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Addictive Behaviors



The development and psychometric evaluation of the Internet Disorder Scale (IDS-15)

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HIGHLIGHTS

- The IDS-15 was developed to assess IA based on the IGD (DSM-5) definition.
- The IDS-15 is a valid and reliable instrument to assess IA.
- Internet users may be classed along a continuum with varying degrees of IA risk.
- The phenomenon of IA is not black white and may be better understood as a continuum.
- More research is needed to further validate the IDS-15 in other cultural contexts.

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ABSTRACT

Introduction: Previously published research suggests that improvement in the assessment of Internet addiction (IA) is paramount in advancing the field. However, little has been done to address inconsistencies in the assessment of IA using a more updated framework. The aim of the present study was to develop a new instrument to assess IA based on a modification of the nine Internet Gaming Disorder (IGD) criteria as suggested by the American Psychiatric Association in the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), and to provide a taxonomy of the potential risk of IA risk among participants.

Methods: A heterogeneous sample of Internet users ($n = 1105$) was recruited online (61.3% males, mean age 33 years). Construct validity of the new instrument – Internet Disorder Scale (IDS-15) – was assessed by means of factorial, convergent, and discriminant validity. Criterion-related validity and reliability were also investigated. Additionally, latent profile analysis (LPA) was carried out to differentiate and characterize Internet users based on their potential IA risk.

Results: The construct and criterion-related validity of the IDS-15 were both warranted. The IDS-15 proved to be a valid and reliable tool. Using the LPA, participants were classed as “low addiction risk” ($n = 183, 18.2\%$), “medium addiction risk” ($n = 456, 41.1\%$), and “high addiction risk” ($n = 455, 40.77\%$). Furthermore, key differences emerged among these classes in terms of age, relationship status, cigarette consumption, weekly Internet usage, age of Internet use initiation, and IDS-15 total scores.

Conclusions: The present findings support the viability of using adapted IGD criteria as a framework to assess IA.

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1. Introduction

Over the past two decades, Internet Addiction (IA) has received increasing attention from scholars of different fields due to its clinical and sociological importance (Kuss, Griffiths, Karila, & Billieux, 2014). IA can be broadly characterized by excessive or poorly controlled preoccupations, urges, or behaviors regarding Internet use that lead to impairment or distress (Weinstein, Feder, Rosenberg, & Dannon, 2014). A consistent and large body of emerging research suggests that IA is a

serious condition that is often associated with several psychosocial and psychological factors such as social anxiety in young adults (Weinstein, Dorani, Elhadif, Bukovza, & Yarmulnik, 2015), lower levels of family functioning, life satisfaction as well as more 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 wellbeing, 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, Soylu, & Guzel, 2015).

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Although IA is not (as yet) recognized as an official disorder, many researchers from all over the world have backed its inclusion in the diagnostic manuals given that the knowledge of this emerging disorder has grown markedly over the last two decades (Kuss et al., 2014; Pontes, Kuss, & Griffiths, 2015). Even though the knowledge base on IA and its neurobiological correlates have progressed considerably over the last 15 years (Pontes et al., 2015), research in the area comes with a caveat in terms of definition and characterization of this phenomenon, ultimately leading to inadequate psychometric assessment of this phenomenon on the basis of extant assessment tools.

More recently, Király, Nagygyörgy, Koronczai, Griffiths, and Demetrovics (2014) conducted a review on the nine most used instruments for assessing IA and found several inconsistencies among them. Most of the discrepancies identified were observed at the level of (i) theoretical basis of instruments, (ii) factor structures, (ii) and psychometric properties. More specifically, the majority of instruments to assess IA were based on the DSM-IV criteria for pathological gambling and/or substance dependence (American Psychiatric Association, 1994). Additionally, some instruments did not report their factor structure, although in general, instruments tend to present with either one or up to seven factors, and only a few psychometric properties were assessed.

Recently, Internet Gaming Disorder (IGD) was included in the Section 3 of the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) by the American Psychiatric Association (APA) (APA, 2013) as a condition worthy of future study. The nine IGD criteria relate to the following aspects of excessive and problematic gaming: (i) preoccupation with Internet gaming; (ii) withdrawal symptoms when Internet is taken away; (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 the 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 or career opportunity because of Internet gaming use.

Arguably, one of the arguments sustaining the initial inclusion of IGD in the DSM-5 relates to the latest developments in the neurobiological field that further support the status of this condition as a tentative behavioral addiction. Nevertheless, although IGD refers exclusively to gaming addiction, researchers have recently suggested the potential benefits and advantages of applying the nine IGD criteria to assess IA (e.g., Rumpf et al., 2015). In order to overcome some of the problems found in most instruments that are used to assess IA, Koronczai et al. (2011) suggested that a suitable measure should meet the following six criteria: (i) comprehensiveness (i.e. examining many and possibly all aspects of IA); (ii) brevity, so that it can be used for 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.

