TITLE: ASSESSMENT OF INTERNET GAMING DISORDER IN CLINICAL RESEARCH: PAST AND PRESENT PERSPECTIVES.

SHORT TITLE: INTERNET GAMING DISORDER ASSESSMENT REVIEW

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Abstract

Internet Gaming Disorder [IGD] has recently received nomenclatural recognition from official medical bodies as a potential mental health disorder, despite evident variability and inconsistencies in its core conceptualization and psychometric assessment. In the present review, the authors argue how the adoption of inconsistent criteria and psychometric tools to assess IGD negatively influenced the field. Additionally, this review provides an overview of how the field evolved in terms of its historical developments, present definitions and frameworks, developments in the neuroscientific research, psychometric assessment, and emerging trends in the assessment of gaming addiction. After a careful review of the literature, it was concluded that (i) research on gaming addiction dates back to the 1970 and since then important changes in the field occurred, especially in terms of (ii) definition and conceptualization of the phenomenon, which resulted in a (iii) multiplicity of strategies in the assessment of IGD via inconsistent criteria or psychometric tools. Lastly, it is presented (iv) alternative emerging methods for assessing IGD via sound psychometric tools based on updated and officially recognized conceptualization of the phenomenon of IGD.

Keywords: Internet Gaming Disorder; DSM-5; Assessment; Internet Addiction; Literature Review;

1. Introduction

According to a report by the Entertainment Software Association [ESA] (1), 59% of the entire American population plays video games, with a mean average of two gamers in each game-playing household. The ESA report also notes that among US households that 68% play video games on consoles, 53% play on smartphones, and 41% play on wireless devices. During 2012, playing video games via smartphones and wireless devices increased by 22% and 37%, respectively (1). The same report also concluded that the average video game player is 31 years old, with 52% being male and 48% female (1). Similarly, several academic studies also suggested that the stereotype of an adolescent male gamer as the typical game addicted is no longer the case since most regular gamers appear to be young adults males (2) although the number of women playing casual video games has risen substantially over the last decade (3, 4). The number of female gamers aged 50 years and older increased by 32% from 2012 to 2013 (1). These numbers illustrate how widespread and prevalent that video gaming has become across most segments of the population.

Given the increased popularity and prevalence of video gaming, researchers in gaming studies, addiction treatment specialists, policy-makers, and the general public have expressed concern that some players may be playing video games pathologically and that cause detrimental effects that interfere with day-to-day life functioning (5-8).

Over the past decade, there has been a significant increase in research examining various behavioral addictions such as addictions *to* and *on* the internet (9). In the psychological study of excessive internet use, the primary object of addiction is the experience that is stimulated by the online material residing online, and/or the interactive experience of gaining access to this material or applications online (10). In respect to the negative detrimental effects caused by the playing of video games, researchers have

adopted a broad range of terminologies to define and conceptualize the phenomenon including computer game dependence (11), computer addiction (12), problem videogame playing (13), video game addiction (14), internet gaming addiction (6), pathological video-game use (8), problem videogame play (15), game addiction (16), online gaming addiction (17), problematic online game use (18), video game dependency (19), pathological gaming (20), online video game addiction (21), and problematic online gaming (22).

All these slightly different terminologies, alongside the use of different non-standardized assessment tools to investigate the phenomenon of gaming addiction has fostered many debates amongst scholars as to whether the phenomenon is a unique clinical entity (23-25) and to whether or not 'Internet Addiction Disorder' should have been included as a new disorder in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* [DSM-5] (26). As a result of these debates, the Substance Use Disorder Work Group recommended that the DSM-5 include 'Internet Gaming Disorder' [IGD] in Section III ("Emerging Measures and Models") as an area that required further research before possible inclusion in future editions of the DSM (24). Furthermore, researchers in the gaming studies field have noted that empirical evidence is needed to identify the defining features of IGD, obtain cross-cultural data on reliability and validity of specific diagnostic criteria, determine prevalence rates in representative epidemiological samples in countries around the world, evaluate its natural history, and examine its associated biological features (24).

Furthermore, the IGD classification proposed by the DSM-5 is similar in nature to 'Gambling Disorder' (in the DSM-5) and comprises nine core criteria: (i) preoccupation with internet games; (ii) withdrawal symptoms when internet gaming is discontinued; (iii) tolerance: the need to spend increasing amounts of time engaged in

internet gaming; (iv) unsuccessful attempts to control participation in internet gaming; (v) loss of interest in hobbies and entertainment as a result of, and with the exception of, internet gaming; (vi) continued excessive use of internet games despite knowledge of psychosocial problems; (vii) deception of family members, therapists, or others regarding the amount of internet gaming; (viii) use of internet 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 internet games (26).

It is also worth noting that the use of the term IGD to describe problematic gaming behavior may limit the concept of IGD as the phenomenon also occurs in offline games (e.g., 27, 28). Moreover, IGD may also be involved in non-internet computerized games, although these have been less researched (26). According to Spekman, Konijn, Roelofsma and Griffiths (29), within the gaming studies field, it is gaming addiction that generates the most comment, critique and debate. Therefore, given the variety of potential classification frameworks and assessment approaches for investigating gaming addiction, it is important to review some of the key aspects involved in gaming addiction research and assessment in order to shed some light to the conceptual differences generated in the years prior to the inclusion of IGD in the DSM-5.

More specifically, this review will briefly focus on the assessment of gaming addiction while also providing (i) a brief overview of how the field evolved in terms of its historical developments, (ii) present current definitions and frameworks, (iii) some of the latest neurobiological research findings, (iv) a review of psychometric assessment, and (v) a discussion of the emerging trends in the assessment of gaming addiction. For the sake of consistency, the term Internet Gaming Disorder [IGD] is generally used throughout this review since this is now the nomenclature recognized by official medical

bodies (e.g., 26) except in those studies that specifically examined problematic offline gaming (typically studies prior to 2000).

2. Historical Developments

This section briefly examines the development of research into problematic gaming and IGD during the 1980s, 1990s, and 2000s as these decades correspond to important transitional periods for the field where several theoretical and conceptual milestones took place.

