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Research Article

The Development and Psychometric Properties of the Internet Disorder Scale–Short Form (IDS9-SF)*

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Abstract

Previous research has emphasized the need to improve the psychometric assessment of Internet addiction (IA); however, little research has been conducted to address inconsistencies in the instrumentation used for this purpose. Therefore, the aim of this study was to develop a new instrument to assess IA based on the nine Internet Gaming Disorder (IGD) criteria as suggested by the American Psychiatric Association in the latest edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) and further explore its psychometric properties according to several statistical parameters. A convenience sample of 1,100 participants was recruited from various online forums. Construct validity of the Internet Disorder Scale–Short Form (IDS9-SF) was assessed by means of factorial and nomological validity. Concurrent and criterion validity, as well as reliability were also investigated. At the construct validity level, the results from different analyses confirmed the validity of the scale. Additionally, strong empirical evidence was obtained for the concurrent and criterion validity of the scale. Taken together, these findings support the viability of using the nine IGD criteria as outlined by the APA in the DSM-5 to assess the construct of IA in a parsimonious and uniform fashion.

Keywords

Internet addiction • Internet Gaming Disorder • DSM-5 • Assessment • Behavioral addiction • Psychometric evaluation

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Research concerning Internet addiction (IA) has grown considerably over the last decade (Kuss, Griffiths, Karila, & Billieux, 2014; Pontes, Kuss, & Griffiths, 2015), mostly because of its clinical and sociological relevance (Kuss et al., 2014). In general, IA has been characterized by excessive, or poorly controlled, preoccupation, urges, and/or behaviors regarding Internet use that lead to impairment or distress in many life domains (Weinstein, Feder, Rosenberg, & Dannon, 2014). Several definitions and terminologies can be found in the psychological and psychiatric literature to describe what appears to be the same phenomenon. For instance, IA has been traditionally conceptualized as a problematic behavior akin to pathological gambling, which can be operationally defined as an impulse control disorder that does not involve the ingestion of psychoactive intoxicants (Young, 1998). IA has also been characterized as a form of technological addiction (Griffiths, 1995, 1996, 1998), which is operationally defined as a non-chemical (behavioral) addiction involving excessive human-machine interaction (Griffiths, 1995). In this theoretical framework, technological addictions, such as IA, represent a subset of behavioral addictions featuring six core components: salience, mood modification, tolerance, withdrawal, conflict, and relapse (Griffiths, 2005; Marks, 1990).

A large body of emerging evidence indicates that IA is a serious condition, often linked with the following: social anxiety in young adults (Weinstein, Dorani, Elhadif, Bukovza, & Yarmulnik, 2015); lower levels of family functioning, life satisfaction, and problems in family interactions (Wartberg, Kriston, Kammerl, Petersen, & Thomasius, 2015); attention deficit/hyperactivity disorder and depression (Sariyska, Reuter, Lachmann, & Montag, 2015); higher incidence of substance use, poor emotional well-being, and decreased academic performance in adolescents (Rücker, Akre, Berchtold, & Suris, 2015); increased academic stress (Jun & Choi, 2015); impulsive behaviors (Reed, Osborne, Romano, & Truzoli, 2015); introversion (McIntyre, Wiener, & Saliba, 2015); and higher levels of loneliness, alexithymia, and suicide (Alpaslan, Avci, Soyulu, & Guzel, 2015).

Despite the fact that IA is not yet recognized as an official clinical disorder by relevant medical bodies, researchers have shown support for its inclusion in the mental health diagnostic manuals given that the knowledge of this potential disorder has grown substantially (Kuss et al., 2014; Pontes et al., 2015). Even though the knowledge base of IA and its neurobiological correlates has progressed considerably over the past 15 years (Pontes et al., 2015), research in this field comes with a caveat in terms of the definition and characterization of this phenomenon, ultimately leading to inadequate psychometric assessment on the basis of extant assessment tools (Pontes & Griffiths, 2015a). For instance, a review conducted by Király, Nagygyörgy, Koronczai, Griffiths, and Demetrovics (2014) on the nine most used instruments for assessing IA found several inconsistencies and limitations. According to these

authors, the majority of the discrepancies identified concerned the (i) theoretical basis of instruments, (ii) factor structures, and (iii) psychometric properties. Additionally, the majority of these instruments were based on the DSM-IV criteria for pathological gambling and/or substance dependence (American Psychiatric Association, 1994). The review also found that while the factor structure information of some instruments were not consistently reported, they generally comprised between one and seven factors, and only a few psychometric properties were assessed.