To date, and to the best of the authors' knowledge, only one study (i.e., Cho et al., 2014) has adopted this approach to assess IA based on modification of the nine IGD criteria. However, the new instrument (i) was arguably lengthy as it contained 41 items, and might constitute a problem for time-limited research, (ii) was developed using a limited sample of adolescents (aged 13 and 14 years), thus limiting the extent as to which it could be assumed that the new instrument would work adequately in other segments of the population (i.e., adults and elderly),

and (iii) lacked robust psychometric properties (e.g., very low reliability, $\alpha = .49$ and $\alpha = .65$ in two latent factors).

In light of the conceptual and methodological issues raised, the aim of the present study was twofold. The primary goal was to develop a new robust standardized psychometric tool to assess IA by using a set of items based on modification of the nine IGD criteria outlined in the DSM-5 (APA, 2013) while also providing evidence of its validity and reliability. The second goal was to further explore and characterize the different types of Internet users based on their potential risk for developing IA. By identifying factors that may explain the risk of IA, such insights may help provide useful clinical recommendations for emerging prevention and treatment interventions (Stavropoulos, Kuss, Griffiths, & Motti-Stefanidi, 2015).

2. Method

2.1. Participants and procedure

To aid participant recruitment, a cross-sectional design and a web-based recruitment strategy involving opportunity and snowball sampling methods was utilized. More specifically, several online forums (e.g., *Something Awful*, *The Student Room*, etc.) and social networking websites (e.g., *Facebook* and *LinkedIn*) were used to attract potential Internet users to participate in the present study. By strategically using forum threads, social network posts, and personalized messages, invitations to participate in a study were sent out to contact Internet users over a period of six months spanning (February to July 2014). Whenever possible, personalized feedback was provided to participants' questions and issues encountered during survey administration.

In order to take part in the study, participants had to (i) be at least 16 years of age and (ii) provide individualized online written informed consent. Furthermore, participants took part in this study voluntarily, without receiving any form of compensation (e.g., financial, material, etc.). The survey took approximately 5 to 7 min to complete. The recruited sample included 1105 Internet users that filled out the study's questionnaires. Data cleaning was performed before conducting the final statistical analysis. Moreover, both univariate normality and univariate outliers were checked. As for the univariate normality, no item of the newly developed instrument had absolute values of Skewness >3.0 and Kurtosis >8.0 , thus warranting univariate normality of the study's main measure (Kline, 2011). In order to screen for univariate outliers, a standardized composite sum score of the dependent variable (i.e., IA) as assessed by the new instrument was created, and participants were deemed univariate outliers if they scored ≥ 3 standard deviation points above or below the standardized mean. This procedure yielded 11 outliers that were then removed from the dataset and subsequent analyses. As a result, the final sample comprised 1094 Internet users. Of those, 36.7% ($n = 405$) were from the United States of America, 30.4% ($n = 336$) from India, 24.6% ($n = 272$) from the United Kingdom, and a small minority ($n = 92$, 8.3%) from other countries. The sample was predominantly male ($n = 671$, 61.3%) with ages ranging from 16 to 70 years ($M_{\text{age}} = 33$ years, $SD = 12.25$). All participants were assured of anonymity and confidentiality, and the study was granted with approval of the research team's university Ethics Committee.

2.2. Measures

2.2.1. Socio-demographics, substance, and internet use

A questionnaire was developed in order to collect data on gender, age (year at the time of survey completion), relationship status (not in a relationship/in a relationship), weekly Internet usage (average weekly hours spent on the Internet for leisure purposes), cigarette usage (smoke cigarettes more than three times a week - yes/no) and alcohol

usage (drink alcohol more than three times a week – yes/no) consumption, age of Internet use initiation (age participant remembers first using the Internet), and ownership of Internet-enabled electronic devices (yes/no).

2.2.2. The Internet Disorder Scale (IDS-15)

The IDS-15 is a psychometric tool that was developed by the authors of the present study by modifying the nine IGD criteria outlined in the DSM-5 (APA, 2013) to adjust to the case of IA. Based on this rationale, the IDS-15 aims to assess the severity of IA and the impact of its detrimental effects by only focusing upon users' online leisure activity (i.e., excluding academic and/or occupational Internet use) from any device with Internet access in the past year. After developing the items of the IDS-15 and on the basis of a qualitative analysis, it was found that the new 15 items could be grouped at the theoretical level, into four main and 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."). Participants respond to items using 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 is obtained by summing up participants' responses and can range from 15 to 75, with higher scores being an indication of higher degrees of IA.

