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Problematic Internet and Facebook Use and Online Gaming among University Students: An Exploratory Study*

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Advances in technology have introduced new challenges and issues for policymakers and researchers. There is some debate in the literature whether the Internet, Facebook, and online gaming addictions may be true addiction disorders or are all manifestations of a more general information technology addiction. The purpose of this study is to explore gender differences in problematic Internet and Facebook use and online gaming, and the independence of these phenomena. The study sample comprised 500 college students, who completed a sociodemographic questionnaire, the Internet Addiction Test, Bergen Facebook Addiction Scale, and Online Gaming Scale. Males had more problems related to online gaming, and more problematic Internet and Facebook use. A bifactor model with one general and three specific factors – problematic online gaming, problematic Internet use and problematic Facebook use – obtained the best fit to the data. However, the specific variance explained by the factors of problematic Internet and Facebook use was low, but high in the case of problematic online gaming. Therefore, problematic online gaming seems to have more distinctive characteristics than the other two types of behavioural addictions.

Key words: Problematic Internet use, Problematic Facebook use, Online gaming disorder, bifactor modelling, digital addictive behaviors

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Highlights:

- Males show more problematic Facebook and Internet use and online gaming than females.
- A bifactor model with a general factor and three specific factors had the best fit.
- Problematic online gaming has more distinctive features than the remaining addictions.

Over the past three decades, we have witnessed a significant increase in the use and popularity of the Internet, social networks and online gaming. The popularity and diversity of Web 2.0 tools have been accompanied by research on their problematic use, particularly among adolescents and young people (Boyd, 2008; Valkenburg & Peter, 2009). College students seem to be among the groups facing the greatest challenges in this area, given the developmental changes they undergo, while possessing high levels of freedom, autonomy, and ease of access to the Internet (Griffiths, 2014). Therefore, college students appear to have slightly higher rates of dependence on these tools compared to other populations (Brezing, Derevensky, & Potenza, 2010; Young, 2010). Although research on Internet addiction, as a behavioural addition, began in the 1990s (Griffiths, 1996; Young, 1998), research on its development in the years that followed was comparatively scarce. With the widespread use of social networks and Internet accessibility, empirical studies began multiplying only two decades after these first studies (Pontes & Patrão, 2014). Despite the potentialities of social networks and online gaming, such as the development of cognitive and motor skills and the improvement of socialization skills (e.g., Abreu, Karam, Goés, & Spritzer, 2008; Dias, Garcia del Castillo, & Castillo-López, 2017; Valkenburg & Peter, 2009), evidence of potential mental health risks for users has also started to emerge (Abreu, Karam, Goés, & Spritzer, 2008; Carras, Rooij, Mheen, Musci, Xue, & Mendelson, 2017; Hyun al., 2015; Irles & Gomis, 2015; Kruss & Griffiths, 2011; Lemos & Santana, 2012). However, research also suggests that the problematic use of these tools differs across groups, particularly across gender. Some studies suggest that young males present more problematic use of Internet and social networks (Dias, Cadime, Castillo-López, & García del Castillo, 2018; Durkee et al., 2012; Rehbein, Kleinmann, & Mößle, 2010), as well as of problematic gaming (Irles & Gomis, 2015; Mentzoni et al., 2011; Molde, Pallesen, Bartone, Hystad, & Johnsen, 2009) and problematic online gaming (Chen, Oliffe, & Kelly, 2018; Griffiths, 2014; Király, et al., 2014) than females. The comparison of addiction levels across different subgroups requires the use of measures that are invariant across these subgroups, so that the comparisons are meaningful and valid. Evidence of strong measurement

