Griffiths, M.D. & Pontes, H.M. (2020). A history and overview of videogame addiction. In M.N. Potenza, K.A. Faust & D. Faust (Eds). *The Oxford Handbook of Digital Technologies and Mental Health* **(pp. 18-32). New York: Oxford University Press.**

Abstract

The last decade has witnessed a significant increase in the number of empirical studies examining various aspects of problematic video game play, video game addiction, and more recently gaming disorder. This chapter begins with a brief past history of how research into video game addiction has changed over the last four decades in the 1980s (arcade videogame addiction), 1990s (home console videogame addiction), and 2000s and beyond (online videogame addiction). The chapter also overviews the (i) features of gaming addiction, (ii) prevalence of problematic video game use and gaming addiction, (iii) demographics and gaming addiction, (iv) negative consequences of excessive video game use, (v) Internet Gaming Disorder and the DSM-5, and (vi) treatment of gaming addiction. Based on the published empirical studies, and particularly those published over the last decade, it appears that in extreme cases, excessive gaming can have potentially damaging effects upon individuals who appear to display compulsive and/or addictive behaviour similar to other more traditional addictions. However, the field has been hindered by the use of inconsistent and non-standardized criteria to assess and identify problematic and/or addictive video game use.

Keywords: excessive gaming; videogame addiction; gaming addiction; gaming disorder; internet gaming disorder; problematic gaming;

Introduction

According to the Entertainment Software Association (2017) [ESA], 67% of the American households own a device that is used to play video games. Additionally, among the households that own a device to play video games, 97% play on personal computers, 81% on smartphones, 61% on wireless devices, 48% on dedicated consoles, 22% on dedicated handheld systems, and 11% on virtual reality devices (ESA, 2017). In terms of demographics, the average gamer is 35 years old, while the average female and male video game player is 37 and 33 years old respectively. Overall, 59% of the US these video game players are male, and 41% are female (ESA, 2017).

Given the pervasiveness of gaming across several countries and different segments of the population, the study of its associated effects on general human behaviour, physical and mental health has become an important topic for dedicated research agendas from various scientific domains in addition to psychology and psychiatry (e.g., Blocher, 2015; Dreier, Wölfling, & Müller, 2013; Johnston, Boyle, MacArthur, & Manion, 2013). Taken together, findings in this developing field suggest both favourable and unfavourable effects of gaming, outcomes that could inform decisions made by health care professionals, parents, policymakers, (Przybylski, 2014) and other stakeholders such as researchers and the video game industry (Yousafzai, Hussain, & Griffiths, 2013).

One topic that has become a topic of increasing research interest is gaming addiction and 'internet gaming disorder' (IGD). The last decade has witnessed a significant increase in the number of empirical studies examining various aspects of problematic video game play and video game addiction (Männikkö et al., 2018; Pontes & Griffiths, 2014). This chapter begins with a brief past history of how research into video game addiction has changed over the last three decades (i.e., the 1980s, 1990s and 2000s). The chapter addresses concerns related to video game addiction and how it made its way into the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013). The chapter also briefly examines features of videogame addiction and examines the contemporary research literature by analysing the prevalence of video game addiction, factors associated with video game addiction, and the treatment of video game addiction.

Gaming addiction in the 1980s
Following the release of the first commercial video games in the early 1970s, it took until the 1980s for the first reports of video game addiction to appear in the psychological and psychiatric literature. In the early 1980s, Ross, Finestone, and Lavin reported three cases of '*Space Invaders* obsession' and Nilles (1982) described a similar phenomenon but called it 'computer catatonia'. Arguably the first reference to 'video game addiction' was by Soper and Miller (1983), who based on their observations as school counsellors, claimed the disorder was like any other behavioural addiction and consisted of a compulsive behavioural involvement, a lack of interest in other activities, association mainly with other addicts, and physical and mental symptoms when attempting to stop the behaviour (e.g., the shakes). Some credence was given to these claims that video game addiction

existed following papers on the seemingly successful treatment of video game addiction using cognitive behavioural therapy (Kuczmierczyk, Walley, & Calhoun, 1987; Keepers, 1990). However, all of these studies were somewhat observational, anecdotal, and/or case studies, primarily based on teenage males, and all based on a particular type of video game in a particular medium (i.e., 'pay-to-play' arcade video games).

Shotton (1989) carried out the first empirical study specifically on gaming addiction on a relatively small sample of 127 people (almost all teenage or young adult males) who described themselves as "hooked" on home video games for at least five years. Shotton's conceptualization of game addiction was more positive than negative, and she reported that her 'addicts' were on the whole highly intelligent, motivated, and achieving people that were often misunderstood by others in society. In relation to gaming addiction, the main problem with the study was that no standardized measure of addiction was actually used. The only criterion for being 'addicted' was the individual's own admission that they were 'hooked' on computer games. Despite this major shortcoming, recent research by Widyanto, Griffiths, and Brunsden (2011) reported that a person's self-diagnosis of whether they were addicted to the Internet or not was correlated highly with more standardized measures of Internet addiction.

Gaming addiction in the 1990s

The 1990s saw a small but significant increase of research into video game addiction, with almost all of these studies being carried out by surveying children in school settings in the UK (e.g., Brown & Robertson, 1993; Fisher, 1994; Griffiths & Hunt, 1995; 1998; Griffiths, 1997; Parsons, 1995; Phillips, Rolls, Rouse, & Griffiths, 1995). In contrast to the early 1980s studies, these studies mainly examined non-arcade video game playing (i.e., home console games, handheld games, PC gaming). However, all of these studies were self-report surveys, relatively small scale, and all of them assessed video game addiction using adapted versions of the DSM-III-R or DSM-IV criteria for pathological gambling (American Psychiatric Association, 1987; 1994). Based on further analysis of the adapted DSM criteria used, these studies were later criticized as being more likely to be assessing video game preoccupation rather than video game addiction (Charlton, 2002).

Gaming addiction in the 2000s and beyond

The 2000s saw a substantial growth in the number of studies on video game addiction, particularly as gaming expanded into the new online medium where games could be played as part of a gaming community (i.e., massively multiplayer online role-playing games [MMORPGs] such as *World of Warcraft* and *Everquest*). Approximately sixty studies were published on gaming addiction between 2000 and 2010 (Kuss & Griffiths, 2012) and a vast majority of these studies examined MMORPG addiction and were not limited to only studying adolescent males. Further, many of these studies collected their data online, and a significant number of studies examined various aspects of video game addiction using non-self-report methodologies. These include studies using polysomnographic measures and visual and verbal memory tests (Dworak, Schierl, Bruns, & Struder, 2007), medical examinations including the patient's history, and physical, radiologic, intraoperative, and pathologic findings (Cultrara & Har-El, 2002), functional Magnetic Resonance Imaging (Han, Hwang, & Renshaw, 2010; Hoeft et al., 2008; Ko, et al., 2009), electroencephalography (Thalemann, Wölfling, & Grüsser, 2007), and genotyping (Han et al., 2007). Given the methodological shortcomings of the studies published prior to 2000, and the fact that gaming has evolved substantially over the last decade, the remainder of this chapter will mainly focus on studies published in the last decade or so (i.e., post-2000 papers) with the exception of those concerning the health and medical consequences of excessive video game play.