2.3. Statistical analysis

Statistical analysis comprised (i) descriptive statistics of the main sample's characteristics (i.e., frequencies and percentages), (ii) a psychometric evaluation of the IDS-15 that included analysis of the construct validity (i.e., factorial validity via confirmatory factor analysis [CFA], convergent and discriminant validity analysis based on the average variance extracted [AVE] coefficients of each latent variable), and criterion-related validity (i.e., bootstrapped correlation with Bias-corrected accelerated 95% confidence intervals between the IDS-15 overall scores and the chosen criterion), and reliability analysis using different coefficients and indicators of internal consistency (i.e., Cronbach's alpha, composite reliability, and factor determinacies). Finally, (iii) a latent profile analysis (LPA) was carried out in order to identify and describe the taxonomy and patterns of the Internet users alongside their potential risk of IA based on their responses to the four subscales of the IDS-15, with the resulting final classes being subject to Wald's chi-square test using several socio-demographic and Internet-related variables in order to ascertain the characteristics and specificities of each class. All statistical analyses were performed using Mplus 7.2 (Muthén & Muthén, 2012) and IBM SPSS Statistics Version 20.0 (IBM Corp., 2011).

3. Results

3.1. Descriptive statistics

Table 1 summarizes participants' main socio-demographic characteristics, substance use, and Internet use patterns. The majority of participants reported being in a relationship ($n = 741$, 67.7%) and started using the Internet only after 18 years of age ($n = 445$, 40.7%), followed by those that reported starting to use it between 13 and 17 years ($n = 312$, 28.5%), between 7 and 12 years ($n = 283$, 25.9%), and before the age of 6 years ($n = 22$, 2%). Only 2.9% of the participants ($n = 32$) reported not remembering their age of

Table 1

Sample's main socio-demographic characteristics, and substance, and Internet use patterns.

N	1094
Gender (male, %)	671 (61.3)
Age (years) (mean, SD)	33 (12.3)
Country of origin (n, %)	
United States of America	405 (37)
India	327 (29.9)
United Kingdom	271 (24.8)
Other countries	91 (8.3)
Relationship status (in a relationship, %)	741 (67.7)
Weekly Internet usage (n, %)	
Less than 7 h	48 (4.4)
Between 8 and 14 h	141 (12.9)
Between 15 and 20 h	186 (17)
Between 21 and 30 h	229 (20.9)
Between 31 and 40 h	170 (15.5)
More than 40 h	320 (29.3)
Cigarette consumption (>3 times a week, %)	211 (19.3)
Alcohol consumption (>3 times a week, %)	248 (22.7)
Age of Internet use initiation (n, %)	
Before 6 years old	22 (2)
Between 7 and 12 years old	283 (25.9)
Between 13 and 17 years old	312 (28.5)
After 18 years old	445 (40.7)
Do not remember	32 (2.9)
Ownership of Internet-enabled electronic devices (yes, %)	988 (90.3)

Internet use initiation at the time they filled out the survey. Moreover, 90.3% ($n = 988$) of the sample reported owning Internet-enabled electronic devices (see Table 1).

3.2. Construct validity

As outlined in the in the previous section, in order to examine the construct validity of the IDS-15, factorial, convergent, and discriminant validity were investigated.

3.2.1. Factorial Validity: Confirmatory Factor Analysis (CFA)

As aforementioned, the indicators of the IDS-15 appeared to be associated, at least at the theoretical level, to four distinct domains of IA (i.e., Escapism and Dysfunctional Emotional Coping, Withdrawal Symptoms, Impairments and Dysfunctional Self-Regulation, and Dysfunctional Internet-related Self-Control.). Hence, a CFA on the fifteen items of the IDS-15 with maximum likelihood with robust standard errors estimation method (MLR) was performed on the whole sample ($N = 1094$). Because 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 fifteen indicators were entered into a four first-order factorial solution. The results obtained for the four first-order model provided an acceptable model fit for the IDS-15 (χ^2 [84] = 343.6, χ^2/df = 4; RMSEA = 0.053 [90% CI: 0.047–0.059], p -close = .18; SRMR = 0.039, CFI = .95; TLI = .94) with acceptable standardized item loadings (i.e., $\lambda_{ij} \geq .50$) (see Table 2). Thus, it can be concluded that the results of the CFA warrant the factorial validity of the IDS-15 given that the obtained fit indices were acceptable, and that all standardized factor loadings were relatively high (i.e., $\lambda_{ij} \geq .50$) (Marôco, 2014).

3.2.2. Convergent validity, discriminant validity, and reliability

Convergent validity relates to the extent to which the items of an instrument appear to be indicators of a single underlying construct (Lee,

Table 2
Confirmatory factor analysis (CFA) of the 15 items of the Internet Disorder Scale (IDS-15)^a.