invariance (i.e., scalar invariance) across gender has been found in measures of Internet addiction (Chiu, Hong, & Chiu, 2013; Teo & Kam, 2014) and in measures of addiction to varied social networks (Lin, Broström, Nilsen, Griffiths, & Pakpour, 2017; Marino, Vieno, Altoè, & Spada, 2017). In particular, strong measurement invariance of the Bergen Facebook Addiction Scale (BFAS; Andreassen et al., 2012) has been found in Peruvian university students (Vallejos-Flores, Copez-Lonzoy, & Capa-Luque, 2018) and evidence of partial measurement invariance across gender for a unidimensional factor structure of the Internet Addiction Test (Young, 1998) has been found in Croatian high school students (Černja, Vejmelka, & Rajter, 2019). Regarding measures of online gaming addictions, some studies have provided evidence of strong measurement invariance (Királi et al., 2019), whereas others have found only partial invariance across gender (Gaetan, Bonnet, Brejard, & Cury, 2014; de Palo et al., 2019).

Discussion about the classification of behavioural addictions as mental disorders is a contemporary debate (Petry, Zajac, & Ginley, 2018). The inclusion of the Internet gaming disorder in the research appendix of the Diagnostic and statistical manual of mental disorders (DSM–5; American Psychiatric Association [APA], 2013) is generating an intense debate (e.g., King & Potenza, 2019; Király & Demetrovics, 2017; Király, Griffiths, & Demetrovics, 2015; van Rooij et al., 2018; Rumpf et al., 2018) and requires additional research and clinical knowledge (Gentile et al., 2017; Müller et al., 2015; Petry & O'Brien, 2013; Petry, Zajac, & Ginley, 2018; Potenza, 2014).

Although these conditions refer to different concepts and nosological entities (e.g., Rehbein & Mößle, 2013), several studies have indicated a relationship between the problematic use of technologies, Internet and online gaming, among both adolescents (Király et al., 2014) and adults (Andreassen et al., 2016; Nam, 2017; Sigerson, Li, Cheung, & Cheng, 2017). A common factor underlying these addictions can account for the high correlations observed in these studies. Based on this idea and on Billieux's model of cyber addictions (2012), Sigerson et al. (2017) tested the existence of a common factor – an information technology addiction – that explained the similar risk factors and symptoms among Internet addiction, Internet gaming disorder, Facebook addiction and smartphone addiction, although they have specific characteristics. Their results provided evidence that a common latent factor accounted for the variance observed in measures of these addictions and also suggested that this underlying factor is more associated to other behavioural addictions, such as problematic gambling, than to substance-related addictions. These claims seem to support the cognitive-behavioural model of Davies (2001), in which the author suggests a distinction between a specific and a generalized pathological Internet use. Specific symptoms are related to the use of the Internet for particular functions, such as the problematic use of online sexual materials,

online stock trading or gambling. The generalized use describes a broader and more global set of behaviours, such as the overuse of Internet, wasting time without purpose online, among other social aspects of the Internet. Despite some empirically support provided by Caplan (2010), this model did not gather much support in the literature. In another perspective, Billieux (2012) suggested a spectrum of related disorders, yet independent. These claims were reinforced in recent studies from Starcevic and Billieux (2017) that led authors to reject the idea of an umbrella term for "Internet addiction", once it overlooks important differences among the various addictive online activities. These authors argue that, despite the relationships between entities, they should be acknowledged as distinct. A view that, in some way, reinforces the APA's choice to include "Internet Gaming Disorder" as an independent disorder in DSM–5, instead of including it within a broader disorder of Internet addiction or similar (Griffiths, Kuss, Billieux, & Pontes, 2016).

The present study has as a general objective to study the phenomena of problematic online gaming and problematic Internet and Facebook use among Portuguese college students. As these students are one of the most at risk populations, the results of the study may improve the understanding of the phenomenon and provide clues to its prevention. The first specific objective was to explore differences in problematic Internet and Facebook use and online gaming as a function of gender. Considering the results of the previously indicated studies, it is expected that males exhibit the highest levels of problematic Internet and Facebook use and online gaming. In order to allow meaningful comparison between groups, the invariance of measures used to assess the constructs was explored. The second specific objective was to explore whether problematic Internet and Facebook use and online gaming were independent conditions or manifestations of a common, general, latent factor (e.g., Sigerson et al., 2017; Starcevic & Billieux, 2017).

