

# Online gaming addiction in children and adolescents: A review of empirical research

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(Received: November 3, 2011; revised manuscript received: December 9, 2011; accepted: December 10, 2011)

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*Background and aims:* Research suggests that excessive online gaming may lead to symptoms commonly experienced by substance addicts. Since games are particularly appealing to children and adolescents, these individuals may be more at risk than other groups of developing gaming addiction. *Methods:* Given these potential concerns, a literature review was undertaken in order (i) to present the classification basis of online gaming addiction using official mental disorder frameworks, (ii) to identify empirical studies that assess online gaming addiction in children and adolescents, and (iii) to present and evaluate the findings against the background of related and established mental disorder criteria. *Results:* Empirical evidence comprising 30 studies indicates that for some adolescents, gaming addiction exists and that as the addiction develops, online gaming addicts spend increasing amounts of time preparing for, organizing, and actually gaming. *Conclusions:* Evidence suggests that problematic online gaming can be conceptualized as a behavioral addiction rather than a disorder of impulse control.

**Keywords:** internet gaming addiction, online games, adolescents, children, literature review, classification

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## INTRODUCTION

Play is an innate human drive that begins in very early childhood (Caillois, 1961). Today, much game play has been transferred from the real (i.e., the embodied world) to the online world and is verified by software sales. In 2010, both video and PC game software retail sales amounted to approximately \$15.5 (US) billion (Johnson, 2011). The most popular online game is *The Sims 3* followed by *World of Warcraft's Wrath of the Lich King*. This suggests that 'Simulation Games' and 'Massively-Multiplayer Online Role-Playing Games' (MMORPGs) are favored by gaming communities (The NPD Group, 2010). These games allow players to (i) inhabit massive game worlds concurrently, (ii) develop virtual alter egos, namely avatars, and (iii) play with others all over the world anytime and anywhere. Furthermore, they enable immersion in a reality that is both simultaneously fantastic and poignantly real. Therefore, these games can be seen as "systems[s] in which reality itself [...] is entirely captured, fully immersed in a virtual image setting, in the world of make believe, in which appearances are not just on the screen through which experience is communicated, but they become the experience" (Castells, 1996, p. 404).

The manifold possibilities that online games offer for aficionados and novices alike clearly highlight the wide appeal of these games. Moreover, according to the latest report of the Entertainment Software Association (ESA), 25% of the computer and video game players are under the age of 18 years and 60% are male. The ESA also reported that 25% of parents do not impose time limits on their children's Internet use in general and 17% of parents do not impose time limits on video and computer game playing (ESA, 2010). From these statistics, it appears that gaming, and particularly online gaming, is an integral element of children and adolescents' leisure time activities.

Whilst gaming is a pleasurable pastime activity, research suggests that excessive online gaming may in extreme cases lead to symptoms commonly experienced by substance addicts, namely salience, mood modification, craving, and tolerance (Hsu, Wen & Wu, 2009; Ko et al., 2009; Mevrouw & Griffiths, 2010; Wölfling, Grüsser & Thalemann, 2008; Young, 2009). A recent systematic literature review suggests that it is particularly excessive engagement with MMORPGs that can lead to addiction in a small minority of players (Kuss & Griffiths, 2011). Since online and offline video and computer games are particularly appealing to children and adolescents (ESA, 2010), it appears reasonable to suggest that these groups may be particularly at risk (i.e., more vulnerable and susceptible) of developing gaming addiction. Furthermore, it has been argued that because of the 24/7 nature and almost mandatory excessive play required in playing MMORPGs (such as *World of Warcraft* and *Everquest*), online gaming may be more problematic for 'at risk' individuals than offline gaming (Griffiths & Meredith, 2009).

Assessing online gaming addiction in children and adolescents is relevant for several reasons. With regards to developmental psychopathological findings, it appears that addictions tend to have precursors during adolescence (Hawkins & Fitzgibbon, 1993). Also, it is relatively common that substance dependencies develop in early adulthood (APA, 2000). Therefore, prevention efforts must be established that target adolescents who have their first experiences with addictive substances and behaviors during their pubescence. During this period of time, adolescents are confronted with a variety of cumulated stressors, such as physi-

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cal and hormonal changes, as well as shifts in personal value and belief systems. Parental influence is diminished whereas the peer group gains more importance. Peer pressure may lead to a variety of problems (Silbereisen & Kastner, 1998) that may eventuate in the development of pathological behaviors, such as chemical and behavioral addictions (Wölfling & Müller, 2009).

Adolescents may use online games as a way of coping with stressors and gaming can become a dysfunctional media-focused coping strategy (Thalemann, 2009). Similarly, relationships between problematic gaming and the ways in which adolescents cope with stressors and frustrations have been reported (Wölfling, Thalemann & Grüsser, 2008). For instance, problematic gamers play games significantly more frequently than non-problematic gamers as a reaction to anger and frustration. Thus, they appear to use gaming as a strategy for emotion regulation in order to decrease negative feelings. This seems particularly problematic because those adolescents who play online games excessively are likely to get little chance to actually develop healthy ways of coping with stressors because they are constantly occupied with playing online games instead. Therefore, their psychosocial development may be significantly impaired. The consistent blocking out of and passive coping with stressful experiences is a strategy that may be successful in the short-term. However, viewed from a long-term perspective, it may limit the potential to have fundamental experiences that are necessary for developing a protective way to cope. In this case, it appears more likely that once new stressors appear, some adolescents continue to use escapist and media-focused coping mechanisms. This results in a vicious circle (Wölfling & Müller, 2009).

A wide variety of empirical and prospective studies have investigated the negative consequences of stressors upon psychological and physiological parameters when the former are inadequately dealt with. Accordingly, a repertoire of coping strategies that is underdeveloped may be seen as a risk factor for the development of a variety of negative psychological and psychosomatic problems. These entail direct effects on the immune system (Charlton, 2002) as well as negative affectivity (Kim et al., 2006) and psychosomatic problems (Batthyány, Müller, Benker & Wölfling, 2009). Moreover, adolescents aged 17–19 years treated for their pathological gambling and online gaming addiction at the Outpatient Clinic for Gaming Addictions in Mainz, Ger-

many, have been found to suffer from depressive symptoms, anxiety, and somatization (Wölfling & Müller, 2009). Such clinical observations hint at the importance of assessing excessive and potentially pathological online gaming behavior.

### *Clinical diagnosis*

Behavioral addictions, such as online gaming addiction, have typically been categorized either within the frameworks of impulse control disorders or substance dependencies (Grüsser & Thalemann, 2006). To date, criteria developed for the diagnosis of online gaming addiction in empirical studies have been based on either the criteria for pathological gambling or the criteria for substance dependence. According to the American Psychiatric Association's (2000) official diagnosis, pathological gambling is an impulse control disorder not otherwise specified (see Table 1). The main characteristic of impulse control disorders is the "failure to resist an impulse, drive, or temptation to perform an act that is harmful to the person or to others" (APA, 2000, p. 663).

An alternative approach to assessing online gaming addiction is the reliance on the official criteria for substance dependence or the dependence syndrome (APA, 2000; WHO, 1992). The discriminative features of substance dependence include "a cluster of cognitive, behavioral, and physiological symptoms indicating that the individual continues use of the substance despite significant substance-related problems" (APA, 2000, p. 192). The relevant diagnostic items for substance dependence are presented below in Table 2.

Unlike pathological gambling, a diagnosis for substance dependence requires the presence of the respective criteria within a period of 12 months. Thus, it adds a time criterion to diagnosis that is relevant for the identification of genuine pathology. Moreover, another main distinguishing feature is the absence of a withdrawal criterion in the case of pathological gambling relative to substance dependence. Therefore, for pathological gambling, the actual activity of engaging in the potentially maladaptive behavior takes a prime role over any other possible negative consequences the engagement may result in. Typically, the reliance on substance dependence criteria is used for the classification of behavioral addictions (Batthyány & Pritz, 2009; Grüsser & Thalemann, 2006). With behavioral addictions such as online gaming ad-

Table 1. Diagnostic criteria for 312.31 pathological gambling

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- A. Persistent and recurrent maladaptive gambling behavior as indicated by five (or more) of the following:
- (1) is preoccupied with gambling (e.g., preoccupied with reliving past gambling experiences, handicapping or planning the next venture, or thinking of ways to get money with which to gamble)
  - (2) needs to gamble with increasing amounts of money in order to achieve the desired excitement
  - (3) has repeated unsuccessful efforts to control, cut back, or stop gambling
  - (4) is restless or irritable when attempting to cut down or stop gambling
  - (5) gambles as a way of escaping from problems or of relieving a dysphoric mood (e.g., feelings of helplessness, guilt, anxiety, depression)
  - (6) after losing money gambling, often returns another day to get even ("chasing" one's losses)
  - (7) lies to family members, therapist, or others to conceal the extent of involvement with gambling
  - (8) has committed illegal acts such as forgery, fraud, theft, or embezzlement to finance gambling
  - (9) has jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling
  - (10) relies on others to provide money to relieve a desperate financial situation caused by gambling
- B. The gambling behavior is not better accounted for by a Manic Episode.
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*Note:* The criteria presented originate from the American Psychiatric Association's taxonomy (2000, p. 674), which is similar to the World Health Organization's classification of pathological gambling within the category of "habit and impulse disorders, F63.0" (1992).

Table 2. Criteria for substance dependence

A maladaptive pattern of substance use, leading to clinically significant impairment or distress, as manifested by three (or more) of the following, occurring at any time in the same 12-month period:

- (1) tolerance, as defined by either of the following:
  - (a) a need for markedly increased amounts of the substance to achieve intoxication or desired effect
  - (b) markedly diminished effect with continued use of the same amount of the substance
- (2) withdrawal, as manifested by either of the following:
  - (a) the characteristic withdrawal syndrome for the (respective) substance
  - (b) the same (or a closely related) substance is taken to relieve or avoid withdrawal symptoms
- (3) the substance is often taken in larger amounts or over a longer period than was intended
- (4) there is a persistent desire or unsuccessful efforts to cut down or control substance use
- (5) a great deal of time is spent in activities necessary to obtain the substance (e.g., visiting multiple doctors or driving long distances), use the substance (e.g., chain-smoking), or recover from its effects
- (6) important social, occupational, or recreational activities are given up or reduced because of substance use
- (7) the substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance (e.g., current cocaine use despite recognition of cocaine-induced depression, or continued drinking despite recognition that an ulcer was made worse by alcohol consumption)

*Note:* The criteria presented originate from the American Psychiatric Association's classification of "substance dependence" (2000, p. 197), which is similar to the World Health Organization's classification of the "dependence syndrome" (1992).

diction, no psychotropic substances are ingested. Instead, the psychotropic effect results from biochemical changes in the body. These are triggered by rewarding activities that are then engaged in excessively (Holden, 2001).