Items	F1	F2	F3	F4
<i>Escapism and dysfunctional emotional coping</i> (Factor 1)				
1. I never go online to feel better. ^R	.67			
2. I think that being online can greatly change my mood for the better.	.66			
3. I go online to help me cope with any bad feelings I might have.	.84			
4. I go online to forget about whatever's bothering me.	.74			
<i>Withdrawal symptoms</i> (Factor 2)				
5. When I am not online I feel irritable, restless, anxious and/or frustrated.		.74		
6. I feel sad if I am not able to go online.		.76		
7. I tend to get anxious if I can't check what's happening online for any reason.		.80		
8. I feel restless every time I am unable to go online.		.78		
<i>Impairments and dysfunctional self-regulation</i> (Factor 3)				
9. I think the amount of time I spend online has jeopardized the relationship with my partner.			.67	
10. I think the amount of time I spend online is negatively impacting on important areas of my life.			.79	
11. I would like to cut down the amount of time I spend online but it's difficult for me to do.			.70	
12. I often try to spend less time online but find I cannot.			.72	
<i>Dysfunctional Internet-related self-control</i> (Factor 4)				
13. I could easily stop spending time online if I wanted to without any problem. ^R				.69
14. I can easily cut down the time I spend online any time that I want to. ^R				.85
15. I am able to control and/or reduce the time I spend online. ^R				.71
<i>Factors' descriptive statistics</i>				
Mean	3.06	2.50	2.41	2.51
Standard deviation	0.91	1.00	0.90	0.81

Note: All factor loadings are significant at least at $p < .0001$. Abbreviations: **F1**: factor 1; **F2**: factor 2; **F3**: factor 3; **F4**: factor 4.

^R Reversely scored item.

^a 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 for leisure purpose only on either a computer or a laptop, or any other kind of portable device with Internet access.

Cheung, & Chan, 2015). In light of this, convergent validity was deemed adequately when the AVE of each latent variable is $\geq .50$ and the composite reliability is $\geq .70$ (Fornell & Larcker, 1981; Hair, Black, Babin, & Anderson, 2010). As shown in Table 3, the values obtained for the AVE fell between .53 and .60, and the composite reliability ranged from .80 to .85. Additionally, discriminant validity refers to the degree to which the measures of distinct constructs differ (Lee et al., 2015), and can be demonstrated when the square root of the AVE for each construct is higher than the correlations between it and the rest of the constructs (Fornell & Larcker, 1981; Hair et al., 2010). The square root of the AVE for each construct is shown in Table 3 (located in bold on the diagonal of the table). Results demonstrated that the value for each construct was higher than the correlations between it and the other constructs.

The internal consistency of the IDS-15 as assessed by the Cronbach's alpha, composite reliability, and factor determinacies, were relatively

Table 3
Reliability, convergent, and discriminant validity of the Internet Disorder Scale (IDS-15).

Construct	Cronbach's alpha	Factor determinacies	Composite reliability	AVE	Correlation Matrix			
					F1	F2	F3	F4
Factor 1 (F1)	.79	.92	.82	.53	.73			
Factor 2 (F2)	.85	.94	.85	.60	.69	.77		
Factor 3 (F3)	.81	.92	.81	.52	.54	.67	.72	
Factor 4 (F4)	.79	.91	.80	.57	.30	.47	.46	.75

Abbreviations: AVE = Average Variance Extracted.

Note: Factor 1: "Escapism and Dysfunctional Emotional Coping"; Factor 2: "Withdrawal Symptoms"; Factor 3: "Impairments and Dysfunctional Self-Regulation"; Factor 4: "Dysfunctional Internet-related Self-Control". The Cronbach's alpha obtained for all 15 items was .88.

stable and deemed satisfactory (see Table 3). Cronbach's alpha for individual dimensions ranged from .79 to .85 whereas all factor determinacies were above the threshold of $\geq .80$ (Mónok et al., 2012; Muthén & Muthén, 2012; Schembre & Geller, 2011) and composite reliability coefficients also exceeded the desired threshold of $\geq .70$ (Fornell & Larcker, 1981; Hair et al., 2010). Taken altogether, these results illustrate that the IDS-15 demonstrated sufficient convergent validity, discriminant validity, and also reliability.

3.3. Criterion-related validity

Based on the findings of previous empirical studies (e.g., Pontes & Griffiths, 2015b; Pontes, Patrão, & Griffiths, 2014; Quiñones-García & Korak-Kakabadse, 2014; Wartberg et al., 2015), criterion-related validity was assessed by the association (i.e., bootstrapped correlation with Bias-corrected accelerated 95% confidence intervals) between the IDS-15 overall scores and participants' self-reported age of Internet use initiation, relationship status, hours spent on the Internet per week, and the composite score obtained in each one of the four IDS-15 subscales. As expected, participants' level of IA (as assessed by the IDS-15) was associated with the variables of interest, and these correlation coefficients ranged from $-.12$ to $.86$ (see Table 4). Therefore, it can be concluded that the IDS-15 exhibited satisfactory criterion-related validity when considering the variables analyzed.