Method

Participants

The participants were 500 college students attending undergraduate and master's courses at universities in northern Portugal. Table 1 shows the demographic characteristics of the sample. Most students were female and the majority attended undergraduate courses. Their ages ranged between 18 and 38 years (M = 21.93 years, SD = 3.37 years). The students were distributed across 14 study areas (Table 1), and 161 of them failed to pass the grade at least once throughout their academic years. The mean academic grades obtained by participants in the immediately preceding semester was 14.86 (SD = 1.67) and ranged from 10.00 to 19.70 (on a scale ranging between 0 and 20).

Table 1
Characteristics of the participants

Variable	*N* (%)
Sex	
Male	186 (37.2)
Female	314 (62.8)
Age	
≤ 20 years	176 (35.8)
Between 21 and 30	295 (60.1)
≥ 31 years	19 (3.9)
Level	
Bachelor	353 (70.6)
Master	147 (29.4)
School failure	
No	335 (67.5)
Yes	161 (32.5)
Area of studies	
Nursing	38 (7.6)
Psychology	113 (22.6)
Biomedical engineering	15 (3.0)
Material engineering	20 (4.0)
Law	19 (3.8)
Communication Sciences	52 (10.4)
Theology	35 (7.0)
Tourism	48 (9.6)
Public administration	15 (3.0)
Architecture	23 (4.6)
Physiotherapy	21 (4.2)
Economics	53 (10.6)
Social Service	38 (7.6)
Philosophy	10 (2.0)

Instruments

Sociodemographic Instrument. A sociodemographic instrument was used to collect data about age, gender, university, academic degree and year, academic course, grades, and the number of course failures.

Online Gaming Scale (Garcia-del-Castillo, 2016). Developed based on the Griffiths model of addictions (2011), this instrument has 14 items that evaluate the time dedicated to online gaming (e.g., "I spend too much time playing"), gaming interference in significant aspects of everyday life (e.g., "I have problems with my parents or friends because I am playing for a long time"), and the feeling of malaise when not playing (e.g., "If I want to play but I can't at that moment, I get nervous and agitated"). The items are answered on a 7-point Likert scale from 1 (*never*) to 7 (*always*). The higher the scores, the greater the levels of problematic online gaming are. In the present sample, the Cronbach's alpha was .97.

Internet Addiction Test (IAT, Young, 1998). This instrument contains 20 items answered on a 5-point Likert scale, from 1 (*rarely*) to 5 (*always*), to assess the degree of problematic Internet use (PIU). The IAT is one of the instruments most used in this field and has been adapted for the Portuguese population with robust evidence of validity and internal consistency (α = .85; Pontes, Patrão, & Griffiths, 2014). In the present sample, the Cronbach's alpha was .95. The degree of PIU is considered normal when the total score is between 0 and 30 points; mild when the score is between 31 and 49 points; moderate when the score is between 50 and 79 points; and severe when the score exceeds 80 points (Young, 1998).

Bergen Facebook Addiction Scale (BFAS; Andraessen et al., 2012). The BFAS was used to evaluate problematic Facebook use. This scale has 6 items that evaluate the components of salience (i.e., "You spend a lot of time thinking about Facebook or planning how to use it"), tolerance (i.e., "You feel an urge to use Facebook more and more"), mood modification (i.e., "You use Facebook in order to forget about personal problems"), relapse (i.e., "You have tried to cut down on the use of Facebook without success"), withdrawal (i.e., "You become restless or troubled if you are prohibited from using Facebook"), and conflict (i.e., "You use Facebook so much that it has had a negative impact on your job/ studies") that derive from Griffith's addiction model (2011). The higher the scores, the greater the levels of problematic Facebook use are. This instrument was adapted for the Portuguese population by Pontes, Andreassen, and Griffiths (2016) and presented with robust evidence of validity and a high internal consistency (α = .83). In the present sample, the Cronbach's alpha was .90.