Given the variety of potential classification frameworks for online gaming addiction, it appears to be crucial to evaluate each one individually. For this purpose, a literature review was undertaken. The specific aims of this review were to (i) present the classification basis of online gaming addiction using frameworks of officially recognized mental disorders as outlined in the current versions of the Diagnostic and Statistical Manual for Mental Disorders DSM-IV-TR (APA, 2000) and the International Classification of Mental and Behavioral Disorders ICD-10 (WHO, 1992), (ii) identify contemporary empirical studies that assess online gaming addiction in children and adolescents, and (iii) present and evaluate their findings against the background of the established official criteria. For this purpose, the empirical studies identified from the current scientific knowledge base will be delineated and evaluated.

## METHOD

The database *Web of Knowledge* was used to identify all empirical studies published through October 31, 2011. *Web of Knowledge* not only contains peer-reviewed articles and conference proceedings from various social sciences (e.g., medicine and psychology), but it also makes use of papers in the natural sciences and arts and humanities. Therefore, it can be considered to be considerably more comprehensive than other commonly used databases, such as *Psycinfo* or *PubMed*. For the purpose of broad coverage, further studies were accessed via *Google Scholar*. The search terms utilized to detect the relevant studies were "online gam\*", "Internet gam\*", "computer gam\*", "video gam\*", "addict\*", "dependen\*", "excess\*", and "patholog\*". The inclusion criteria upon which the studies were selected were: (i) the inclusion of empirically collected data, (ii) an assessment of online gaming addiction in some form, (iii) the inclusion of children and adolescents (aged 8–18 years) in the sample, (iv) publication in peer-reviewed journals, (v) full text availability, (vi) publication after the year 2000, and (vii) written in either English or German language since these are the authors' main languages. This timeframe was applied because

studies that were published earlier than 2000 were assumed to have a focus different from online games (i.e., they specifically assessed console or arcade video games without an equivalent on the Internet). Following the comprehensive literature search, 30 empirical studies were identified as meeting the inclusion criteria.

## RESULTS

Following a thorough review of the current empirical studies, the latter were classified in accordance with the diagnostic framework that the authors' utilized to identify potentially pathological online game use. Online gaming addiction in these 30 studies was assessed using different classification schemes. These included those based on the criteria for pathological gambling ( $n = 18$ ), those based on the criteria for substance dependence ( $n = 3$ ), those based on a combination of both pathological gambling and substance dependence ( $n = 3$ ), those based on parental referral ( $n = 2$ ), and those based on other miscellaneous classification criteria ( $n = 4$ ). Each of these will be described and subsequently evaluated. An overview is presented in Table 3.

### *Online gaming addiction based on the criteria for pathological gambling*

Based on the database literature search, 18 studies were identified that assessed online gaming addiction by means of using adapted diagnostic criteria for pathological gambling and impulse control disorders not otherwise specified (Chan & Rabinowitz, 2006; Dongdong, Liao & Khoo, 2011; Gentile, 2009; Gentile et al., 2011; Han et al., 2007, 2009; Kwon, Chung & Lee, 2011; Lemmens, Valkenburg & Peter, 2009, 2011a, 2011b; Rau, Peng & Yang, 2006; Thomas & Martin, 2010; van Rooij, Schoenmakers, van de Eijnden & van de Mheen, 2010; van Rooij, Schoenmakers, Vermulst, van de Eijnden & van de Mheen, 2011; Wan & Chiou, 2006a, 2006b, 2007).

In order to assess online gaming addiction, six studies (Chan & Rabinowitz, 2006; Han et al., 2007, 2009; Kwon et al., 2011; Rau et al., 2006; Thomas & Martin, 2010) used an adapted version of Young's (1998) Internet Addiction Scale (Widyanto & McMurrin, 2004; Young, 1996a, 1996b,

Table 3. Overview of included empirical studies

Study	Sample and design	Instruments	Addiction criteria, symptoms and prevalence
Allison, von Wahle, Shockley and Gabbard (2006)	<ul style="list-style-type: none"> <li>– <math>N = 1</math> male adolescent playing computer games excessively (age = 18)</li> <li>– Participant underwent multidisciplinary assessment for 3 days at a psychiatric clinic</li> </ul>	<ul style="list-style-type: none"> <li>Variety of psychological tests incl. WAIS, MMPI, psychiatric interviews, and social work evaluation of his family</li> </ul>	<ul style="list-style-type: none"> <li>– “Game addiction”</li> <li>– No specific diagnostic tool used</li> <li>– 12–16 h gameplay/day</li> <li>– No sleep, limited real-life social contacts</li> <li>– Escapism motivation, obsession with gaming</li> <li>– Symptoms: gaming “overshadowed” participant’s life, continuously missed classes at school, diminished energy, poor concentration, fatigue, muscle tension</li> </ul>
Baththyány, Müller, Benker and Wölfling (2009)	<ul style="list-style-type: none"> <li>– <math>N = 1,231</math> students (grades 3–5) in Vienna (46% female)</li> <li>– Survey</li> </ul>	<ul style="list-style-type: none"> <li>– Assessment of Computer Game Addiction in Children – Revised (CSVK-R) (Thalemann, Albrecht &amp; Grüsser, 2004)</li> </ul>	<ul style="list-style-type: none"> <li>– “Excessive computer game play” found in 12% (<math>n = 1,068</math>; 10% abusive, 3% dependent behavior)</li> <li>– Based on criteria of substance dependence (DSM IV-TR and ICD-10)</li> <li>– Distinction between normal, salient, abusive and addicted</li> </ul>
Bear, Bogusz and Green (2011)	<ul style="list-style-type: none"> <li>– <math>N = 102</math> adolescents (age range = 11–17 years) from out-patient psychiatric clinics in Canada</li> <li>– Surveys completed by children and their parents</li> </ul>	<ul style="list-style-type: none"> <li>– Self-devised Computer/Gaming-station Addiction Scale (CGAS) assessing criteria derived from impulse-control and substance-abuse disorder (based on Ko, Yen, Chen, Chen &amp; Yen, 2005b) on a continuum</li> <li>– Strength and Difficulties Questionnaire (Goodman, Ford, Simmons, Gatward &amp; Meltzer, 2000)</li> <li>– Weiss Functional Impairment Rating Scale-parent (WFIRS-P) (Weiss, 2008)</li> </ul>	<ul style="list-style-type: none"> <li>– Addiction score significantly correlated with higher difficulties, less prosocial behavior in both child and parent reports (i.e., positive correlations with emotional, conduct, and peer problems, and hyperactivity, and negative correlation with prosocial behavior), and functional impairment (i.e., family, learning, life skills, self-concept, and social activity)</li> <li>– Clear distinction between increased gaming time and addiction (gaming time did not correlate with any of the measures)</li> </ul>
Chan and Rabinowitz (2006)	<ul style="list-style-type: none"> <li>– <math>N = 72</math> adolescents (8<sup>th</sup> and 9<sup>th</sup> grades) recruited from high school and <math>N = 72</math> parents</li> <li>– Survey with sections for adolescents and their parents</li> </ul>	<ul style="list-style-type: none"> <li>– Young’s Internet Addiction Scale, modified for VGs (YIAS-VG) (Widyanto &amp; McMurrin, 2004) with good internal consistency, reliability and validity</li> <li>– Time spent playing VGs, watching TV, using the Internet</li> <li>– Conners’ Parent Rating Scale (CPRS; Conners, Sitareinos, Parker &amp; Epstein, 1998) incl. sections on oppositional, hyperactivity, inattention, and ADHD categories</li> </ul>	<ul style="list-style-type: none"> <li>– “Excessive console and Internet video game use”</li> <li>– 6 components of addiction: salience, excessive use, neglecting work, anticipation, lack of control, neglecting social life</li> </ul>
Chiu, Lee and Huang (2004)	<ul style="list-style-type: none"> <li>– <math>N = 1,228</math> students in grades 5–8, sampled from 20 primary and junior high schools in Northern Taiwan</li> <li>– Survey</li> </ul>	<ul style="list-style-type: none"> <li>– Game Addiction Scale (based on Buchman &amp; Funk, 1996; Clymo, 1996)</li> <li>– Demographics including academic achievement</li> <li>– Sensation seeking (including being assertive, bold, and ambitious)</li> <li>– Boredom Inclination Scale (based on Farrell, 1990)</li> </ul>	<ul style="list-style-type: none"> <li>– “Video game addiction”, unspecified</li> <li>– 9-item self-devised scale that assesses 2 factors: game addiction and game concern; <math>\alpha = 0.86</math></li> <li>– Female gender, lower functioning, higher sensation seeking, and higher boredom inclination predict game addiction</li> </ul>
Choo, Gentile, Sim, Li, Khoo and Liau (2010)	<ul style="list-style-type: none"> <li>– <math>N = 2,998</math> primary and secondary school children in Singapore (73% males; mean age = 11 years, <math>SD = 2</math> years)</li> <li>– Survey questionnaire</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological Video-Gaming Scale (Gentile, 2009) based on DSM-IV criteria for pathological gambling (min. 5/10 criteria had to be fulfilled for diagnosis)</li> <li>– General Media Habits Questionnaire (GMHQ) (Anderson &amp; Dill, 2000)</li> <li>– Adult Involvement in Media Scale (Anderson, Gentile &amp; Buckley, 2007; Gentile, Lynch, Linder &amp; Walsh, 2004)</li> </ul>	<ul style="list-style-type: none"> <li>– Prevalence of pathological gaming: 8.7% (12.6% boys, 4.7% girls)</li> <li>– Compared to non-pathological gamers, pathological gamers play 2× more, significantly more likely to have video-game system in bedroom, visit LAN centres, receive poorer grades, more impulse control problems, poorer social competence, greater hostile cognitions, more video-gaming related problems</li> </ul>

Table 3 (cont.)