3.4. Latent profile analysis (LPA)

LPA was carried out to identify and characterize different types of Internet users while also estimating participants' potential IA risk based on their class membership. The LPA procedure is a mixture modeling statistical technique used to identify groups of individuals (categorical latent variables) that give similar responses to specific continuous variables (Collins & Lanza, 2010), which in the context of the present study were participants' responses to the four IDS-15 factors. The analysis was carried out with two to four classes and multiple fit indices were adopted to help determining the optimal number of latent classes, such as those from the (i) information theory (i.e., Akaike Information Criteria [AIC], Bayesian Information Criteria [BIC], and Sample-size Adjusted BIC [SSABIC]) with lower values indicating more parsimonious models, (ii) the Entropy criterion in order ascertain the accuracy of classifying participants into their respective profiles (i.e., higher values suggesting better fit), and (iii) the Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (L-M-R Test) to help determining the final number of classes, where a significant p value (i.e., $< .05$) indicates that the tested model fits better than the previous one (Muthén & Muthén, 2012).

Table 5 summarizes the results obtained from the LPA analysis with two to four classes that was performed on the four dimensions of the IDS-15. According to the aforementioned criteria, the three-class solution was chosen as the optimal solution for several reasons. The AIC, BIC, and SSABIC decreased consistently and continuously with the addition of more classes and the degree of the observed decrease in the model with four classes in comparison to the one with three classes was not substantial. In terms of the entropy, the two-class solution had the best value and the three-class solution the worst. However, a

Table 4

Bootstrapped correlation matrix with Bias-corrected and accelerated 95% confidence interval (BCa 95% CI) between the overall score obtained in the Internet Disorder Scale (IDS-15) and its related variables.

Measure	S-RAIA	BCa 95% CI	R ²
Age of Internet use initiation	-.17**	-.23; -.11	0.03
Relationship status	-.12**	-.18; -.07	0.01
Weekly Internet usage	.23**	.17; .28	0.05
Factor 1	.75**	.72; .78	0.56
Factor 2	.86**	.84; .87	0.74
Factor 3	.78**	.75; .81	0.61
Factor 4	.74**	.71; .77	0.55

Note: Unless otherwise specified, bootstrap results are based on 10,000 bootstrap samples; Factor 1: "Escapism and Dysfunctional Emotional Coping"; Factor 2: "Withdrawal Symptoms"; Factor 3: "Impairments and Dysfunctional Self-Regulation"; Factor 4: "Dysfunctional Internet-related Self-Control". Abbreviations: R²: Coefficient of Determination. ** = $p < .01$

further examination of the L–M–R test values and their levels of significance clearly indicated that the four-class solution should be rejected in favor of the three-class solution.

The final three latent classes and their characteristics are presented in Fig. 1. The first identified class (i.e., "low addiction risk") features Internet users that have a low risk of IA ($n = 183$, 18.2%) as they tended to score low on all four dimensions of the IDS-15, and thus exhibited lower levels of symptoms and impairments caused by IA. Furthermore, participants belonging to this class had an average score of 38.28 ($SD = 11.01$, 95% CI [36.67–39.89]) on the IDS-15. Moreover, the second identified class (i.e., "medium addiction risk") included Internet users exhibiting a relatively medium risk of IA ($n = 456$, 41.1%). Participants belonging to this class scored markedly high on the 'Escapism and Dysfunctional Emotional Coping' dimension and had low scores on the remaining dimensions of the IDS-15. Additionally, the mean score for these participants on the IDS-15 was 38.58 ($SD = 10.75$, 95% CI [37.59–39.57]). Finally, the third class (i.e., "high addiction risk") featured those exhibiting the greatest risk for developing IA ($n = 455$, 40.7%) as their scores on all four dimensions of the IDS-15 was generally higher than the other classes. Participants in this class scored higher on the 'Escapism and Dysfunctional Emotional Coping' and 'Withdrawal Symptoms' dimensions due to their excessive Internet use. Unsurprisingly, participants belonging to this class had an observed mean score of 40.43 ($SD = 10.05$, 95% CI [39.50–41.36]) on the IDS-15, which was greater than the other two classes.

