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# Internet Gaming Disorder and its associated cognitions and cognitive-related impairments: A systematic review using PRISMA guidelines

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Sección Especial: Videojuegos y Cognición

## Abstract

**Background:** Empirical research studies have highlighted the need to investigate the underlying cognitions and cognitive variables in relation to Internet Gaming Disorder (IGD). However, little is known about the possible cognitive-related impairments associated with IGD. **Objectives:** The present paper extends previous research and uncovers additional key general cognitive-related outcomes of IGD via a systematic review of the empirical literature. **Methods:** The PRISMA (Preferred Reporting Item for Systematic Reviews and Meta-analysis) guidelines were adopted. Internet-based bibliographic searches were conducted via seven major electronic databases (i.e., *PsycARTICLES, PsycINFO, Web of Science, Core Collection BIOSIS Citation Index, MEDLINE, SciELO Citation Index*, and *PubMed*) to access studies examining the association between IGD and cognitive outcomes. **Results:** A total of 17 empirical studies meeting the inclusion criteria that investigated the relationships between IGD and cognitions and/or cognitive-related outcomes were identified. Seven distinct cognitions and another ten distinct cognitive-related impairments associated with IGD were identified. **Conclusion:** The present review found empirical evidence supporting the association of IGD with particular types of cognitions and specific cognitive-related impairments.

Key Words:
Internet Gaming Disorder; Gaming Addiction; Behavioral Addictions; DSM-5; PRISMA; Systematic Review.

## Resumen

**Trastorno por juego en internet, cogniciones sociadas y deterioros cognitivos relacionados: Una revisión sistemática utilizando las directrices PRISMA.** Introducción: Investigaciones empíricas han puntualizado la necesidad de indagar sobre las cogniciones subyacentes y las variables cognitivas asociadas con el Trastorno por Juego en Internet (IGD, por sus siglas en inglés). Sin embargo, es escaso el conocimiento sobre los posibles deterioros cognitivos asociados con el IGD. Objetivos: El presente estudio extiende la investigación previa y revela resultados generales de procesos cognitivos del IGD a través de una revisión sistemática de la literatura empírica. Método: Se adoptaron las directrices PRISMA (Preferred Reporting Item for Systematic Reviews and Meta-analysis). Se realizaron búsquedas bibliográficas a través de siete bases de datos electrónicas (p.e., PsycARTICLES, PsycINFO, Web of Science, Core Collection BIOSIS Citation Index, MEDLINE, SciELO Citation Index y PubMed) para acceder a los estudios que examinan la relación entre IGD y resultados cognitivos. Resultados: Un total de 17 estudios empíricos que examinaban la relación entre IGD y cogniciones y/o resultados cognitivos cumplieron con los criterios de inclusión. Se identificaron siete cogniciones distintivas y otros diez deterioros cognitivos relacionados con el IGD. Conclusión: No existe evidencia para sustentar la asociación entre el IGD y determinados tipos de cogniciones y deficiencias cognitivas específicas.

Palabras Clave:
Trastorno por Juego en Internet; Adicción al Juego, Adicciones Conductuales; DSM-5; PRISMA, Revisión Sistemática.

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## 1. Introduction

### *1.1. Rationale.*

In the latest (fifth) edition of the American Psychiatric Association (2013) *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), Internet Gaming Disorder (IGD) emerged in the psychiatric and psychological literature as a tentative disorder warranting further research before being fully recognized as an independent clinical entity (Griffiths, King, & Demetrovics, 2014; Petry & O'Brien, 2013). Additionally, the concept of behavioral

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addictions – which includes such disorders as IGD – is now being increasingly accepted amongst scholars and clinicians. Most notably, the latest DSM-5 reclassified Gambling Disorder from an impulse control disorder to a behavioral addiction (Reilly & Smith, 2013).

In the DSM-5, IGD is defined by nine core criteria, including: (i) pre-occupation with games; (ii) withdrawal symptoms when gaming is discontinued; (iii) tolerance, which is reflected by the need to spend increasing amounts of time engaged in gaming; (iv) unsuccessful attempts to control participation in gaming; (v) loss of interest in hobbies and entertainment as a result of, and with the exception of, gaming; (vi) continued excessive use of games, despite knowledge of psychosocial problems; (vii) deception of family members, therapists, or others regarding the amount of gaming; (viii) use of gaming to escape or relieve a negative mood; and (ix) loss of a significant relationship, job, or educational or career opportunity because of participation in games (American Psychiatric Association, 2013).

A growing body of research has now shown that IGD may be associated with several negative health-related outcomes and psychosocial detriments, such as increased obesity, sleep abnormalities, decreased job performance and/or job loss, decreased academic achievement, relationship problems, increased stress, lower psychosocial wellbeing, depression, and anxiety (Kuss & Griffiths, 2012; Kuss, Griffiths, Karila, & Billieux, 2014; Lam, 2014; Pontes & Griffiths, 2014; Sublette & Mullan, 2012). Due to these potential negative impacts of IGD on general health and psychosocial functioning, there has been a significant increase in academic researchers and clinicians investigating the cognitive, neurobiological, and neuropsychological processes underpinning IGD (Littel et al., 2012). In fact, gaming as an activity has been found to influence a wide range of cognitions and emotions in several ways (West & Bailey, 2013).

To the best of the authors' knowledge, only one systematic review published in a refereed journal to date has focused on identifying the cognitions associated with IGD (i.e., King & Delfabbro, 2014b). In their review, King and Delfabbro (2014b) (i) aimed to summarize available empirical and treatment evidence on the cognitive processes related to IGD and (ii) identify a common set of potential cognitions underlying this phenomenon. After analyzing relevant empirical evidence from 36 quantitative studies conducted since the year 2000, the authors suggested four sets of cognitions related to IGD: (i) beliefs about game reward value and tangibility, (ii) maladaptive and inflexible rules about gaming behavior, (iii) over-reliance on gaming to meet self-esteem needs, and (iv) gaming as a method of gaining social acceptance. Although their overview was systematic, the sets of cognitions and the general findings put forth by King and Delfabbro (2014b) should be cautiously interpreted since their review was primarily concerned with the conceptualization of IGD and arguably lacked robust and objective critical assessment of the indicators of quality (e.g., risk of biases) of the studies reviewed.

Like others in the field (e.g., King & Delfabbro, 2014b, 2014a), the present authors believe that understanding the cognitive factors underpinning IGD is likely to (i) help advance clinical research agendas, (ii) help in the identification of those with gaming disorder, (iii) aid the expansion and improvement of cognitive therapies, and (iv) demarcate the concept of IGD and its particular clinical features from similar, and yet different behavioral addictions (e.g., Gambling Disorder). This latter aspect is of utmost importance, since historically, IGD has been assessed in research by adopting non-standardized and inconsistent criteria lifted from pathological gambling and/or generalized internet addiction (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013; Király, Nagygyörgy, Koronczai, Griffiths, & Demetrovics, 2014; Pontes & Griffiths, 2014).

King et al. (2013) conducted a review on existing IGD assessment tools and suggested that across 18 assessment tools used in 63 studies assessing problematic gaming and/or gaming addiction, most of extant psychometric tools were particularly concerned with the criterion of 'preoccupation', which may be problematic since this indicator lacks clinical validity for distinguishing between disordered and non-disordered gamers (Charlton, 2002; Charlton & Danforth, 2007) and highlighted in published case studies showing that gaming excessively does not necessarily lead to any problems (Griffiths, 2010a). Therefore, the identification of a broad range of cognitive factors associated with IGD may not only help refining current cognitive models of IGD (Brand, Young, & Laier, 2014; Davis, 2001; Haagsma, Caplan,

Peters, & Pieterse, 2013) but also help improve its measurement in research.

### *1.2. Objectives.*

Given that the only previous systematic review examining cognitive factors of IGD did not assess the quality of the studies reviewed in-depth, the present systematic review fills a gap in the current literature of the cognitive psychology of IGD by further uncovering its key general cognitive-related outcomes utilizing The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines. More specifically, this systematic review investigates and synthetizes a comprehensive set of cognitions related to the phenomenon of IGD, while also providing critical information on the cognitive-related impairments that have been associated with IGD in recent empirical studies.