Study	Sample and design	Instruments	Addiction criteria, symptoms and prevalence
Choo, Gentile, Sim, Li, Khoo and Liao (2010) (cont.)		<ul style="list-style-type: none"> <li>– Barratt Impulsiveness Scale (Patton, Stanford &amp; Barratt, 1995)</li> <li>– Personal Strengths Inventory – II (Liao, Chow, Tan &amp; Senf, 2011)</li> <li>– Hostile cognition (Huesmann &amp; Guerra, 1997)</li> <li>– General Mental Health Survey (Crystal et al., 1994)</li> <li>– Functional impairment (adapted from Charlton, 2002)</li> <li>– Raven’s Standard Progressive Matrices Plus (SPM Plus) (Raven, Styles &amp; Raven, 1998)</li> </ul>	<ul style="list-style-type: none"> <li>(incl. health problems), fights with parents over video games, getting little sleep, being late for school, decrease in social contacts, neglect of self-care, relying on friends for homework</li> <li>– Amount of gaming itself insufficient to define pathological gaming</li> </ul>
Cultrara and Har-El (2002)	<ul style="list-style-type: none"> <li>– <i>N</i> = 1 17-year-old boy with suprahyoid muscular hypertrophy caused by video game play</li> <li>– Case report</li> </ul>	<ul style="list-style-type: none"> <li>– Medical examinations</li> <li>– Patient’s history, physical, radiologic, intraoperative, and pathologic finding</li> </ul>	<ul style="list-style-type: none"> <li>– “Excessive video game play”</li> <li>– No specific diagnostic tool used</li> <li>– Muscle hypertrophy secondary to increased activity</li> <li>– Patient stopped video game play and within 4 months, submental mass decreased in size</li> </ul>
Dongdong, Liao and Khoo (2011)	<ul style="list-style-type: none"> <li>– <i>N</i> = 161 secondary school students in Singapore with MMO gaming experience (age range = 13–15 years; mean age = 14 years, <i>SD</i> = 0.7 years; 49% boys)</li> <li>– Questionnaire</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological Gaming Scale (Choo et al., 2010): 10-item scale based on pathological gambling criteria with acceptable reliability (Cronbach’s <math>\alpha</math> = 0.75)</li> <li>– Self Attribute Statement Scale (based on Dittmar, 2005)</li> <li>– MMO Player Motivation Scale (modified from Yee, 2007)</li> <li>– Asian Adolescent Depression Scale (Woo et al., 2004)</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological gaming explained as a function of actual-ideal self-discrepancy, depression, and escapism</li> <li>– Escapism found to have strongest direct influence on pathological gaming</li> <li>– No gender difference in pathological gaming found</li> </ul>
Gentile, Choo, Liao, Sim, Li, Fung and Khoo (2011)	<ul style="list-style-type: none"> <li>– <i>N</i> = 3,034 children in grades 3 (<i>n</i> = 743), 4 (<i>n</i> = 711), 7 (<i>n</i> = 916), 8 (<i>n</i> = 664) from 6 secondary schools (5 boyschools)</li> <li>– 2-year longitudinal study</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological video game use (Gentile, 2009)</li> <li>– Problematic gaming (Charlton, 2002)</li> <li>– General Media Habits Questionnaire (Gentile et al., 2004; Anderson et al., 2007)</li> <li>– Barratt Impulsiveness Scale (Patton et al., 1995)</li> <li>– Personal Strengths Inventory II (Liao et al., 2011)</li> <li>– Children’s Empathic Attitudes Questionnaire (Funk, Fox, Chan &amp; Curtiss, 2008)</li> <li>– Normative beliefs about aggression (Huesmann &amp; Guerra, 1997)</li> <li>– Hostile attribution bias (Crick, 1995)</li> <li>– Aggressive fantasies (Huesmann &amp; Eron, 1986; Nadel, Spellmann, Alvarez-Canino, Lausell-Bryant &amp; Landsberg, 1996)</li> <li>– Self-report of aggression (Linder, Crick &amp; Collins, 2002)</li> <li>– Parent–family connectedness (Resnick et al., 1997)</li> <li>– ADHD screen (University of Massachusetts Medical School, 2007)</li> <li>– Asian adolescent depression scale (Woo et al., 2004)</li> <li>– Anxiety (Birmaher et al., 1997)</li> <li>– Social phobia (Connor, Davidson, Churchill, Sherwood &amp; Weisler, 2000)</li> <li>– School performance</li> </ul>	<ul style="list-style-type: none"> <li>– “Pathological gaming”</li> <li>– Definition based on APA criteria: min. 5/10 items endorsed for pathology classification</li> <li>– Pathological gaming prevalence: 9%</li> <li>– Risk factors for pathological gaming: much gaming, low social competence, greater impulsivity</li> <li>– Outcomes of pathological gaming: depression, anxiety, social phobias, lower school performance</li> </ul>

Table 3 (cont.)

Study	Sample and design	Instruments	Addiction criteria, symptoms and prevalence
Gentile (2009)	<ul style="list-style-type: none"> <li>– Stratified sample of <math>N = 1,178</math> US residents (8–18 years) with equal gender and age distribution</li> <li>– 20 min omnibus online survey</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological Gaming Scale (pathological = satisfies min. 6/11 criteria)</li> <li>– Several items for children's video-game habits (adapted from Anderson et al., 2007; Gentile et al., 2004)</li> </ul>	<ul style="list-style-type: none"> <li>– 8.5% of gamers (88% gamers in total sample) classified as pathological</li> <li>– Compared to non-pathological gamers, pathological gamers were significantly more likely to play for more years, play more frequently and for more time, be more familiar with video-game rating symbols, have worse grades ins school, have difficulties with attention and ADHD, have more health problems, feel addicted to games and have friends that were addicted to games</li> </ul>
Grüsser, Thalemann, Albrecht and Thalemann (2005)	<ul style="list-style-type: none"> <li>– <math>N = 323</math> children, age range = 11–14 years, <math>M = 12</math> years, <math>SD = 1</math>; 54% males</li> <li>– Questionnaire distributed in school</li> </ul>	<ul style="list-style-type: none"> <li>– Assessment of Computer Game Addiction in Children – Revised (CSVK-R) (Thalemann et al., 2004)</li> </ul>	<ul style="list-style-type: none"> <li>– “Excessive computer/video game play” present in 9% of sample</li> <li>– Based on criteria of substance dependence (DSM IV-TR and ICD-10)</li> <li>– Distinction between normal, salient, abusive and addicted</li> </ul>
Han, Lee, Na, Ahn, Chung, Daniels, Haws and Renshaw (2009)	<ul style="list-style-type: none"> <li>– <math>N = 62</math> children with ADHD (52 males; mean age = 9 years, <math>SD = 2</math>)</li> <li>– Questionnaire and visual continuous performance test</li> </ul>	<ul style="list-style-type: none"> <li>– Internet Addiction Scale (Young, 1996b; Korean version) with good internal consistency</li> <li>– ADHD rating scale (So, Noh, Kim, Ko &amp; Koh, 2002)</li> <li>– Computerized Neurocognitive Function Test (Kim et al., 2006)</li> </ul>	<ul style="list-style-type: none"> <li>– 52% comorbidity between “Internet video game addiction” and ADHD</li> </ul>
Han, Lee, Yang, Kim, Lyoo and Renshaw (2007)	<ul style="list-style-type: none"> <li>– <math>N = 79</math> male excessive Internet game players and 75 healthy controls recruited from high schools in South Korea (mean age = 16 years, <math>SD = 1</math> year)</li> <li>– Self-report questionnaires and genotyping</li> </ul>	<ul style="list-style-type: none"> <li>– Internet Addiction Scale (Young, 1998) with good internal consistency</li> <li>– Reward dependence (RD) scale of Cloninger's Temperament and Character Inventory</li> <li>– Frequencies of 3 dopamine polymorphisms</li> <li>– SCID I (First, Gibbon, Spitzer &amp; Williams, 1996)</li> </ul>	<ul style="list-style-type: none"> <li>– “Excessive Internet game players” have higher prevalence of Taq1A1 and low activity (COMTL) alleles</li> </ul>
Kim and Kim (2010)	<ul style="list-style-type: none"> <li>– Phase 1: <math>N = 1,422</math> 5<sup>th</sup> graders (47% females, mean age = 12 years) recruited from 7 private elementary schools in South Korea</li> <li>– Phase 2: <math>N = 199</math> 8<sup>th</sup> graders (mean age = 15 years) from private junior high school</li> <li>– Phase 3: <math>N = 393</math> 11<sup>th</sup> graders (50% females, mean age = 18 years) from 2 public high schools</li> <li>– Survey</li> </ul>	<ul style="list-style-type: none"> <li>– Problematic Online Game Use Scale (based on Armstrong, Phillips &amp; Saling, 2000; Caplan, 2002; Charlton &amp; Danforth, 2007; Lee &amp; Ahn, 2002; Young, 1999) with good reliability, convergent and discriminant validity</li> </ul>	<ul style="list-style-type: none"> <li>– “Problematic online game use”</li> <li>– Criteria assessed: euphoria, health problem, conflict, failure of self-control, preference for virtual relationship</li> </ul>
King and Delfabbro (2009)	<ul style="list-style-type: none"> <li>– <math>N = 38</math> (23 adolescents (15 males, mean age = 16 years, <math>SD = 1</math>; video game playing = 15 hrs/week, <math>SD = 12</math> hours); 15 adults (11 males, mean age = 30 years, <math>SD = 7</math>; video game playing = 18 hrs/week, <math>SD = 11</math>)</li> <li>– Pilot interview study with 7 semi-structured group interviews</li> </ul>	<ul style="list-style-type: none"> <li>– Questions on playing motivations, and psychosocial context of excessive video game playing behavior</li> </ul>	<ul style="list-style-type: none"> <li>– “Excessive video game play”</li> <li>– No specific diagnostic measure used</li> <li>– Online Role-playing Games more rewarding than casual games → more addictive</li> </ul>

Table 3 (cont.)