In addition to the LPA, Wald's chi-square tests were computed to help identify and characterize the final three classes obtained in the LPA. The Wald's chi-square test of mean equality is used for latent class predictors in mixture modeling as it takes into account the probabilistic nature of the LPA classes (see www.statmodel.com/download/meanantest2.pdf for further information). Therefore, the three classes were compared across relevant variables related to IA including gender, age, relationship status, cigarette and alcohol consumption, ownership of Internet-enabled electronic devices, weekly Internet usage, age of

Internet use initiation, and participants' overall total score obtained on the IDS-15.

As shown in Table 6, there were no statistically significant differences between the three classes in terms of gender, drinking alcohol more than three times a week, and owning Internet-enabled electronic devices. However, age differed significantly across the three classes with participants in the "high addiction risk" class being significantly younger than participants in the "low addiction risk" ($\chi^2 = 108.9$, $p \leq .001$) and "medium addiction risk" ($\chi^2 = 28.8$, $p \leq .001$) classes. In terms of relationship status, the "high addiction risk" class had significantly less participants reporting being in a relationship in comparison those belonging to the "low addiction risk" class ($\chi^2 = 18.1$, $p \leq .001$) but not those in the "medium addiction risk" class ($\chi^2 = 0.1$, $p = .79$). Participants with membership in the "high addiction risk" class reported smoking significantly more often more than three cigarettes a week than those in the "low addiction risk" ($\chi^2 = 12.6$, $p \leq .001$) and "medium addiction risk" ($\chi^2 = 9.2$, $p = .002$) classes. As expected, the "high addiction risk" class had a significantly higher proportion of Internet users using the Internet for more than 30 h a week than those in the "low addiction risk" class ($\chi^2 = 26.1$, $p \leq .001$) but not in comparison to participants classed as "medium addiction risk" ($\chi^2 = 0.9$, $p = .342$). In regards to participants' age of Internet use initiation, those in the "high addiction risk" class reported significantly more often that they had started using the Internet before the age of six years than participants in the "low addiction risk" class ($\chi^2 = 7.5$, $p = .006$) but not when compared to those classed as "medium addiction risk" ($\chi^2 = 3.5$, $p = .063$). Finally, participants classed as "low addiction risk" had significantly lower scores on the IDS-15 than participants in the "medium addiction risk" ($\chi^2 = 593.2$, $p \leq .001$) and "high addiction risk" ($\chi^2 = 2226.1$, $p \leq .001$) classes. Moreover, participants in the "high addiction risk" class scored significantly higher than those in the "medium addiction risk" class ($\chi^2 = 981.9$, $p \leq .001$).

4. Discussion

The main aim of this study was to develop a new psychometrically validated instrument to assess IA, and further investigate its psychometric properties in several domains using an updated theoretical framework based on the modified criteria for IGD in the DSM-5 (APA, 2013). In order to achieve this, construct validity was examined on the basis of factorial, convergent, and discriminant validity. Factorial validity was investigated via a CFA and it provided an acceptable model fit according to the results obtained, thus warranting factorial validity for the newly developed instrument. The analysis of both convergent and discriminant validity also yielded satisfactory results that further highlighted the new instrument's convergent and discriminant capabilities. As to the reliability of the IDS-15, the results supported its adequacy concerning its internal consistency as assessed by several indicators such as the Cronbach's alpha, composite reliability, and factor determinacies. The IDS-15 also demonstrated expected associations with key variables (i.e., age of Internet use initiation, relationship status, weekly Internet usage, and all four subdomains of the IDS-15) that are usually associated with IA, thus warranting criterion-related validity.

The second objective of the present study was also to provide a description of the taxonomy and patterns of participants' Internet use alongside their potential IA risk based on their responses given using the IDS-15. According to the results obtained in the LPA, three classes of Internet users based on their risk of addiction were identified. Participants in the "low addiction risk" class represented 18.2% of the sample and were characterized as showing very few problems related to IA and also low scores on the IDS-15. Furthermore, 41.1% of the sample was classed as having a "medium addiction risk" due their excessive online behavior. Participants with "medium addiction risk" tended to rely more on the Internet as a means to escape and cope with their emotions in a dysfunctional manner and scored significantly higher in all four IDS-15 subdomains than participants in the "low addiction risk" class. The

Table 5

Summary of the goodness of fit obtained from the latent profile analysis (LPA)^a.

Number of latent classes	AIC	BIC	SSABIC	Entropy	L–M–R Test	<i>P</i>
2	10765	10829	10788	0.765	902	<.00001
3	10571	10661	10604	0.735	198	<.00001
4	10468	10583	10510	0.753	109	.1942

Abbreviations: AIC: Akaike Information Criteria; BIC: Bayesian Information Criteria; SSABIC: sample-size Adjusted Bayesian Information Criteria; L–M–R Test: Lo–Mendell–Rubin Adjusted Likelihood Ratio Test Value; *P*: *p* value associated with the L–M–R Test.