## 2. Method

The PRISMA statement for reporting systematic reviews (Moher, Liberati, Tetzlaff, Altman, & The Prisma Group, 2009) provides a robust and comprehensive framework to conduct systematic reviews and objectively assess indicators of quality and risk of biases of included studies, and is adopted throughout this review.

### *2.1. Protocol and registration*

The protocol for this review was not previously registered.

### *2.2. Eligibility criteria*

All original studies investigating the phenomenon of IGD and its associated cognitions and cognitive-related impairments were eligible for this systematic review. Further criteria adopted were (i) publication date between 2000 and 2014, (ii) being an empirical study, (iii) written in English language, (iv) published in a scholarly peer-reviewed journal, (v) conducted an assessment of IGD and (vi) a cognition or cognitive-related impairment objectively. Additionally, studies were excluded from review if they were (i) unpublished dissertation and thesis studies, (iii) single-case reports (N = 1), and (iii) not published in a peer-reviewed journal.

### *2.3. Information sources and search*

Studies were identified by searching relevant papers via EBSCO (2000 - August 2014), and included the following electronic databases: *Academic Search Complete, PsycARTICLES, PsycINFO*, via *Web of Science* (2000 - August 2014), which included *Web of Science Core Collection, BIOSIS Citation Index, MEDLINE*, and *SciELO Citation Index*. In addition, an independent literature search was carried out on PubMed (2000 - August 2014). Finally, reference lists of retrieved studies were hand searched in order to identify any additional relevant studies. Several searches in the aforementioned electronic databases were carried out during August 2014 using the following search strategy: (patholog* OR problem* OR addict* OR compulsive OR dependen* OR obsess* OR excess*) AND (video OR computer) gam* AND cognit*.

### *2.4. Study selection and data collection processes.*

After performing the initial literature searches, each study title and abstract was screened for eligibility by the first author. Full text of all potentially relevant studies were subsequently retrieved and further examined for eligibility. The PRISMA flow diagram (Figure 1) provides more detailed information regarding the selection process of the studies retrieved. Information from the included studies was then analyzed and recorded in an electronic spreadsheet designed by the first author. Different types of data were extracted from each study including (i) country in which the data were collected, (ii) key characteristics of the participants (i.e., sample size, gender distribution, and segment of the population assessed), (iii) operationalization of IGD, (iv) effects of IGD on cognitions (including their role and variance explained) and resulting cognitive-related impairments, (v) risk of bias in individual studies, and (vi) methodological features of studies (i.e., assessment method, type of study and design, and main limitations).

The Cochrane Collaboration's tool for assessing risk of bias was adopted to evaluate the risk of bias in individual studies (Higgins & Green, 2011). The following risk of biases were analyzed: (i) *selection bias* (i.e., biased allocation to interventions due to inadequate generation of a randomized sequence), (ii) *performance bias* (i.e., biases due to the knowledge of the allocated interventions by participants and personnel during the study), (iii) *detection bias* (i.e., biases due to knowledge of the allocated interventions by outcome assessors), (iv) *attrition bias* (i.e., biases due to the amount, nature or handling of incomplete outcome data), and (v) *reporting bias* (i.e.,

bias resulting from selective outcome reporting and/or not reporting relevant results outcomes that would have been expected to be reported) (see Higgins & Green, 2011 for a complete description).

In addition to these standard types of biases, other sources of biases analyzed included: (i) *sampling bias* (i.e., bias resulting from the use of non-probability self-selected samples), (ii) *measurement bias* (i.e., bias due to inappropriate measurement of IGD with inconsistent or non-validated criteria), and finally, (iii) *bias in analysis* (i.e., possible biases due to not reporting basic participants' demographic characteristics and/or any other important statistical coefficient that would have been expected to be reported for the analysis carried).

## 3. Results

### *3.1. Study selection*

A total of 1348 studies (EBSCO *n* = 829; Web of Science *n* = 514; PubMed *n* = 4) were identified after the initial search in the aforementioned electronic databases and one study (*n* = 1) retrieved from a list of references contained in another study was included in the identification process. The screening phase involved the examination of titles and abstracts of all studies identified. This process resulted in 1320 studies being excluded as they were deemed not suitable for the present review. Consequently, a total of 28 studies were selected for the eligibility phase. Of these, a total of 11 studies were excluded for not having measured objectively (i.e., with a psychometric tool) a (i) cognitive variable (*n* = 8) or (ii) IGD (*n* = 3). Following this procedure, 17 eligible empirical studies fully met the previously stipulated eligibility criteria for inclusion in the systematic review process (Figure 1).

### *3.2. Study characteristics*

More detailed information regarding the essential methodological features and general characteristics of all 17 studies included in this review can be found alongside Table 1 and Table 2.

**Figure 1.**
PRISMA flow diagram of the study selection process. Produced by Pontes & Griffiths to be used in the present article.

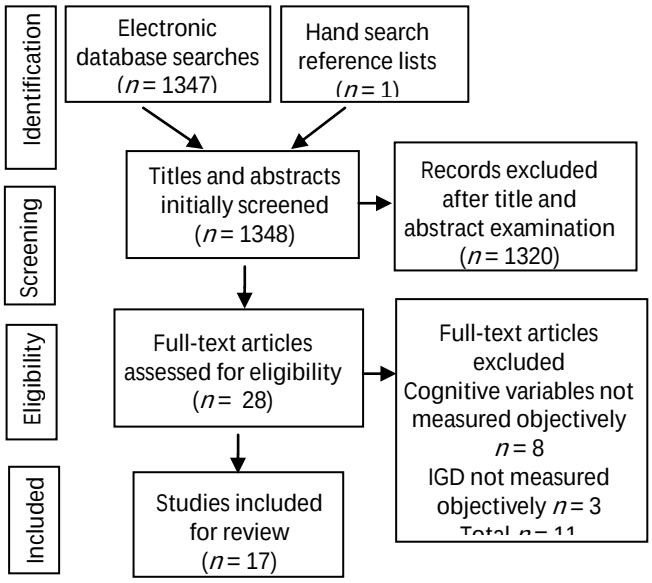


**Table 1**.
Main characteristics of the studies reviewed

| Study | Sample Size | Gender Distribution (%) | Age range (years) and Mean (*SD*) | Sample Characteristics | Operationalization of Gaming Addiction | Main Findings | Study Limitations |
|---|---|---|---|---|---|---|---|
| Haagsma et al. (2013) | 597 | 77% male; 23% female | Range = 12-22; $M_{age}$ = 16 (1.7) | Adolescent students online gamers | Problematic Online Game Use Scale (POGUS) | Preference for online social interaction, mood regulation and deficient self-regulation play an important role in predicting negative gaming-related outcomes. | Lack of sample heterogeneity; Measurement of problematic gaming using modified criteria of generalized problematic Internet use; lack of discriminant validity for the self-regulation construct. |
| Snodgrass et al. (2014) | 133 | 75.2% male; 24.8% female | Range = 15-60; $M_{age}$ = 29 (10.8) | WoW players | Modified version of the Internet Addiction Test (IAT) | IGD may be a response to pre-existing life stress. Less stressed | Lack of control of important variables such as psychopathology; |

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| | | | | | | individuals play WoW in order to enhance their offline lives whereas more highly stressed players further magnify their stress and suffering in their lives via IGD. | lack of previously validated psychometric tools to assess the main cognitive variables; low sample size consisting of World of Warcraft players only; omission of participants' sociodemographic information; lack of analyses of indirect mediation effects. |
| Hilgard et al. (2013) | 672 | 79% male; 21% female | Range = N/R; $M_{age}$ = 22 (5.5) | Mix of online gamers and undergraduate students | Modified DSM-IV criteria for pathological gambling | Three specific factors related to players' individual preferences and motives were associated with IGD: self-escapism, the use of games as social outlet, and positive attitudes toward the steady accumulation of in-game rewards. | Self-selected samples; lack of other sources of validity for the GAMES scale; operationalization of gaming addiction based on inconsistent and modified criteria for pathological gambling. |
| Liu and Peng (2009) | 288 | 66.3% male; 30.2% female; 3.5% undisclosed | Range = N/R; $M_{age}$ = 27 (N/R) | MMORPGs players | Adaptation of the withdrawal subscale of the Generalized Problematic Internet Use Scale (GPIUS) | Both IGD and deficient self-regulation play an important role in predicting game-related negative outcomes. Furthermore, cognitive preference for a virtual life predicts IGD. | Low sample size consisting of gamers; inconsistent operationalization of gaming addiction based on generalized Internet addiction measure. |
| Decker and Gay (2011) | 42 | 100% male | Range = 18-25; $M_{age}$ = 21 (2.2)* | University students and WoW players | Combined modified version of the Alcohol Use Disorders Identification Test (AUDIT) and the T-ACE questions for alcohol dependency | WoW players who play frequently displayed more cognitive biases toward words related to game's content. | Low sample size consisting of World of Warcraft players only; lack of female participants; operationalization of gaming addiction based on inconsistent and modified criteria of alcohol dependency |
| Zhou et al. (2012) | 92 | 69% male; 31% female | Range = 18-36; $M_{age}$ = 26 (8.0) | Gamers with IGD and healthy controls | Modified version of the Young's Diagnostic Questionnaire (YDQ) | IGD accompany cognitive biases toward information related to gaming. These biases alongside poor executive functioning skills might be responsible for IGD. | Low sample size; operationalization of gaming addiction based on inconsistent and non-standardized criteria for generalized Internet addiction |