Importantly, Internet Gaming Disorder (IGD) was included in Section 3 of the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) by the American Psychiatric Association (APA, 2013) as a condition in need of further study. The nine IGD criteria relate to the following aspects: (i) preoccupation with Internet gaming; (ii) withdrawal symptoms; (iii) tolerance, expressed by the need to spend increasing amounts of time engaged with Internet gaming; (iv) unsuccessful attempts to control Internet gaming use; (v) continued excessive Internet use despite knowledge of negative psychosocial problems; (vi) loss of interests/previous hobbies, entertainment as result of, and with the exception of, Internet gaming use; (vii) use of Internet gaming to escape or relieve a dysphoric mood; (viii) deception of family members, therapists, or others regarding the amount of Internet gaming; and (ix) jeopardizing or losing a significant relationship, job, or educational/career opportunity because of Internet gaming.

Although the theoretical framework proposed by the APA for IGD confusingly refers to both online and offline gaming addiction, several recent studies on technological addictions (e.g., Cho et al., 2014; Pontes & Griffiths, 2015a; van den Eijnden, Lemmens, & Valkenburg, 2016) have adapted the IGD theoretical framework to understand other potential behavioral addictions. This provides an opportunity to formally standardize the operational definition of the main construct under investigation and potentially unify the area in terms of psychometric assessment by adopting an agreed upon assessment criteria, which is key for advancing the field. The IGD framework proposed by the APA has helped researchers develop numerous psychometric instruments for a number of different technological addictions, such as gaming addiction (e.g., Pontes & Griffiths, 2015b; Pontes, Király, Demetrovics, & Griffiths, 2014), social networking addiction (e.g., van den Eijnden et al., 2016), and generalized IA (Cho et al., 2014; Pontes & Griffiths, 2015a).

More recently, a select number of studies applied this rationale to the case of generalized IA in cross-sectional research. For instance, Cho et al. (2014) conducted a survey with a sample of 1,192 South Korean adolescents to develop and validate a standardized self-diagnostic IA scale based on the diagnostic criteria for IGD as defined in the DSM-5 (APA, 2013). According to the authors, 41 items grouped into

nine latent factors selected from previous IA assessment tools were used to develop a new IA tool. The authors concluded that the model based on the DSM-5 was not appropriate for the instrument in question, which led the authors to restructure their theoretical model according to statistical results obtained in the original model. As the new instrument presented with several shortcomings, such as inconsistent factor structure and relative lack of brevity, Pontes and Griffiths (2015a) recruited a heterogeneous sample of 1,105 Internet users (age range = 16 to 70 years; $M_{age} = 33$ years) to develop and analyze the psychometric properties of the Internet Disorder Scale (IDS-15). The IDS-15 defines generalized IA via four main latent domains: (i) Escapism and Dysfunctional Emotional Coping, (ii) Withdrawal Symptoms, (iii) Impairments and Dysfunctional Self-Regulation, and (iv) Dysfunctional Internet-related Self-Control. The IDS-15 was developed to assess the severity of IA and the impact of its detrimental effects during a 12-month period. The results of the study found that the IDS-15 provided robust evidence in terms of factorial, convergent, and discriminant validity at the construct validity level. Evidence regarding the criterion validity and reliability of the instrument was also satisfactory.

To the best of the authors' knowledge, only two studies (i.e., Cho et al., 2014; Pontes & Griffiths, 2015a) have used this strategy to develop IA psychometric tools. Although other researchers have suggested it might be beneficial to adopt such an approach to understand and assess IA (e.g., Rumpf et al., 2015), little research has addressed this issue, and the existing evidence remains unclear. For instance, Cho et al. (2014) provided an important effort and contribution, but several limitations emerged as the psychometric properties of their instrument remain questionable. Specifically, the new instrument: (i) was arguably lengthy, which is problematic for time-limited research; (ii) had its items lifted from previous problematic IA instruments; (iii) was developed using a limited sample of adolescents, thus limiting its generalizability to other segments of the population (i.e., adults and the elderly); and (iii) lacked robust psychometric properties (e.g., low reliability, $\alpha = .49$ and $\alpha = .65$ in two factors). On the other hand, although the results obtained in the study of the IDS-15 (Pontes & Griffiths, 2015a) were robust and promising, the IDS-15 requires refinement both in terms of latent factors and number of items because the scale presents with a relatively complex factor structure, whereas most new tools adopting the IGD framework are unidimensional in nature.

In light of the conceptual and methodological issues raised, the present study adds to the current debate regarding the viability of adapting the nine IGD criteria outlined by the APA (2013). Hence, this study is one of the first studies to assess generalized IA by developing a new standardized psychometric tool for measuring generalized IA using a slightly modified version of the nine criteria for IGD to reflect Internet use instead of gaming. The main goal of this study is to expand the findings reported by

Pontes and Griffiths (2015a) by developing and exploring the psychometric properties of the Internet Disorder Scale–Short Form (IDS9-SF), a short version of the IDS-15 (Pontes & Griffiths, 2015a).

Method

Participants and Procedure

A convenience sample of Internet users was recruited from several online forums (e.g., *Something Awful* and *The Student Room*) and social networking websites (e.g., *Facebook* and *LinkedIn*). Participants were sent invitations via online posts and forum threads to participate in the study over a period of six months from February to July 2014. Personalized feedback was provided to participants to address questions and issues encountered during survey administration throughout the data collection process.