Procedure

Authorization was obtained from the authors to use the instruments and from the directors of high education institutions units for data collection. The sampling process was non-probabilistic, by convenience, particularly because of geographical proximity, and it was performed in institutions in northern Portugal. The collection was completed during normal school hours in a classroom context at a time agreed upon with professors of the courses. The objectives of the study were presented, and the anonymity and confidentiality of the data were ensured. Participants were only allowed to participate in the study after signing informed consent.

Data Analysis

Univariate and multivariate normality of items were inspected using the MVN package for R (Korkmaz, Goksuluk, & Zararsiz, 2014). For univariate normality, skewness and kurtosis for each item were computed. Skewness values below |2| and kurtosis values below |7| are considered acceptable (West, Finch, & Curran, 1995). Multivariate normality was assessed by computing Mardia's multivariate skewness and kurtosis statistics. The items' skewness ranged between -0.201 and 2.257, but only five items of the online gaming measure exceeded the reference value of 2. Kurtosis was below 7 for all items, thus suggesting no violation of univariate normality. However, Mardia's tests suggested violations to the multivariate normality ($p < .001$). Analyses were conducted with Mplus, version 7 (Muthén & Muthén, 2012). The maximum likelihood estimation with robust standard errors (MLR; Yuan & Bentler, 2000) was used, as it accounts for deviations from normality (Li, 2016). To account for missing data, the full information maximum likelihood (FIML) method was used. FIML uses all the data available to estimate the model, without imputing data or removing cases from the analysis (Peeters, Zondervan-Zwijnenburg, Vink, & van de Schoot, 2015).

Multi-group confirmatory factor analysis (CFA) was performed to test the invariance of the factor structure across males and females, following the guidelines indicated by Byrne (2012). A one-factor structure was tested for each measure, given that this factor structure has been consistently found in previous studies (Garcia-del-Castillo, 2016; Pontes, Andreassen, & Griffiths, 2016; Pontes, Patrão, & Griffiths, 2014). To assess the global fit of the tested models, the following criteria were used: the chi-square (χ^2) values, the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR). Model fit was considered acceptable if CFI and TLI values were higher than .90, RMSEA lower than .05 and SRMR lower than .10 (Schermelleh-Engel, Moosbrugger, & Müller, 2003). First, each measurement model was fitted separately for males and females. In case of poor fit, the modification indices (Lagrange multiplier tests) were examined and changes in the models were introduced to achieve an acceptable fit. Configural, metric and scalar invariance were then tested in three successive models. In the configural model, all factor loadings and intercepts were freely estimated in both groups. In a second model metric invariance was assessed, where the factor loadings were constrained but the intercepts were freely estimated in each group. Finally, in a third model, scalar invariance was tested, where loadings and intercepts were constrained. For purposes of model identification, factor means were constrained to zero and factor variances were constrained to one, given that the factor loadings were all estimated. Evidence for the invariance of the model across samples is achieved when the constraint of parameters performed in testing the subsequent models does not worsen the fit indices. To perform this comparison, the Satorra–Bentler scaled chi-square difference test ($\Delta SB - \chi^2$), the difference in CFI (ΔCFI) and the difference in RMSEA ($\Delta RMSEA$) were calculated. Values of ΔCFI equal to or lower than .01 and values of $\Delta RMSEA$ equal to or lower than .015 indicate that the hypothesis of invariance should not be rejected (Chen, 2007; Cheung & Rensvold, 2002) intercepts, and residual variances. Standardized root mean square residual (SRMR. The Bayesian Information Criterion (BIC) was also used. The model with the lowest BIC value is considered the most adequate. After we established the invariance of the factor structure, differences in the latent means between males and females were calculated. For purposes of model identification, the latent means of the first group (males) were constrained to zero, and the latent means of the second group (females) were freely estimated and then compared by means of a *z*-test. Results were considered statistically significant when $p < .05$.

In a second step, structural equation modelling (SEM) was used to test the independence of the three constructs: symptoms of online gaming disorder, PIU and problematic Facebook use. Model fit was assessed using the same criteria as in invariance analysis.