Features of gaming addiction

There are a multitude of psychological perspectives on addiction, which has led to addiction being defined in many different ways. However, most models of addictive behaviour refer to a persistent and uncontrollable urge to consume a substance, or engage in an activity, that results in significant personal harm and interpersonal conflict for the user (King, Delfabbro, & Griffiths, 2013). Thus, gaming addiction is often said to be present when an individual has completely lost control over their game playing and their excessive playing behaviour has had a detrimental effect on all aspects of their life, compromising their job and/or educational activities, interpersonal relationships, hobbies, general health, and psychological well-being (King, Delfabbro, & Griffiths, 2013). These two criteria (impaired control and harmful consequences) are regarded as fundamentally important criteria for addiction. An alternative model of addictive behaviour has proposed six features or *components* of gaming addiction (Griffiths, 2005). To indicate addiction, it is thought that these criteria must be sustained for at least three

to six months. Otherwise, they may simply indicate a temporary absorption in video games. These criteria include:

- *Salience.* This occurs when gaming becomes the most important activity in a person's life, dominating their thoughts (preoccupation and cognitive distortions), emotions (cravings), and behaviour (deterioration of normal behaviours). An addicted gamer is obsessed with all aspects of video games and, when not playing, will be anticipating or planning the next playing session.

- *Mood modification.* This refers to changes in a person's mood state that occur as a result of gaming. Mood change may involve a subjective feeling of euphoria as well as an increase in physiological arousal (increased heart rate, muscle tension, or shaky hands) or, alternatively, a tranquilising feeling of calm or numbing sensation.

- *Tolerance.* This refers to the process whereby increasing amounts of gaming are required to achieve the former mood-modifying effects. This means that players gradually increase the amount of time they spend engaged in gaming. It could be argued that addicted gamers build up their tolerance to the point that they will end a playing session only when they have become mentally or physically exhausted.

- *Withdrawal.* These are the aversive mood states and/or physical effects that occur when gaming is suddenly discontinued or reduced. Psychological withdrawal symptoms include feelings of frustration, irritability and flattened affect. Withdrawal motivates the individual to play video games on a regular basis, and to minimise periods of absence from a video game, in order to alleviate these unpleasant feeling states.

- *Relapse.* This refers to the tendency for the player to make repeated reversions to earlier patterns of gaming, and for even the most extreme patterns typical of the height of excessive gaming to be quickly restored after periods of abstinence or moderation. Relapse usually indicates that the individual has lost personal agency over their behaviour.

- *Conflict (Harm).* This refers to the negative consequences of excessive gaming. Harm includes conflicts between the addicted video game player and other people (family members and friends), other activities (job, school, social life,

hobbies and interests), and from within the addict themselves (psychological distress).

Charlton (2002) suggests that three of these features may not be reliable indicators of video game addiction. His research suggests that cognitive salience (preoccupation), euphoria (mood modification) and tolerance also indicate *high engagement,* or a type of healthy obsession, with gaming. Therefore, studies may overestimate the prevalence of problem video game play if high engagement with gaming is not properly distinguished from gaming addiction. Given these issues of reliability, many addiction specialists maintain that impaired control and harmful effects are the most appropriate criteria for identifying gaming addiction.

Prevalence of problematic video game use and gaming addiction

At present, it is quite difficult to estimate the prevalence of problematic online gaming due to the lack of a clear definition, the application of measures without proper psychometric characteristics, and studies using different samples and different research methodologies. Large sample studies generally report prevalence values well below 10%. Prevalence rates tend to differ between studies around the world, with the slightly higher prevalence reported in Asian countries.

Overall, prevalence rates of gaming addiction reported in recent robust studies using large samples have been found to range anywhere from 0.7% in Norway (Brunborg, Hanss, Mentzoni, & Pallesen, 2015) to 9.3% in Lithuania (Ustinavičienė et al., 2016). Moreover, a study conducted in the US on a national representative sample of teenagers (Gentile, 2009), as well as a large sample of Singaporean children (Gentile et al., 2011) both reported a problematic game use of approximately 9%. Results of another representative study in Germany showed that 3% of the male and 0.3% of the female students were diagnosed as dependent on video games, while another 4.7% of male and 0.5% of female students were at risk of becoming dependent (Rehbein et al., 2010). On a large Hungarian online gamer sample 3.4% of gamers belonged to the high-risk group of problematic gaming and another 15.2% to the medium-risk group (Demetrovics et al., 2012). A proportion of 4.6% of Hungarian adolescents (approx. 16 years old) belonging to a national sample were classified as high-risk users (Pápay et al., 2013) (see Table 1).

INSERT TABLE 1 ABOUT HERE

Demographics and gaming addiction

According to an online survey examining all types of online gamers (Nagygyörgy et al., 2012) (N=4374), the mean age was 21 years, and participants were mostly male (91%) and single (66%). Their average weekly game time varied between less than 7 hours (10%) and more than 42 hours (also 10%) with most of the gamers playing 15-27 hours weekly (35%). Furthermore, 16% of all gamers were playing either professionally (i.e., they make a living off of sponsorships and money won from tournaments) or competitively (i.e., they participate in competitions and earn money if they win). The majority of the sample (79%) had a clear gaming preference, namely they played one single game type most of the time.

Data regarding the three main game types give a more nuanced view. The proportion of female gamers is the lowest in the case of Massively Multiplayer Online First-Person Shooter (MMOFPS) games (1-2%) (Jansz & Tanis, 2007; Nagygyörgy et al., 2012) and the highest between Massively Multiplayer Online Role Playing Game (MMORPG) users (15-30%) (Cole & Griffiths, 2007; Nagygyörgy et al., 2012; Yee, 2006a). MMOFPS users are the youngest (18-19.8 years) (Jansz & Tanis, 2007; Nagygyörgy, Urbán, et al., 2012), while both Massively Multiplayer Online Real Time Strategy (MMORTS) (22 years) (Nagygyörgy et al., 2012) and MMORPG players (21-27 years) (Nagygyörgy et al., 2012; Yee, 2006a) are significantly older. Among the three main groups, MMORPG gamers spend the most time playing (Nagygyörgy et al., 2013). Since MMORPGs are the most researched games (most likely because they allow players interact to form friendships, create communities, and work together to accomplish a variety of goals [Barnett & Coulson, 2010]), there is additional information regarding such players that is still unknown in the case of other game types. For instance, half of MMORPG players work full time, 22.2% are students, and 14.8% are homemakers (89.9% of whom were female). Furthermore, 36% of the gamers are married and 22% of them have children (Yee, 2006a, 2006d). Overall, the demographic composition of MMORPG users is quite varied, and probably more diverse than the composition of MMORTS and MMOFPS users (although this needs to be empirically established).

From a substantive perspective, there are some generalizations that can be made with regard to the demographic characteristics of gamers and problem gamers. The literature, to date, suggests that adolescent males and young male adults appear to be at greater risk of experiencing problematic video game play. However, the course and severity of these problems is not well known (King et al., 2012) and the finding that this group is more at risk may be a consequence of sampling bias and the fact that this group plays video games more frequently than other socio-demographic groups. It has also been suggested that university students may be vulnerable to developing problematic video gaming. Reasons for this include their flexible tuition and study hours, ready access to high-speed broadband on a 24/7 basis, and multiple stressors associated with adjusting to new social obligations and/or living out-of-home for the first time (Young, 1998a; King et al., 2012).