Study	Sample and design	Instruments	Addiction criteria, symptoms and prevalence
Ko, Yen, Chen, Chen and Yen (2005a)	<ul style="list-style-type: none"> <li>– <math>N = 221</math> online game playing adolescents (63% males; mean age = 13.8 years, <math>SD = 0.7</math> years, range = 13–15 years) recruited in junior high school</li> <li>– Survey</li> </ul>	<ul style="list-style-type: none"> <li>– Chinese Internet Addiction Scale (Chen, Weng, Su, Wu &amp; Yang, 2003): continuous measure including 26 items that assess five dimensions, namely compulsive use, withdrawal, tolerance, interpersonal relationships, health and time management (Cronbach's <math>\alpha = 0.96</math>)</li> <li>– Rosenberg Self-Esteem Scale (Rosenberg, 1965)</li> <li>– Questionnaire for Playing Online Games to assess age of gaming begin, time and money spent playing, location of play, and motives for play; daily life satisfaction and total number of stressors encountered in daily life</li> </ul>	<ul style="list-style-type: none"> <li>– Males significantly more likely to be addicted to playing online games than females</li> <li>– For males, older age, lower self-esteem, and lower daily life satisfaction predicted online gaming addiction</li> </ul>
Kwon, Chung and Lee (2011)	<ul style="list-style-type: none"> <li>– <math>N = 1,136</math> middle school students in Seoul, Korea (61% males; mean age = 14 years, <math>SD = 0.5</math>)</li> <li>– Questionnaire</li> </ul>	<ul style="list-style-type: none"> <li>– Internet Game Addiction (IGA) (modified from Young, 1996a)</li> <li>– Real-Ideal Self Discrepancy (R-I self) (Hoge &amp; McCarthy, 1983)</li> <li>– The Escape from Self Scale (Shin, 1992)</li> <li>– Current Negative Mood Scale (Lee, 1991)</li> <li>– Peer Intimacy Scale (Ray &amp; Cohen, 1997), Korean version</li> <li>– Perceived Parent–Child Relationship Scale – Parent (Lee, 1981)</li> <li>– Perceived Parental Supervision Scale (Korean Institute of Criminal Justice Policy, 1998)</li> </ul>	<ul style="list-style-type: none"> <li>– Main finding: IGA is a consequence of escape from self</li> <li>– IGA most strongly predicted by escape, followed by perceived parent hostility, real-ideal self discrepancy, and parental supervision</li> <li>– Study provides empirical evidence for Baumeister's escape from self theory (Baumeister, 1991)</li> </ul>
Lemmens, Valkenburg and Peter (2011b)	<ul style="list-style-type: none"> <li>– <math>N = 851</math> Dutch adolescents (543 gamers; age range 11–17 years, <math>M = 13.9</math>, <math>SD = 1.4</math>; 51% male)</li> <li>– 2-wave panel study including a paper- and pencil survey distributed in schools</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological gaming (Lemmens et al., 2009) with good convergent validity and criterion validity</li> <li>– Time spent on games</li> <li>– UCLA Loneliness Scale (Russell, 1996)</li> <li>– Satisfaction with Life Scale (Diener, Emmons, Larsen &amp; Griffin, 1985)</li> <li>– Social competence (based on Buhrmester, Furman, Wittenberg &amp; Reis, 1988; Inderbitzen &amp; Foster, 1992)</li> <li>– Self-Esteem Scale (Rosenberg, Schooler &amp; Schoenbach, 1989)</li> </ul>	<ul style="list-style-type: none"> <li>– “Pathological gaming”</li> <li>– Criteria: salience, tolerance, mood modification, relapse, withdrawal, conflict, problems</li> <li>– Social competence, self-esteem, and loneliness predicted pathological gaming six months later</li> <li>– Low psychosocial well-being is antecedent and loneliness is consequence of pathological gaming</li> </ul>
Lemmens, Valkenburg and Peter (2011a)	<ul style="list-style-type: none"> <li>– <math>N = 851</math> Dutch adolescents (age range 11–17 years, <math>M = 13.9</math>, <math>SD = 1.4</math>; 51% male; 540 game players, 30% female)</li> <li>– 2-wave panel study including a paper and pencil survey that was distributed in schools</li> </ul>	<ul style="list-style-type: none"> <li>– Pathological gaming (Lemmens et al., 2009) with good convergent validity and criterion validity</li> <li>– Time spent on games</li> <li>– Violent game play (games played analyzed for violent content using Pan-European Game Information database using weighted measure of time spent on violent games)</li> <li>– Physical Aggression Subscale of Aggression Questionnaire (Buss &amp; Perry, 1992)</li> </ul>	<ul style="list-style-type: none"> <li>– “Pathological gaming”</li> <li>– Salience, tolerance, mood modification, relapse, withdrawal, conflict, problems</li> <li>– More gaming predicted more time spent on gaming six months later</li> <li>– Pathological gaming increased physical aggression in boys</li> </ul>
Lemmens, Valkenburg and Peter (2009)	<ul style="list-style-type: none"> <li>– 2 independent samples of Dutch game-playing adolescents (<math>N = 352</math> and 369) recruited from 6 schools of secondary education (32% girls; age range: 12–18 years, mean age = 15 years, <math>SD = 1.5</math>)</li> <li>– 2 surveys</li> </ul>	<ul style="list-style-type: none"> <li>– Game Addiction Scale for Adolescents with good reliabilities and concurrent validity</li> <li>– Time spent on games</li> <li>– UCLA Loneliness Scale (Russell, 1996)</li> <li>– Satisfaction with Life Scale (Diener et al., 1985)</li> </ul>	<ul style="list-style-type: none"> <li>– “Game addiction”</li> <li>– Criteria measured: salience, tolerance, mood modification, relapse, withdrawal, conflict, problems</li> <li>– Game addiction correlated with use, loneliness, life satisfaction, social competence, and aggression</li> </ul>

Table 3 (cont.)

Study	Sample and design	Instruments	Addiction criteria, symptoms and prevalence
Lemmens, Valkenburg and Peter (2009) (cont.)		<ul style="list-style-type: none"> <li>– Social competence (based on Buhrmester et al., 1988; Inderbitzen &amp; Foster, 1992)</li> <li>– Physical Aggression Subscale of Aggression Questionnaire (Buss &amp; Perry, 1992)</li> </ul>	
Rau, Peng and Yang (2006)	<ul style="list-style-type: none"> <li>– <math>N = 64</math>, age range: 9–20; <math>n = 26</math> expert players (only males), <math>n = 38</math> novices (16 females); education levels: from elementary to graduate school</li> <li>– Experimental study</li> </ul>	<ul style="list-style-type: none"> <li>– Internet Addiction Self-test (IAT; based on Young, 1996a)</li> <li>– Experiment: Participants were playing Diablo in cybercafe</li> </ul>	<ul style="list-style-type: none"> <li>– “Internet addiction” found in 8%</li> <li>– Discrepancy between self-report and questionnaire scores</li> </ul>
Rehbein, Kleimann and Mößle (2010)	<ul style="list-style-type: none"> <li>– <math>N = 44,910</math> German 9<sup>th</sup> graders (mean age = 15 years, <math>SD = 1</math>; 51% male; mean VG usage/day = 2 hrs)</li> <li>– German nationwide survey, conducted by Criminological Research Institute of Lower Saxony (KFN)</li> </ul>	<ul style="list-style-type: none"> <li>– Video Game Dependency Scale based on Internet Addiction Scale (Hahn &amp; Jerusalem, 2001) adapted for video game dependency (Rehbein &amp; Borchers, 2009) with good discriminatory power</li> </ul>	<ul style="list-style-type: none"> <li>– “Video game dependency”: diagnosed in 3% of males, 0.3% of females</li> <li>– 3% classified as at risk and 2% as dependent on video games (mainly boys: 5% at risk and 3% dependent; girls: 0.5% are at risk and 0.3% are dependent)</li> <li>– 90% of youths at risk, 91% of dependents are males</li> <li>– Based on ICD-10 criteria of dependency</li> <li>– Criteria: preoccupation/salience, conflict, loss of control, withdrawal symptoms, tolerance</li> </ul>
Salguero and Moran (2002)	<ul style="list-style-type: none"> <li>– <math>N = 223</math> Spanish adolescents (age range: 13–18 years, mean age = 15 years, <math>SD = 1</math>; 53% male)</li> <li>– Questionnaires distributed during tutorials in school</li> </ul>	<ul style="list-style-type: none"> <li>– Problem Video Game Playing Scale (PVP; self-devised scale, unidimensional, acceptable internal consistency, good construct validity)</li> <li>– Severity of Dependence Scale (Gossop et al., 1995)</li> <li>– Demographics</li> </ul>	<ul style="list-style-type: none"> <li>– “Problem video game playing”</li> <li>– Self-devised questionnaire (9 items) assessing problem video game playing based on DSM criteria for substance dependence and pathological gambling present in previous year cross-validated with results of Severity of Dependence Scale (Gossop et al., 1995)</li> </ul>
Skoric, Teo and Neo (2009)	<ul style="list-style-type: none"> <li>– <math>N = 333</math> elementary school video gamers from Singapore (age range = 8–12 years, mean age = 10 years, <math>SD = 1</math>; 54% males, 57% Chinese, 34% Malay)</li> <li>– Two-survey studies</li> </ul>	<ul style="list-style-type: none"> <li>– Assessment of addiction tendencies (based on APA, 2000; Danforth, 2003) with good internal reliability</li> <li>– Assessment of engagement tendencies (based on Brown, 1991)</li> <li>– Demographics</li> <li>– Amount of time spent playing video games</li> <li>– School grades</li> </ul>	<ul style="list-style-type: none"> <li>– “Video game addiction”</li> <li>– Criteria: behavioral salience, conflict, withdrawal symptoms (based on Brown, 1991, 1993) and further unspecified DSM-IV items</li> </ul>
Thomas and Martin (2010)	<ul style="list-style-type: none"> <li>– <math>N = 1,326</math> students (990 secondary and 335 college students, 657 females, grades 7–13) and <math>N = 705</math> (509 female, mean age = 22 years, <math>SD = 7</math>, 84% Australian) university students</li> <li>– Questionnaire distributed in schools</li> </ul>	<ul style="list-style-type: none"> <li>– Addiction (adapted from Fisher, 1994; Young, 1998)</li> <li>– Participation habits</li> </ul>	<ul style="list-style-type: none"> <li>– “Video-arcade/computer game/Internet addiction”</li> <li>– Salience, mood modification, tolerance, withdrawal, loss of control, conflict, relapse, and escape (min. 5/8 met for addiction classification)</li> <li>– Addiction to video-arcade games (4%), computer games (5%) and the Internet (5%)</li> <li>– Prevalence of social computer game users (55%) and Internet addiction (56%)</li> </ul>
Van Rooij, Schoenmakers, Vermulst, van den Eijnden and van de Mheen (2011)	<ul style="list-style-type: none"> <li>– <math>N = 3,048</math> Dutch adolescent online gamers (first four classes of Dutch secondary school, age range: 13–16)</li> <li>– Sample stratified according to region, urbanization, and education level</li> </ul>	<ul style="list-style-type: none"> <li>– Compulsive Internet Use Scale (Meerkerk, Van den Eijnden, Vermulst &amp; Garretsen, 2009) with good concurrent, construct validity, and internal consistency</li> <li>– Weekly hours online gaming</li> <li>– Rosenberg’s Self-Esteem Scale (Rosenberg et al., 1989)</li> </ul>	<ul style="list-style-type: none"> <li>– “Online video game addiction” found in 3%, representative of 1.5% of 13–16 years old Dutch children</li> <li>– Loss of control, preoccupation, conflict, withdrawal symptoms, and coping</li> </ul>



Table 3 (cont.)