Results

Invariance and Gender Differences

Regarding problematic online gaming, the fit of the model was inadequate both for males and females (see Table A in Appendix). The inspection of the Lagrange multiplier tests suggested that allowing the estimation of three error covariances would improve model fit in both groups. Regarding PIU, the fit of the model was also inadequate both for males and females (see Table A in Appendix). The Lagrange multiplier tests also suggested that the estimation of ten error covariances would lead to an improvement in model fit and this was found for both groups. Allowing the estimation of these covariances led to an

acceptable model fit both for males and females (see Table 2). For both measures – problematic online gaming and PIU – all factor loadings for unidimensional models were significant and higher than .35, in both groups, whether error covariances were estimated or not. Thus, the results support the unidimensional structure for both measures. Given that the models with error covariances had a better fit, these were used for measurement invariance testing. Regarding problematic Facebook use, the model fit was adequate in both groups, as can be seen in Table 2.

Table 2 also presents the results for measure invariance between males and females in each of the three measures. Configural invariance model fit of the online gaming and PIU measures was adequate after allowing the estimation of error covariances, suggested by the examination of the Lagrange multiplier tests. The fit indices for the metric and scalar invariance models were also adequate. Although some of the SB–$\Delta\chi^2$ were significant, ΔCFI and ΔRMSEA did not exceed the reference values, indicating that the metric invariance models fitted as well as the configural invariance models and that the scalar invariance models fitted as well as the metric invariance models. The BIC for the scalar models was also lower than that obtained for the configural and metric models. Therefore, evidence of strong invariance was achieved for both measures[2].

Regarding problematic Facebook use, the metric invariance model of the instrument fitted as well as the configural model, but the ΔCFI and ΔRMSEA exceeded the reference values when comparing the metric and the scalar invariance model. The examination of the Lagrange Multiplier tests suggested that one intercept was not invariant. The free estimation of this intercept in each group lead to a good model fit (see model 3 in Table 2). Therefore, this model was taken as the final model to conduct latent means comparisons.

The comparison of the latent means indicated that the females' sample had lower scores in problematic online gaming (ΔM = -.267, p = .027), PIU (ΔM = -.256, p = .009), and problematic Facebook use (ΔM = -.246, p = .018).

2 Table A in the appendix shows the results of measurement invariance testing without the estimation of error covariances. Regardless of the poorer fit, the results are similar to the ones obtained with the estimation of these covariances, which suggests that these do not impact the main findings.

Table 2
Measurement invariance between males and females

Model	MLR $\chi^2(df)$	CFI	TLI	RMSEA	90% CI RMSEA	SRMR	BIC	$\Delta SB{-}\chi^2(df)$	ΔCFI	ΔRMSEA
Problematic online gaming[a]										
Males	138.08 (74)***	.942	.929	.068	[.050, .086]	.032	6782.268	-	-	-
Females	191.28 (74)***	.910	.890	.071	[.059, .084]	.045	10480.852			
Model 0: Configural	335.64 (148)***	.923	.905	.071	[.061, .081]	.040	17328.554	-	-	-
Model 1: Metric	363.60 (162)***	.917	.907	.071	[.061, .080]	.097	17292.944	26.778 (14)*	.006	.000
Model 2: Scalar	393.91 (176)***	.910	.907	.070	[.061, .080]	.090	17234.341	28.733 (14)*	.007	.001
Problematic internet use[b]										
Males	324.54 (160)***	.901	.882	.074	[.063, .086]	.068	10040.907	-	-	-
Females	473.50 (160)***	.901	.882	.079	[.071, .087]	.058	16005.312	-	-	-
Model 0: Configural	793.23 (320)***	.901	.883	.077	[.070, .084]	.062	26148.004	-	-	-
Model 1: Metric	818.33 (340)***	.900	.889	.075	[.068, .082]	.065	26037.541	14.866 (20)	.001	.002
Model 2: Scalar	871.52 (360)***	.894	.888	.075	[.069, .082]	.073	25968.465	54.641 (20)***	.006	.000
Problematic Facebook use										
Males	10.33 (9)	.996	.994	.028	[.000, .090]	.021	2682.529	-	-	-
Females	12.58 (9)	.995	.991	.036	[.000, .078]	.019	4284.767	-	-	-
Model 0: Configural	22.89 (18)	.995	.992	.033	[.000, .069]	.020	6993.470	-	-	-
Model 1: Metric	27.02 (24)	.997	.996	.022	[.000, .058]	.033	6959.578	3.115 (6)	.002	.011
Model 2: Scalar	44.11 (30)*	.986	.986	.043	[.006, .069]	.054	6942.597	20.611 (6)*	.011	.021
Model 3: Partial Scalar[c]	34.32 (29)	.995	.995	.027	[.000, .058]	.058	6936.404	7.844 (5)	.002	.005