Negative consequences of excessive video game use

Irrespective of whether problematic video game play can be classed as an addiction, there is now a relatively large number of studies all indicating that excessive video game play can lead to a wide variety of negative psychosocial consequences for a minority of affected individuals. A recent systematic review and meta-analysis of 50 empirical studies on problematic gaming (Männikkö et al., 2018) found that problematic gaming is significantly associated with a wide range of detrimental health-related outcomes, including increased symptoms of depression, anxiety, obsessive-compulsive disorder, and somatisation. Previous studies have also identified other correlates, such as sacrificing work, education, hobbies, socializing, time with partner/family, and sleep (Batthyány et al., 2009; Griffiths, Davies, & Chappell, 2004; King & Delfabbro, 2009; Liu & Peng, 2009; Peng & Liu, 2010; Peters & Malesky, 2008; Rehbein et al., 2010; Yee 2006a, 2006b), increased stress (Batthyány et al., 2009), an absence of real life relationships (Allison, von Wahlde, Shockley, & Gabbard, 2006), lower psychosocial well-being and loneliness (Lemmens, Valkenburg, & Peter, 2011), poorer social skills (Griffiths, 2010; Zamani et al, 2010), decreased academic achievement (Chiu, Lee, & Huang, 2004; Jeong & Kim, 2010; Rehbein et al., 2010; Skoric et al., 2009), increased inattention (Batthyány et al., 2009; Chan & Rabinowitz, 2006), aggressive/oppositional behaviour and hostility (Chan & Rabinowitz, 2006; Chiu et al., 2004), maladaptive coping (Batthyány et al., 2009; Hussain & Griffiths, 2009a, 2009b), decreases in verbal memory performance (Dworak et al., 2007), maladaptive cognitions (Peng & Liu, 2010), and suicidal ideation (Rehbein et

al., 2010).

In addition to the reported negative psychosocial consequences, there are also many reported health and medical consequences that may result of excessive video game playing. These include epileptic seizures (Maeda et al., 1990; Graf, Chatrian, Glass, & Knauss, 1994; Harding & Jeavons, 1994; Quirk et al., 1995; Millett, Fish, & Thompson, 1997; Chuang, 2006), auditory hallucinations (Ortiz de Gortari & Griffiths, 2014a; Spence, 1993), visual hallucinations (Ortiz de Gortari & Griffiths, 2014b), enuresis (Schink, 1991), encoprisis (Corkery, 1990), obesity (Shimai, Yamada, Masuda, & Tada, 1993; Deheger, Rolland-Cachera, & Fontvielle, 1997; Johnson & Hackett, 1997; Vandewater, Shim, & Caplovitz, 2004), wrist pain (McCowan, 1981), neck pain (Miller, 1991), elbow pain (Miller, 1991), tenosynovitis – also called "nintendinitis" (Reinstein, 1983; Brasington, 1990; Casanova & Casanova, 1991; Siegal, 1991), blisters, calluses, sore tendons, and numbness of fingers, (Loftus & Loftus, 1983), hand-arm vibration syndrome (Cleary, McKendrick, & Sills, 2002), sleep abnormalities (Allison et al., 2006; Dworak et al., 2007), psychosomatic challenges (Batthyány et al., 2009), and repetitive strain injuries (Mirman & Bonian, 1992).

Taken together, this relatively long list of potential psychosocial and medical negative consequences indicates that excessive gaming is an issue irrespective of whether it is an addiction. It also suggests that more extensive recognition is needed of the wide range of potential negative and life-limiting consequences of excessive video play.

Factors associated with problematic video game use and video game addiction
A number of studies have examined the role of different personality factors, comorbidity factors, and biological factors, and their association with gaming addiction. In relation to personality traits, gaming addiction has been shown to have association with neuroticism (Mehroof & Griffiths, 2010; Peters & Malesky, 2008), aggression and hostility (Caplan, Williams, & Yee, 2009; Chiu et al., 2004; Kim, Namkoong, Ku, & Kim, 2008; Mehroof & Griffiths, 2010), avoidant and schizoid interpersonal tendencies (Allison et al., 2006), loneliness and introversion (Caplan et al., 2009), social inhibition (Porter et al., 2010), boredom inclination (Chiu et al., 2004), sensation-seeking (Chiu et al., 2004; Mehroof & Griffiths, 2010), diminished agreeableness (Peters & Malesky, 2008), diminished self-control and narcissistic personality traits (Kim et al., 2008), low self-esteem (Ko et al.,

2005), state and trait anxiety (Mehroof & Griffiths, 2010), and low emotional intelligence (Parker et al., 2008). It is hard to assess the etiological significance of these associations with gaming addiction as they may not be unique to the disorder. Further research is therefore needed.

Research has also shown gaming addiction to be associated with a variety of comorbid disorders. This includes attention deficit hyperactivity disorder (Allison et al., 2006; Batthyány et al., 2009; Chan & Rabinowitz, 2006; Han et al., 2009), symptoms of generalized anxiety disorder, panic disorder, depression, social phobia (Allison et al., 2006), school phobia (Batthyány et al., 2009), and various psychosomatic symptoms (Batthyány et al., 2009).

Through use of fMRI, biological research has shown that gaming addicts show similar neural processes and increased activity in brain areas associated with substance-related addictions and other behavioural addictions, such as pathological gambling (significant activation in the left occipital lobe, parahippocampal gyrus, dorsolateral prefrontal cortex, nucleus accumbens, right orbitofrontal cortex, bilateral anterior cingulate, medial frontal cortex, and the caudate nucleus (Han et al., 2010; Hoeft et al., 2008; Ko et al., 2009). It has also been reported that gaming addicts (like substance addicts) have a higher prevalence of two specific polymorphisms of the dopaminergic system (i.e., Taq1A1 allele of the dopamine D2 receptor and the Val158Met in the Catecholamine-O-Methyltransferase) (Han et al., 2007).

Internet Gaming Disorder and the DSM-5

Prior to the publication of the latest DSM-5 (American Psychiatric Association, 2013), there had been some debate as to whether 'internet addiction' should be introduced into the text as a separate disorder (Block, 2008; Petry & O'Brien, 2013). Alongside this, there was debate as to whether those researching the online addiction field should be researching generalized internet use and/or the potentially addictive activities that can be engaged on the internet (e.g., gambling, video gaming, sex, shopping, etc.) (Griffiths, 2000; Griffiths, King, & Demetrovics, 2014). Following these debates, the Substance Use Disorder Work Group (SUDWG) recommended that the DSM-5 include a sub-type of problematic internet use (i.e., internet gaming disorder [IGD]) in Section 3 ('Emerging Measures and Models') as an area that needed future research before being included in

future editions of the DSM (Petry & O'Brien, 2013). According to Petry and O'Brien (2013), IGD will not be included as a separate mental disorder until the (i) defining features of IGD have been identified, (ii) reliability and validity of specific IGD criteria have been obtained cross-culturally, (iii) prevalence rates have been determined in representative epidemiological samples across the world, and (iv) etiology and associated biological features have been evaluated.