2.1. Early and Modern Perspectives

The release of the first commercial video games date to the early 1970s and it took approximately ten years for the first reports of gaming disorder emerge in the psychological and psychiatric literature (28). For instance, Ross, Finestone and Lavin (30) described three cases of (offline) video game obsession whereas Nilles (31) reported a similar phenomenon described as “computer catatonia”. A more detailed description of IGD was brought forth later by Soper and Miller (32) where it was observed that ‘video game addiction’ was akin to other behavioral addictions and consisted of compulsive behavioral involvement, a lack of interest in other activities, association and friendship circles essentially with other disordered gamers, and physical and mental symptoms when the players attempted to cease the behavior. In the mid- to late 1980s, reports by clinicians (e.g., 33, 34, 35) noted that many of the children counseled were seemingly addicted to video games as several had skipped classes and spent their lunch money or, alternatively, stole or begged money to get their “video game fix” (33, p. 396).

Arguably, the first empirical study published in a refereed journal specifically addressing problematic video gaming – which was viewed back then as a compulsion –

was conducted by Egli and Meyers (36). They investigated whether playing video games had any perceived positive or negative impact on players' lives in a sample of 151 participants with ages ranging from 10 to 20 years. The data collected allowed the authors to develop a psychometric tool comprising a total of 28 questions rated on 7-point Likert scale to assess gaming compulsion based on the participants' perception of compulsive behavior. As a result, the authors demonstrated that 13% of the total sample (n = 20) displayed compulsive video game playing behavior. Despite using an innovative and modern methodology to assess 'gaming compulsion', the relatively small sample size alongside the exclusive reliance on participants' perception about their supposedly compulsive behavior towards game playing, severely limited the generalizability of the authors' findings.

At the end of the 1980s, Shotton (37) investigated 127 players who self-reported as being "hooked" on video games for at least five years, with a large proportion of these (n = 75) being measured against two control groups. Despite the results obtained, the author positively portrayed the disordered video game players as overall highly intelligent, motivated, and achieving people that were often misunderstood by society. After a five-year follow up, it was concluded that the young cohort had done well both educationally and professionally. Nevertheless, this study had its own limitations. More specifically, no standardized measure for IGD was used and the only prerequisite for being considered disordered was the individual's own perception of being "hooked" on computer games. Despite the methodological shortcoming of these studies' reliance on participants' perception of problematic gaming, more recent empirical research suggested that a person's self-diagnosis of internet addiction might be indicative of the presence of an addiction since this measure is highly associated with more standardized measures of internet addiction (38).

With the exception of the studies carried by Egli and Meyers (36) and Shotton (37), the generality of the published studies from the 1980s were not systematic or empirically based since they were somewhat observational, anecdotal, and/or case studies, based on samples of teenage males and on a particular type of video game using a particular medium (i.e., arcade video games) (28). During the 1990s, the field underwent important changes research wise. Contrary to the trend established by the studies in the early 1980s, the studies conducted during the 1990s were mainly carried in the UK and investigated non-arcade video game playing (i.e., video games played on consoles, handheld devices, and/or personal computers) typically using adolescent samples in school settings (e.g., 11, 39, 40-44). Despite the increase of research into problematic video gaming in the 1990s in contrast with research conducted in the previous decade, one of the key limitations of these studies was that authors often used self-report surveys with relatively small sample sizes.

As pointed by Griffiths et al. (28), the main issue with these studies in the 1990s was that they assessed 'gaming addiction' using adapted versions of the DSM-III-R or DSM-IV criteria for pathological gambling. A similar critique was also made by Shaffer et al. (10) where the authors suggested that "it seems theoretically and clinically premature to assume that the psychodynamics of gambling and computer-related disorders are identical." (p. 167). Most important, although similar, pathological gambling and excessive gaming do not present with the same clinical features, and some have argued that using the diagnostic criteria for pathological gambling in order to diagnose gaming addiction only taps into obsessive use and preoccupation rather than actual psychopathology (45).

Given the fact that most studies published before 2000 specifically investigated arcade and/or console video games rather than online video games (2), there was a

substantial growth in the number of studies on problematic gaming almost solely due to the introduction of online video games where games could be played as part of a gaming community (i.e., massively multiplayer online role playing games [MMORPGs] such as *World of Warcraft* and *Everquest*) (46).

MMORPGs are immersive three-dimensional gaming environments that enable large numbers of users to interact with one another via the internet (47, 48). Simply put, MMORPGs can be thought of as a scenic chat room with a variety of interactive tasks where users experience cities, jungles, and even the falling rain or snow in rich real-time three-dimensional graphics, while communicating with each other (49). They interact with the world through a combination of mouse-driven interfaces and typed commands, and participate in a large number of varied activities or quests that increase in complexity, reward, and time involvement that typically operate on a random-ratio reinforcement schedule (49).

Contrary to video game playing on other platforms (e.g., in an arcade, offline consoles, etc.), in MMORPGs, the gaming environment exists before the player logs on, and continues to exist even after the player logs off (49). More importantly, events and interactions occur in the world (driven by other users) even when the user is not logged on in the virtual gaming world (49). Given these features and the subsequent empirical evidence (see 27 for a recent review), MMORPGs appear to have an increased addictive potential in that players feel highly obligated to stay online, help their clans or guilds, protect their virtual assets, and engage in hours of ‘grinding’ just so that the whole clan or guild can benefit.

According to recent reviews on the topic (6, 28, 46), approximately 60 studies were published on gaming addiction between 2000 and 2010. Most of these studies focused on MMORPG addiction, and the samples used in most of these studies were not

limited to adolescent males (although almost all were self-selected and non-representative). Furthermore, many of these studies collected their data online, and examined various other aspects of video game addiction using non-self-report methodologies (e.g., polysomnographic measures and visual and verbal memory tests; medical evaluations; functional magnetic resonance imaging; electroencephalography; and genotyping) (28, 46). These reviews generally concluded that gaming addiction is a clinical entity and that can be categorized as a disorder that can potentially cause many problems in a minority gamers' lives.

In order to study any disorder with a low prevalence rate such as gaming addiction, large sample pools are necessary for providing reliable estimates of prevalence rates amongst a population. However, very few studies have used nationally representative samples although there are a few (8, 19, 50, 51). Furthermore, even among those using nationally representative samples, different assessment instruments for estimating the prevalence rates of problematic gaming and gaming addiction have been used. Nonetheless, prevalence rates reported among those studies using representative samples ranged from 3% in one study (19) to 9.4% in another (51). Despite the relatively low prevalence rates reported, several methodological shortcomings are evident including the: (i) lack of consistent assessment criteria (i.e., no study used the same measure to assess gaming addiction); (ii) inclusion of children and adolescents samples only, that limits the generalizability of the findings to other segments of the population (e.g., adult population); (iii) exclusive adoption of self-report measures; and (iv) lack of longitudinal studies designed in order to evaluate the causal pathways of gaming addiction.