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; BIC = Bayesian Information Criterion; $\Delta SB{-}\chi^2$ = Satorra–Bentler scaled chi-square difference test. [a] Models for the problematic online gaming measure included the estimation of three error covariances (Item 1 with Item 2; Item 4 with Item 5; Item 13 with Item 14); [b] Models for the problematic Internet use measure included the estimation of ten error covariances (Item 20 with Item 19; Item 19 with Item 3; Item 19 with Item 6; Item 7 with Item 3; Item 18 with Item 17; Item 7 with Item 1; Item 16 with Item 10; Item 20 with Item 7; Item 17 with Item 16; Item 8 with Item 6); [c] Intercept of item 3 freely estimated.*$p < .05$; ***$p < .001$.

Relationships between Problematic Internet and Facebook Use and Online Gaming

To investigate the relationships and the relative independence of the three constructs, a series of structural equation models was considered. In all models, the items of each measure were used as observed indicators of the factors and all included the estimation of the error covariances identified in invariance analyses[3]. We started by testing a hierarchical model in which problematic use was a second-order factor and problematic Internet and Facebook use and online gaming were the first-order factors. However, the standardized coefficient of the second-order factor on PIU was slightly higher than 1, which indicated the presence of a Heywood case. This model was therefore abandoned and instead, a correlated three-factor model, which is mathematically equivalent to the previous model, was tested. The correlated three-factor model presented an adequate fit (see Table 3). However, the correlation between PIU and problematic Facebook use was high (see Figure 1). Therefore, the second model was tested, in which the items of these two measures were combined to form a single factor of problematic use, whereas online gaming was taken as the second factor. This correlated two-factor structure also presented an adequate fit, but the BIC was higher than the one obtained for the correlated three-factor model (see Table 3). Next, a one-factor model, in which all items were combined into a single factor was tested. As shown in Table 3, this model did not fit the data.

Table 3
Model fit for the testing of independence of problematic online gaming, Internet, and Facebook use

Model	MLR χ^2 (*df*)	CFI	TLI	RMSEA	90% CI RMSEA	SRMR	BIC
Model 1: Correlated three-factor model	1823.82 (724)***	.903	.896	.055	[.052, .058]	.048	49357.301
Model 2: Correlated two-factor model	2014.36 (726)***	.887	.878	.060	[.056, .063]	.051	49621.855
Model 3: One-factor model	4807.19 (727)***	.641	.615	.106	[.103, .109]	.136	53712.596
Model 4: Bifactor model	1476.43 (687)***	.931	.921	.048	[.045, .051]	.035	49104.249

Note. CFI = Comparative Fit Index; TLI=Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; BIC = Bayesian Information Criterion. ***$p < .001$.

3 Results in Table 3 are for the models including the estimation of error covariances. The results for the same models without the inclusion of the estimation of these parameters are presented in Table B of the appendix and suggest similar conclusions.