Study	Sample and design	Instruments	Addiction criteria, symptoms and prevalence
Van Rooij, Schoenmakers, Vermulst, van den Eijnden and van de Mheen (2011) (cont.)	– Repeated cross-sectional survey study with a longitudinal cohort based on Dutch Monitor Study Internet and Youth including a 1 hour questionnaire completed in schools	– UCLA Loneliness Scale (Russell, Peplau & Cutrona, 1980) – Depressive Mood List (Engels, Finkenauer, Meeus & Dekovic, 2001; Kandel & Davies, 1986; Kandel & Davies, 1982) – Revised Social Anxiety Scale for Children (La Greca & Stone, 1993)	
Van Rooij, Schoenmakers, van den Eijnden and van de Mheen (2010)	– $N = 4,920$ (in 2007) and $4,753$ (in 2008), mean age = $14$ , $SD = 1$ ; 78% Dutch adolescents – Survey study – Data obtained from Monitor Study Internet and Youth	– Compulsive Internet Use Scale (Meerkerk et al., 2009) with good concurrent, construct validity, and internal consistency – Online communications, games, and other Internet functions	– Loss of control, preoccupation, conflict, withdrawal symptoms, and coping – Online gaming has strongest association with “Compulsive Internet Use”
Wan and Chiou (2006a)	– Study 1: $N = 177$ Taiwanese adolescents (age range: 16–24) – Study 2: $N = 182$ frequent MMORPG players (age range: 16–22) – Survey studies	– Internet Addiction Scale for high schoolers in Taiwan with good internal consistency, construct and discriminatory validity (adapted from Lin & Tsai, 1999) – Optimal experience/flow state (Choi, Kim & Kim, 2000) – Self-developed Two-factor Evaluation on Needs for Online Games (TEN0) to measure intensity of psychological needs on satisfaction and dissatisfaction dimensions	– “Online game addiction” – Compulsive use/withdrawal, tolerance, related problems of family, school, and health, and related problems of peer interaction and finance
Wan and Chiou (2006b)	– $N = 10$ Taiwanese adolescents with online game addiction (6 chosen from Internet cafes, 4 were referred), 7 male, 8 students, all spent >48 hrs/week in game – In-depth interviews	– Internet Addiction Scale for high schoolers in Taiwan with good internal consistency, construct and discriminatory validity (adapted from Lin & Tsai, 1999) – Sentence completion test and semi-structured interviews, four realms: (1) surface motivations, (2) source motivations, (3) self-conception, and (4) interpersonal relationships in real life	– “Online game addiction” – Emergent themes: (1) addicts’ psychological needs and motivations; (2) online games as the everyday focus of the addicts; (3) the interplay of real self and virtual self; (4) online games as the compensatory or extensive satisfaction for addicts’ needs; and (5) addicts’ self-reflections
Wan and Chiou (2007)	– Study 1: $N = 199$ adolescents (age range: 16–23) – Study 2: $N = 426$ adolescents (age range: 17–24) – Survey studies	– Internet Addiction Scale with good internal consistency, construct and discriminatory validity (adapted from Lin & Tsai, 1999) – Online Gaming Motivation Scale (based on Choi & Kim, 2004; Chou & Hsiao, 2000; Ng & Wiemer-Hastings, 2005)	– “Online game addiction”

1998). More specifically, the IAS assesses the following addiction components: (i) salience, (ii) excessive use, (iii) neglecting work, (iv) anticipation, (v) lack of control, and (vi) neglecting social life. The scale was found to have good internal consistency, reliability and validity (Widyanto & McMurrin, 2004). In three studies, pathological gaming was measured by means of the Game Addiction Scale for Adolescents (Lemmens et al., 2009, 2011a, 2011b). The scale has good reliability and good concurrent, convergent and criterion validity, and measures the following addiction symptoms: salience, tolerance, mood modification, relapse, withdrawal, conflict, and problems (Lemmens et al., 2009).

In three other studies (Choo et al., 2010; Gentile, 2009; Gentile et al., 2011), pathological gaming was assessed using the Pathological Video Game Use Scale (Gentile, 2009).

This scale uses the DSM-IV-TR criteria for pathological gambling and diagnoses addiction when at least five (of ten) symptoms are met. Similarly, in another study (Dongdong et al., 2011), the Pathological Video Gaming Scale (Choo et al., 2010) was used. It is yet another measure utilizing the official DSM-IV criteria for pathological gambling and includes ten items. Moreover, two studies have used the Compulsive Internet Use Scale (Meerkerk et al., 2009) to assess online video game addiction (van Rooij et al., 2010, 2011). The scale measures symptoms that relate particularly to the compulsive and impulse control elements of the behavior, including loss of control, preoccupation, conflict, withdrawal symptoms and coping. It was found to have good concurrent and construct validity, as well as good internal consistency (Meerkerk et al., 2009). Finally, three studies

used the adapted version of the Internet Addiction Scale<sup>1</sup> (Lin & Tsai, 1999). This scale measures compulsive use and withdrawal, tolerance, related problems of family, school, and health, and related problems of peer interaction and finance. It was found to have good internal consistency, construct and discriminatory validity (Lin & Tsai, 1999).

The samples used in these 18 studies included 72 adolescents in grades eight and nine (mean age = 15 years, *SD* = 1 year) as well as their parents (Chan & Rabinowitz, 2006), 62 children (mean age = 9 years, *SD* = 2 years) with Attention Deficit Hyperactivity Disorder (ADHD) (Han et al., 2009), 154 male adolescents (mean age = 16 years, *SD* = 1 year), half of which were excessive Internet game players (Han et al., 2007), 161 secondary school students in Singapore with MMO experience (mean age = 14 years, *SD* = 0.7 years) (Dongdong et al., 2011), large samples (the respective sample sizes ranged from more than 800 to less than 5,000 participants) of Dutch adolescents (mean age = 14 years, *SD* = 1 year) (Lemmens et al., 2011a, 2011b; van Rooij et al., 2010) and adolescent Dutch online game players (*N*s = 721 and 3,048; age range = 13–17 years) (Lemmens et al., 2009; van Rooij et al., 2011), American youths (*N* = 1,178, age range = 8–18 years with equal gender and age distribution) (Gentile, 2009), Korean adolescents (*N* = 1,136, mean age = 14 years, *SD* = 0.5 years; 61% male) (Kwon et al., 2011), and Singaporean youth (*N* = 2,998, mean age = 11 years, *SD* = 2 years, 73% male), 64 children and adolescents (age range = 9–20 years) (Rau et al., 2006), 3,034 secondary school children (mean age = 11 years, *SD* = 2 years) (Gentile et al., 2011), 1,326 secondary school and college students (mean age = 22 years, *SD* = 7 years) (Thomas & Martin, 2010), 177 Taiwanese adolescents and young adults (age range = 16–24 years) (Wan & Chiou, 2006a, 2007), and 182 Taiwanese adolescent and young adult MMORPG players (age range = 16–22 years) (Wan & Chiou, 2006a), and ten Taiwanese adolescents with no explicit age specification with online game addiction (Wan & Chiou, 2006b).

With regards to classification, van Rooij et al. (2010) contend that compared to using the Internet for other applications (e.g., downloading, social networking, using messenger, chatting, blogging, etc.), online gaming has the strongest association with compulsive Internet use. This indicates that a subgroup of compulsive Internet users should be classified as compulsive online gamers. Based on these assessments, a prevalence estimate of compulsive Internet use in secondary school (age range = 9–16 years) and college students (mean age = 21 years, *SD* = 6 years) was provided by four studies (Choo et al., 2010; Gentile et al., 2011; Thomas & Martin, 2010; van Rooij et al., 2011). Online video game addiction was found to be present in 3% of Dutch adolescent online gamers, which is representative of 1.5% of 13–16 year old Dutch adolescents (van Rooij et al., 2011). Pathological gaming was found in 8.5% of US youth online gamers (Gentile, 2009) and in 9% of secondary school children in Singapore (Choo et al., 2010; Gentile et al., 2011). Finally, 4%, 5%, and 5% of secondary school and

college students were found to be addicted to video-arcade games, computer games, and the Internet, respectively. In addition, lifetime participation, frequency, and duration of playing games as well as the prevalence of addiction was found to be larger for Internet and computer games relative to video-arcade games (Thomas & Martin, 2010).

In terms of play patterns and motivations, in comparison to a healthy control group, adolescent excessive Internet game players in South Korea were reported to play more, play longer, and to have higher reward dependence (Han et al., 2007). Similarly, children and adolescent expert online game players were reported to have started playing online games earlier and to play longer than novice players (Gentile, 2009; Rau et al., 2006). Also, the expert players underestimated the time they spent playing online games (Rau et al., 2006). Similarly, more time spent on games predicted gaming addiction (Choo et al., 2010; Gentile, 2009; Gentile et al., 2011; Lemmens et al., 2009, 2011a). Moreover, it has been reported that ‘flow’ state<sup>2</sup> during game play was not predictive of addiction. Related to this, the absence of playing online games generated dissatisfaction (Wan & Chiou, 2006a, 2006b). Furthermore, Taiwanese adolescent online game addicts indicated that playing online games was a focus in their lives and the interplay between their real and their virtual selves was important to them (Wan & Chiou, 2006b). In addition, another study of Taiwanese adolescent and young adults reported online game addicts exhibited higher intrinsic motivation to play games rather than an extrinsic motivation compared to non-addicted adolescents (Wan & Chiou, 2007). Finally, escapism appeared as the most important factor predicting Internet gaming addiction (Kwon et al., 2011) and pathological gaming (Dongdong et al., 2011), followed by perceived parent hostility, real-ideal self-discrepancy, and parental supervision (Kwon et al., 2011), and actual-ideal self-discrepancy and depression (Dongdong et al., 2011).