One of the key reasons that IGD was not included in the main text of the DSM-5 was that the SUDWG concluded that no standard diagnostic criteria were used to assess gaming addiction across these many studies (Griffiths et al., 2014). A review of instruments assessing problematic, pathological and/or addictive gaming by King and colleagues (2013) reported that 18 different screening instruments had been developed, and that these had been used in 63 quantitative studies comprising 58,415 participants. This comprehensive review identified both strengths and weaknesses of these instruments. The main strengths of the instrumentation included the: (i) the brevity and ease of scoring, (ii) excellent psychometric properties such as convergent validity and internal consistency, and (iii) robust data that will aid the development of standardized norms for adolescent populations. However, the main weaknesses identified in the instrumentation included: (i) core addiction indicators being inconsistent across studies, (ii) a general lack of any temporal dimension, (iii) inconsistent cut-off scores relating to clinical status, (iv) poor and/or inadequate inter-rater reliability and predictive validity, and (v) inconsistency and/or dimensionality. It has also been noted by a number of authors that the criteria for IGD assessment tools are theoretically based on a variety of different potentially problematic activities including substance use disorders, pathological gambling, and/or other behavioural addiction criteria (King et al., 2013; Petry & O'Brien, 2013). There are also issues surrounding the settings in which diagnostic screens are used, as those used in clinical practice settings may require a different emphasis than those used in epidemiological, experimental and neurobiological research settings (King et al., 2013; Koronczai et al., 2011).

A review by Pápay and colleagues (2014) argued that some researchers consider video games as the starting point for examining the characteristics of IGD, while others consider the internet as the main platform that unites different addictive internet activities, including online games. Recent studies (Demetrovics et al., 2012; Kim & Kim,

2010) have made an effort to integrate both approaches. Consequently, IGD can either be viewed as a specific type of video game addiction, as a variant of internet addiction, or as an independent diagnosis (Griffiths et al., 2014).

Griffiths (2005) has argued that although all addictions have particular and idiosyncratic characteristics, they share more commonalities than differences (i.e., salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse), and likely reflect a common etiology of addictive behaviour. Consequently, online game addiction is viewed as a specific type of video game addiction. Similarly, Porter and colleagues (2010) do not differentiate between problematic video game use and problematic online game use. They conceptualized problematic video game use as excessive use of one or more video games resulting in a preoccupation with and a loss of control over playing video games, and various negative psychosocial and/or physical consequences. However, unlike Griffiths (2005), their criteria for problematic video game use does not include other features usually associated with dependence or addiction, (e.g., tolerance, physical symptoms of withdrawal), as they say there is no clear evidence that problematic gaming is associated with such phenomena. Researchers such as Young (1998b) view online gaming addiction as a sub-type of internet addiction, as they believe the internet itself provides situation-specific characteristics that facilitate gaming becoming problematic and/or addictive.

Kim and Kim's (2010) Problematic Online Game Use (POGU) model take a more integrative approach and claims that neither of the approaches outlined above adequately capture the unique features of online games such as Massively Multiplayer Online Role Playing Games (MMORPGs). They argue that the internet is just one channel where people may access the content they want (e.g., gambling, shopping, sex, etc.) and that such users may become addicted to the particular content rather than the channel itself. This is analogous to the argument by Griffiths (2000) that there is a fundamental difference between addiction *to* the internet, and addictions *on* the internet. MMORPGs also differ from single player video games, as there are social and/or role-playing dimensions that allow interaction with other gamers.

The POGU model resulted in five underlying dimensions of addictive gameplay (i.e., euphoria, health problems, conflict, failure of self-control, and preference of virtual

relationships). Demetrovics and colleagues (2012) also support the integrative approach, and stress the need to include all types of online games in addiction models in order to make comparisons between genres and gamer populations possible (such as those who play online Real-Time Strategy (RTS) games and online First Person Shooter (FPS) games in addition to the widely researched MMORPG players). Their model comprises six dimensions (i.e., preoccupation, overuse, immersion, social isolation, interpersonal conflicts, and withdrawal).

Irrespective of approach or model, the components and dimensions that comprise online gaming addiction outlined above are very similar to the IGD criteria in Section 3 of the DSM-5. For instance, Griffiths' (2005) six addiction components directly map onto the nine proposed criteria for IGD (of which five or more need to be endorsed and result in clinically significant impairment). More specifically: (1) *preoccupation with internet games* [salience]; (2) *withdrawal symptoms when internet gaming is taken away* [withdrawal]; (3) *the need to spend increasing amounts of time engaged in internet gaming* [tolerance], (4) *unsuccessful attempts to control participation in internet gaming* [relapse/loss of control]; (5) *loss of interest in hobbies and entertainment as a result of, and with the exception of, internet gaming* [conflict]; (6) *continued excessive use of internet games despite knowledge of psychosocial problems* [conflict]; (7) *deception of family members, therapists, or others regarding the amount of internet gaming* [conflict]; (8) *use of the internet gaming to escape or relieve a negative mood* [mood modification]; and (9) *loss of a significant relationship, job, or educational or career opportunity because of participation in internet games* [conflict].

Treatment of gaming addiction

Clinical interventions and treatment for problematic and/or addictive gaming vary considerably in the literature, with most of the very few published studies employing some type of cognitive-behavioural therapy (CBT), pharmacotherapy, and/or self-devised psychological interventions (Griffiths & Meredith, 2009; Han et al., 2009, 2010; King et al., 2010; King, et al., 2012; Torres-Rodriguez et al., 2018; Young, 2013). Han et al. (2010; 2012) presented some successful case studies regarding pharmacotherapeutic treatment. After a six-week (Han et al., 2010) and a twelve-week (Han & Renshaw, 2012) period of bupropion sustained release treatment, problematic gamers showed significant improvement both in decreased problem behaviour and decreased depression scores. The researchers' pharmacological choice had been driven by the similarities in

neurological activity of different behavioural addictions (Han et al., 2011; Ko et al., 2009; Kuss & Griffiths, 2012).

Currently, the evidence base on the treatment of problematic and/or addictive gaming is limited. Furthermore, the lack of consistent approaches to treating problematic video game playing and video game addiction makes it difficult to produce any definitive conclusions as to the efficacy of treatment, although at this stage CBT (as with the treatment efficacy of other addictions) appears to show good preliminary support (King et al., 2012; Torres-Rodriguez et al., 2018). There remains a need for controlled, comparative studies of psychological and pharmacological treatments, administered individually and in combination with each other, to determine the optimal treatment approach.

The lack of comparative treatment studies might suggest that there is a general lack of demand for psychological services for problematic video game play and/or video game addiction (King et al., 2010). However, this may not necessarily be the case. For instance, Woog (2004) surveyed a random sample of 5000 US mental health professionals. Although only 229 participants completed the questionnaire, two-thirds had treated someone with excessive computer use problems in the year prior to the survey. Woog also reported that problematic gaming was most common among 11 to 17-year old clients. However, this may not be truly representative, as this age group may be more likely to present in therapy. Anecdotal evidence suggests 11 to 17-year old clients are typically forced by concerned parents to attend treatment. Adult gaming addicts may not seek treatment, or seek treatment at a later stage for other psychological problems (e.g., depression) that develop after experiencing the severe negative consequences of gaming.