To participate in the study, participants had to be at least 16 years of age and provide individualized online written informed consent. A total of 1,107 Internet users completed the study questionnaire. After cleaning the data, the final sample of the study comprised 1,100 participants. The majority of the sample (91%) were from the United States of America ($n = 406$; 36.9%), India ($n = 331$; 30.1%), or from the United Kingdom ($n = 270$; 24.5%), with a small minority ($n = 100$; 9%) from other countries. The sample was predominantly male ($n = 673$, 61.2%) with ages ranging from 16 to 70 years ($M_{\text{age}} = 33$ years, $SD = 12.33$). All participants were assured of anonymity and confidentiality, and approval was granted from the research team's University Ethics Committee.

Measures

Socio-demographics and Internet use. A questionnaire was developed to collect data on gender, age, relationship status, weekly Internet usage (average weekly hours spent on the Internet for leisure purposes), cigarette, and alcohol usage (smoke cigarettes or drink alcohol more than three times a week–yes/no), age of Internet use initiation (age participant remembers first using the Internet), and ownership of Internet-enabled electronic devices (yes/no).

The Internet Disorder Scale (IDS-15) (Pontes & Griffiths, 2015a). The IDS-15 is a 15-item psychometric tool used to assess IA based on the modified nine IGD criteria outlined in the DSM-5 (APA, 2013). The scale assesses the severity of IA and the impact of its detrimental effects by focusing upon users' online leisure activity (i.e., excluding academic and/or occupational Internet use) on any device with Internet access during the past year. The IDS-15 includes items that can be grouped at the theoretical level into four qualitatively distinct IA-related domains: (i)

Escapism and Dysfunctional Emotional Coping (e.g., “*I go online to help me cope with any bad feelings I might have.*”); (ii) Withdrawal Symptoms (e.g., “*I tend to get anxious if I can’t check what’s happening online for any reason.*”); (iii) Impairments and Dysfunctional Self-Regulation (e.g., “*I think the amount of time I spend online is negatively impacting on important areas of my life.*”); and (iv) Dysfunctional Internet-related Self-Control (e.g., “*I am able to control and/or reduce the time I spend online.*”). All items are responded to on a 5-point Likert scale: 1 (“*Strongly disagree*”); 2 (“*Disagree*”); 3 (“*Neither agree nor disagree*”); 4 (“*Agree*”); or 5 (“*Strongly agree*”). The total IDS-15 score can range from 15 to 75, with higher scores being an indication of higher degrees of IA.

The Internet Disorder Scale–Short Form (IDS9-SF). The IDS9-SF is a unidimensional (see Figure 1), standardized psychometric tool developed by the authors of the present study by slightly modifying the wording of the original nine IGD criteria outlined in the DSM-5 (APA, 2013). Although the nine items of the IDS9-SF were essentially derived from the nine IGD criteria, the scale represents the short version of the IDS-15 (Pontes & Griffiths, 2015a) and can be used to estimate the severity of IA and the impact of its detrimental effects by focusing upon users’ online leisure activity (i.e., excluding academic and/or occupational Internet use) on any device with Internet access during the past year. The nine questions comprising the IDS9-SF are answered using a 5-point Likert scale: 1 (“*Never*”); 2 (“*Rarely*”); 3 (“*Sometimes*”); 4 (“*Often*”); and 5 (“*Very often*”). Total scores can range from nine to 45, with higher scores being indicative of a higher degree of Internet use disorder. Although the authors of the present study discourage the use of this tool to diagnose cases of IA in isolation, a strict diagnostic approach of an endorsement of five or more of the nine items as assessed by the IDS9-SF on the basis of answering “*Very often*” should only be considered if there is a need to differentiate between likely-disordered and non-disordered cases.

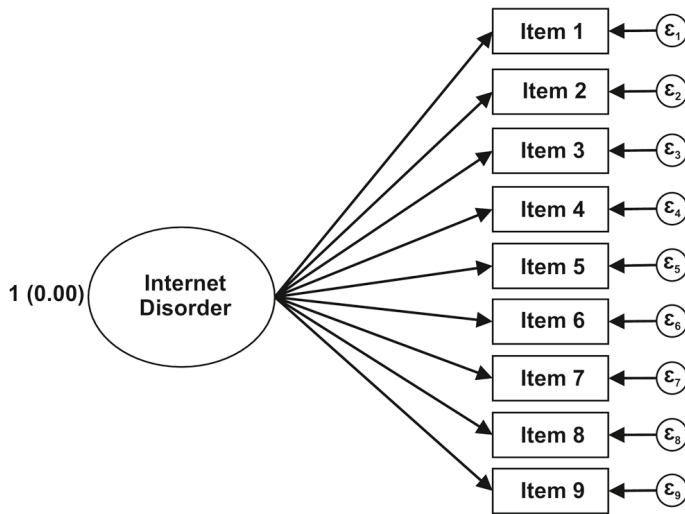


Figure 1. Measurement model of the theoretical factor structure of the Internet Disorder Scale – Short Form (IDS9-SF).