With respect to psychosocial characteristics, it has been reported that low social competence was related to pathological gaming (Choo et al., 2010; Lemmens et al., 2011b), and that psychosocial well-being and self-esteem predicted pathological gaming six months later, with the same being true for high loneliness (Lemmens et al., 2011b). Moreover, low psychosocial well-being was found to be an antecedent, whereas loneliness was a consequence of pathological gaming (Lemmens et al., 2011b). Similarly, studies have shown that game addiction correlates with loneliness (Lemmens et al., 2009; van Rooij et al., 2011), low self-esteem (van Rooij et al., 2011), low life satisfaction (Lemmens et al., 2009), and low social competence (Choo et al., 2010; Gentile et al., 2011; Lemmens et al., 2009) and that pathological gamers are significantly more likely to have decreasing social contacts compared to non-pathological gamers (Choo et al., 2010). With regards to aggression, ambivalent findings were reported. In one study, no association was found between playing video games and oppositional and/or aggressive behavior (Chan & Rabinowitz, 2006). In two other studies, time spent gaming and pathological gaming increased physical aggression in boys (Lemmens et al., 2009, 2011a) and was found to be related to having more hostile cognitions (Choo et al., 2010), and greater impulsivity was reported to be a risk factor for pathological gaming (Choo et al., 2010; Gentile et al., 2011). Moreover, online gaming addiction was found to be associated with lower grade point average and school performance (Chan & Rabinowitz, 2006; Choo et al., 2010; Gentile, 2009; Gentile et al., 2011).

<sup>1</sup> Lin and Tsai’s scale (1999) is loosely based on Young’s original Internet Addiction Test (1998). The former is a self-devised scale that shares the same name with Young’s original scales since it measures a similar phenomenon.

<sup>2</sup> According to Csikszentmihalyi (1990), the flow state is characterized by an optimal experience, where the level of challenge of a task is matched with the person’s skill.

Regarding comorbidity, findings indicate a significant association between time spent playing games for more than one hour per day and Internet addiction, inattention, and number and intensity of ADHD symptoms (Chan & Rabinowitz, 2006; Gentile, 2009). Similarly, it was reported that 52% of children who had previously been diagnosed with ADHD were diagnosed with Internet video game addiction as well (Han et al., 2009). Moreover, the outcomes of pathological gaming included depression (Dongdong et al., 2011; Gentile et al., 2011; van Rooij et al., 2011), anxiety, and social phobias (Gentile et al., 2011; van Rooij et al., 2011), as well as physical health problems, such as hand and wrist pain (Choo et al., 2010; Gentile, 2009), and neglect of self-care (i.e., skipping meals, and insufficient personal hygiene) (Choo et al., 2010). With regards to pathophysiology, one study has reported that adolescent excessive Internet game players had a significantly higher number of Taq1A1 and low activity alleles (COMTL) relative to a healthy control group (Han et al., 2007). This suggests that genetic polymorphisms contribute to online gaming addiction. Overall, the presented studies suggest that online gaming addiction is reasonably similar to pathological gambling. Moreover, research indicates that children and adolescents who use online games in a way that is clinically noticeable experience symptoms that are typically experienced by those suffering from pathological gambling. Nevertheless, a number of pathological gambling symptoms are not entirely commensurate with online gaming addiction. These include the involvement of money that is increased throughout the gambling career as well as borrowed from family members and friends, the chasing of losses, and engaging in illegal acts. In light of pathological gambling, these symptoms appear to clearly demarcate excessive engagement from addiction. Since this classification does not hold true for online gaming addiction, it appears questionable in how far an exclusive reliance on pathological gambling criteria for the classification of online gaming addiction is appropriate, particularly when considering the monetary involvement.

However, some evidence suggests that rather than playing for money, gamblers play for the excitement and get aroused by taking risks (APA, 2000). Risk taking, in this regard, may include making larger bets. Similarly, gamers can take risks when they play online games, such as choosing to fight high-level opponents and working together with new group members. Similarly, they often pay monthly subscription fees to participate in the game, and often buy in-game items. Therefore, even the criterion of monetary involvement for pathological gambling appears to have a near equivalent in gaming addiction. Nevertheless, the chasing of losses appears to be unique to pathological gambling. Consequently, while gaming addiction is closely related to pathological gambling due to symptom similarity, it cannot entirely be equated with pathological gambling as gaming addiction appears to manifest itself somewhat differently. Accordingly, exclusively basing a diagnosis of gaming addiction on an adaptation of pathological gambling criteria is insufficient.

#### *Online gaming addiction based on the criteria for substance dependence*

Three studies were identified in the database search that adapted the official criteria for substance dependence in order to classify online gaming addiction (Batthyány et al.,

2009; Grüsser et al., 2005; Rehbein et al., 2010). The basis of assessment were the official criteria for substance dependence and the dependence syndrome as based on the international classification manuals (APA, 2000; WHO, 1992). More specifically, in two studies (Batthyány et al., 2009; Grüsser et al., 2005), excessive computer game play was diagnosed with the Assessment of Computer Game Addiction in Children – Revised (Fragebogen zum Computerspielverhalten bei Kindern, CSVK-R; Thalemann et al., 2004). Using this instrument, computer game play is classified as pathological when children and adolescents score a minimum of seven out of 27 points on the scale. The psychometric qualities of the scale have been validated (Thalemann et al., 2004). Moreover, video game dependency was diagnosed with the Video Game Dependency Scale (Rehbein & Borchers, 2009) that was adapted from the Internet Addiction Scale<sup>3</sup> (Hahn & Jerusalem, 2001). It assesses the following addiction criteria: preoccupation and salience, conflict, loss of control, withdrawal symptoms, and tolerance. Its discriminatory power was found to be good (Rehbein & Borchers, 2009).

The studies included 1,231 Austrian students in grades three to five (mean age = 14 years, *SD* = 1 year) (Batthyány et al., 2009), 323 children in Germany with a mean age of 12 years (*SD* = 1 year) (Grüsser et al., 2005), and a representative sample of 44,910 German ninth-graders with a mean age of 15 years (*SD* = 1 year) (Rehbein & Borchers, 2009). In terms of online gaming addiction prevalence, the German nationwide study indicated that 3% of the entire sample was classified as at-risk and 2% as being dependent on video games. Also, there appeared clear gender differences, with 91% of dependents being male. More specifically, 3% of male adolescents and 0.3% of female adolescents were diagnosed as dependent on playing video games, with 5% of males and 0.5% of females at-risk of developing dependence (Rehbein et al., 2010). Furthermore, using the cut-off point of 7, which includes both computer game abuse and addiction (i.e., dependence), it was reported that 9% of German children (Grüsser et al., 2005) and 12% of Austrian children (Batthyány et al., 2009) played computer games excessively. Of the latter, 10% were abusing computer games, whereas 3% were identified as dependent.

The primary motivation for playing video games was coping with daily stressors (Batthyány et al., 2009; Grüsser et al., 2005). Psychosocial problems that were found to be related to excessive computer game use included increased social conflict, stress (Batthyány et al., 2009), lower school achievement, increased truancy, and limited leisure time activities (Rehbein et al., 2010). Moreover, related psychopathological problems and comorbidities comprised concentration deficits, psychosomatic challenge, school phobia (Batthyány et al., 2009), reduced sleep time and increased suicidal ideations (Rehbein et al., 2010).

Analyzing these studies, it appears that the symptoms of online gaming addiction in children and adolescents are commensurate with the official symptoms for substance dependence. The only distinguishing feature is the lack of the ingestion of a psychoactive substance for people suffering from online gaming addiction. Moreover, the only nation-

<sup>3</sup> Similar to Lin and Tsai's scale (1999) Hahn and Jerusalem's Internet Addiction Scale (2001) is a self-devised measurement instrument that is not identical to Young's Internet Addiction Test (1998).

wide prevalence study conducted in Germany (Rehbein & Borchers, 2009) suggests that 2% of adolescents are addicted to online games. This is an important finding as it appears to show that online gaming addiction appears to be a genuine health problem for youth. Furthermore, this is emphasized by the deleterious effect that online gaming addiction has on adolescent health, including anxiety, psychosomatic, psychosocial and academic problems, and suicidal ideation.

*Online gaming addiction based on the criteria for both pathological gambling and substance dependence*

Three studies have made use of a classification framework based on self-devised scales combining both pathological gambling and substance dependence adapted criteria in order to diagnose potentially addictive online gaming behaviors (Bear et al., 2011; Salguero & Moran, 2002; Skoric et al., 2009). Salguero and Moran (2002) designed a 9-item scale that they cross-validated with results from the Severity of Dependence Scale (Gossop et al., 1995) in a sample of 223 Spanish adolescents aged 13–18 years. They reported that their Problematic Video Game Playing Scale measured a unidimensional construct, and had an acceptable internal consistency and good construct validity. Moreover, the authors concluded that problem video game play is similar to the dependence syndrome (Salguero & Moran, 2002).

Similarly, Skoric et al. (2009) developed a scale based on the American Psychiatric Association's criteria for pathological gambling and substance dependence (2000) as well as Danforth's classification of online game addiction (2003). The specific criteria included were behavioral salience, conflict, and withdrawal symptoms (based on Brown, 1991, 1993), as well as further unspecified DSM-IV symptoms (Skoric et al., 2009). They used a sample of 333 elementary school video gamers from Singapore aged 8–12 years. The findings indicated that online game addiction correlated negatively with performance in school. However, neither time spent playing games nor the engagement in games correlated with poor school performance (Skoric et al., 2009).

Bear et al. (2011) also created a scale that investigates both adolescents' as well as their parents' reports. It is based on criteria for Internet addiction for adolescents as proposed by Ko et al. (2005) and it includes the criteria for impulse control and substance abuse disorders. The items specifically assessing addiction criteria include (i) a preoccupation with computer/gaming-station activities, (ii) a failure to resist the impulse to use, (iii) tolerance, (iv) withdrawal, (v) longer than intended use, (vi) unsuccessful efforts to cut down, (vii) excessive efforts put into gaining access, and (viii) continued use despite the knowledge that it causes problems. Bear et al.'s Computer/Gaming-station Addiction Scale (CGAS) (2011) investigates these criteria on a continuum with addiction scores ranging from 8 to 40 points. In order to assess the patterns of computer and gaming station use in youth, they surveyed 102 adolescents aged between 11 and 17 years as well as their parents. The results indicate that the addiction score significantly correlated with experiencing more difficulties in life as well as less prosocial behavior as reported by both adolescents and their parents. Furthermore, the addiction score significantly correlated with functional impairments across multiple life domains, namely

family, learning, life skills, self-concept, and social activity (Bear et al., 2011).