3. Current Definitions and Frameworks

Over the last few years, research into IGD adopted different approaches for defining and conceptualizing the phenomenon before the release of the DSM-5 (26). Broadly speaking, behavioral addictions, such as IGD, have typically been categorized either within the frameworks of “impulse control disorders” or “substance dependencies” (2). However, criteria developed for the clinical diagnosis of IGD in empirical studies – prior the release of the DSM-5 – were essentially based on either the criteria for pathological gambling (52) or on the criteria for substance dependence as in the DSM-IV (52).

This approach was mainly used because – since there was no standard definition for the phenomenon – it was believed that the way of determining whether behavioral addictions were addictive in a non-metaphorical sense was to compare them against clinical criteria for other established drug-ingested addictions (53-55). Similarly, other researchers (56) believed that the phenomenon of internet addiction could also be defined as an impulse-control disorder that did not involve the ingestion of a psychoactive substance (i.e., similar to disorders such as pathological gambling). Such conceptualizations also influenced the way in which research on IGD was conducted.

IGD was initially conceptualized as a specific subtype of internet addiction (12). Based on a study involving therapists (23 females and 12 males) with an average of 14 years of clinical practice, Young et al. (12) concluded from her studies that five general subtypes of internet addiction could be identified, including (i) cybersexual addiction; (ii) cyber-relationship addiction; (iii) net compulsions; (iv) information overload; and (v) computer addiction (i.e., obsessive computer game playing).

As noted before by key authors in the field (10, 55, 57), the computer use itself may be the object of addiction, while in other cases the computer may be the mechanism for administering – or gaining access to – the object of addiction. The same may apply to

the distinction between generalized internet use and video game playing. Without this distinction, it may be the case that some clinicians may overlook other specific internet-based addictive behaviors that involve other technologies, such as video and computer-based games.

Furthermore, the typology put forth by Young et al. (12) had its own limitations. One of the issues raised by this conceptualization was that many of the addicted users are not "internet addicts" *per se* but just used the internet as a medium to fuel other addictions (54, 57). In other words, using an example of a gambling addict or a computer game addict who engages in their chosen behavior online, it can be intuitively concluded that these users are not addicted to the internet since the internet is just the place where they engage their chosen behavior (54, 57). In fact, the distinction made between addictions *to* the internet and addictions *on* the internet originated from this idea (57, 58).

The corollary of this initial conceptualization and internet addiction typology suggested by Young et al. (12) was that several authors (e.g., 15, 19, 59, 60-62) heavily relied on instruments designed to measure generalized internet addiction to assess IGD, therefore creating methodological problems to the assessment and understanding of IGD. The cognitive-behavioral model of pathological internet use [PIU] (63) was developed to describe the set of symptoms related to PIU and its etiology. This model was very influential in the early 2000s because it was the first to clearly distinguish between specific pathological internet use [SPIU] and generalized pathological internet use [GPIU]. As noted by Davis (63), SPIU can be broadly defined as a type of internet addiction where people are dependent on a specific function of the internet (e.g., gaming), whereas GPIU relates to a general, multidimensional overuse of the internet (e.g., use of many different online applications).

One of the salient features of this model is the emphasis on the importance and role of maladaptive cognitions in the development and maintenance of PIU rather than focusing on the well-documented behavioral factors (e.g., withdrawal, tolerance) associated with PIU. In order to explain the nature of the cognitive theory of PIU, Davis (63) introduced the concepts of distal and proximal contributory causes of PIU. Distal causes include preexisting psychopathology (e.g., depression, social anxiety, substance dependence), and behavioral reinforcement (provided by the internet itself throughout the experience of new functions and situational cues which contribute to conditioned responses). Proximal causes involve maladaptive cognitions that are seen as a sufficient condition that can lead to both GPIU and SPIU, and also cause the set of symptoms associated with PIU. Another important proximal cause that contributes to the causal pathway of GPIU is related to the social context of the individual (e.g., lack of social support, social isolation). As hypothesized by Davis (63), GPIU involves spending abnormal amounts of time on the internet, either wasting time with no directive purpose or spending excessive amounts of time in chat rooms. Moreover, procrastination is also assumed to play an important role in both the development and maintenance of GPIU.

In this model, symptoms of PIU primarily derive from maladaptive cognitions. These symptoms relate more to cognitive symptoms and as such may include obsessive thoughts about the internet, diminished impulse control, inability to cease internet use, as well as the generalized feeling that the internet is the only place where individuals feel good about themselves (63). Other symptoms may include thinking about the internet while offline, anticipating future time online, decreasing interest for other activities or hobbies, and social isolation (63).

More recently, Brand, Young and Laier (64) further developed Davis' model (63) by taking into account important neuropsychological mechanisms and control processes

mediated by executive functions, and prefrontal cortical areas. Therefore, this model attempts to explain and understand the development and maintenance of both generalized internet addiction [GIA] and specific internet addiction [SIA] (e.g., Internet Gaming Disorder). According to Brand et al. (64), it is important to distinguish between functional internet use, GIA and SIA. While functional internet use encompass the use of the internet as a tool for dealing with personal needs and goals in everyday life in a healthy way, both GIA and SIA may serve different purposes in the context of addiction.

Furthermore, in the development and maintenance of GIA, the user has some needs and goals that can be satisfied using certain internet applications. It is assumed that psychopathological symptoms (e.g., depression, anxiety) are predisposing factors for developing GIA. Moreover, social cognitions (e.g., perceived social isolation, lack of offline support) are also assumed to be related to GIA (64).

Accordingly, particular emphasis is given to internet use expectancies as it may involve anticipations of how the internet can be helpful for distracting individuals from thinking about their problems and/or escaping from reality. Such activity can also be used to enhance positive mood states and/or minimize negative mood states. These expectancies may also interact with the user's general coping style and self-regulation capacities. Therefore, when going online, the user receives reinforcement in terms of dysfunctional coping strategies with negative feelings or problems in everyday life. While internet use expectancies are positively reinforced, given the strong reinforcement character of certain internet applications, the cognitive control concerning the internet use becomes more effortful. This should particularly be the case if internet-related cues interfere with executive processes.