^a The best loglikelihood value has been successfully replicated across all analyses even after a twofold increasing of the random starts. Information in bold represent the goodness of fit of the final three-class solution.

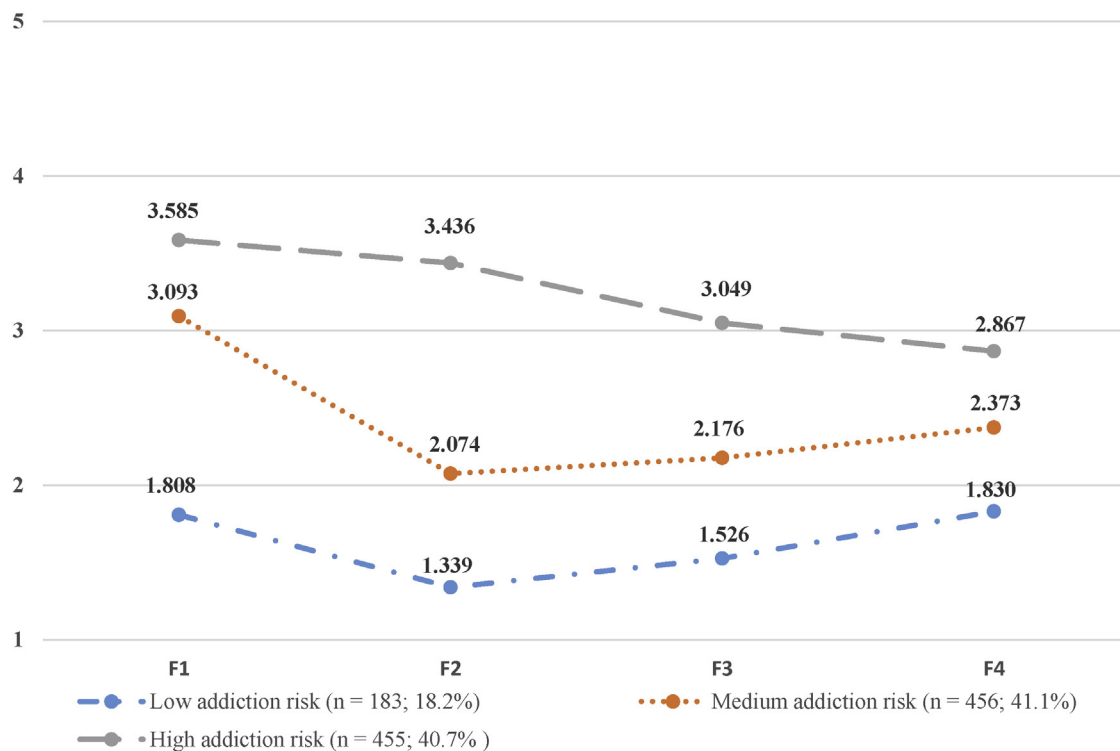


Fig. 1. The three-class solution obtained from the latent profile analysis (LPA) and the potential risk of Internet addiction associated with each class on the basis of participants' responses to the four subscales of the Internet Disorder Scale (IDS-15). Abbreviations: F1: Factor 1: "Escapism and Dysfunctional Emotional Coping"; F2: Factor 2: "Withdrawal Symptoms"; F3: Factor 3: "Impairments and Dysfunctional Self-Regulation"; F4: Factor 4: "Dysfunctional Internet-related Self-Control".

third and final class represented those with "high addiction risk" as participants in this class scored significantly higher on all four dimensions of the IDS-15 and therefore exhibited more Internet-related problems than the other two classes. Although none of the three classes represent the condition of being addicted to the Internet, participants classed as having "high addiction risk" can be characterized as being more avoidant since they used the Internet more as a means to escape and cope with their negative emotions, experiencing more withdrawal symptoms due to excessive Internet use, having more conflicts and impairments alongside dysfunctional self-regulation towards Internet use, and also showing more difficulties in using the Internet in a healthy and balanced way.

The three classes obtained in the LPA were also further characterized in terms of participants' socio-demographic and Internet-related variables in order to ascertain the characteristics and specificities of each class. The results of this analysis demonstrated that key differences emerged among the three classes. Overall, the main differences observed were in (i) age, (ii) relationship status, (iii) weekly cigarette