In South East Asia there appears to be significant demand for treatment for online-related problems, including gaming addiction. The South Korean government has reportedly established a network of over 140 counseling centers for treatment of online addiction (Kim, 2008). In Western countries, gaming addiction clinics have also started to emerge in places such as Holland and the UK (Griffiths & Meredith, 2009; King, Delfabbro, Griffiths, & Gradisar, 2011). There are also treatment groups that are modeled on 12-step self-help treatment (e.g., Online Gamers Anonymous) (Griffiths &

Meredith, 2009). However, little detail is known about the treatment protocols or their efficacy.

Conclusions

Based on the published empirical studies, and particularly those published over the last decade, it appears that in extreme cases, excessive gaming can have potentially damaging effects upon individuals who appear to display compulsive and/or addictive behaviour similar to other more traditional addictions. However, the field has been hindered by the use of inconsistent and non-standardized criteria to assess and identify problematic and/or addictive video game use. Furthermore, most studies' recruitment methods have serious sampling biases with an over-reliance on self-selected samples.

Despite these shortcomings, there are several noticeable trends that can be drawn from this review of problematic video game play and gaming addiction.

- There has been a significant increase in empirical research decade by decade since the early 1980s.
- There has been a noticeable (and arguably strategic) shift in researching the mode of video game play. In the 1980s, research mainly concerned 'pay-to-play' arcade video games. In the 1990s, research mainly concerned stand alone (offline) video games played at home on consoles, PCs or handheld devices. In the 2000s, research mainly concerned online massively multiplayer video games.
- There has been a noticeable shift in how data is collected. Up until the early 2000s, data about video game behaviour was typically collected face-to-face, whereas contemporary studies collect data online, strategically targeting online forums where gamers are known to (virtually) congregate. These samples are typically self-selecting and (by default) unrepresentative of the general population. Therefore, generalization is almost always one of the methodological shortcomings of this data collection approach.
- Survey study sample sizes have generally increased. In the 1980s and 1990s, sample sizes were typically in the low hundreds. In the 2000s, sample sizes in their thousands – even if unrepresentative – are not uncommon.
- There has been a diversification in the way data is collected, including experiments, physiological investigations, secondary analysis of existing data (such as data collected from online forums), and behavioural tracking studies.

- There has been increased research on adult (i.e., non-child and non-adolescent) samples, reflecting the fact that the demographics of gaming have changed.
- There has been increasing sophistication in relation to issues concerning assessment and measurement of problematic video game play and video game addiction. In the last few years, instruments have been developed that have more robust psychometric properties in terms of reliability and validity. However, there are still some concerns as many of the most widely used screening instruments were adapted from adult screens and much of the video game literature has examined children and adolescents. King, et al. (2012) assert that to enable future advances in the development and testing of interventions for video game-related problems, there must be some consensus among clinicians and researchers as to the precise classification of these problems.

The fact that IGD was included in Section 3 of the DSM-5 appears to have been well received by researchers and clinicians in the gaming addiction field (and by those individuals that have sought treatment for such disorders and had their experiences psychiatrically validated). However, for IGD to be included in the section on 'Substance-Related and Addictive Disorders' along with 'Gambling Disorder', the gaming addiction field must unite and start using the same assessment measures so that comparisons can be made across different demographic groups and different cultures. For epidemiological purposes, Koronczai and colleagues (2011) assert that the most appropriate measures in assessing problematic online use (including internet gaming) should meet six requirements. Such an instrument should have: (i) brevity (to make surveys as short as possible and help overcome question fatigue); (ii) comprehensiveness (to examine all core aspects of problematic gaming as possible); (iii) reliability and validity across age groups (e.g., adolescents vs. adults); (iv) reliability and validity across data collection methods (e.g., online, face-to-face interview, paper-and-pencil); (v) cross-cultural reliability and validity; and (vi) clinical validation. It was also noted that an ideal assessment instrument should serve as the basis for defining adequate cut-off scores in terms of both specificity and sensitivity.

Clearly, there exist a number of gaps in current understanding of problematic video game play and gaming addiction. King, Delfabbro, and Griffiths (2013) note there is a need for epidemiological research to determine the incidence and prevalence of clinically

significant problems associated with video game play in the broader population. There are too few clinical studies that describe the unique features and symptoms of problematic video game play and/or video game addiction. Most of the studies tend to examine problematic video play from the perspective of the individual. However, there is a small body of research suggesting that the characteristics of the video games themselves may have a role in the acquisition, development, and maintenance of video game addiction. These studies have investigated the role of structural characteristics of video games in maintaining problem playing behaviour (Wood, Griffiths, Chappell, & Davies, 2004; Westwood & Griffiths, 2010; King et al., 2011), but there is little empirical research that examines why some individuals may be protected from developing excessive playing habits, or whether some individuals simply mature out of their problem playing behaviour.

Another growing concern is the recent explosion of online and mobile gaming although, as yet, little research has been done. There are also strong links between online gaming, gambling, non-gambling fantasy games, role-playing games, board games and card games. These may be an additional cause for concern as youth migrate from free gaming sites to online gambling sites. It should also be noted that video game playing does not occur in a vacuum, but is one behaviour engaged in alongside many others. To date, very few studies have been used to examine links between video games and other risk behaviours (e.g., gambling, drug and alcohol use, seatbelt use, poor school performance, conduct problems, truancy, delinquency, violence and sexual activity).

References

Allison, S. E., von Wahlde, L., Shockley, T., & Gabbard, G. O. (2006). The development of the self in the era of the Internet and role-playing fantasy games. *American Journal of Psychiatry, 163,* 381–385.

American Psychiatric Association. (1987). Diagnostic and Statistical Manual for Mental Disorders (Third Edition). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (1994). Diagnostic and Statistical Manual for Mental Disorders (Fourth Edition). Washington, DC: American Psychiatric Association.

American Psychiatric Association (2013) *Diagnostic and Statistical Manual of Mental Disorders - Text Revision (Fifth Edition)*. Washington, D.C.: Author.

Barnett, J. & Coulson, M. (2010). Virtually real: A psychological perspective on massively multiplayer online games. *Review of General Psychology,* 4, 167-179.

Baggio, S., Studer, J., Dupuis, M., Mohler-Kuo, M., Daeppen, J. B., & Gmel, G. (2015). Pathological video game use among young Swiss men: The use of monothetic and polythetic formats to distinguish between pathological, excessive and normal gaming. *Journal of Addictive Behaviors, Therapy & Rehabilitation, 4*(1). doi:10.4172/2324-9005.1000133

Batthyány, D., Müller, K. W., Benker, F., & Wölfling, K. (2009). Computer game playing: clinical characteristics of dependence and abuse among adolescents. Wiener Klinsche Wochenschrift, 121(15–16), 502–509.

Blocher, J. M. (2015). Gaming. In R. Papa (Ed.), *Media Rich Instruction* (pp. 219-234): Springer International Publishing.