In the development and maintenance of SIA it is argued by Brand et al. (64) that psychopathological symptoms are also particularly involved in this type of internet

addiction. Therefore, it is hypothesized that specific person's predispositions increase the probability that an individual receives gratification from the use of certain applications and overuses these applications again. In this framework, it is postulated that the expectancy that such internet applications can satisfy certain desires increases the likelihood that these applications will be used frequently, and that the individual begins to lose of control over the use of such applications. Consequently, gratification is experienced and therefore the use of such applications and also the specific internet use expectancies and the coping style are reinforced positively. Another assumption of this perspective for understanding SIA, is that the more general psychopathological tendencies (e.g., depression, social anxiety) are negatively reinforced due to the fact that additional specific internet applications can be used to distract from problems in the real life or to avoid negative feelings, such as loneliness or social isolation.

Contrary to the theory proposed by Davis (63) where the model of PIU has been put to test by developing a theory-driven instrument to assess internet addiction (see 65, 66, 67), the theoretical framework put forth by Brand et al. (64) despite being promising, still remains to be tested empirically. On the other hand, the components model of addiction (68) is another well-established theoretical framework for conceptualizing behavioral addictions as a whole. This model was put forth by some of the Griffiths' early works (57, 68-70) and drew upon (and then slightly modified) the six core components outlined by Brown (71) (i.e., salience, mood modification, tolerance, withdrawal, relapse, and conflict). Simply put, this model postulates that substance-related and behavioral addictions (e.g., IGD) develop via similar biopsychosocial processes and share a number of similar characteristics, most notably the addiction criteria of salience, mood modification, tolerance, withdrawal, relapse, and conflict. More recently, it has been argued by Griffiths, King and Demetrovics (72) that the nine criteria of IGD as outlined

in the DSM-5 (26) is very similar to the six components present in the components model of addiction (see Table 1).

[Please insert Table 1. here]

In the components model of addiction framework, other concepts are equally involved. For instance, technological addictions, which are defined by non-chemical (behavioral) addictions involving human-machine interactions, can be regarded as a subset of behavioral addictions (57, 69, 70, 73). In turn, technological addictions can either be passive (e.g., television) or active (e.g., computer games) and usually contain inducing and reinforcing features which may contribute to the promotion of addictive tendencies (57, 69). Addictive behaviors in turn, are operationally defined as any behavior featuring all six core components of addiction (57). In short, any behavior (including video game playing) that features all six addiction criteria would be operationally defined as addictions.

The robustness and strength of this model can be witnessed by the fact that psychometric tools to assess other behavioral addictions have been derived from this model including Facebook addiction (74), exercise addiction (75), work addiction (76), and gaming addiction (16). Additionally, this framework helps to clarify the issues of construct validity surrounding behavioral addictions (and also IGD) since this process necessitates the development of an underlying model or scientific theory (10).

4. Developments in Neurobiological Research

More recently, several reviews have focused on the latest neurobiological findings concerning IGD and have summarized important findings (e.g., 64, 77, 78-80). Understanding the emerging biological basis of IGD – while important – is beyond the

scope of this paper due to space constraints (but readers can consult other key reviews of this research including Brand et al. (64), Kuss and Griffiths (78)). Nevertheless, some of the overall key findings are reported below.

In these types of studies, the most common methods and techniques adopted to study the neural correlates of IGD often encompass the use of electroencephalogram [EEG], positron emission tomography [PET], single photon emission computed tomography [SPECT], functional magnetic resonance imaging [fMRI], structural magnetic resonance imaging [sMRI] and diffusion-tensor imaging [DTI] (78). Several cortical areas have been identified and associated with IGD. In the case of generalized internet addiction, a recent review on the topic (64) reported that certain prefrontal functions (in particular executive control functions) are related to symptoms of internet addiction, which is in line with recent theoretical models on the development and maintenance of the addictive use of the internet. Additionally, control processes appear to be particularly reduced when individuals with internet addiction are confronted with internet-related cues representing their first choice use. Although these findings relate to generalized internet addiction, there is good reason to suspect that they may also be of importance in IGD.

In a recent study, Weng and colleagues (81) used voxel-based morphometry analysis and tract-based spatial statistics to investigate the microstructural changes in addicted gamers and assessed the relationship between these morphology changes and the Internet Addiction Test (82) scores in disordered gamers. The total sample consisted of 34 participants. Of these, 17 (13 females and 4 males) were diagnosed with IGD based the answers given to the Young's diagnostic questionnaire (56) where respondents that answered "yes" to questions 1 through 5 and positively to at least any one of the remaining three questions were classified as disordered gamers. The control group comprised 17

healthy participants (15 females and 2 males). According to the authors (81), the results showed that disordered gamers had significantly reduced fractional anisotropy in the right genu of corpus callosum, bilateral frontal lobe white matter, and right external capsule. Moreover, gray matter volumes of the right orbitofrontal cortex, bilateral insula and fractional anisotropy values of the right external capsule were significantly positively correlated with Internet Addiction Test scores among the disordered players. In addition, the findings suggested that microstructure abnormalities of gray and white matter are present in IGD.

In a recently published neuroimaging meta-analysis (80) that combined voxel-wise whole-brain studies to investigate the functional responses to cognitive tasks in relation to IGD, 10 functional neuro-imaging studies were analyzed and summarized using a quantitative ES-SDM meta-analytic method. Results showed that compared to healthy controls, individuals with IGD showed a significant activation in the bilateral medial frontal gyrus and the left cingulate gyrus, as well as the left medial temporal gyrus and fusiform gyrus. Furthermore, time spent online by IGD individuals was positively correlated with activations in the left medial frontal gyrus and the right cingulated gyrus.

It should also be noted that there is mounting empirical evidence from several studies (64, 83-88) supporting the hypothesis that IGD is a behavioral addiction that may share similar neurobiological abnormalities with other addictive disorders. In a recent fMRI study conducted by Ko et al. (84) the brain correlates of cue-induced gaming urges or smoking craving among males with both IGD and nicotine dependence was investigated in order to make a simultaneous comparison of cue induced brain reactivity for gaming and smoking. In this study, 16 male participants with both IGD and nicotine dependence (i.e., comorbid group) were recruited by an advertisement that asked for volunteers who smoked 10 or more cigarettes a day and played online games for four or

more hours on weekdays and eight or more hours at weekends over the past year. A control group of 16 participants with no history of either IGD or nicotine dependence was also recruited. All participants were interviewed by a psychiatrist to confirm the diagnoses of both IGD and nicotine dependence, in accordance with the Diagnostic Criteria for Internet Addiction (DCIA) developed by Ko et al. (89) and the DSM-IV-TR (90), respectively.