Data Analytic Strategy and Statistical Analysis

The data were cleaned in two steps prior to the statistical analyses. The first step included cleaning the data via a thorough analysis of each case to identify missing values above the threshold of 10% in all relevant instruments of the study, which resulted in no case being excluded. The second step of the data management process involved the analysis of the (i) univariate normality of all nine items of the IDS9-SF, (ii) univariate outliers, and (iii) multivariate outliers in the dataset. As for the univariate normality, no item of the IDS9-SF had absolute values of skewness > 3.0 and kurtosis > 8.0 (Kline, 2011), thus supporting univariate normality of the main measure. In order to screen for univariate outliers, a standardized composite sum score of the IDS9-SF using all nine items was created and participants were deemed univariate outliers if they scored ± 3.29 standard deviations from the IDS9-SF z-scores, as this threshold includes approximately 99.9% of the normally distributed IDS9-SF z-scores (Field, 2013). Based on this analysis, no cases of univariate outliers were found, and therefore no further cases were excluded. Finally, the data were screened for multivariate outliers using Mahalanobis distances and the critical value for each case based on the chi-square distribution values, which resulted in seven cases being excluded from the dataset. Thus, the final sample size for all subsequent analyses was $N = 1,100$.

The statistical analysis of the clean dataset included: (i) descriptive statistics of the main sample's characteristics (i.e., frequencies and percentages); (ii) assessment of the dimensionality and factorial structure of the IDS9-SF with confirmatory factor

analysis (CFA); (iii) nomological validation of the IDS9-SF to strengthen the case of construct validity by performing a full structural equation modeling (SEM) analysis of the coefficient estimates of a theoretical model reflecting a nomological network that replicates the pattern of association known for each construct in the model with IA; (iv) concurrent and criterion validity analysis by investigating the bootstrapped correlation coefficients with 95% Bias-corrected and accelerated (BCa) confidence intervals between the IDS9-SF, the IDS-15 total scores, and time spent on the Internet weekly; (v) analysis of the reliability of the IDS9-SF using different coefficients and indicators of internal consistency (i.e., Cronbach's alpha, factor determinacy, composite reliability, and correct item-total correlation coefficients). All analyses were performed using MPLUS 7.2 (Muthén & Muthén, 2012) and SPSS Statistics v.20 (IBM Corporation, 2011).

Results

Characteristics of the sample

Participants' socio-demographic characteristics, substance use, and Internet use patterns are summarized in Table 1. 67.8% of the participants reported being in a relationship ($n = 746$). 40.6% of the participants started using the Internet after the age of 18 years ($n = 447$), followed by those that started to use the Internet between 13 and 17 years ($n = 314$; 28.5%), between 7 and 12 years ($n = 284$; 25.8%), and before the age of 6 years ($n = 25$; 2.3%). Only 2.7% of the participants ($n = 30$) reported not remembering their age of Internet use initiation at the time they completed the survey. The vast majority of the sample ($n = 994$; 90.4%) reported owning Internet-enabled electronic devices (see Table 1).

Construct validity: Confirmatory factor analysis (CFA)

A CFA was performed on the nine items of the IDS9-SF using the theoretical model shown in Figure 1 with maximum likelihood with robust standard errors estimation method (MLR) on the sample ($N = 1,100$). Since there is no consensus on the fit indices for evaluating structural equation models (see Bollen & Long, 1993; Boomsma, 2000; Hoyle & Panter, 1995), the goodness of fit was based on several fit indices using the following thresholds: χ^2/df [1;4]; Root Mean Square Error of Approximation (RMSEA) [0.05;0.08]; RMSEA 90% confidence interval with its lower limit close to 0 and the upper limit below .08, *p-close* > .05; Standardized Root Mean Square Residual (SRMR) [0.05;0.08]; Comparative Fit Index (CFI); and Tucker-Lewis Fit Index (TLI) [.90; .95]. All nine indicators were entered into a unidimensional factorial solution reflecting the nine criteria outlined by the APA. The results obtained for the one-factor model provided an acceptable model fit for

the IDS9-SF ($\chi^2 [25] = 110.1$, $\chi^2/df = 4.4$; RMSEA = 0.056 [90% CI: 0.045–0.066], $p\text{-close} = .18$; SRMR = 0.023; CFI = .98; TLI = .97) with acceptable standardized item loadings (i.e., $\lambda_{ij} \geq .50$) (see Table 2). These results support the factorial validity of the IDS9-SF given that the obtained fit indices were acceptable and all standardized factor loadings were high (i.e., $\lambda_{ij} \geq .50$).