These studies highlight two important facts. First, although in all three cases the authors relied on both substance dependence and pathological gambling criteria in order to assess online gaming addiction, from the information provided it appears that their focus was weighted on diagnostic criteria for substance dependence. To be more precise, Salguero and Moran (2002) specifically point out that online gaming addiction in adolescents is similar to the dependence syndrome, which indicates that the former is a genuine addiction worthy of clinical management. Second, the studies were conducted in Singapore, Spain and Canada and therefore the results may have varied because of the sociocultural embedding of the participants in their respective home country. Consequently, it would appear highly important to assess culturally-relevant factors in online gaming addiction in children and adolescents. Depending on the sociocultural context in which gaming occurs, in addition to the connotations online gaming has, gaming practices, the prevalence of online gaming addiction, and online gaming addiction symptoms may differ. Future researchers should therefore be encouraged to assess online gaming addiction in children and adolescents cross-culturally, using assessment instruments that are commensurate with an official clinical diagnosis of the disorder, and that pay respect to the cultures they are used in.

*Online gaming addiction based on parental reports*

In two studies (Allison et al., 2006; Cultrara & Har-El, 2002), the psychopathological status of two male adolescents addicted to online gaming was based on their parents' reports. Allison et al. (2006) reported the case of an 18-year-old male adolescent whose life, according to his parents, had been taken over by playing online role-playing games for up to 16 hours daily. The adolescent was admitted into a psychiatric hospital by his parents where he underwent a variety of psychological and psychiatric assessments for three days, including an intelligence test, a personality test, and diagnostic and psychosocially based interviews. His primary motivation was reported to be to escape from real life problems. His gaming resulted in a variety of psychosocial (limited real life social contacts, missing classes at school), psychosomatic (poor concentration, muscle tension), and psychopathological problems (diminished energy, fatigue) (Allison et al., 2006). Similar results have been noted in case studies of adult excessive gamers (Griffiths, 2010).

In a more unusual case, Cultrara and Har-El (2002) reported the account of a 17-year-old male adolescent who, during video game play, continuously moved his lower jaw up and down, repeatedly grimaced and swallowed, and protruded and retruded his tongue. This resulted in muscle hypertrophy that was found to be secondary to the actual activity of his excessive video game playing. Once he stopped playing video games, the submental mass that he had developed decreased in size (Cultrara & Har-El, 2002).

The above studies are significant for general reasons. First, they provide a qualitative account of how adolescents experience online gaming addiction as well as the symptoms associated with it. These in-depth insights not only provide a more elaborate description of individual experience, but they aid researchers in discerning what consequences online

gaming addiction can have for individual adolescents. Second, the studies highlight the fact that for many children and adolescents, it is their parents who initially realize that their children's online gaming extends beyond pure enjoyment of playing and can in fact be problematic.

In fact, a recent study suggests that contact with the Outpatient Clinic for Gaming Addictions in Mainz (Germany) was initiated by mothers of potentially addicted adolescents in 86% of the cases (Beutel, Hoch, Wölfling & Müller, 2011), suggesting that parental referral is important for some adolescents who have not yet discerned that their behavior may indeed be problematic. It also hints at the significance of social support particularly for adolescents because (i) they find themselves in critical periods of cognitive, behavioral, and social development during their adolescence, and (ii) they cannot overcome their problems by themselves and are thus in need of both social and professional assistance. Notwithstanding this, a professional evaluation of the situation and the adolescents' addiction status is an essential second step that may potentially lead to clinical treatment of online gaming addiction.

#### *Online gaming addiction based on other miscellaneous classification criteria*

Four studies (Chiu et al., 2004; Kim & Kim, 2010; King & Delfabbro, 2009; Ko et al., 2005a) could not be categorized in any of the aforementioned frameworks. Each of these is addressed in turn. Chiu et al. (2004) aimed to assess video game addiction in 1,228 children and adolescents in grades 5–8 in Taiwan. They used the self-devised Game Addiction Scale (based on Buchman & Funk, 1996; Clymo, 1996) comprising a 9-item scale that assesses two factors, namely game addiction and game concern. The reported internal consistency has a Cronbach's  $\alpha$  of 0.86. Unfortunately, from the information the authors provide in their paper, it is unclear how their term "video game addiction" was defined and what kinds of symptoms it included. Moreover, none of the referenced articles specifically addresses addiction and pathology. Nevertheless, they found that video game addiction correlated negatively with academic achievement and positively with hostility. Furthermore, lower function, higher sensation seeking, and higher boredom inclination predicted game addiction. Counter-intuitively, female gender predicted game addiction (Chiu et al., 2004).

Kim and Kim (2010) aimed to develop a measure of problematic online game use by identifying factors that underlie problematic online game use and to test the external validity of their scale by having three independent samples of 5<sup>th</sup>, 8<sup>th</sup> and 11<sup>th</sup>-graders in South Korea ( $n = 2,014$ ) participating in their study. They devised the Problematic Online Game Use Scale (based on Armstrong et al., 2000; Caplan, 2002; Charlton & Danforth, 2007; Lee & Ahn, 2002; Young, 1999) that assessed the following criteria: euphoria, health problem, conflict, failure of self-control, and preference for virtual relationships. They reported that their scale had good reliability, as well as convergent and discriminatory validity. Moreover, problematic online game use was found to be negatively correlated with academic self-efficacy and satisfaction with daily life and positively correlated with anxiety and loneliness (Kim & Kim, 2010).

King and Delfabbro (2009) investigated the psychological and social context of video game playing in order to understand excessive video game play using pilot group inter-

views with a sample of 23 adolescents (mean age = 16 years,  $SD = 1$  year) and 15 adults. Their findings indicated that online role-playing games were more rewarding and hence more addictive than casual games. Video game playing was defined as excessive when it "create[d] adverse personal and social consequences in a person's life" (p. 62). As hypothesized, they found that excessive video game players experienced a variety of problems, such as conflicts with important life responsibilities, they neglected their social relationships, scholastic and professional productivity suffered, they ignored their household duties, and they had irregular sleeping patterns (King & Delfabbro, 2009).

Finally, Ko et al. (2005a) assessed gender differences and related factors affecting online gaming addiction among 221 Taiwanese adolescents aged 13 to 15 years (mean age = 13.8 years,  $SD = 0.7$  years). They used the Chinese Internet Addiction Scale (Chen et al., 2003), a continuous measure that includes 26 items to assess five dimensions of problems related to Internet use, adapted to measure online gaming experiences exclusively. Investigated Internet-related problems include compulsive use, withdrawal, tolerance, interpersonal relationships, health, and time management. Originally, the scale was found to have a good internal consistency with a Cronbach's  $\alpha$  of 0.96 (Chen et al., 2003). The findings indicate that males are significantly more likely to be addicted to playing online games. Moreover, for males, several factors predicted online gaming addiction, namely older age, lower self-esteem, and lower daily life satisfaction (Ko et al., 2005a).

As the aforementioned studies used miscellaneous classification frameworks, they will be evaluated in turn. As mentioned previously, Chiu et al.'s (2004) study suffered from a variety of methodological and conceptual problems, such as the omission of defining video game addiction. Moreover, the finding that females were more likely to have a video game addiction appears questionable since numerous studies indicate the opposite (e.g. Rehbein & Borchers, 2009). This suggests that the measure used lacked sensitivity and specificity. Alternatively, one could argue that being a female is likely to be a better predictor of certain aspects of addiction because it is less commonly associated with addiction. In either case, these findings require further investigation.

The particularly insightful aspect of Kim and Kim's study (2010) was their reliance on game-immanent factors. They designed a scale that specifically assessed online gaming addiction, such as a preference for virtual relationships. Although their scale has been validated in different samples, its utility as a clinical assessment tool to clearly demarcate online gaming addiction from mere engagement (Charlton, 2002) has not been established. With regards to the symptoms it assesses, it also appears questionable in how far euphoria can be used as an addiction symptom from a conceptual point of view. Specifically, it has been asserted that healthy enthusiasm adds to life whereas addiction takes away from it (Griffiths, 2002). This suggests that euphoria does not necessarily have to feature within an addiction framework, as suggested by Charlton and Danforth (2007). In sum, although Kim and Kim's study (2010) assumes online game addiction as being entirely based on the virtual world, the respective criteria used for classifying online gaming addiction may prove less useful in a clinical context.

King and Delfabbro's study (2009) indicated that adolescents that play online games excessively experience a variety of problems because of their game play. Nevertheless, no

validated measurement tool was utilized to actually validate the participants' addiction status. Therefore, it appears relatively problematic to deduce implications for online gaming addiction and mental health status in adolescents from their study.

Finally, Ko et al.'s survey study (2005) did not use an assessment instrument that was based on established diagnostic criteria. Only very loosely are the criteria their measurement instrument uses commensurate to substance dependence because criteria such as tolerance and withdrawal were included. Thus, it is unclear on what basis the other criteria have been chosen and how online gaming addiction has been defined. No cut-off values were provided, and as such, clinical diagnosis is not possible. The authors however contend that "[b]efore constructing specific diagnostic criteria, it would be practical to measure levels of addiction to Internet use with a multidimensional and continuous questionnaire such as the CIAS" (Ko et al., 2005a, p. 277). However, they do not offer a reasonable explanation for why utilizing a continuous measure would make sense in the first place. Therefore, their logic seems flawed and puts the use of the CIAS into question. Ultimately, assessments of online gaming addiction must go beyond the purpose of furthering research endeavors in the area by specifically targeting potential clinical practices. Only then are the individuals who suffer from a potentially debilitating mental disorder heard and helped.