Finally, to test if the data were consistent both with a single common factor and multidimensional latent structures, a bifactor model was tested, in which responses were accounted for both by a general factor of problematic use and specific factors (more detailed information on the potentialities of bifactor models can be found in Reise, 2012). This model obtained the best fit and the lowest BIC of all models. The standardized parameters of this model are presented in Figure 2. As depicted in Figure 2, the standardized regression coefficients of the general factor were high. The factor loadings of the specific factor of online gaming were also high and statistically significant ($p < .05$), ranging between .61 and .79. Factor loadings for the specific factor of problematic Facebook use ranged between .18 and .42 and were also statistically significant ($p < .05$). However, the regression coefficients of the items 3, 9, 10, 11, 13, 15, 18, 19, and 20 of IAT on the specific factor of PIU were negative or close to zero (non-significant)[4]. Table 4 presents additional indices for the bifactor model, calculated using the tool provided by Dueber (2017). The explained common variance (ECV) was high not only for the general factor, but also for the specific factor of problematic online gaming. However, the ECV for the two remaining specific factors was low. The values of the omega hierarchical for the specific factors, which indicate the proportion of variance after controlling for the variability attributed to the general factor (Dueber, 2017), reinforce these findings (see Table 4). The values of the reliability index H, which is an indicator of how well a latent variable is defined and for which minimum values of .80 are recommended (Hancock, & Mueller, 2001), also suggest that only problematic online gaming is a well-defined specific factor.

Table 4
Bifactor model indices

	ECV	Omega	Omega H	H
General Factor	.615	.978	.814	.970
Problematic online gaming	.727	.970	.707	.938
Problematic Internet use	.140	.957	.050	.665
Problematic Facebook use	.220	.905	.192	.491

Note. ECV = explained common variance; Omega H = Omega hierarchical.

4 Similar results were obtained in the models without the estimation of error covariances.

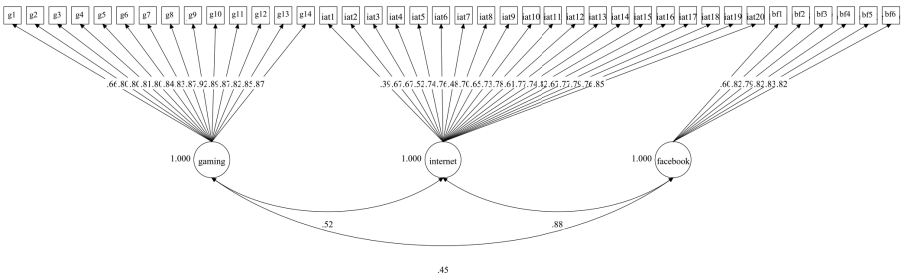

Figure 1. Standardized coefficients for the correlated three-factor model (model 1).

Note. Error covariances were estimated in the model but are omitted in the diagram for purposes of clarity. Gaming = online gaming addiction; Internet = problematic Internet use; Facebook = problematic Facebook use.

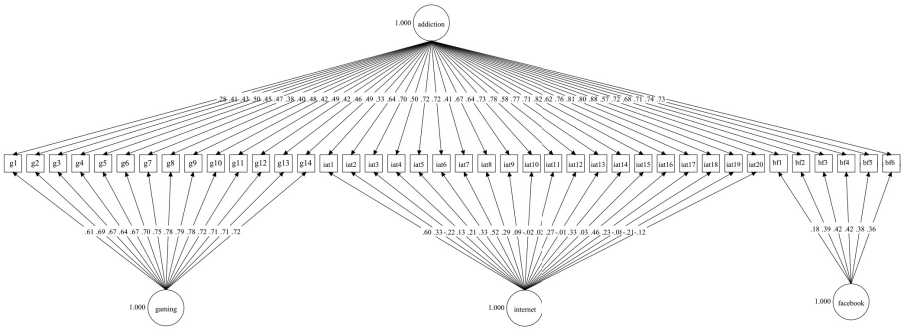

Figure 2. Standardized coefficients for the bifactor model (model 4).

Note. Error covariances were estimated in the model but are omitted in the diagram for purposes of clarity. Addiction = information technology addiction; Gaming = online gaming addiction Internet = problematic Internet use; Facebook = problematic Facebook use.