Table 1

Sample's Main Socio-Demographic Characteristics, Substance, and Internet Use Patterns

N	1,100
Gender (male, %)	673 (61.2)
Age (years) (mean, SD)	33 (12.3)
Country of origin (n, %)	
United States of America	406 (36.9)
India	331 (30.1)
United Kingdom	270 (24.5)
Other Countries	93 (8.5)
Relationship status (In a relationship, %)	746 (67.8)
Weekly Internet usage (n, %)	
Less than 7 hours	48 (4.4)
Between 8 and 14 hours	142 (12.9)
Between 15 and 20 hours	188 (17.1)
Between 21 and 30 hours	230 (20.9)
Between 31 and 40 hours	170 (15.5)
More than 40 hours	322 (29.3)
Cigarette consumption (> 3 times a week, %)	211 (19.2)
Alcohol consumption (> 3 times a week, %)	248 (22.5)
Age of Internet use initiation (n, %)	
Before 6 years old	25 (2.3)
Between 7 and 12 years old	284 (25.8)
Between 13 and 17 years old	314 (28.5)
After 18 years old	447 (40.6)
Do not remember	30 (2.7)
Ownership of Internet-enabled electronic devices (yes, %)	994 (90.4)

Table 2

Summary of the Confirmatory Factor Analysis (CFA) and Overall Item-related Descriptive Statistics Results of the Internet Disorder Scale – Short Form (IDS9-SF)

Item	λ^*	Min	Max	Me	M	SD	Sk	Ku
1. Do you feel preoccupied with your online behavior? (Some examples: Do you think about previous sessions online or anticipate the next online session? Do you think being online has become the dominant activity in your daily life?)	.76	1	5	2	2.53	1.15	0.23	-0.90
2. Do you feel more irritability, anxiety and/or sadness when you try to either reduce or stop using the internet?	.81	1	5	2	2.19	1.14	0.65	-0.50
3. Do you feel the need to spend increasing amount of time engaged online in order to achieve satisfaction or pleasure?	.81	1	5	2	2.30	1.22	0.50	-0.90
4. Do you have difficulties in trying to control, cut down, and/or cease your online usage?	.77	1	5	2	2.24	1.17	0.62	-0.60
5. Have you lost interest in previous hobbies and other leisure activities as a result of being online?	.77	1	5	2	2.21	1.24	0.62	-0.80
6. Have you continued to go online despite knowing it was causing problems between you and other people?	.81	1	5	2	2.02	1.18	0.86	-0.39
7. Have you deceived any of your family members, therapists or other people because the amount of time you spend online?	.73	1	5	1	1.78	1.14	1.26	0.39
8. Do you go online in order to escape or feel better (e.g., helplessness, guilt, anxiety)?	.66	1	5	3	2.54	1.23	0.24	-0.94
9. Have you jeopardized or lost an important relationship, career or an educational opportunity because of your online usage?	.72	1	5	1	1.79	1.16	1.19	0.12

*: All factor loadings were statistically significant at $p < .001$.

Note. λ = standardized factor loadings; Min = minimum value observed; Max = maximum value observed; Me = median; M = mean; SD = standard deviation; Sk = skewness; Ku = kurtosis

Scale instructions: "Instructions: These questions relate to your internet usage during the past year (i.e., 12 months). By internet usage we mean any activity performed online on either a computer or a laptop, or any other kind of portable device with internet access."

Participants' rating scale: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Very Often

Construct validity: Nomological validation

The assessment of the construct validity of IA also involved identifying a relevant network of key constructs associated with the construct and to explicate the pattern of interrelationships that exist among them (Bryant, King, & Smart, 2007). This procedure has been elaborated and discussed by Cronbach and Meehl (1955) who argued that it is necessary to understand the nature of a construct through the statistical or deterministic laws underlying the network of key constructs, often referred to as the nomological network. The nomological network is considered an aspect of construct validity of a given phenomenon and was assessed by replicating the structural and causal relationships between IA and age, age of Internet use initiation, and time spent on the Internet weekly in the present study. This decision was informed by several

studies (e.g., Pontes & Griffiths, 2015c; Siciliano et al., 2015; Tsitsika et al., 2014; Vink, van Beijsterveldt, Huppertz, Bartels, & Boomsma, 2015) that found these variables to be associated with the phenomenon of addictive Internet use. For this reason, a full SEM analysis was performed on the data to investigate the nomological validity of the IA construct. The structural model included IA as the outcome of age, age of Internet use initiation, and time spent on the Internet weekly. The results produced an adequate fit to the data ($\chi^2 [49] = 213.3$, $\chi^2/df = 4.3$; RMSEA = 0.055 [90% CI: 0.048–0.063], $p\text{-close} = .12$; SRMR = 0.031; CFI = .97; TLI = .96). For each outcome in the model, age explained 38% of the variance in age of Internet use initiation ($R^2 = 0.38$, $p < .0001$), and 3% of the variance of time spent on the Internet weekly ($R^2 = 0.03$, $p = .004$). The total variance explained in the outcome (i.e., IA) by all three predictors was 18% ($R^2 = 0.18$, $p < .0001$) (see Figure 2).