All participants underwent 3-T fMRIs scans while viewing images associated with online games, smoking, and neutral images, and results showed that anterior cingulate, and parahippocampus activated higher for both cue-induced gaming urges and smoking craving in the comorbid group in comparison to the control group. Additionally, the conjunction analysis demonstrated that bilateral parahippocampal gyrus activated to a greater degree for both gaming urge and smoking craving among the comorbid group in comparison to the control group. In sum, despite having included only male individuals, this was one of the first studies to demonstrate that both IGD and nicotine dependence share similar mechanisms of cue-induced reactivity over the fronto-limbic network, particularly for the parahippocampus. The authors also asserted that the parahippocampus is a key mechanism for not only cue-induced smoking craving, but also for cue-induced gaming urges.

In summary, some of the latest neurobiological findings related to IGD demonstrates there is a significant progress in mapping the brain areas related to the phenomenon of IGD. The results appear to show that addictive use of the internet and online gaming is linked to functional brain changes involving parts of the prefrontal cortex, accompanied by changes in other cortical and subcortical regions (64). Furthermore, there is some evidence that online addictive activity can lead to structural brain changes involving parts of the prefrontal cortex. The functional changes in

prefrontal and striatal areas are primarily observable when individuals with internet addiction perform certain tasks, in particular those measuring executive functions and cue-reactivity (64).

Despite these promising results, full comprehension and understanding of the neurobiological mechanisms of IGD remains relatively unknown (91). Additionally, some of the key limitations of these studies is that a vast majority tend to (i) use generalized internet addiction instruments to measure IGD; (ii) have low sample sizes; (iii) sometimes include only male participants, and (iv) not address systematically the age of the participants. This makes it difficult to compare the neural correlates of IGD across different ages groups.

5. Psychometric Assessment

The heterogeneity of conceptual frameworks adopted by researchers to understand gaming addiction has led to the development of multiple psychometric instruments, each measuring different aspects associated with gaming problems and addiction. Consequently, this has resulted in diagnostic and conceptual confusion leading some researchers to call for more commonly agreed criteria in which both reliability and validity can be better ascertained across studies (92). Based on recent reviews on gaming addiction assessment (93, 94), Table 2 summarizes some of the most widely used instruments for assessing gaming addiction.

[Please insert Table 2. here]

In a recent systematic review, King et al. (93) examined a total of 63 quantitative studies including 18 different instruments that had been used to assess problematic

gaming and gaming addiction. According to the authors, the instruments reviewed could broadly be characterized as inconsistent since no two measures were alike in their conceptualization and ability to "map out" diagnostic features. Some of the key limitations included: (i) inconsistent coverage of core addiction indicators, (ii) varying cut-off scores to indicate clinical status, (iii) a lack of a temporal dimension, (iv) untested or inconsistent dimensionality, and (v) inadequate data on predictive validity and inter-rater reliability. Despite these criticisms, positive aspects of the 18 available measures included: (i) short length and ease of scoring, (ii) excellent internal consistency and convergent validity, and (iii) potentially adequate data for development of standardized norms for adolescent populations.

In a different analysis, Király et al. (94) reviewed 12 psychometric measures on gaming addiction according to strict criteria. To be included, the assessment instrument had to have (i) been used in two or more empirical studies, (ii) used considerable sample sizes in their development, and (iii) shown good psychometric properties. Based on the authors' review, Király et al. (94) pointed out the fact that a relatively large amount studies on gaming addiction (e.g., 21, 61, 88, 95, 96, 97) measured the construct with psychometric tools for generalized internet addiction and/or the criterion of time spent on online gaming.

Assessing gaming addiction with generalized internet addiction measures or other non-standardized tools has become common practice. However, this method may underestimate the number of addicted gamers because for some of them, gaming may not be perceived as an internet activity but rather as a specific yet separate activity (94). For these gamers, the content may be more relevant and important than the medium itself (i.e., internet). Additionally, most instruments developed to assess internet addiction report several different dimensions and factorial structures for the same construct. The

heterogeneity of factorial structures reported for similar instruments may be partly explained by (i) different statistical methods used to define these dimensions (e.g., EFA vs. CFA); (ii) use of heuristic approaches (e.g., Kaiser criterion for the interpretation of the eigenvalues, subjective scree plot interpretation); (iii) subjective labeling of the factors underlying the latent construct and/or (iv) different cross-cultural aspects which are not being systematically addressed.

In relation to some of the problems raised concerning the cut-off points of most psychometric tools developed, one of the main problems regarding gaming addiction assessment (and psychometric research more generally) concerns the fact that the vast majority of the available measures were not validated using clinical samples. This is especially important due to the fact that this is the only way to ascertain how robust the measures perform in truly discriminating gaming addicts from game enthusiasts. Nevertheless, some authors have recently proposed an empirically data-driven approach in order to distinguish between disordered and non-disordered players based on advanced statistical analyses such as latent class analysis (21). The latent class analysis is a mixture modelling technique based on structural equation modelling used to identify the patterns of responses given by participants in the measure used, allowing the researcher to take into account the groups of participants (i.e., the classes) that scored higher in the measure adopted, and then use it as a 'gold standard' to later study the sensitivity and specificity of the measure regarding its diagnostic power. The sensitivity and specificity analyses provides an empirical overview of how accurate several cut-off points can perform in discriminating disordered and non-disordered players.

In general, most studies developing measures for assessing IGD have not established empirical or clinical cut-off points. Nevertheless, the use of such advanced statistical approaches to develop empirical cut-off points may not accurately distinguish

between true disordered and non-disordered players since they still lack clinical validity. Furthermore, this is a procedure entirely based on empirical – rather than clinical – assumptions. In line with the notion of addictions *on* the internet and addiction *to* the internet (54), Rehbein and Mößle (98) asserted that gaming addiction and generalized internet addiction should be assessed separately since these, despite being somewhat related, are different phenomena.

6. Emerging Trends in Assessment

Given the heterogeneity of instruments designed for assessing gaming addiction and some of the criticisms previously made to them (i.e., inconsistency in the conceptualization of gaming addiction; use of non-standardized criteria; use of *ad hoc* cut-off points, etc.), experts in the field have now called for unification in the assessment of gaming addiction (24, 72, 93, 99). The call for a commonly agreed upon assessment criteria or a standardized instrument results from the need to increase reliability and validity across gaming addiction studies. This, in turn, will help to advocate adequate and efficacious treatments for the condition (92). The unification is equally important if the phenomenon of gaming addiction (i.e., IGD) is to be fully recognized by official medical bodies as a separate clinical disorder.