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| Yuan et al. (2013) | 36 | 67% male; 33% female | Range = 17-22; $M_{age}$ = 19 (3.1) | Disordered WoW players and healthy controls | Modified version of the Young's Diagnostic Questionnaire (YDQ) | Disordered players presented with increased cortical thickness in the left precentral cortex, precuneus, middle frontal cortex, inferior temporal and middle temporal cortices in late adolescents with IGD. | Low sample size; gaming addiction group consisting solely of World of Warcraft players; operationalization of gaming addiction based on inconsistent and non-standardized criteria for generalized Internet addiction; limited generalizability due to study's design |
| Sun et al. (2008) | 60 | 100% male | Range = N/R; $M_{age}$ = 20 (1.4)* | University male students action video game players | Problem Video Game Playing (PVP) | Based on the results of a MOT task, players with previous history of IGD performed better than control participants. However, current disordered players performed worse than previously disordered players, suggesting that current IGD may be related to cognitive deficits. | Low sample size; lack of female participants; gaming addiction group not heterogeneous; gaming addiction measured with a translated and non-validated measure for the Chinese context |
| Li et al. (2011) | 161 | 49.1% male; 50.9% female | Range = 13-15; $M_{age}$ = 14 (0.7) | Secondary school students from Chinese, Malay, and Indian ethnicity that played MMORPGs | Modified version of the Pathological Gaming Scale (PGS) | Depression mediated the relationship between AISDs and escapism whereas escapism mediated the relationship between depression and IGD. IGD may be an over-regulated coping strategy to approaching the ideal self and avoiding the actual self. | Low sample size; gaming addiction conceptualized after pathological gambling; limited generalizability due to study's design |
| Littel et al. (2012) | 52 | 63% male; 37% female | Range = N/R; $M_{age}$ = 20 (2.9)* | University students that played WoW | Video Game Addiction Test (VAT) | Disordered gamers showed reduced error-related negativity amplitudes in response to incorrect trials relative to correct trials, suggesting poor error processing. Additionally, IGD displayed higher levels of | Low sample size; the vast majority of game addicts were male; gamers consisted exclusively in World of Warcraft players; conceptualization and measurement of gaming addiction using the VAT based on modified criteria for generalized internet addiction |

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| | | | | | | impulsivity. | |
| Pawlikowski and Brand (2011) | 38 | 73% male; 27% female | Range = 19-34; $M_{age}$ = 23 (3.9)* | University students that played WoW and non-gamers | Modified version of the Internet Addiction Test (IAT) to measure addiction to World of Warcraft | Based on the results of the GDT, IGD players showed reduced decision-making ability. Moreover, disordered players exhibited higher psychiatric symptomatology in contrast to controls. The reduced decision-making found in IGD is comparable with patients with other forms of behavioral addictions, impulse control disorders or substance abusers. | Low sample size; overrepresentation of male gender; gamers consisted exclusively in World of Warcraft players; conceptualization and measurement of gaming addiction using a modified version of the IAT; lack of consistency and statistical significance regarding the reported correlations |
| Bailey et al. (2013) | 149 | 53% male; 47% female | Range = 16-30; $M_{age}$ = N/R | Undergraduate students that played FPS and strategy games | Revised version of the Problem Video Game Playing (PVP) | Number of hours gaming was associated with increased impulsivity, this relationship was sensitive to the genre of video game played. Hours per week and IGD predicted greater risk-taking in two tasks. | Low sample size; gamers limited to two specific genres of video games; gaming addiction as measured by the PVP did not correlate itself with most of the risky decisions measures investigated |
| Peng and Liu (2010) | 131 | 63% male; 33% female; 4% undisclosed | Range = N/R; $M_{age}$ = 26 (N/R) | Online gamers volunteers from different backgrounds | Criteria adapted from generalized Internet Addiction definition | Maladaptive cognitions, shyness, and depression were positively associated with IGD. Furthermore, IGD was also positively related to different types of negative life outcomes. | Low sample size; assessment of gaming addiction using inconsistent and non-standardized previously validated measure; lack of appropriateness for the statistical modelling due to severely low sample size |
| Dauriat et al. (2011) | 696 | 93% male; 7% female | Range = 13-54; $M_{age}$ = 25 (7.4) | European MMORPG players | Criteria adapted from generalized Internet Addiction definition | Five types of motivations to play MMORPGs were identified: achievement, socializing, immersion, relaxing, and escaping. IGD was predicted by achievement, escapism, and socializing motives. | Exclusion of gamers that did not play MMORPGs; inconsistent assessment of gaming addiction using a measure of gaming addiction that had not been used nor validated before by previous studies |

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| | | | | | | Gender was also a predictor of IGD. | |
| Huanhuan and Su (2013) | 495 | 47.5% male; 52.5% female | Range = 12-19; $M_{age}$ = 15 (2.0) | Adolescents from middle schools | Modified version of the Young's Diagnostic Questionnaire (YDQ) | Rumination and short-term thinking were the best predictors of IGD, while all-or-nothing thinking predicted IGD at marginal significant levels. Males had greater risk of IGD than females. Both CBT and basic counselling had similar positive treatment effects. | Self-selected samples; operationalization of gaming addiction based on inconsistent and non-standardized criteria for generalized Internet addiction; limited generalizability due to study's design |
| Yee (2006) | 3.200 | 86.5% male; 13.5% female | Range = N/R; $M_{age}$ = 27 (8.6) | MMORPGs players | Modified version of the Young's Diagnostic Questionnaire (YDQ) | A pattern of ten motivations to play MMORPGs that could be grouped into three components emerged: achievement, social, and immersion. Furthermore, IGD was associated with self-escapism. | Self-selected samples; operationalization of gaming addiction based on inconsistent and non-standardized criteria for generalized Internet addiction; limited generalizability of the findings due to inclusion of only MMORPGs players; omission of results concerning several important demographic variables relative to the sample's characteristics |
| Wan and Chiou (2007) | 615 | 69.9% male; 30.1% female | Range = 16-24; $M_{age}$ = 20 (1.9) | Taiwanese adolescents with previous experience in online gaming | Modified version of the Internet Addiction Scale for high schoolers in Taiwan (IAST) which was developed to measure generalized Internet addiction | IGD players exhibited higher intrinsic than extrinsic motivation, whereas non-disordered players showed an opposite relationship, suggesting that intrinsic motivation plays a crucial role in IGD. Furthermore, extrinsic rewards undermine intrinsic motivation when they are of high expectancy, relevance, tangible, and non-contingent. | Self-selected samples; conceptualization and measurement of gaming addiction using a modified version of the IAST; omission of results concerning several important demographic variables relative to the sample's characteristics; findings related to MMORPGs gamers only |

**Notes**: * = Information regarding the "gaming addiction" group only. Abbreviations: IGD = Internet Gaming Disorder; WoW = World of Warcraft; MOT = Multiple Object Tracking; AISDs = Actual-ideal self-discrepancies; GDT = Game of Dice Task; MMORPGs = Massively-Multiplayer Online Role-Playing Games; FPS = first-person shooters games; CBT = Cognitive-behavioral therapy.