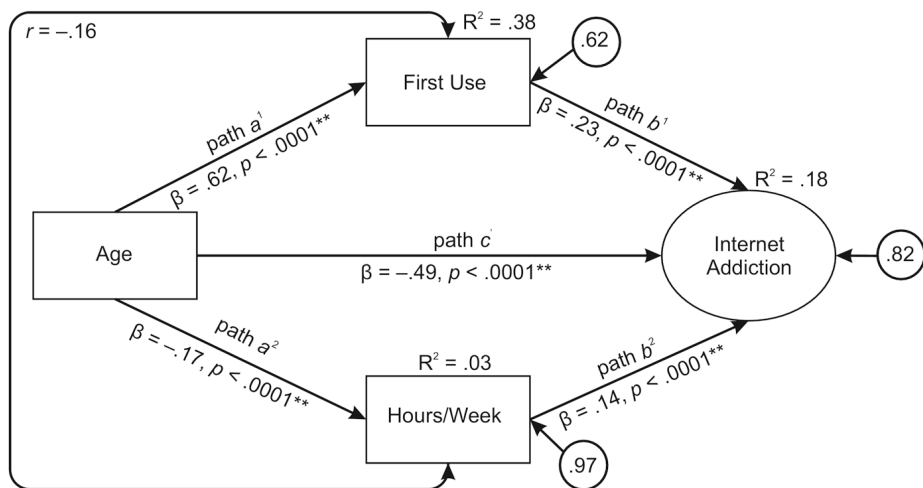


Figure 2. Summary of the nomological validation analysis of the Internet Disorder Scale – Short Form (IDS9-SF).

Note. $**p < 0.0001$; β , standardized beta coefficient; Overall goodness of fit: $X^2 [49] = 213.3$, $X^2/df = 4.3$; RMSEA = 0.055 [90% CI: 0.048–0.063], $p\text{-close} = .12$; SRMR = 0.031, CFI = .97; TLI = .96. Acronyms: CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker-Lewis Fit Index.

Concurrent and Criterion Validity Analysis

Concurrent validity was investigated by examining the bootstrapped Pearson's correlation coefficient with 10,000 bootstrap samples and 95% BCa CI between the IDS-15 and IDS9-SF's total scores, which yielded adequate results ($r = 0.80$, $R^2 = 0.64$, $p < .0001$, 95% BCa CI [0.78–0.82]), supporting the concurrent validity of the scale. Furthermore, criterion validity was ascertained through the demonstration of a statistically significant association between IA and a reliable and recognized indicator

of the construct. To achieve this goal, a bootstrapped Spearman's rho correlation coefficient with 10,000 bootstrap samples and 95% BCa CI between IDS9-SF's total scores and time spent on the Internet weekly ($r_s = 0.18$, $R^2 = 0.03$, $p < .0001$, 95% BCa CI [0.12–0.24]) was estimated. These results provided further support for the criterion validity of the IDS9-SF.

Reliability Analysis

The reliability of the IDS9-SF was assessed using several indicators of reliability. The Cronbach's alpha reliability coefficient was high ($\alpha = .93$) and could not be improved from the deletion of any item. The factor determinacy of the IDS9-SF was .96, which is well above the desired threshold of .80 (Muthén & Muthén, 2012). The analysis of the composite reliability provided a coefficient of .93, which is also beyond the accepted threshold of .70 (Fornell & Larcker, 1981; Hair, Black, Babin, & Anderson, 2010). Finally, the item/domain discriminating power was assessed using corrected item-total correlations. Accordingly, all items were statistically significant, and positively associated with the total score with correlation coefficients ranging from .63 to .79 (see Table 3). Overall, these results strongly support the adequacy and reliability of the unidimensional factor solution of the IDS9-SF in the present sample.

Table 3

Summary of the Reliability Results of the Internet Disorder Scale – Short Form (IDS9-SF)

Reliability Coefficients			Correct Item-Total Correlation ^a								
α	FD	CR	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9
.93	.96	.93	.72	.77	.77	.73	.74	.79	.74	.63	.73

^a: All correlation coefficients were statistically significant ($p \leq .001$).

Note. α = Cronbach's alpha; FD = factor determinacies; CR = composite reliability; AVE = Average Variance Extracted.

Discussion

The aim of the present study was to develop a new psychometrically validated instrument to assess IA and further investigate its psychometric properties in several distinct domains using the theoretical framework outlined by the APA regarding the nine DSM-5 criteria for IGD (APA, 2013). To achieve the goals of the study, the IDS9-SF underwent rigorous psychometric scrutiny. The results from the CFA and the nomological validation provided adequate results concerning the construct validity of the instrument. In terms of the factor structure of the IDS9-SF, the results obtained in the present study mirrored those reported in previous studies (Pontes & Griffiths, 2015b, 2016) that found a unidimensional factor structure for the nine IGD criteria. The analysis of both concurrent and criterion validity also yielded satisfactory results that further highlighted the concurrent and criterion validity of the new instrument. It is worth noting that the correlation coefficient obtained for the criterion validity

analysis was weak, which might be a result of the non-parametric analysis due to the ordinal operationalization of the variable (i.e., time spent on the Internet weekly). However, the results obtained for the concurrent validity analysis provided strong evidence in this regard. Additionally, the results supported the internal consistency of the IDS9-SF as assessed by several indicators, including the Cronbach's alpha, factor determinacy, composite reliability, and corrected item-total correlation.