In line with the latest advancements in the field, two psychometric tools developed by the present authors aimed to cater for the need of a unified approach in the assessment of gaming addiction (100, 101) using the official nine criteria for IGD as in the DSM-5 (26). The first of these two measures, the Internet Gaming Disorder Test [IGD-20 Test] was developed using a sample of 1,003 English-speaking gamers from 58 different countries. The IGD-20 Test is an instrument for measuring the severity of gaming disorder throughout 20 items rated on a 5-point Likert scale (1 “Strongly disagree” to 5

"Strongly agree") (see Table 3) reflecting the original nine IGD criteria incorporated in the theoretical framework of the components model of addiction (68). In order to conform with the conceptualization of IGD as outlined in the DSM-5, the test examines both online and offline gaming activities occurring over a 12-month period.

Furthermore, the IGD-20 Test is a reliable and valid psychometric tool comprising six dimensions (i.e., salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse). In addition to investigating the test's factorial validity, other sources of validity have also been obtained during the development of the IGD-20 Test, including criterion-related validity and concurrent validity. One of the advantages of this instrument over others is that during the validation process, the present authors employed sophisticated statistical techniques in order to provide an empirical cut-off. Therefore, based on the results of a latent profile analysis, sensitivity and specificity analyses, the present authors proposed an optimal cut-off of 71 points (out of 100) for distinguishing between disordered and non-disordered gamers.

[Please insert Table 3. here]

Following the development of the IGD-20 Test and using the same rationale underpinning its development, Pontes and Griffiths (100) conducted a study utilizing a sample of 1,397 English-speaking gamers from 58 different countries where the Internet Gaming Disorder Scale – Short-Form [IGDS9-SF] was developed. The IGDS9-SF is a short psychometric tool adapted from the nine core criteria that define IGD according to the DSM-5 (26). Similar to the 20-item version, the aim of this instrument is to assess the severity of IGD and its detrimental effects by examining both online and/or offline

gaming activities occurring over a 12-month period. The nine questions are answered using a 5-point Likert scale (1 “Never” to 5 “Very often”) (see Table 4).

[Please insert Table 4. here]

As noted by Pontes and Griffiths (100), the main purpose of the IGDS9-SF is not to diagnose IGD but to assess its severity and accompanying detrimental effects to the gamers’ life. However, for research purposes only, it may be possible to classify disordered gamers and non-disordered gamers by considering only those gamers that obtain a minimum of 36 out of 45 points in the test (i.e., those who answered ‘often’ and ‘very often’ to all nine questions). For clinical diagnosis purposes, the APA symptom checklist containing the nine IGD criteria in their ‘yes/no’ format should be given preference over the IGDS9-SF for diagnosing IGD since the former appears to have clinical diagnostic validity (102).

As with the IGD-20 Test, the IGDS9-SF also underwent rigorous psychometric analyses encompassing exploratory factor analysis, confirmatory factor analysis, analyses of the criterion-related and concurrent validity, reliability, standard error of measurement, population cross-validity, and lastly, the authors also checked for floor and ceiling effects. As a result of these analyses, the nine items of the IGDS9-SF revealed a single-factor structure that was tested in two independent samples. Furthermore, the test demonstrated satisfactory validity, reliability and proved to be highly suitable for measuring IGD (100). By developing these two psychometric measures, it was also envisaged by the present authors that both tools will help facilitate unified research in the field and also help to overcome some of the incongruences in the assessment of the phenomenon of gaming addiction.

Despite these two initial efforts, it is equally important that future studies test these two new instruments in different contexts using heterogeneous samples. As mentioned earlier, studies in the field using clinical samples are sparse, therefore, studies using these two measures in the clinical setting may help to corroborate the findings in regards to the adequacy of the assessment of IGD using these two instruments.

7. Conclusions

After more than two decades of research, official medical bodies (i.e., APA) have now officially recognized for the first time that IGD is a condition that requires consideration by clinicians and researchers (92) standing alongside the only other behavioral addiction (i.e., Gambling Disorder), situating it clearly within the diagnostic category of Substance-Related and Addictive Disorders. Throughout this review, the latest research findings and official reports suggest the number of gamers and those with IGD have increased over the last few years. It is clear that the gaming industry will continue to innovate and that more complex and demanding games will be developed to cater for the ever-growing need of players for new and more complex games.

The issues encountered by contemporary researchers and clinicians regarding the assessment of IGD appear complex and include several factors. Firstly, it has been noted how historically the use of inconsistent heterogeneous and non-consensual nomenclatures to describe what appears to be the same phenomenon (i.e., IGD) has influenced the development of a varied number of definitions and frameworks for understanding and assessing IGD. Secondly, despite being important at some point, these definitions and frameworks largely contributed to the “boom” in the development of several psychometric tools for assessing IGD irrespective of the their viability. Thirdly, as

outlined by recent literature reviews on the assessment of most used psychometric tools (93, 94), these tools have a wide range of problems. Some of these conceptual problems found in the literature regarding the assessment of IGD are important because – as noted by Shaffer et al. (10) – without conceptual clarity and empirical support for treatment efficacy, it is also premature to offer clinical guidelines for the treatment of generalized internet addiction or IGD.

Furthermore, because some of the early conceptualizations where IGD was seen as a subtype of internet addiction (e.g., 12), a trend for assessing IGD using generalized internet addiction tools have been established and translated by a substantial number of studies using this method (e.g., 15, 19, 59, 60-62). This in turn, has contributed to some of the methodological problems in the literature regarding the assessment and understanding of IGD.

When dealing with the issue of IGD in the clinical setting, clinicians faced with patients that are struggling with online addictions must perform thorough diagnostic evaluations and determine the extent of comorbid conditions (10). In this sense, it has also been highlighted how the patient's perceived self-diagnosis of internet addiction may be representative of a real internet addiction (38). Therefore, clinicians are advised to take into account patients' subjective assessment regarding their difficult struggles with IGD.

Around 19 instruments have been analyzed in the present review in light of previous works (93, 94). Surprisingly, all instruments were inconsistent and none were alike in terms of the conceptualization of the IGD phenomenon. Most notably, clinical validation is severely lacking in all instruments and therefore this should be considered in future research.

In order to overcome some of the problems found in most instruments used to assess IGD, Koronczai et al. (103) suggested that a good measurement instrument should

meet six criteria: (i) comprehensiveness (i.e., examining many and possibly all aspects of IGD); (ii) brevity, so that the instrument can be used impulsive individuals and fit time-limited surveys; (iii) reliability and validity for different data collection methods; (iv) reliability and validity across different age groups; (v) cross-cultural reliability and validity; and (vi) validation on clinical samples for determining more precise cut-off points based not only on empirical data.