### *3.3. Country in which the data were collected*

In regards to the geographic characteristics of the studies included, six studies were from the United States (Bailey, West, & Kuffel, 2013; Decker & Gay, 2011; Hilgard, Engelhardt, & Bartholow, 2013; Liu & Peng, 2009; Snodgrass et al., 2014; Yee, 2006), five were from China (Huanhuan & Su, 2013; Peng & Liu, 2010; Sun, Ma, Bao, Chen, & Zhang, 2008; Yuan et al., 2013; Zhou, Yuan, & Yao, 2012), two from The Netherlands (Haagsma et al., 2013; Littel et al., 2012), one from Singapore (Li, Liau, & Khoo, 2011), one from Germany (Pawlikowski & Brand, 2011), one from Taiwan (Wan & Chiou, 2007), and another one from Switzerland (Dauriat et al., 2011) respectively.

### *3.4. Participants*

The studies reviewed included a total of 7457 participants. Additionally, in terms of gender distribution[2], the vast majority of the studies reviewed recruited more male participants (*n* = 5422; 79.8%) than female participants (*n* = 1373; 20.2%). Not surprisingly, 11 of the reviewed studies (Bailey et al., 2013; Dauriat et al., 2011; Decker & Gay, 2011; Haagsma et al., 2013; Huanhuan & Su, 2013; Li et al., 2011; Pawlikowski & Brand, 2011; Snodgrass et al., 2014; Wan & Chiou, 2007; Yuan et al., 2013; Zhou et al., 2012) explicitly included adolescent samples.

Furthermore, nine studies included student samples (Bailey et al., 2013; Decker & Gay, 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Li et al., 2011; Littel et al., 2012; Pawlikowski & Brand, 2011; Sun et al., 2008). With the exception of only one study (i.e., Huanhuan & Su, 2013), all studies reviewed included gamers in their samples. More specifically, eight studies (Dauriat et al., 2011; Li et al., 2011; Littel et al., 2012; Liu & Peng, 2009; Pawlikowski & Brand, 2011; Snodgrass et al., 2014; Yee, 2006; Yuan et al., 2013) explicitly included Massively-Multiplayer Online Role-Playing Games (MMORPGs) gamers in their samples.

### *3.5. Operationalization of Internet Gaming Disorder.*

Operationalization of a variable comprises describing how a concept is objectively measured (Dantzker & Hunter, 2011). Nevertheless, 12 studies (Dauriat et al., 2011; Haagsma et al., 2013; Huanhuan & Su, 2013; Littel et al., 2012; Liu & Peng, 2009; Pawlikowski & Brand, 2011; Peng & Liu, 2010; Snodgrass et al., 2014; Wan & Chiou, 2007; Yee, 2006; Yuan et al., 2013; Zhou et al., 2012) used modified versions of generalized Internet addiction scales and/or inconsistent criteria to measure IGD based on the operational definition of pathological gambling alone (Bailey et al., 2013; Hilgard et al., 2013; Li et al., 2011) or combined with the criteria for substance use disorder (Sun et al., 2008) or alcohol dependency (Decker & Gay, 2011).

### *3.6. Effects of Internet Gaming Disorder on Cognitions*[3]

A total of seven distinct cognitions associated with IGD were reported across seven studies. More specifically, (i) *preference for online social interaction* (Haagsma et al., 2013), (ii) *mood regulation* (Haagsma et al., 2013), (iii) *cognitive diversion* (Snodgrass et al., 2014), (iv) *self-escapism* (Dauriat et al., 2011; Hilgard et al., 2013; Li et al., 2011; Yee, 2006), (v) *positive attitude toward in-game rewards* (Hilgard et al., 2013), (vi) *actual-ideal self-discrepancy* (Li et al., 2011), and (vii) *intrinsic motivation to play* (Wan & Chiou, 2007).

In addition, 11 studies found IGD to be associated with 10 different cognitive-related impairments. These were (i) *deficient self-regulation* (Haagsma et al., 2013), (ii) *preference for a virtual life* (Liu & Peng, 2009), (iii) *cognitive bias* (Decker & Gay, 2011; Zhou et al., 2012), (iv) *decision bias* (Zhou et al., 2012), (v) *impaired cognitive control ability* (Yuan et al., 2013), (vi) *cognitive deficits* (Sun et al., 2008), (vii) *poor cognitive error processing* (Littel et al., 2012), (viii) *decision-making deficits* (Bailey et al., 2013;

[2] Some studies (Wan & Chiou, 2007) did not report the gender distribution of participants, while others (Liu & Peng, 2009; Peng & Liu, 2010) reported cases where gender was undisclosed. Moreover, two studies comprised of male participants only (Decker & Gay, 2011; Sun et al., 2008).

[3] Due to the cross-sectional nature of most studies included in this review, this effect could also be validly interpreted in the opposite direction (i.e., effects of cognitions and/or cognitive-related impairments on the development of IGD). This should not be interpreted as a limitation of the present review since the main objective was to uncover the cognitions and cognitive-related impairments associated with IGD.

Pawlikowski & Brand, 2011), (ix) *maladaptive cognitions* (Peng & Liu, 2010), and (x) *cognitive distortions* (Huanhuan & Su, 2013).

### *3.7. Risk of bias in individual studies*

A general overview and summary of possible risks of bias across all reviewed studies is presented in Table 3.

In terms of selection bias, most studies (Bailey et al., 2013; Dauriat et al., 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Li et al., 2011; Liu & Peng, 2009; Peng & Liu, 2010; Snodgrass et al., 2014; Wan & Chiou, 2007; Yee, 2006; Yuan et al., 2013) were rated as low risk due to their cross-sectional design and the low likelihood that the absence of random allocation of participants would possibly bias their outcomes. On the other hand, five studies (Decker & Gay, 2011; Littel et al., 2012; Pawlikowski & Brand, 2011; Sun et al., 2008; Zhou et al., 2012) were rated as high risk due to increased likelihood of bias resulting from (i) non-random component in the sequence generation process and/or (ii) non-random allocation of participants that involved judgment or other non-random method of categorization of participants (e.g., results of test scores assessing IGD).

Potential performance bias was found to be of high risk across five studies (Littel et al., 2012; Pawlikowski & Brand, 2011; Sun et al., 2008; Yuan et al., 2013; Zhou et al., 2012) as in these studies, blinding of key study participants and personnel were not attempted, thus representing potential sources of biases at the outcome levels. However, most studies (Bailey et al., 2013; Dauriat et al., 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Liu & Peng, 2009; Peng & Liu, 2010; Snodgrass et al., 2014; Wan & Chiou, 2007; Yee, 2006) were rated low risk at this level, and two studies (Decker & Gay, 2011; Li et al., 2011) were of unclear risk since there was insufficient information to permit judgment of risk level.