## DISCUSSION

This systematic literature review provides important insights into the state of current knowledge of online gaming addiction in children and adolescents. From the identified empirical studies, it appears that different classification schemes have been adopted, typically based on the official criteria for pathological gambling, substance dependence, or a combination of the two. Additionally, parental reports and other miscellaneous criteria and assessment instruments have been used to determine gaming addiction. From the identified studies, it appears that the large majority of studies adapted pathological gambling criteria in order to assess the extent to which online gaming addiction is present in samples of children and adolescents. This appears acceptable since online gaming and online gambling share a variety of similar characteristics that have been extensively discussed in the psychological literature for over 20 years (Griffiths, 2005; Johansson & Götestam, 2004). It suggests that monetary reward is not necessary in order to classify an excessive engagement with games as potential addiction and could potentially be substituted by a higher likelihood for risk-taking. Similarly, traditionally land-based gambling is gradually moving towards Internet portals (Kuss & Griffiths, 2012) and there are now a number of overviews highlighting the convergence between Internet, gaming and gambling (e.g., Griffiths, 2002; King, Delfabbro & Griffiths, 2010; ). This suggests that the (potentially pathogenetic) gaming and gambling activities are progressively converging. Nevertheless, although gaming and gambling share a variety of similarities, they cannot be necessarily equated with one another.

On the other hand, some researchers claim that the classification of behavioral addictions within the framework of

pathological gambling appears relatively insufficient and it can have negative consequences for actual treatment when no use is made of therapeutic elements for patients suffering from substance dependence (Poppelreuter & Gross, 2000). Moreover, in light of the diagnostic criteria for pathological gambling, impulsivity remains the main distinguishing characteristic. However, this explanation seems relatively inadequate given a deficiency in impulse control is also considered to be one of the main features of substance dependence (Volkow & Fowler, 2000). Applying knowledge from substance dependence treatments to those for a behavioral addiction may actually be beneficial over and above typical treatment for pathological gamblers. Similarly, the framework of behavioral addictions as based on its similarities with substance dependence seems particularly appealing as it incorporates the craving of behavioral addicts for engaging in their behavior and it also includes the physical and psychological discomfort and irritability they experience when they cannot engage in the behavior, both mirroring the symptoms of craving as well as withdrawal (Holden, 2001; Orford, 2001).

Furthermore, with non-chemical addictions, it appears that tolerance is another criterion that is not accounted for by a classification that is based on pathological gambling. However, tolerance appears to play an important role in behavioral addictions because addicts need to increase their engagement (i.e., the time and effort they invest in engaging in the activity) over the course of time in order to experience pleasurable effects, which may be seen as a homeostatic restoration of balance within the body (Grüsser & Thalemann, 2006). Thus, online gaming is used as a form of self-medication (Han et al., 2009). With regards to excessive online gamers, both individual accounts of behaviors as well as empirical quantitative findings show that as their addiction develops, online gaming addicts spend increasing amounts of time preparing for, organizing, and actually gaming (Chan & Rabinowitz, 2006; Kim & Kim, 2010; King & Delfabbro, 2009; Lemmens et al., 2011a). This is common among substance abusers, and it is one of the DSM criteria for substance dependence.

There is further evidence to suggest that problematic online gaming be conceptualized as a behavioral addiction rather than a disorder of impulse control. From a clinical perspective, patients suffering from behavioral addictions present with problems that are similar to those experienced by people suffering from substance dependencies (Poppelreuter & Gross, 2000; Shaffer & Kidman, 2003). In comparison to the phaseology model of alcoholism (Jellinek, 1946), it appears that those addicted to certain behaviors progress through different phases in their addiction as well, which was found to be true for pathological gamblers (Custer, 1987). This does not mean that a behavioral addiction, such as online gaming addiction, should be classified in the same way as pathological gambling, namely within the spectrum of impulse control disorders. Instead, both online gaming addiction and pathological gambling appear to fit better within the classification akin to substance dependencies, namely behavioral addictions. This is furthermore supported by the efforts of the American Psychiatric Association to include 'Gambling Disorder' in the category of substance-related and addictive disorders rather than impulse control disorders in the proposed new fifth edition of

the Diagnostic and Statistical Manual for Mental Disorders. Viewing pathological gambling as an addictive disorder (i.e., a behavioral addiction) can therefore be seen as the first step towards a reconceptualization of both substance-related and non-chemical addictions as spectrum disorders (Shaffer et al., 2004).

Another argument in favor of this conjecture relates to the high comorbidity rates of behavioral addictions with substance dependencies and vice versa (Poppelreuter & Gross, 2000). Similarly, comorbidities frequently experienced by substance users, such as affective and anxiety disorders as well as attention-deficit hyperactivity disorder, are experienced by pathological online gamers (Kuss & Griffiths, 2011). These comorbidities do not occur with persons who suffer from obsessive-compulsive disorders (Blanco, Moreyra, Nunes, Saiz-Ruiz & Ibanez, 2001). Also, there are further similarities between substance dependence and several behavioral addictions, namely with regards to the gender distribution as well as neuropsychology and neurocognition (Bechara, 2003; Rugle & Melamed, 1993). In terms of psychophysiology, it furthermore appears that there are additional analogies between substance dependence and pathological gambling (Reuter et al., 2005) and online gambling addiction (Han, Hwang & Renshaw, 2010; Hoeft, Watson, Kesler, Bettinger & Reiss, 2008; Ko et al., 2009). With regards to molecular genetics, polymorphisms in the D2 dopamine receptor genes and the Val158Met in the Catecholamine-O-Methyltransferase (COMT) genes have been found in pathological gamblers (Blum, Wood, Sheridan, Chen & Comings, 1995) and those addicted to online gaming (Han et al., 2007). These findings clearly substantiate the contention that online gaming addiction may indeed be viewed as behavioral addiction.

Additionally, it has been reported that pathological gamblers and alcoholics share an "excessive attachment" to their addiction of choice (Orford, Morison & Somers, 1996). Furthermore, Shaffer et al. (2004) contend that both behavioral and substance-related addictions share the same etiology. That is, antecedents for addiction include neurobiological (i.e., genetic risk) and psychosocial elements (i.e., psychological and sociological risk factors) that all contribute to the vulnerability for developing addiction. In addition to this, exposure and interaction with the substance/behavior of choice as well as a desirable shift in subjective state (i.e., the mood-modifying properties of the substance/behavior) serve as further antecedents. Once biopsychosocial events occur and the substance/behavior is paired with a desirable shift repeatedly, addiction may be developed (Shaffer et al., 2004).

The manifestations and sequelae shared between different addictions are related to the biological cluster (i.e., tolerance, withdrawal, neuroanatomical changes, and genetic expression), the psychological cluster (i.e., psychopathology and comorbidity), the social cluster (i.e., deviant behaviors, social drift), natural history (i.e., exposure, relapse, sequencing of recovery), treatment non-specificity (i.e., psychopharmacological or cognitive-behavioral therapy), and object substitution (i.e., replacing the addiction of choice with another addiction). On the other hand, addictions differ in their expression (i.e., substance-related versus behavioral) and their unique manifestations and sequelae. For instance, drinking alcohol can lead to liver cirrhosis, whereas pathological gambling can lead to financial debt and mental health disorders. In sum, the similar etiology of addictions indicates that instead of viewing respective addictions as sepa-

rate pathological entities, they are better viewed as a syndrome (Shaffer et al., 2004). This gives strong support to the conjecture that pathological online gaming should be understood as a behavioral addiction rather than an impulse-control disorder.

With regards to children and adolescents who are potentially vulnerable to becoming addicted to playing online games, classification is essential because it will help to develop and initiate prevention efforts. Only when online gaming addiction is more clearly and comprehensively understood, can risk variables be targeted and protective factors fostered from a mental health point of view and on a large scale. Among groups of young people, prevention efforts may include both psycho-education as well as provision of information and tools that focus on developing healthy ways of coping with daily stressors. The earlier preventive efforts are initiated, the greater the chance that children and adolescents are protected from the dangers and ramifications of online gaming addiction.

The empirical studies examining online gaming addiction in children and adolescents in this review suffer from a variety of limitations. A major limitation is the frequent lack of sensitivity and specificity of measures used. On the one hand, it appears difficult to judge the extent to which the assessment tools utilized are sensitive enough to actually determine online gaming addiction status within children and adolescents. Thus, the question of sensitivity remains. On the other hand, it is unclear in how far the measurement instruments used are able to specifically identify adolescents who are not addicted to online gaming. Therefore, problems in the instruments' specificity may arise because the latter appears to be rather limited. In addition, the almost exclusive utilization of self-report measures calls into question the accuracy of diagnosis. Psychological and psychiatric assessments as well as parental reports appear to be indispensable complements for judging whether and to what extent a child or adolescent is actually addicted to online gaming particularly in light of a variety of symptoms that are commonly experienced comorbidly.

Another problem that materialized with the large majority of identified studies was the utilization of small, specified, self-selected, and/or mixed samples. Small samples are not representative of whole populations and therefore establishing representative prevalence estimates is obstructed. Furthermore, if samples are particularly specified (i.e., using a limited age group in a particular country, etc.), the participants' responses cannot be generalized to larger populations either. The opposite problem occurs if samples are mixed. It is unclear to what extent the findings can be generalized to specified populations. Self-selected samples comprise only those people who were enthused enough to participate and therefore these samples are somewhat unrepresentative of most target populations. Each of these problems calls for improvements in future research in order to increase the external validity of the studies' results. In addition, research in the field calls for studies that assess online gaming addiction cross-culturally because by comparing and contrasting the disorder within diverse sociocultural contexts, the differences and similarities can be discerned and treatment approaches can be tailored to the respective needs of particular cultural groups.

Conclusively, establishing a nosology of online gaming addiction satisfies two crucial aims. First, it enables the actual classification of the disorder within the classification systems. Second, it allows for the appropriate choice of re-

levant psychotherapeutic and/or psychopharmacological treatments (Du, Jiang & Vance, 2010; Griffiths & Meredith, 2009; Lee & Mysyk, 2004). As long as there is no coherent diagnostic framework upon which to base online gaming addiction diagnosis, not only does conceptual confusion ensue, but both further research endeavors as well as potential treatment plans are seriously complicated. Correspondingly, once this framework is established and accepted, the efforts of including online gaming addiction in the official diagnostic manuals (APA, 2007; Block, 2008; O'Brien, 2008) will finally come to fruition. Prevention efforts may be developed that specifically target children and adolescents who appear to be particularly at risk to developing online gaming addiction as well as associated developmental problems and disorders. Moreover, awarding online gaming addiction with an official status as mental disorder will enable diagnosis, communication about, study, treatment and prognosis of this psychopathology (Kemper, 2008; Springer, 2009; te Wildt, 2009).

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