Given the recent call for unification in the assessment of IGD from experts in the field (24, 72, 93, 99) two new psychometric tools (100, 101) have been developed by the present authors in order to help overcome some of the challenges regarding the assessment of IGD.

Despite the promise that these two new measurement tools hold, their validity regarding other more heterogeneous samples and even clinical samples remain to be tested. Therefore, researchers using these tools are encouraged to put them to test in clinical samples and other contexts. In comparison to other more established fields (i.e., Gambling Disorder), the IGD field is still in its early infancy. However, the benefits of an IGD diagnosis may include reliability across research, destigmatization of individuals struggling with this condition, development of efficacious treatments, and the creation of an incentive for public health care and insurance providers (92).

Additionally, the adoption of new assessment tools that properly and appropriately reflect the official conceptualization proposed by the DSM-5 (26) and the use of a more standardized and consensual nomenclature (i.e., IGD) should be taken into account by researchers and clinicians wishing to research in this area as the use of old nomenclatures may be stigmatizing to patients struggling with IGD (92). The current review indicates that research on IGD is on its way to overcoming some of its previously outlined limitations. Additionally, more research aimed to understanding the context of

IGD in large representative samples – using not only using cross-sectional designs as most of the previous research – and also in the clinical setting by using clinical samples is needed.

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Table 1. Model Comparison: "Components" Model (Griffiths, 2005) vs. Internet Gaming Disorder DSM-5 criteria (APA, 2013)

Components Model (Griffiths, 2005)	**Comparison**	**Internet Gaming Disorder DSM-5 (APA, 2013)**	
Salience	Overlaps with the criterion	**1**	1. Preoccupation with Internet Games (The individual thinks about previous gaming activity or anticipates playing the next game; Internet gaming becomes the dominant activity in daily life.
Mood Modification	Overlaps with the criterion	**8**	8. Use of Internet Games to escape or relieve a negative mood (e.g., feelings of helplessness, guilt, anxiety).
Tolerance	Overlaps with the criterion	**3**	3. Tolerance – the need to spend increasing amounts of time engaged in Internet games.
Withdrawal	Overlaps with the criterion	**2**	2. Withdrawal Symptoms when Internet gaming is taken away. (These symptoms are typically described as irritability, anxiety, or sadness, but are no physical signs of pharmacological withdrawal.
Conflict	Overlaps with the criterion	**5**, **6**, **7** and **9**	5. Loss of interests in previous hobbies and entertainment as a result of, and with the exception of, Internet games. 6. Continued excessive use of Internet games despite knowledge of psychosocial problems. 7. Has deceived family members, therapists, or others regarding the amount of Internet gaming. 9. Has jeopardised or lost a significant relationship, job, or educational career opportunity because of participation in Internet games.
Relapse	Overlaps with the criterion	**4**	4. Unsuccessful attempts to control the participation in Internet games[1].

Note*:* [1] = *Possible overlap with Conflict (as proposed in Components Model – Griffiths, 2005).*

Table 2. Summary of instruments traditionally used for assessing gaming addiction[1, 2]

Instrument	Author	Components	Number of Items	Time-scale	Addiction Criteria[3]	Clinical Validation	Sample Size / Characteristics
Adapted DSM-IV-TR for pathological gambling†	APA (2000)	Preoccupation; tolerance; loss of control; withdrawal; escape; chasing; lies; illegal acts; negative consequences; bail out.	10/11	12 months	≥ 4/5 criteria	No	-
Adapted DSM-IV-TR for substance dependence†	APA (2000)	Loss of control; negative consequences of use;	7	12 months	> 3 criteria	No	-
Addiction-Engagement Questionnaire (revised) †††	Charlton and Danforth (2007)	Addiction; engagement.	24	NR	≥ 4 out of 7 "core" addiction criteria; highly engaged	No	N = 442 Mostly males adolescents and adults from the USA and Canada
Compulsive Internet Use Scale (CIUS) †	Meerkerk,Van den Eijnden and Garretsen (2006)	Loss of control; preoccupation; withdrawal; conflict; coping.	14	NR	None	No	N = 447 Male and female adult Dutch heavy internet users
Exercise Addiction Inventory (adapted) †	Hussain and Griffiths (2009)	NR	6	NR	"At-risk of addiction" ≥ 24 out of 30 criteria	No	N = 119 Male and female adolescents and adults from the USA, Canada and UK
Game Addiction Scale (GAS) †††	Lemmens et al. (2009)	Salience; tolerance; mood modification; withdrawal; relapse; conflict; problem.	21/7	6 months	At least "3 sometimes" on all 7 items	No	N = 721 Male and female Dutch young adolescents
Korean Internet Addiction Test (KIAT) †	Lee et al. (2007)	Disturbance of adaptive functions; disturbance of reality testing; addictive automatic thoughts; withdrawal; virtual interpersonal relationships; deviant behavior, tolerance.	40	NR	NR	No	N = 627 Male and female South Korean young adolescents
Online Game Addiction Scale for Adolescents in Taiwan (OAST) †††	Wan and Chiou (2006)	Compulsive use; withdrawal; tolerance; conflict.	29	NR	> 3	No	N = 127 Male and female Taiwanese young adolescents

Online Game Addiction Index (OGAI) †	Zhou and Li (2009)	Control; conflict; injury.	12	6 months	NR	No	N = 195 Male and female Chinese adolescents and young adults
Problem Videogame Playing (PVP) Scale†††	Salguero and Moran (2002)	Preoccupation; tolerance; loss of control; withdrawal; escape; lies and deception disregard for physical or psychological consequences.	9	12 months	≥ 4 criteria	No	N = 223 Male and female Spanish young adolescents
Problematic Internet Use Scale (ISS-20) (adapted) †	Stetina et al. (2011)	Loss of control, problems in social offline relationships; withdrawal symptoms; tolerance; impairments in daily life.	20	NR	"Problematic": average ranking larger than 3 according to each item (88 percentile)	No	N = 468 Mostly male German-speaking adolescents and adults
Problematic Online Game Use Scale (POGU) †††	Kim and Kim (2010)	Euphoria; health problems; conflict; failure of self-control; preference for virtual relationship.	20	NR	NR	No	N = 2,014 Male and female children and young adolescents from South Korea
Problematic Online Gaming Questionnaire†††	Demetrovics et al. (2012)	Preoccupation; overuse; immersion; social isolation; interpersonal conflicts; withdrawal.	28	NR	"Problematic": ≥ 65	No	N = 3,415 Male and female Hungarian-speaking adolescent and young adult gamers
Problematic Online Gaming Questionnaire Short Form (POGQ-SF) ††	Pápay et al. (2013)	Preoccupation; overuse; immersion; social isolation; interpersonal conflicts; withdrawal.	12	NR	"Problematic": ≥ 32	No	N = 2,774 Male and female Hungarian adolescent gamers
Video Game Addiction Test (VAT) †††	Van Rooij et al. (2012)	Loss of control; intra- and inter- personal conflicts; preoccupation; mood modification; withdrawal.	14	NR	NR	No	N = 2,894 Male and female Dutch adolescent gamers
Video Game Dependency Scale (KFN-CSAS-II) †††	Rehbein et al. (2010)	Preoccupation/salience; conflict; loss of control; withdrawal; tolerance.	14	NR	"Dependent": ≥ 42	No	N = 15,168 Male and female German adolescents