**Table 2**.
Internet Gaming Disorder associated cognitions and cognitive-related impairments and their role

| Supporting Research | Country of Origin | Cognition | Cognition Role | Variance Explained ($R^2$) | Assessment Method | Type of Study and Design |
|---|---|---|---|---|---|---|
| Haagsma et al. (2013) | The Netherlands | Preference for online social interaction | Predictor via indirect effects | 79% | Online self-report survey | Quantitative Cross-sectional |
| | | Mood regulation | Predictor via Indirect effects | | | |
| | | Deficient self-regulation | Predictor via direct effects | | | |
| Snodgrass et al., (2013) | United States | Cognitive diversion[1] | Mediator | 34% | Online self-report survey; Ethnographic participant-observation; | Correlational Mixed-Methods Cross-sectional |
| Hilgard et al. (2013) | United States | Self-escapism | Associated | N/R | Online and paper-and-pencil self-report survey | Quantitative Cross-sectional |
| | | Positive attitude toward in-game rewards | Associated | N/R | | |
| Liu and Peng (2009) | United States | Preference for a virtual life[2] | Associated | 26.9% | Online self-report survey | Quantitative Cross-sectional |
| Decker and Gay (2011) | United States | Cognitive bias | Associated | N/R | Paper-and-pencil survey; computerized go/no-go task | Quantitative Experimental |
| Zhou et al. (2012) | China | Cognitive bias | Associated | 14.4% | Paper-and-pencil survey; computerized go/no-go task | Quantitative Experimental |
| | | Decision bias | Associated | N/R | | |
| Yuan et al. (2013) | China | Impaired cognitive control ability | Associated | N/R | Paper-and-pencil survey; computerized Stroop task; MRI data | Quantitative Cross-sectional |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sun et al. (2008) | China | Cognitive deficits | Associated | N/R | Paper-and-pencil survey; computerized multiple object tracking task | Quantitative Experimental |
| Li et al. (2011) | Singapore | Self-escapism | Associated | 7.3% | Paper-and-pencil survey | Quantitative Cross-sectional |
| | | Actual-ideal self-discrepancy | Associated | 19.4% | | |
| Littel et al. (2012) | The Netherlands | Poor cognitive error processing | Associated | N/R | Paper-and-pencil survey; computerized go/no-go task; electroencephalogram | Quantitative Cross-sectional |
| Pawlikowski and Brand (2011) | Germany | Decision-making deficits | Associated | 26% | Paper and pencil survey; computerized Game of Dice Task | Quantitative Cross-sectional |
| Bailey et al. (2013) | United States | Decision-making deficits | Associated | N/R | Paper and pencil survey; computerized Iowa Gambling Task, Temporal Discounting Task, Probabilistic Selection Task, Risk Task | Quantitative Cross-sectional |
| Peng and Liu (2010) | China | Maladaptive cognitions[3] | Predictor | N/R | Online self-report survey | Quantitative Cross-sectional |
| Dauriat et al. (2011) | Switzerland | Self-escapism | Predictor | N/R | Online self-report survey | Quantitative Cross-sectional |
| Huanhuan and Su (2013) | China | Cognitive distortions[4] | Associated | N/R | Paper and pencil survey | Quantitative Cross-sectional |
| Yee (2006) | United States | Self-escapism | Associated | N/R | Online self-report survey | Quantitative Cross-sectional |
| Wan and Chiou (2007) | Taiwan | Intrinsic motivations to play | Associated | N/R | Paper and pencil survey | Quantitative Cross-sectional Experimental |

***Notes***: [1] = The term "Cognitive Diversion" was used by the study's authors to describe the mediating effects of Relaxing Escape and Engagement in the relationship between perceived stress and gaming addiction. Furthermore, Cognitive Diversion was assessed by the WoW Relaxing Escape Scale and the WoW Engagement Scale separately.
[2] = "Preference for a virtual life" is a constructed that was proposed based on the concept of maladaptive cognitions and preference for online social interaction.
[3] = Defined as cognitive distortions about the self and the world (Peng & Liu, 2010, p. 329). 4 = The term "cognitive distortions" was operationally defined by four sub-types of cognitive distortions, namely, all-or-nothing thinking, online comfort, rumination, and short-term thinking (see Huanhuan & Su, 2013).

**Table 3**.
Assessment of risk of bias in individual studies.

Detection bias was rated of low risk in 10 studies (Bailey et al., 2013; Dauriat et al., 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Liu & Peng, 2009; Peng & Liu, 2010; Snodgrass et al., 2014; Wan & Chiou, 2007; Yee, 2006). Furthermore, two studies (Decker & Gay, 2011; Li et al., 2011) were of unclear risk due to insufficient information being reported to permit judgment of low or high risk. Finally, five studies (Littel et al., 2012; Pawlikowski & Brand, 2011; Sun et al., 2008; Yuan et al., 2013; Zhou et al., 2012) were deemed of potential high risk of bias in this domain due to knowledge of the allocated interventions by outcome assessors.

Regarding attrition bias, the majority of studies (Dauriat et al., 2011; Haagsma et al., 2013; Hilgard et al., 2013; Li et al., 2011; Littel et al., 2012; Pawlikowski & Brand, 2011; Peng & Liu, 2010; Snodgrass et al., 2014; Sun et al., 2008; Yuan et al., 2013; Zhou et al., 2012) were rated as low risk since the amount, nature, and/or handling of incomplete outcome data was done adequately. However, in five studies (Bailey et al., 2013; Decker & Gay, 2011; Liu & Peng, 2009; Wan & Chiou, 2007; Yee, 2006) the risk level was unclear due to insufficient reporting of attrition or exclusions of participants to allow the rating of low or high risk. Additionally, only one study (Huanhuan & Su, 2013) was rated as high risk for potential attrition bias due to the unclear nature of handling of the missing data.

Reporting bias was rated high risk in 10 studies (Bailey et al., 2013; Decker & Gay, 2011; Hilgard et al., 2013; Littel et al., 2012; Pawlikowski & Brand, 2011; Peng & Liu, 2010; Snodgrass et al., 2014; Sun et al., 2008; Wan & Chiou, 2007; Yee, 2006). This is because several key variables that should have been reported were not (e.g., correlation coefficients, effect sizes, etc.). Furthermore, three studies (Haagsma et al., 2013; Li et al., 2011; Liu & Peng, 2009) were rated as low risk, and four studies (Dauriat et al., 2011; Huanhuan & Su, 2013; Yuan et al., 2013; Zhou et al., 2012) were not rated for risk since the information provided could not be adequately rated either as high or low risk.

| Study | Selection bias | Performance bias | Detection bias | Attrition bias | Reporting bias | Other bias | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Sampling bias | Measurement bias | Bias in analysis |
| Haagsma et al. (2013) | - | - | - | - | - | + | + | + |
| Snodgrass et al. (2014) | - | - | - | - | + | + | + | + |
| Hilgard et al. (2013) | - | - | - | - | + | + | + | + |
| Liu and Peng (2009) | - | - | - | ? | - | + | + | - |
| Decker and Gay (2011) | + | ? | ? | ? | + | + | + | + |
| Zhou et al. (2012) | + | + | + | - | ? | + | + | + |
| Yuan et al. (2013) | - | + | + | - | ? | + | + | + |
| Sun et al. (2008) | + | + | + | - | + | + | + | - |
| Li et al. (2011) | - | ? | ? | - | - | + | + | - |
| Littel et al. (2012) | + | + | + | - | + | + | + | + |
| Pawlikowski and Brand (2011) | + | + | + | - | + | + | + | + |
| Bailey et al. (2013) | - | - | - | ? | + | + | + | + |
| Peng and Liu (2010) | - | - | - | - | + | + | + | + |
| Dauriat et al. (2011) | - | - | - | - | ? | + | + | + |
| Huanhuan and Su (2013) | - | - | - | + | ? | + | + | + |
| Yee (2006) | - | - | - | ? | + | + | + | + |
| Wan and Chiou (2007) | - | - | - | ? | + | + | + | - |

***Notes***: $^{+}$ = High Risk of Bias; $^{-}$ = Low Risk of Bias; $^{?}$ = Unclear Risk of Bias.

Assessment of other sources of biases involved the examination of sampling bias, measurement bias, and bias in analysis. On these biases, all studies were rated as high risk of sampling bias due to (i) widespread use of self-selected samples, (i) lack of

probability sampling techniques, (iii) recruitment of male-only samples, and/or (iv) lack of inclusion of clinical samples. In addition, measurement bias was rated as high risk in all reviewed studies due to (i) inconsistent conceptualization and/or (ii) measurement of the outcomes. Finally, bias in analysis was rated as high risk in the majority of the studies (Bailey et al., 2013; Dauriat et al., 2011; Decker & Gay, 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Littel et al., 2012; Pawlikowski & Brand, 2011; Peng & Liu, 2010; Snodgrass et al., 2014; Yee, 2006; Yuan et al., 2013; Zhou et al., 2012) due to lack of reporting and/or omission of key statistical results that would normally be expected to be reported (e.g., correlation coefficients, coefficients of determination, effect sizes). Only four studies (Li et al., 2011; Liu & Peng, 2009; Sun et al., 2008; Wan & Chiou, 2007) were rated low risk in this domain.

### *3.8. Methodological features of studies*

In regards to studies' key methodological features, all reviewed studies were of quantitative and empirical nature. However, the majority of the studies used a cross-sectional design (Bailey et al., 2013; Dauriat et al., 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Li et al., 2011; Littel et al., 2012; Liu & Peng, 2009; Pawlikowski & Brand, 2011; Peng & Liu, 2010; Wan & Chiou, 2007; Yee, 2006; Yuan et al., 2013), three studies adopted an experimental design (Decker & Gay, 2011; Sun et al., 2008; Zhou et al., 2012), and one study employed a mixed-methods design (Snodgrass et al., 2014).