Block, J. J. (2008). Issues for DSM-V: Internet addiction [Editorial]. *American Journal of Psychiatry, 165*, 306

Brasington, R. (1990). Nintendinitis. *New England Journal of Medicine, 322,* 1473–1474.

Brown, R.I.F., & Robertson, S. (1993). Home computer and video game addictions in relation to adolescent gambling: Conceptual and developmental aspects. In W. R. Eadington & J. A. Cornelius (Eds.), *Gambling Behavior and Problem Gambling*, pp. 451–471. Reno: University of Nevada Press.

Brunborg, G. S., Hanss, D., Mentzoni, R. A., & Pallesen, S. (2015). Core and peripheral criteria of video game addiction in the game addiction scale for adolescents. *Cyberpsychology, Behavior, and Social Networking, 18*(5), 280-285.

Caplan, S. E., Williams, D., & Yee, N. (2009). Problematic internet use and psychosocial well-being among MMO players. *Computers in Human Behavior, 25*, 1312–1319.

Carras, M. C., Van Rooij, A. J., Van de Mheen, D., Musci, R., Xue, Q. L., & Mendelson, T. (2017). Video gaming in a hyperconnected world: A cross-sectional study of heavy gaming, problematic gaming symptoms, and online socializing in adolescents. *Computers in Human Behavior, 68*, 472-479.

Casanova, J., & Casanova, J. (1991). Nintendinitis. *Journal of Hand Surgery, 16,* 181.

Charlton, J.P. (2002). A factor-analytic investigation of computer 'addiction' and engagement. *British Journal of Psychology*, *93*, 329–344.

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

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(1),* 16–26.

Chuang, Y.C. (2006). Massively multiplayer online role-playing game-induced seizures: a neglected health problem in Internet addiction. *CyberPsychology and Behavior, 9*, 451–456.

Cleary, A.G., Mckendrick, H., & Sills, J.A. (2002). Hand-arm vibration syndrome may be associated with prolonged use of vibrating computer games. *British Medical Journal, 324,* 301.

Corkery, J.C. (1990). Nintendo power. *American Journal of Diseases in Children, 144,* 959.

Cultrara, A., & Har-El, G. (2002). Hyperactivity-induced suprahyoid muscular hypertrophy secondary to excessive video game play: a case report. *Journal of Oral and Maxillofacial Surgery, 60,* 326–327.

Deheger, M., Rolland-Cachera, M.F., & Fontvielle, A.M. (1997). Physical activity and body composition in 10 year old French children: Linkages with nutritional intake? *International Journal of Obesity, 21,* 372– 379.

Demetrovics, Z., Urbán, R., Nagygyörgy, K., Farkas, J., Griffiths, M. D., Pápay, O., . . . Oláh, A. (2012). The development of the Problematic Online Gaming Questionnaire (POGQ). *PLoS ONE, 7*(5), e36417.

Dreier, M., Wölfling, K., & Müller, K. W. (2013). Psychological Research and a Sociological Perspective on Problematic and Addictive Computer Game Use in Adolescents. In A. Tsitsika, M. Janikian, D. E. Greydanus, H. A. Omar, & J. Merrick (Eds.), *Internet Addiction: A Public Health Concern in Adolescence* (pp. 87-110). New York: Nova Science Publishers.

Dworak, M., Schierl, T., Bruns, T., & Struder, H. K. (2007). Impact of singular excessive computer game and television exposure on sleep patterns and memory performance of school-aged children. *Pediatrics, 120*, 978–985.

Entertainment Software Association. (2017) Essential facts about the computer and video game industry. Washington, DC: Retrieved from http://www.theesa.com/wp-content/uploads/2017/09/EF2017_Design_FinalDigital.pdf.

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

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

Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D. D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: a two-year longitudinal study. *Pediatrics, 127*(2), 319-329.

Graf, W. D., Chatrian, G. E., Glass, S. T., & Knauss, T. A. (1994). Video-game related seizures: A report on 10 patients and a review of the literature. *Pediatrics, 3,* 551–556.

Griffiths, M.D. (1997). Computer game playing in early adolescence. *Youth and Society*, *29*, 223-237.

Griffiths, M.D. (2000). Internet addiction - Time to be taken seriously? *Addiction Research, 8*, 413-418.

Griffiths, M.D. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance Use*, 10, 191-197.

Griffiths, M.D. (2010). Computer game playing and social skills: A pilot study. *Aloma: Revista de Psicologia, Ciències de l'Educació i de l'Esport,* 27, 301-310.

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

Griffiths, M.D. & Hunt, N. (1995). Computer game playing in adolescence: Prevalence and demographic indicators. *Journal of Community and Applied Social Psychology*, 5, 189-193.

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

Griffiths, M.D., King, D.L. & Demetrovics, Z. (2014). DSM-5 Internet Gaming Disorder needs a unified approach to assessment. *Neuropsychiatry*, 4(1), 1-4.

Griffiths, M.D. & Meredith, A. (2009). Videogame addiction and treatment. *Journal of Contemporary Psychotherapy, 39(4),* 47-53.

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

Han, D. H., Lee, Y. S., Yang, K. C., Kim, E. Y., Lyoo, I. K., & Renshaw, P. F. (2007). Dopamine genes and reward dependence in adolescents with excessive internet video game play. *Journal of Addiction Medicine, 1,* 133–138.

Han, D. H., Lee, Y. S., Na, C., Ahn, J. Y., Chung, U. S., Daniels, M. A., et al. (2009). The effect of methylphenidate on Internet video game play in children with attention-deficit/hyperactivity disorder. *Comprehensive Psychiatry, 50,* 251–256.

Han, D.H., Hwang, J.W., & Renshaw, P.F. (2010). Bupropion sustained release treatment decreases craving for video games and cue-induced brain activity in patients with Internet video game addiction. *Experimental and Clinical Psychopharmacology, 18,* 297–304.

Harding, G.F.A., & Jeavons, P. M. (1994). *Photosensitive Epilepsy.* London: Mac Keith Press.

Henchoz, Y., Studer, J., Deline, S., N'Goran, A. A., Baggio, S., & Gmel, G. (2016). Video gaming disorder and sport and exercise in emerging adulthood: A longitudinal study. *Behavioral Medicine, 42*(2), 105-111.

Hoeft, F., Watson, C. L., Kesler, S. R., Bettinger, K. E., & Reiss, A. L. (2008). Gender differences in the mesocorticolimbic system during computer game-play. *Journal of Psychiatric Research, 42*, 253–258.

Hussain, Z., & Griffiths, M.D. (2009a). The attitudes, feelings, and experiences of online gamers: a qualitative analysis. *CyberPsychology and Behavior, 12*, 747–753.

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

Jeong, E. J., & Kim, D. W. (2011). Social activities, self-efficacy, game attitudes, and game addiction. *Cyberpsychology, Behavior & Social Networking, 14*, 213-221.

Johnson, B., & Hackett, A. F. (1997). Eating habits of 11–14-year-old schoolchildren living in less affluent areas of Liverpool, UK. *Journal of Human Nutrition and Dietetics, 10,* 135–144.

Johnston, B., Boyle, L., MacArthur, E., & Manion, B. F. (2013). The role of technology and digital gaming in nurse education. *Nursing Standard, 27*(28), 35-38.