Internet Addiction Diagnostic Questionnaire (IADQ) †††	Young (1998a)	Preoccupation; tolerance; loss of control/relapse; withdrawal; conflict; mood modification.	8	NR	"Dependent": ≥ 5 symptoms	No	N = 496 Male and female adults from the USA
Internet Addiction Test (IAT) †††	Young (1998b)	Salience; excessive use; neglect-work; anticipation; lack of control; neglect-social.[5]	20	NR	"Addiction": 70-100 points	Yes: Limited clinical utility[4]	N = 86 / Male and female English-speaking internet users[5]
Pathological-Gaming Scale (PGS) ††	Gentile (2009)	DSM-IV criteria for pathological gambling; salience; euphoria or relief; tolerance; withdrawal symptoms; conflict; relapse and reinstatement.	11	NR	≥ 6 symptoms	No	N = 1,178 / Male and female children and young adolescents from the USA

Notes: [1]: The term gaming addiction is used because none of the instruments were specifically developed according to the nine IGD criteria as proposed by the DSM-5 (APA, 2013). [2]: This table was partially based on King et al. (2013) and Király et al. (2014) review studies. [3]: Cut-off score for addiction diagnose. [4]: As concluded by a study (Kim, S. J., Park, D.-H., Ryu, S.-H., Yu, J., & Ha, J. H. (2013). Usefulness of Young's Internet Addiction Test for clinical populations. Nordic Journal of Psychiatry, 67(6), 393-399.). [5]: Since the assessment of the psychometric properties of the IAT was not conducted by the original author of this test, the information provided refer to the first psychometric study conducted for this test: Widyanto, L., & McMurran, M. (2004). The psychometric properties of the internet addiction test. CyberPsychology & Behavior, 7(4), 443-450. †: Instruments originally included in King et al. (2013) review; †† Instruments originally included in Király et al. (2014) review. †††: Instruments included in both reviews.

Table 3. The Internet Gaming Disorder Test, Dimensionality and Instructions

Internet Gaming Disorder Test (IGD Test)*
1. I often lose sleep because of long gaming sessions.
2R**. I never play games in order to feel better.
3. I have significantly increased the amount of time I play games over last year.
4. When I am not gaming I feel more irritable.
5. I have lost interest in other hobbies because of my gaming.
6. I would like to cut down my gaming time but it's difficult to do.
7. I usually think about my next gaming session when I am not playing.
8. I play games to help me cope with any bad feelings I might have.
9. I need to spend increasing amounts of time engaged in playing games.
10. I feel sad if I am not able to play games.
11. I have lied to my family members because the amount of gaming I do.
12. I do not think I could stop gaming.
13. I think gaming has become the most time consuming activity in my life.
14. I play games to forget about whatever's bothering me.
15. I often think that a whole day is not enough to do everything I need to do in-game.
16. I tend to get anxious if I can't play games for any reason.
17. I think my gaming has jeopardised the relationship with my partner.
18. I often try to play games less but find I cannot.
19R**. I know my main daily activity (i.e., occupation, education, homemaker, etc.) has not been negatively affected by my gaming.
20. I believe my gaming is negatively impacting on important areas of my life.
Dimensions
Salience: 1, 7, 13
Mood Modification: 2R, 8, 14
Tolerance: 3, 9, 15
Withdrawal Symptoms: 4, 10, 16
Conflict: 5, 11, 17, 19R, 20
Relapse: 6, 12, 18

*Instructions: These questions relate to your gaming activity during the past year (i.e., 12 months). By gaming activity we mean any gaming-related activity that was played on either a computer/laptop, gaming console and/or any other kind of device online and/or offline.
** Reversely score items.
*** Items answered in a 5-poin scale: 1 "strongly disagree", 2 "disagree", 3 "neither agree or disagree", 4 "agree", 5 "strongly agree".
**** Suggested empirical cut-off for the test: 71 points.

Table 4. Internet Gaming Disorder 9 Criteria, Instructions and Reliability

Modified Internet Gaming Disorder 9 criteria (DSM-5) (APA, 2013)*

1. Do you feel preoccupied with your gaming behaviour? (Some examples: Do you think about previous gaming activity or anticipate the next gaming session? Do you think gaming has become the dominant activity in your daily life?)
2. Do you feel more irritability, anxiety or even sadness when you try to either reduce or stop your gaming activity?
3. Do you feel the need to spend increasing amount of time engaged gaming in order to achieve satisfaction or pleasure?
4. Do you systematically fail when trying to control or cease your gaming activity?
5. Have you lost interests in previous hobbies and other entertainment activities as a result of your engagement with the game?
6. Have you continued your gaming activity despite knowing it was causing problems between you and other people?
7. Have you deceived any of your family members, therapists or others because the amount of your gaming activity?
8. Do you play in order to temporarily escape or relieve a negative mood (e.g., helplessness, guilt, anxiety)?
9. Have you jeopardised or lost an important relationship, job or an educational or career opportunity because of your gaming activity?

*Instructions: These questions will ask you about your gaming activity during the past year (i.e., last 12 months). By gaming activity we understand any gaming-related activity that has been played either from a computer/laptop or from a gaming console or any other kind of device (e.g., mobile phone, tablet, etc.) both online and/or offline.
** Items answered in a 5-poin scale: 1 “never”, 2 “rarely”, 3 “sometimes”, 4 “often”, 5 “very often”.
*** Reliability (Cronbach’s Alpha) for the 9 criteria = .87.