All 17 studies used self-report questionnaires to collect data. Additionally, 10 studies (Bailey et al., 2013; Decker & Gay, 2011; Huanhuan & Su, 2013; Li et al., 2011; Littel et al., 2012; Pawlikowski & Brand, 2011; Sun et al., 2008; Wan & Chiou, 2007; Yuan et al., 2013; Zhou et al., 2012) used paper-and-pencil survey methods for assessing their independent and outcome variables while six studies (Dauriat et al., 2011; Haagsma et al., 2013; Liu & Peng, 2009; Snodgrass et al., 2014; Yee, 2006) used online surveys with self-report measures to assess participants. One study (Hilgard et al., 2013) combined both online and offline approaches to collecting data.

As to the sampling methods employed, no study used a probability-sampling technique to recruit representative samples. More specifically, 15 studies (Bailey et al., 2013; Dauriat et al., 2011; Decker & Gay, 2011; Haagsma et al., 2013; Hilgard et al., 2013; Huanhuan & Su, 2013; Li et al., 2011; Littel et al., 2012; Liu & Peng, 2009; Pawlikowski & Brand, 2011; Snodgrass et al., 2014; Sun et al., 2008; Yee, 2006; Yuan et al., 2013; Zhou et al., 2012) used convenience and self-selected sampling, one study (Peng & Liu, 2010) used non-probability snowball sampling method and another study (Wan & Chiou, 2007) used non-probability stratified sampling method to recruit participants.

Several types of limitations were identified across all 17 studies (Table 1). The limitations found can be broadly categorized within three major categories at three different levels: (i) *operationalization and measurement issues*, (ii) *sampling issues*, and (iii) *reporting issues*. Operationalization and measurement issues found within reviewed studies involved a wide range of problems related to the assessment of IGD, such as (i) the use of inconsistent definitions, (ii) use of non-validated criteria, and (iii) use of modified psychometric tools that were originally designed to assess generalized Internet addiction or other less-related construct (e.g., alcohol dependency). Sampling issues involved (i) widespread use of non-probability sampling techniques, (ii) lack of sampling heterogeneity with some studies using male-only samples, (iii) lack of clinical samples, and (iv) relatively low sample sizes. Reporting issues limiting the interpretation of the findings within the reviewed studies were essentially (i) inconsistency in reporting statistical significance estimates (e.g., presenting a non-statistically significant correlation coefficient in a way it was significant), (ii) omission of key demographic findings related to the sample recruited (e.g., age range, mean age, and gender distribution), and (iii) non-reporting of important correlation coefficients associated with the main variables assessed in studies that adopted a correlational cross-sectional design.

## 4. Discusion

The present review aimed to identify relevant empirical evidence to the effects of IGD on a variety of cognitions and cognitive-related impairments. Additionally, data extracted from the studies reviewed encompassed: (i) country in which the data were collected, (ii) key characteristics of the participants, (iii) operationalization of IGD, (iv) effects of IGD on cognitions and resulting cognitive-related impairments, (v) risk of bias in individual studies, and

(vi) methodological features of studies reviewed.

In terms of geographic dispersion, most studies (i.e., 10) were conducted either in the United States and/or European context, with a smaller percentage (i.e., seven) of the remaining studies being conducted in the Asian context. As for the participants included across all reviewed studies, important patterns emerged in this research as the generality of studies recruited unevenly more (i) male participants than female, (ii) adolescent samples than children, adult and/or elderly samples, (iii) student samples rather than individuals from the more general population, and, (iv) more MMORPGs gamers than other non-MMORPGs gamers. Given the present findings, it is important that future research on IGD include (i) a more representative samples of gamers not entirely made of MMOPGs players, (ii) recruit participants from other developmental stages rather than focusing on adolescent samples, (iii) other types of participants (e.g., clinical samples, players from other video game genres) rather than students who have been extensively researched across several domains. On the other hand, the relative increase of participants being recruited in studies of this nature is perhaps a positive aspect since it may help increase studies' external validity of findings reported related to specific populations.

Attention should be paid to the way researchers operationalize and measure IGD in their research. Evidence from the present review suggest that around 70.6% of the reviewed studies measured IGD either on the basis of (i) modified and/or adapted versions of psychometric tests that were designed to measure generalized Internet addiction and/or the (ii) adoption of inconsistent criteria used to assess pathological gambling alone or (iii) combined with the criteria for substance use disorder, or even more thorny (iv) using the criteria for alcohol dependency. As suggested by previous authors (e.g., King et al., 2013; Király et al., 2014; Pontes & Griffiths, 2014), the extensive use of inconsistent and non-validated criteria to measure IGD may render additional methodological difficulties in its assessment, potentially compromising the advancement of the field in the long run as cross-cultural research will be likely to be less reliable. As a tentative solution to the issue of inconsistency in operationalization and measurement of IGD (Griffiths et al., 2014), researchers should employ more updated and well-validated psychometric tools (e.g., Pontes & Griffiths, 2015; Pontes, Király, Demetrovics, & Griffiths, 2014) to measure IGD and test the psychometric properties of such instruments in different contexts in order to produce more reliable cross-cultural research.

One of the main objectives of the present review was to identify relevant cognitions and cognitive-related impairments that have been associated with IGD. Results demonstrated seven distinct cognitions reported across seven studies. More specifically, (i) preference for online social interaction (Haagsma et al., 2013), (ii) mood regulation (Haagsma et al., 2013), (iii) cognitive diversion (Snodgrass et al., 2014), (iv) self-escapism (Dauriat et al., 2011; Hilgard et al., 2013; Li et al., 2011; Yee, 2006), (v) positive attitude toward in-game rewards (Hilgard et al., 2013), (vi) actual-ideal self-discrepancy (Li et al., 2011), and (vii) intrinsic motivation to play (Wan & Chiou, 2007). Interestingly, escapism emerged more often as a cognition associated with IGD. This partly mirrors the findings from studies on pathological gambling (Wood & Griffiths, 2007a) where researchers report that escapism may be the prime characteristic present in the gambling experience as it may facilitate the continuation of problem gambling by modifying the gamblers' mood while also providing them with a dysfunctional coping strategy that allows players to fill a void and/or avoid problems. The same may be true in disordered gamers. However, such an assertion warrants further research. Several research questions may be asked in this regard: (i) Is escapism a risk factor for IGD? and (ii) Is it embedded in the behavior itself, therefore constituting an important dimension of this behavioral addiction? These questions may pave the way for in-depth qualitative research to address these inconsistencies while also providing a qualitative-based rationale as to why disordered gamers play to escape.

Evidence was also found supporting the associations between cognitive-related impairments amongst disordered players. In fact, 11 studies reported at least one or more types of cognitive impairments in these participants, including (i) deficient self-regulation (Haagsma et al., 2013), (ii) preference for a virtual life (Liu & Peng, 2009), (iii) cognitive bias (Decker & Gay, 2011; Zhou et al., 2012), (iv) decision bias (Zhou et al., 2012), (v) impaired cognitive control ability (Yuan et al., 2013), (vi) cognitive deficits (Sun et al., 2008), (vii) poor cognitive

error processing (Littel et al., 2012), (viii) decision-making deficits (Bailey et al., 2013; Pawlikowski & Brand, 2011), (ix) maladaptive cognitions (Peng & Liu, 2010), and (x) cognitive distortions (Huanhuan & Su, 2013). These findings highlight the fact that cognitive impairments were more often and frequently reported by the studies reviewed than the general cognitions associated with IGD, potentially illustrating and emphasizing the importance of taking this condition more seriously from a clinical standpoint.

The present findings regarding the cognitions and cognitive impairments found in the present review lend support to King and Delfabbro's (2014a, 2014b) studies and also help extending their findings since in addition to their findings, several cognitive-related impairments associated with IGD were pinpointed in the current study. These present findings have the potential to refine extant theoretical models of IGD and treatment approaches that are rooted in the cognitive framework as academics and clinicians should not grow blasé about the underlying cognitive-related variables associated with IGD. Furthermore, in terms of risk of bias in individual studies, high risk of sampling bias and measurement bias was found in all studies, closely followed by bias in analysis and reporting bias. Selection bias, performance bias, detection bias, and attrition bias were not so prominent across the studies reviewed.