In light of these findings, future studies should expand on these results by further examining different samples and cultural contexts. Even though the results obtained here appear promising, they are preliminary in nature. Particularly, the scale still requires testing using a clinical sample, which can provide useful results to help confirm or disconfirm the suggested cut-off point for the IDS9-SF. Furthermore, although the present study provided robust findings, it is not without its limitations. First, the study was conducted using a convenience sample of Internet users that was not necessarily representative of all users. Therefore, the present findings should be cautiously interpreted and not generalized to all Internet users. Another aspect that might have negatively affected this study was the use of self-report questionnaires and their associated possible biases, such as social desirability and short-term recall biases. Finally, although several forms of validity were examined, other types of validity, such as predictive validity, could also have been assessed.

In sum, the findings of the present study support the concept of IA and its psychometric assessment when using modified IGD criteria as outlined in the DSM-5 (APA, 2013). Furthermore, the IDS9-SF may prove to be a psychometrically robust tool to assess IA if future studies can replicate and expand the present findings in different research settings and clinical samples.

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References

- Alpaslan, A. H., Avci, K., Soylu, N., & Guzel, H. I. (2015). The association between problematic internet use, suicide probability, alexithymia and loneliness among Turkish medical students. *Journal of Psychiatry, 18*(208). <http://dx.doi.org/10.4172/psychiatry.1000208>
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.
- Bollen, K. A., & Long, J. S. (1993). Introduction. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 1–9). Newbury Park, CA: Sage.
- Boomsma, A. (2000). Reporting analyses of covariance structures. *Structural Equation Modeling: A Multidisciplinary Journal*, 7(3), 461–483. http://dx.doi.org/10.1207/S15328007SEM0703_6
- Bryant, F. B., King, S. P., & Smart, C. M. (2007). Multivariate statistical strategies for construct validation in positive psychology. In A. D. Ong & M. H. M. V. Dulmen (Eds.), *Oxford handbook of methods in positive psychology* (pp. 61–82). Oxford, UK: Oxford University Press.
- Cho, H., Kwon, M., Choi, J.-H., Lee, S.-K., Choi, J. S., Choi, S.-W., & Kim, D.-J. (2014). Development of the internet addiction scale based on the internet gaming disorder criteria suggested in DSM-5. *Addictive Behaviors*, 39(9), 1361–1366. <http://dx.doi.org/10.1016/j.addbeh.2014.01.020>
- Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin*, 52(4), 281–302. <http://dx.doi.org/10.1037/h0040957>
- Field, A. (2013). *Discovering statistics using IBM SPSS Statistics* (4th ed.). London, UK: Sage.
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <http://dx.doi.org/10.2307/3151312>
- Griffiths, M. D. (1995). Technological addictions. *Clinical Psychology Forum*, 76, 14–19.
- Griffiths, M. D. (1996). Internet “addiction”: An issue for clinical psychology? *Clinical Psychology Forum*, 97, 32–36.
- Griffiths, M. D. (1998). Internet addiction: Does it really exist? In J. Gackenbach (Ed.), *Psychology and the internet: Intrapersonal, interpersonal and transpersonal applications* (pp. 61–75). New York, NY: Academic Press.
- Griffiths, M. D. (2005). A “components” model of addiction within a biopsychosocial framework. *Journal of Substance Use*, 10(4), 191–197. <http://dx.doi.org/10.1080/14659890500114359>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis. A global perspective* (7th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
- Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues and application* (pp. 158–176). Thousand Oaks, CA: Sage.
- Jun, S., & Choi, E. (2015). Academic stress and internet addiction from general strain theory framework. *Computers in Human Behavior*, 49, 282–287. <http://dx.doi.org/10.1016/j.chb.2015.03.001>
- 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, UK: Oxford University Press.
- Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3th ed.). New York, NY: The Guildford Press.
- 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. <http://dx.doi.org/10.2174/13816128113199990617>