Keepers, G.A. (1990). Pathologicical preoccupation with video games. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 49–50.

Kim, E. J., Namkoong, K., Ku, T., & Kim, S. J. (2008). The relationship between online game addiction and aggression, self-control and narcissistic personality traits. European Psychiatry, 23, 212–218.

Kim, J. (2008). The effect of a R/T group counselling program on the Internet addiction level and self-esteem of Internet addiction university students. *International Journal of Reality Therapy, 17,* 4-12.

Kim, M.G., & Kim, J. (2010). Cross-validation of reliability, convergent and discriminant validity for the problematic online game use scale. *Computers in Human Behavior, 26,* 389–398.

King, D. L., & Delfabbro, P. (2009). Understanding and assisting excessive players of video games: a community psychology perspective. *The Australian Community Psychologist, 21(1),* 62–74.

King, D.L., Delfabbro, P.H. & Griffiths, M.D. (2010). Cognitive behavioural therapy for problematic video game players: Conceptual considerations and practice issues. *Journal of CyberTherapy and Rehabilitstion, 3*, 261-273.

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*, 320-333.

King, D.L., Delfabbro, P.H. & Griffiths, M.D. (2012). Clinical interventions for technology-based problems: Excessive Internet and video game use. *Journal of Cognitive Psychotherapy,* 26, 43-56.

King, D. L., Delfabbro, P. H., & Griffiths, M. D. (2013). Video game addiction. In P. Miller (Ed.) *Principles of Addiction: Comprehensive Addictive Behaviors and Disorders.* (Vol. 1, pp. 819-825). San Diego: Academic Press.

King, D.L., Delfabbro, P.H., Griffiths, M.D. & Gradisar, M. (2011). Assessing clinical trials of Internet addiction treatment: A systematic review and CONSORT evaluation. *Clinical Psychology Review, 31,* 1110-1116.

King, D.L., Haagsma, M.C., Delfabbro, P.H., Gradisar, M.S., Griffiths, M.D. (2013). Toward a consensus definition of pathological video-gaming: A systematic review of psychometric assessment tools. *Clinical Psychology Review,* 33, 331-342.

Ko, C. H., Yen, J. Y., Chen, C. C., Chen, S. H., & Yen, C. F. (2005). Gender differences and related factors affecting online gaming addiction among Taiwanese adolescents. *Journal of Nervous and Mental Disease, 193*, 273–277.

Ko, C. H., Liu, G. C., Hsiao, S. M., Yen, J. Y., Yang, M. J., Lin, W. C., et al. (2009). Brain activities associated with gaming urge of online gaming addiction. Journal of Psychiatric Research, 43, 739–747.

Koronczai, B., Urban, R., Kokonyei, G., Paksi, B., Papp, K., Kun, B., . . . Demetrovics, Z. (2011). Confirmation of the three-factor model of problematic internet use on off-line adolescent and adult samples. *Cyberpsychology, Behavior and Social Networking, 14*, 657–664.

Kuczmierczyk, A. R., Walley, P. B., & Calhoun, K. S. (1987). Relaxation training, in vivo exposure and response-prevention in the treatment of compulsive video-game playing. *Scandinavian Journal of Behaviour Therapy*, *16*, 185–190.

Kuss, D.J. & Griffiths, M.D. (2012). Online gaming addiction: A systematic review. *International Journal of Mental Health and Addiction,* 10, 278-296.

Lemmens, J. S., Valkenburg, P. M., & Gentile, D. A. (2015). The Internet Gaming Disorder Scale. *Psychological Assessment, 27*(2), 567-582.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). Psychosocial causes and consequences of pathological gaming. *Computers in Human Behavior, 27*, 144-152.

Liu, M., & Peng, W. (2009). Cognitive and psychological predictors of the negative outcomes associated with playing MMOGs (massively multiplayer online games). *Computers in Human Behavior, 25*, 1306–1311.

Loftus, G. A., & Loftus, E. F. (1983). *Mind at play: The psychology of video games.* New York: Basic Books.

Maeda, Y., Kurokawa, T., Sakamoto, K., Kitamoto, I., Kohji, U., & Tashima, S. (1990). Electroclinical study of video-game epilepsy. *Developmental Medicine and Child Neurology, 32*, 493–500.

Männikkö, N., Ruotsalainen, H., Miettunen, J., Pontes, H. M., & Kääriäinen, M. (2018). Problematic gaming behaviour and health-related outcomes: A systematic review and meta-analysis. *Journal of Health Psychology*. doi:10.1177/1359105317740414

McCowan, T. C. (1981). Space Invaders wrist. *New England Journal of Medicine, 304,* 1368.

Mehroof, M., & Griffiths, M. D. (2010). Online gaming addiction: the role of sensation seeking, self-control, neuroticism, aggression, state anxiety, and trait anxiety. *CyberPsychology and Behavior, 13*, 313–316.

Miller, D.L.G. (1991). Nintendo neck. *Canadian Medical Association Journal, 145*, 1202.

Millett, C.J., Fish, D.R., & Thompson, P.J. (1997). A survey of epilepsy-patient perceptions of video-game material/electronic screens and other factors as seizure precipitants. *Seizure, 6,* 457–459.

Mirman, M. J., & Bonian, V. G. (1992). "Mouse elbow": A new repetitive stress injury. *Journal of the American Osteopath Association, 92*, 701.

Müller, K. W., Janikian, M., Dreier, M., Wölfling, K., Beutel, M. E., Tzavara, C., . . . Tsitsika, A. (2015). Regular gaming behavior and internet gaming disorder in European adolescents: Results from a cross-national representative survey of prevalence, predictors, and psychopathological correlates. *European Child and Adolescent Psychiatry, 24*(5), 565-574.

Nilles, J.M. (1982). *Exploring the world of the personal computer.* Englewood Cliffs, NJ: Prentice Hall.

Ortiz de Gortari, A.B. & Griffiths, M.D. (2014a). Auditory experiences in Game Transfer Phenomena: An empirical self-report study. *International Journal of Cyber Behavior, Psychology and Learning,* 4(1), 59-75.

Ortiz de Gortari, A.B. & Griffiths, M.D. (2014b). Altered visual perception in Game Transfer Phenomena: An empirical self-report study. *International Journal of Human-Computer Interaction,* 30, 95-105.

Pápay, O., Urbán, R., Griffiths, M. D., Nagygyörgy, K., Farkas, J., Elekes, Z., . . . Demetrovics, Z. (2013). Psychometric properties of the Problematic Online Gaming Questionnaire Short-Form (POGQ-SF) and prevalence of problematic online gaming in a national sample of adolescents. *Cyberpsychology, Behavior and Social Networking,* 16, 340-348.

Pápay, O., Nagygyörgy, K., Griffiths, M.D. & Demetrovics, Z. (2014). Problematic online gaming. In K. Rosenberg & L. Feder (Eds.), *Behavioral Addictions: Criteria, Evidence and Treatment* (pp.61-95). New York: Elsevier.

Park, S., Jeon, H. J., Son, J. W., Kim, H., & Hong, J. P. (2017). Correlates, comorbidities, and suicidal tendencies of problematic game use in a national wide sample of Korean adults. *International Journal of Mental Health Systems, 11*(1), 35.