In addition to the analysis conducted, the studies reviewed also underwent systematic scrutiny regarding their methodological features. From this, it was evident that the majority of studies adopted cross-sectional designs rather than more complex and costly designs (e.g., longitudinal and experimental). However, a few studies used experimental and mixed-methods design, thus not limiting the present findings to cross-sectional studies. It is also worth noting that the widespread adoption of cross-sectional designs may limit the generalizability of the findings of the studies reviewed.

Paper-and-pencil surveys were used by most of studies whereas a smaller number relied on online surveys or a combination of both. Taken together, these findings suggest that the use of online survey is becoming increasingly popular in this field of research, perhaps as a reflection of studies supporting the reliability and validity of this approach (Gosling, Vazire, Srivastava, & John, 2004; Pettit, 2002) and its inherently practical benefits such as increased self-disclosure (Joinson, 2001) and disinhibition (Suler, 2004) and possible reduced social desirability and research-related costs (Griffiths, 2010a; Wood & Griffiths, 2007b). As to the sampling method used, probability-sampling was found to be severely lacking, therefore, future research should attempt to carry out research using more representative samples. In sum, the main limitations present in the reviewed studies can be broadly associated with the following domains: (i) operationalization and measurement issues, (ii) sampling issues, and (iii) reporting issues. It is envisaged by the present authors that future research take into account the present limitations identified here in order to enhance the quality of published studies in the field of IGD.

### *4.1. Limitations*

Definitive conclusions that can be made regarding the strength of association and causal pathway between IGD and its associated cognitions and resulting cognitive impairments are limited due to the relatively small amount of studies that have been conducted to date. Additionally, a few studies used small samples (e.g., Decker & Gay, 2011; Littel et al., 2012; Pawlikowski & Brand, 2011; Sun et al., 2008; Yuan et al., 2013) and some did not include control group findings (e.g., Dauriat et al., 2011; Hilgard et al., 2013; Liu & Peng, 2009; Yee, 2006). Furthermore, the adoption of differing methodologies and measurement tools to assess IGD used across all the studies constitutes a further complication and possible compromise to the degree as to which the present findings may be replicated using a more consensual and unified measure to assess the phenomenon of IGD. This limitation of IGD research has been noted previously (Dowling, 2014) and partly explains why Asian countries usually report high prevalence rates of IGD in general. It is also worth noting that the influence of comorbidity on IGD is difficult to disentangle from the main findings, therefore caution is advised when interpreting the present findings. Finally, risk of bias across studies was not examined in the present review. However, publication bias is likely to be present as studies reporting no correlation between the main outcomes assessed are unlikely to be published (Allely, 2014; Impey & Heun, 2012).

### *4.2. Conclusions*

As a concluding note, the present findings elucidate the usefulness of including cognitive

variables in studies of IGD rather than relying solely on variables measuring levels of addiction. This empirically supports the suggestions made by Caplan and High (2006) in relation to generalized Internet addiction research. It is also the present authors' view that including cognitive variables in studies attempting to predict or explain the associated etiological factors underpinning IGD should yield more meaningful and definitive insights that may be used to refine the conceptualization and treatment of IGD using an evidence-based framework such as the cognitive-behavioral therapy.

Due to the emerging nature of IGD, future research may improve the understanding of this phenomenon by providing (i) expert consensus or empirical evidence supporting the guidelines for diagnosing IGD based on the DSM-5 framework, (ii) data on functional impairments associated with IGD as well as its course, remission, and relapse rates, (iii) insights from prospective interview studies on the causal pathway between IGD and psychiatric disorders (e.g., attention deficit hyperactivity disorder, depression, and social phobia), (iv) data from imaging studies on the essential mechanisms of addiction applying the DSM-5 criteria for IGD using an adequate sample size and a robust design, (v) data on gender differences regarding the underlying mechanisms of IGD, (vi) cross-cultural information to compare IGD in different cultural contexts, and (vii) empirical studies aimed to devise standard treatments adopting both psychological and pharmacological approaches to treat IGD (Ko, 2014).

Although it appears that including IGD in the DSM-5 was well received by researchers and clinicians, the current diagnostic criteria for IGD are still lacking widespread empirical testing and validation (Dowling, 2014). Notwithstanding this, the present review adds to the literature of IGD by extending the findings from previous works and identifying a potential set of cognitive-related impairments that are associated with IGD. Despite the impossibility to generalize these findings and their causal pathway at this point, there is clear empirical evidence that IGD is a serious condition that may accompany detrimental effects at several levels, including the cognitive level. Consequently, it is the view of the present authors that IGD is a behavioral addiction that should be taken more seriously since it represents a threat to the physical and mental health of a minority of the population.

## References


Allely, C. (2014). The association of ADHD symptoms to self-harm behaviours: a systematic PRISMA review. *BMC Psychiatry, 14*(1), 133. doi: 10.1186/1471-244X-14-133

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (5th ed.)*. Arlington, VA: Author.

Bailey, K., West, R., & Kuffel, J. (2013). What would my avatar do? Gaming, pathology, and risky decision making. *Frontiers in Psychology, 4*, 609. doi: 10.3389/fpsyg.2013.00609

Brand, M., Young, K. S., & Laier, C. (2014). Prefrontal control and Internet addiction: a theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience, 8*(375). doi: 10.3389/fnhum.2014.00375

Caplan, S. E., & High, A. C. (2006). Beyond Excessive Use: the Interaction between cognitive and behavioral symptoms of problematic internet use. *Communication Research Reports, 23*(4), 265-271. doi: 10.1080/08824090600962516

Charlton, J. P. (2002). A factor-analytic investigation of computer 'addiction' and engagement. *British Journal of Psychology, 93*(3), 329-344. doi: 10.1348/000712602760146242

Charlton, J. P., & Danforth, I. D. W. (2007). Distinguishing addiction and high engagement in the context of online game playing. *Computers in Human Behavior, 23*(3), 1531-1548. doi: 10.1016/j.chb.2005.07.002

Dantzker, M. L., & Hunter, R. (2011). *Research Methods for Criminology and Criminal Justice (Third Edition)*. London: Jones & Bartett Learning.

Dauriat, F. Z., Zermatten, A., Billieux, J., Thorens, G., Bondolfi, G., Zullino, D., & Khazaal, Y. (2011). Motivations to play specifically predict excessive involvement in massively multiplayer online role-playing games: evidence from an online survey. *European Addiction Research, 17*(4), 185-189. doi: 10.1159/000326070

Davis, R. A. (2001). A cognitive-behavioral model of pathological internet use. *Computers in Human Behavior, 17*(2), 187-195. doi: 10.1016/S0747-5632(00)00041-8

Decker, S. A., & Gay, J. N. (2011). Cognitive-bias toward gaming-related words and disinhibition in World of Warcraft gamers. *Computers in Human Behavior, 27*(2), 798-810. doi: 10.1016/j.chb.2010.11.005

Dowling, N. A. (2014). Issues raised by the DSM-5 internet gaming disorder classification and proposed diagnostic criteria. *Addiction, 109*(9), 1408-1409. doi: 10.1111/add.12554

Gosling, S. D., Vazire, S., Srivastava, S., & John, O. P. (2004).

Should we trust web-based studies? A comparative analysis of six preconceptions about internet questionnaires. *American Psychologist, 59*(2), 93. doi: 10.1037/0003-066X.59.2.93

Griffiths, M. D. (2010a). The role of context in online gaming excess and addiction: some case study evidence. *International Journal of Mental Health and Addiction, 8*(1), 119-125. doi: 10.1007/s11469-009-9229-x

Griffiths, M. D. (2010d). The use of online methodologies in data collection for gambling and gaming addictions. *International Journal of Mental Health and Addiction, 8*(1), 8-20. doi: 10.1007/s11469-009-9209-1

Griffiths, M. D., King, D. L., & Demetrovics, Z. (2014). DSM-5 internet gaming disorder needs a unified approach to assessment. *Neuropsychiatry, 4*(1), 1-4. doi: 10.2217/npy.13.82

Haagsma, M. C., Caplan, S. E., Peters, O., & Pieterse, M. E. (2013). A cognitive-behavioral model of problematic online gaming in adolescents aged 12–22 years. *Computers in Human Behavior, 29*(1), 202-209. doi: 10.1016/j.chb.2012.08.006

Higgins, J. P. T., & Green, S. (2011). *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0 [updated March 2011]. Retrieved from www.cochrane-handbook.org.

