S)
6. In the past year, have you ever lied to family or friends about how much you play video games? (Y/N/S)
7. In the past year, have you ever committed illegal/unsocial acts such as theft from family, friends, or elsewhere in order to get video games? (Y/N/S)
8. In the past year, have you ever neglected household chores to spend more time playing video games?
9. (For students) In the past year, have you ever done poorly on a school assignment or test because you spent too much time playing video games? (For non-students) In the past year, has your work ever suffered (e.g., postponing things, not meeting deadlines, being too tired to function well, etc.) because you spent too much time playing video games? (Y/N/S)
10. In the past year, have you ever needed friends or family to help you financially because you spent too much money on video game equipment, software, or game/Internet fees? (Y/N/S)

Notes: These items are shown for measuring pathological video game use, but should be modified to ask about computer use and Internet use if one wanted to measure those specifically. If one wished to assess all three foci, we recommend measuring each individually by three full sets of items.