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.

Parsons, K. (1995, April). Educational places or terminal cases: Young people and the attraction of computer games. Paper presented at the British Sociological Association Annual Conference, University of Leicester.

Peng, W., & Liu, M. (2010). Online gaming dependency: a preliminary study in China. *Cyberpsychology, Behavior and Social Networking, 13,* 329–333.

Peters, C. S., & Malesky, L. A. (2008). Problematic usage among highly-engaged players of massively multiplayer online role playing games. *CyberPsychology and Behavior, 11,* 480–483.

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

Phillips, C.A., Rolls, S., Rouse, A. & Griffiths, M.D. (1995). Home video game playing in schoolchildren: A study of incidence and pattern of play. *Journal of Adolescence, 18,* 687-691.

Pontes, H. & Griffiths, M.D. (2014). The assessment of internet gaming disorder in clinical research. *Clinical Research and Regulatory Affairs,* DOI: 10.3109/10601333.2014.962748.

Pontes, H. M., Macur, M., & Griffiths, M. D. (2016). Internet Gaming Disorder among Slovenian primary schoolchildren: Findings from a nationally representative sample of adolescents. *Journal of Behavioral Addictions, 5*(2), 304-310.

Porter, G., Starcevic, V., Berle, D., & Fenech, P. (2010). Recognizing problem video game use. *The Australian and New Zealand Journal of Psychiatry, 44(2),* 120–128.

Quirk, J.A., Fish, D.R., Smith, S.J.M., Sander, J.W., Shorvon, S. D., & Allen, P.J. (1995). First seizures associated with playing electronic screen games: A com- munity based study in Great Britain. *Annals of Neurology, 37,* 110–124.

Rehbein, F., Kleimann, M., & Mossle, T. (2010). Prevalence and risk factors of video game dependency in adolescence: results of a German nationwide survey. *CyberPsychology, Behavior and Social Networking, 13,* 269–277.

Reinstein, L. (1983). De Quervain's stenosing tenosynovitis in a video games player. *Archives of Physical and Medical Rehabilitation, 64,* 434–435.

Rosenkranz, T., Müller, K. W., Dreier, M., Beutel, M. E., & Wölfling, K. (2017). Addictive potential of Internet applications and differential correlates of problematic use in Internet gamers versus generalized Internet users in a representative sample of adolescents. *European Addiction Research, 23*(3), 148-156.

Ross, D.R., Finestone, D.H. & Lavin, G.K. (1982). Space Invaders obsession. *Journal of the American Medical Association, 248*, 1117.

Schink, J. C. (1991). Nintendo enuresis. *American Journal of Diseases in Children, 145,* 1094.

Shimai, S., Yamada, F., Masuda, K., & Tada, M. (1993). TV game play and obesity in Japanese school children. *Perceptual and Motor Skills, 76*, 1121–1122.

Shotton, M. (1989). *Computer addiction? A study of computer dependency.* London: Taylor and Francis.

Siegal, I. M. (1991). Nintendonitis. *Orthopedics, 14*, 745.

Skoric, M. M., Teo, L. L. C., & Neo, R. L. (2009). Children and video games: addiction, engagement, and scholastic achievement. *CyberPsychology and Behavior, 12*, 567–572.

Soper, W. B., & Miller, M. J. (1983). Junk time junkies: An emerging addiction among students. *School Counsellor, 31,* 40–43.

Spence, S.A. (1993). Nintendo hallucinations: A new phenomenological entity. *Irish Journal of Psychological Medicine, 10*, 98–99.

Strittmatter, E., Kaess, M., Parzer, P., Fischer, G., Carli, V., Hoven, C. W., . . . Wasserman, D. (2015). Pathological Internet use among adolescents: Comparing gamers and non-gamers. *Psychiatry Research, 228*(1), 128-135.

Thalemann, R., Wölfling, K., & Grüsser, S. M. (2007). Specific cue reactivity on computer game-related cues in excessive gamers. *Behavioral Neuroscience, 12,* 614–618.

Thomas, N.J., & 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*, 59-66.

Torres-Rodriguez, A., Griffiths, M. D., Carbonell, X. Farriols-Hernando, N. & Torres-Jimenez, E. (2018). Internet gaming disorder treatment: A case study evaluation of four adolescent problematic gamers. *International Journal of Mental Health and Addiction.* Epub ahead of print. doi: 10.1007/s11469-017-9845-9

Ustinavičienė, R., Škėmienė, L., Lukšienė, D., Radišauskas, R., Kalinienė, G., & Vasilavičius, P. (2016). Problematic computer game use as expression of Internet addiction and its association with self-rated health in the Lithuanian adolescent population. *Medicina, 52*(3), 199-204.

Vandewater, E.A., Shim, M. & Caplovitz, A.G. (2004). Linking obesity ad activity level with children's television and game use. *Journal of Adolescence, 27*, 71-85.

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

Wartberg, L., Kriston, L., & Thomasius, R. (2017). The prevalence and psychosocial correlates of Internet Gaming Disorder - analysis in a nationally representative sample of 12- to 25-year-olds. *Deutsches Ärzteblatt International, 114*(25), 419-424.

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

Widyanto, L., Griffiths, M.D. & Brunsden, V. (2011). A psychometric comparison of the Internet Addiction Test, the Internet Related Problem Scale, and Self-Diagnosis. *Cyberpsychology, Behavior, and Social Networking, 14*, 141-149.

Wood, R.T.A., Griffiths, M.D., Chappell, D. & Davies, M.N.O. (2004). The structural characteristics of video games: A psycho-structural analysis. *CyberPsychology and Behavior, 7,* 1-10.

Woog, K. (2004). A survey of mental health professionals clinical exposure to problematic computer use. Unpublished study. Located at: http://www.wooglabs.com/ (last accessed August 18, 2011).

Yee, N. (2006a). The demographics, motivations and derived experiences of users of massively-multiuser online graphical environments. *PRESENCE: Teleoperators and Virtual Environments,* 15, 309–329.

Yee, N. (2006b). The psychology of MMORPGs: emotional investment, motivations, relationship formation, and problematic usage. In R. Schroeder & A. Axelsson (Eds.), *Avatars at work and play: Collaboration and interaction in shared virtual environments* (pp. 187–207). London: Springer.

Young, K. (1998). *Caught in the Net.* Chichester: Wiley.

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

Young, K. S. (2013). Treatment outcomes using CBT-IA with Internet-addicted patients. *Journal of Behavioral Addictions*, *2*(4), 209–215.

Yousafzai, S., Hussain, Z., & Griffiths, M. D. (2013). Social responsibility in online

videogaming: What should the videogame industry do? *Addiction Research & Theory, 22*(3), 181-185.

Yu, H., & Cho, J. (2016). Prevalence of Internet Gaming Disorder among Korean adolescents and associations with non-psycothic psychological symptoms, and physical aggression. *American Journal of Health Behavior, 40*(6), 705-716.

Zamani, E., Kheradmand, A., Cheshmi, M., Abedi, A. &, Hedayati, N. (2010). Comparing the social skills of students addicted to computer games with normal students. *Journal of Addiction and Health*, *2,* 59-69.