- Marks, I. (1990). Behavioural (non-chemical) addictions. *British Journal of Addiction*, 85(11), 1389–1394. <http://dx.doi.org/10.1111/j.1360-0443.1990.tb01618.x>
- McIntyre, E., Wiener, K. K. K., & Saliba, A. J. (2015). Compulsive internet use and relations between social connectedness, and introversion. *Computers in Human Behavior*, 48, 569–574. <http://dx.doi.org/10.1016/j.chb.2015.02.021>
- Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide seventh edition*. Los Angeles, LA: Muthén & Muthén.
- Pontes, H. M., & Griffiths, M. D. (2015a). The development and psychometric evaluation of the Internet Disorder Scale (IDS-15). *Addictive Behaviors*. <http://dx.doi.org/10.1016/j.addbeh.2015.09.003>
- Pontes, H. M., & Griffiths, M. D. (2015b). Measuring DSM-5 internet gaming disorder: development and validation of a short psychometric scale. *Computers in Human Behavior*, 45, 137–143. <http://dx.doi.org/10.1016/j.chb.2014.12.006>
- Pontes, H. M., & Griffiths, M. D. (2015c). The role of age, age of Internet access initiation, and time spent online in the etiology of internet addiction. *Journal of Behavioral Addictions*, 4(Suppl. 1), 30–31. <http://dx.doi.org/10.1556/JBA.4.2015.Suppl.1>
- Pontes, H. M., & Griffiths, M. D. (2016). Portuguese validation of the Internet Gaming Disorder Scale–Short-Form. *CyberPsychology, Behavior & Social Networking*, 19(4), 288–293. <http://dx.doi.org/10.1089/cyber.2015.0605>
- 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. <http://dx.doi.org/10.1371/journal.pone.0110137>
- Pontes, H. M., Kuss, D. J., & Griffiths, M. D. (2015). Clinical psychology of Internet addiction: A review of its conceptualization, prevalence, neuronal processes, and implications for treatment. *Neuroscience and Neuroeconomics*, 4, 11–23. <http://dx.doi.org/10.2147/NAN.S60982>
- Reed, P., Osborne, L. A., Romano, M., & Truzoli, R. (2015). Higher impulsivity after exposure to the internet for individuals with high but not low levels of self-reported problematic internet behaviours. *Computers in Human Behavior*, 49, 512–516. <http://dx.doi.org/10.1016/j.chb.2015.03.064>
- Rücker, J., Akre, C., Berchtold, A., & Suris, J.-C. (2015). Problematic internet use is associated with substance use in young adolescents. *Acta Paediatrica*, 104(5), 504–507. <http://dx.doi.org/10.1111/apa.12971>
- Rumpf, H., Bischof, G., Bischof, A., Besser, B., Meyer, C., & John, U. (2015, March). *Applying DSM-5 criteria for Internet gaming disorder for the broader concept of internet addiction*. Paper presented at the 2nd International Conference on Behavioral Addictions, Budapest, Hungary.
- Sariyska, R., Reuter, M., Lachmann, B., & Montag, C. (2015). Attention deficit/hyperactivity disorder is a better predictor for problematic internet use than depression: Evidence from Germany. *Journal of Addiction Research and Therapy*, 6(209). <http://dx.doi.org/10.4172/2155-6105.1000209>
- Siciliano, V., Bastiani, L., Mezzasalma, L., Thanki, D., Curzio, O., & Molinaro, S. (2015). Validation of a new short problematic internet use test in a nationally representative sample of adolescents. *Computers in Human Behavior*, 45, 177–184. <http://dx.doi.org/10.1016/j.chb.2014.11.097>

- Tsitsika, A., Janikian, M., Schoenmakers, T. M., Tzavela, E. C., Ólafsson, K., Wójcik, S., ... Richardson, C. (2014). Internet addictive behavior in adolescence: A cross-sectional study in seven European countries. *Cyberpsychology, Behavior, and Social Networking*, *17*(8), 528–535. <http://dx.doi.org/10.1089/cyber.2013.0382>
- van den Eijnden, R. J. J. M., Lemmens, J. S., & Valkenburg, P. M. (2016). The social media disorder scale: Validity and psychometric properties. *Computers in Human Behavior*, *61*, 478–487. <http://dx.doi.org/10.1016/j.chb.2016.03.038>
- Vink, J. M., van Beijsterveldt, T. C. E. M., Huppertz, C., Bartels, M., & Boomsma, D. I. (2015). Heritability of compulsive Internet use in adolescents. *Addiction Biology*, *21*(2), 460–468. <http://dx.doi.org/10.1111/adb.12218>
- Wartberg, L., Kriston, L., Kammerl, R., Petersen, K. U., & Thomasius, R. (2015). Prevalence of pathological internet use in a representative German sample of adolescents: Results of a latent profile analysis. *Psychopathology*, *48*(1), 25–30. <http://dx.doi.org/10.1159/000365095>
- Weinstein, A., Dorani, D., Elhadif, R., Bukovza, Y., & Yarmulnik, A. (2015). Internet addiction is associated with social anxiety in young adults. *Annals of Clinical Psychiatry*, *27*(1), 2–7.
- Weinstein, A., Feder, L. C., Rosenberg, K. P., & Dannon, P. (2014). Internet addiction disorder: Overview and controversies. In K. P. Rosenberg & L. C. Feder (Eds.), *Behavioral addictions* (pp. 99–117). San Diego, CA: Academic Press.
- Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior*, *1*(3), 237–244. <http://dx.doi.org/10.1089/cpb.1998.1.237>