consumption, (iv) weekly Internet usage, (v) age of Internet use initiation, and in the (vi) IDS-15 total score. More specifically, participants exhibiting "high addiction risk" were generally younger, single (i.e., not in a romantic relationship), smoked more cigarettes weekly, used the Internet for longer hours weekly, started using the Internet at an earlier age, and scored significantly higher in the IDS-15 in comparison to the other classes. This finding parallels the results of previous studies in which younger age (e.g., Vink, van Beijsterveldt, Huppertz, Bartels, & Boomsma, 2015), not being in a romantic relationship (e.g., Pontes & Griffiths, 2015a), increased cigarette consumption (e.g., Evren, Dalbudak, Evren, & Demirci, 2014), high weekly Internet usage (e.g., Bouna-Pyrrou, Mühle, Kornhuber, & Lenz, 2015), and early Internet use initiation (e.g., Pontes & Griffiths, 2015b) were found to be associated with greater risk for developing IA. Notwithstanding this, clinicians working with patients fulfilling the conditions for a clinical diagnosis of IA could employ the IDS-15 in order to further extend the present findings regarding the LPA analysis. This would represent an important contribution to the development of this particular study

Table 6

Comparison of the three latent classes: testing equality for latent class predictors.

	Low addiction risk (N = 183)	Medium addiction risk (N = 456)	High addiction risk (N = 455)	Overall test	
				Wald's χ^2	p value
Gender (male %)	55.8 (0.04) _a	62.5 (0.03) _a	62.7 (0.03) _a	2.2	.339
Age (years), Mean (SE)	41.9 (1.07) _a	34.2 (0.65) _b	29.7 (0.47) _c	73.4	<.0001
Relationship status (in a relationship %)	81.0 (0.03) _a	65.3 (0.02) _{bc}	64.3 (0.02) _c	17.2	<.0001
Cigarette consumption (yes %)	13.3 (0.03) _a	16.1 (0.02) _a	25.3 (0.02) _c	11.9	.003
Alcohol consumption (yes %)	26.2 (0.03) _a	21.5 (0.02) _a	22.3 (0.02) _a	1.4	.494
Ownership of Internet-enabled electronic devices (yes %)	88.3 (0.03) _a	89.9 (0.02) _a	91.6 (0.01) _a	0.9	.646
Weekly Internet usage (≥ 30 h %)	27.8 (0.04) _a	46.8 (0.03) _{bc}	50.4 (0.03) _c	20.3	<.0001
Age of Internet use initiation (<6 years %)	0.5 (0.01) _a	1.4 (0.01) _{ac}	3.5 (0.01) _c	4.9	.083
IDS-15 total score, Mean (SE)	24.2 (0.42) _a	36.5 (0.29) _b	48.9 (0.29) _c	1300.7	<.0001

Note: Means having different subscript letters are different on at least $p < .05$ level according to the pairwise Wald's chi-square test of mean equality for latent class predictors in mixture modeling (<http://bit.ly/NNCxju>).

as it would further allow the confirmation or rejection of the results presented here, ultimately, helping the field further progress.

The findings obtained from the LPA and the Wald's chi-square tests concur with the idea put forth by Stavropoulos et al. (2015) about the conceptualization of the development of IA. Therefore, the risk for developing IA should be framed as a result of the dynamic interplay between individual and ecological risks and resources over time (Stavropoulos et al., 2015). Consequently, IA can be conceptualized as being a continuum that ranges from minimum to maximum risk, and that its associated factors involving age-related changes, characteristics of the individual user, factors within Internet users' proximate context, and factors that refer to characteristics of the medium as well as their interactions, should all be taken into account (Stavropoulos et al., 2015). Future studies could expand on these results by further examining how well the IDS-15 instrument identifies and replicates the classes found here in other samples and contexts. Future research could also provide information on the IDS-15's invariance across both genders and other sociodemographic groups. Additionally, studies using clinical samples aimed to derive an empirically and clinically-based cut-off point for the IDS-15 might also be beneficial to researchers using this instrument.

Although the present study provided reliable findings, it is not without its limitations. The study used a convenience sample of Internet users that was not necessarily representative of all Internet users. The fact that the study used a self-selected sample of internet users may have also impacted on the relatively high percentage of individuals in the 'high addiction risk' group. Therefore, the present findings should be cautiously interpreted and not generalized to a more broad population. An important and difficult issue to tackle is the use of self-report questionnaires and their associated possible biases such as social desirability biases and short-term recall biases. Finally, although several forms of validity were examined, other types of validity could also have been assessed (e.g., concurrent validity).

Taken as a whole, 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 IDS-15 may prove to be a psychometrically robust tool to assess IA provided that future studies can replicate and expand the present findings in different research contexts and cultures.

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Contributors

The authors worked in collaboration for this study. Halley Pontes conceived the idea of the study and Mark Griffiths helped improve the original idea while also contributing to the design and methodological aspects of the study. Halley Pontes conducted all statistical analysis and prepared the initial draft of the manuscript. Mark Griffiths gave substantial contributions to the interpretation of results and critically revised the drafted manuscripts several times.

Conflict of Interest

The authors declare that they have no conflict of interest.

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