Hilgard, J., Engelhardt, C. R., & Bartholow, B. D. (2013). Individual differences in motives, preferences, and pathology in video games: the gaming attitudes, motives, and experiences scales (GAMES). *Frontiers in Psychology, 4*, 608. doi: 10.3389/fpsyg.2013.00608

Huanhuan, L., & Su, W. (2013). The role of cognitive distortion in online game addiction among Chinese adolescents. *Children and Youth Services Review, 35*(9), 1468-1475. doi: 10.1016/j.childyouth.2013.05.021

Impey, M., & Heun, R. (2012). Completed suicide, ideation and attempt in attention deficit hyperactivity disorder. *Acta Psychiatrica Scandinavica, 125*(2), 93-102. doi: 10.1111/j.1600-0447.2011.01798.x

Joinson, A. N. (2001). Knowing me, knowing you: reciprocal self-disclosure in Internet-based surveys. *CyberPsychology and Behavior, 4*(5), 587-591. doi: 10.1089/109493101753235179

King, D. L., & Delfabbro, P. H. (2014a). Internet Gaming Disorder Treatment: A Review of Definitions of Diagnosis and Treatment Outcome. *Journal of Clinical Psychiatry, 70*(10), 942-955. doi: 10.1002/jclp.22097

King, D. L., & Delfabbro, P. H. (2014b). The cognitive psychology of Internet Gaming Disorder. *Clinical Psychology Review, 34*(4), 298-308. doi: 10.1016/j.cpr.2014.03.006

King, D. L., Haagsma, M. C., Delfabbro, P. H., Gradisar, M., & Griffiths, M. D. (2013). Toward a consensus definition of pathological video-gaming: a systematic review of psychometric assessment tools. *Clinical Psychology Review, 33*(3), 331-342. doi: 10.1016/j.cpr.2013.01.002

Király, O., Nagygyörgy, K., Koronczai, B., Griffiths, M. D., & Demetrovics, Z. (2014). Assessment of problematic internet use and online Video Gaming. In V. Starcevic & E. Aboujaoude (Eds.), *Mental Health in the Digital Age: Grave Dangers, Great Promise* (pp 46-68.). Oxford: Oxford University Press. doi: 10.1093/med/9780199380183.001.0001

Ko, C.-H. (2014). Internet Gaming Disorder. *Current Addiction Reports, 1*(3), 177-185. doi: 10.1007/s40429-014-0030-y

Kuss, D. J., & Griffiths, M. D. (2012). Internet gaming addiction: a systematic review of empirical research. *International Journal of Mental Health and Addiction, 10*(2), 278-296. doi: 10.1007/s11469-011-9318-5

Kuss, D. J., Griffiths, M. D., Karila, L., & Billieux, J. (2014). Internet addiction: a systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design, 20*(25), 4026-4052. doi: 10.2174/13816128113199990617

Lam, L. T. (2014). Internet gaming addiction, problematic use of the internet, and sleep problems: a systematic review. *Current Psychiatry Reports, 16*(4), 1-9. doi: 10.1007/s11920-014-0444-1

Li, D., Liau, A., & Khoo, A. (2011). Examining the influence of actual-ideal self-discrepancies, depression, and escapism, on pathological gaming among massively multiplayer online adolescent gamers. *Cyberpsychology, Behavior, and Social Networking, 14*(9), 535-539. doi: 10.1089/cyber.2010.0463

Littel, M., van den Berg, I., Luijten, M., van Rooij, A. J., Keemink, L., & Franken, I. H. A. (2012). Error processing and response inhibition in excessive computer game players: an event-related potential study. *Addiction Biology, 17*(5), 934-947. doi: 10.1111/j.1369-1600.2012.00467.x

Liu, M., & Peng, W. (2009). Cognitive and psychological predictors of the negative outcomes associated with playing MMOGs (massively multiplayer online games). *Computers in Human Behavior, 25*(6), 1306-1311. doi: 10.1016/j.chb.2009.06.002

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The Prisma Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Medicine, 6*(7), e1000097. doi: 10.1371/journal.pmed.1000097

Pawlikowski, M., & Brand, M. (2011). Excessive internet gaming and decision making: do excessive World of Warcraft players have problems in decision making under risky conditions? *Psychiatry Research, 188*(3), 428-433. doi: 10.1016/j.psychres.2011.05.017

Peng, W., & Liu, M. (2010). Online gaming dependency: a preliminary study in China. *Cyberpsychology,*

*Behavior, and Social Networking, 13*(3), 329-333. doi: 10.1089/cyber.2009.0082

Petry, N. M., & O'Brien, C. P. (2013). Internet gaming disorder and the DSM-5. *Addiction, 108*(7), 1186–1187. doi: 10.1111/add.12162

Pettit, F. A. (2002). A comparison of World-Wide Web and paper-and-pencil personality questionnaires. *Behavior Research Methods, Instruments, & Computers, 34*(1), 50-54. doi: 10.3758/BF03195423

Pontes, H. M., & Griffiths, M. D. (2014). Assessment of internet gaming disorder in Clinical Research: past and present perspectives. *Clinical Research and Regulatory Affairs, 31*(2-4), 35-48. doi: 10.3109/10601333.2014.962748

Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 Internet Gaming Disorder: Development and Validation of a Short Psychometric Scale. *Computers in Human Behavior, 45*, 137-143. doi:10.1016/j.chb.2014.12.006

Pontes, H. M., Király, O., Demetrovics, Z., & Griffiths, M. D. (2014). The conceptualisation and measurement of DSM-5 internet gaming disorder: the development of the IGD-20 test. *PLoS ONE, 9*(10), e110137. doi: 10.1371/journal.pone.0110137

Reilly, C., & Smith, N. (2013). The evolving definition of pathological gambling in the DSM-5. *National Center for Responsible Gaming*, 1-6.

Snodgrass, J. G., Lacy, M. G., Dengah II, H. J., Eisenhauer, S., Batchelder, G., & Cookson, R. J. (2014). A vacation from your mind: problematic online gaming is a stress response. *Computers in Human Behavior, 38*, 248-260. doi: 10.1016/j.chb.2014.06.004

Sublette, V. A., & Mullan, B. (2012). Consequences of play: a systematic review of the effects of online gaming. *International Journal of Mental Health and Addiction, 10*(1), 3-23. doi: 10.1007/s11469-010-9304-3

Suler, J. (2004). The online disinhibition effect. *CyberPsychology and Behavior, 7*(3), 321-326. doi: 10.1089/1094931041291295

Sun, D.-L., Ma, N., Bao, M., Chen, X.-C., & Zhang, D.-R. (2008). Computer games: a double-edged sword? *CyberPsychology Behavior, 11*(5), 545-548. doi: 10.1089/cpb.2007.0145

Wan, C., & Chiou, W. (2007). The motivations of adolescents who are addicted to online games: a cognitive perspective. *Adolescence, 42*(165), 179.

West, R., & Bailey, K. (2013). Video games and attention. In E. K. Dill (Ed.), *The Oxford Handbook of Media Psychology* (pp. 403-420). Oxford: Oxford University Press.

Wood, R. T. A., & Griffiths, M. D. (2007a). A qualitative investigation of problem gambling as an escape-based coping strategy. *Psychology and Psychotherapy: Theory, Research and Practice, 80*(1), 107-125. doi: 10.1348/147608306X107881

Wood, R., & Griffiths, M. D. (2007b). Online data collection from gamblers: Methodological issues. *International Journal of Mental Health and Addiction, 5*(2), 151-163. doi: 10.1007/s11469-007-9055-y

Yee, N. (2006). Motivations for play in online games. *CyberPsychology & Behavior, 9*(6), 772-775. doi: 10.1089/cpb.2006.9.772

Yuan, K., Cheng, P., Dong, T., Bi, Y., Xing, L., Yu, D. & Liu, Y. (2013). Cortical thickness abnormalities in late adolescence with online gaming addiction. *PLoS ONE, 8*(1), e53055. doi: 10.1371/journal.pone.0053055

Zhou, Z., Yuan, G., & Yao, J. (2012). Cognitive biases toward internet game-related pictures and executive deficits in individuals with an internet game addiction. *PLoS ONE, 7*(11), e48961. doi: 10.1371/journal.pone.0048961