Discussion

The overall objective of this study was to study problematic online gaming, Internet and Facebook use among students in higher education. As this population is one of the populations at highest risk of addiction (Brezing, Derevensky, & Potenza, 2010; Griffiths, 2014; Young, 2010; Wittek et al., 2016), studies using higher education students are useful for deepening knowledge of an emerging reality for which gaps in research remain and divergent results have been obtained. Although there is some research in the Portuguese context with young populations (Dias et al., 2017; Dias et al., 2018; Pontes, Andreassen, & Griffiths, 2016; Pontes, Patrão, & Griffiths, 2014), studies clarifying the interdependence of possible behavioural addictions are scarce.

The first goal of this study was to explore the existence of gender differences in problematic online gaming, Facebook, and Internet use. The results indicated gender invariance in the constructs as measured by the instruments. However, contrarily to the study by Vallejos-Flores, Copez-Lonzoy, and Capa-Luque (2018), in which full measurement invariance across gender was found for the BFAS, we found that the intercept of one item ("Used Facebook in order to forget about personal problems") was non-invariant and higher in the females' group. This item implies that Facebook can be used as a coping strategy (Kardefelt-Winther, 2014a), i.e., is a way to manage stress, but coping strategies used by males and females are typically different. Moreover, mean differences results are consistent with the international literature, namely, by showing excessive use of online gaming and a more problematic use of the Internet and Facebook among young males (Andreassen et al., 2016; Dias et al., 2018; Irles & Gomis, 2015; King & Potenza, 2019; Király et al., 2014; Rehbein et al., 2010). As with other addictions, many people use online gaming Internet and Facebook regularly but males tend to show more engagement in persistent use and a higher risk of addiction.

The second goal of this study concerned the independence between problematic online gaming, Internet and Facebook use. Some authors have raised the issue whether there is an underlying factor common to several possible behavioural addictions (Sigerson et al., 2017), as they all encompass common components such as mood modification, withdrawal symptoms or conflict with other occupations (Griffiths, 2005; Kim & Hodgins, 2018). Revision studies point out inconclusive data, as well as terminological and methodological issues to be improved (Petry, Zajac, & Ginley, 2018). The results of our study suggest that a general factor of problematic use – "information technology addiction" or "digital addiction" – seems to account for the communality between items in the measurement instruments and that there were also three domain specific factors – problematic online gaming, Internet and Facebook use – that account for specific variance above and beyond the more general factor. Therefore, we can assume that these are different constructs and nosological entities with distinctive characteristics (e.g., Rehbein & Mößle, 2013), although they all encompass the previously referred common components. These results are consistent with research that suggests that a common underlying factor permeates the results obtained in measures that assess these types of behavioural addictions (Sigerson et al., 2017), but also supports the claims of others that state that these addictions have specific characteristics and therefore should be clearly acknowledged as distinct (Davis, 2001; Starcevic & Billieux, 2017). Our results suggest that this is particularly the case of problematic online gaming, which seems to have distinctive characteristics. On the contrary, the results for PIU and problematic Facebook use suggest that these behaviours are more dependent on a general factor of information technology addiction.

However, some limitations of this study must be considered. The first is the use of a convenience sample, particularly limited to the north of Portugal, which limits the generalization of the findings. The sampling technique also led

to a second limitation with almost 2/3 of the sample being composed of females. This imbalance in our sample echoes the gender differences in higher education in Portugal, but once again limits the generalization. Future studies should take this issue into account and include a more balanced sample.

Conclusions

The present study confirmed gender differences in relation to online gaming, PIU, and problematic Facebook use and found that the three constructs although conceptually different could be related to the general factor of problematic use. To summarize, these findings reinforce the need to develop focused research and specific measures to explore different conditions related to digital technology-based behaviors (King & Potenza, 2019; Griffits & Kuss, 2017).

The results nonetheless support the importance of adequate prevention through either educational policies that favour the development of social and emotional skills or digital literacy. Although pilot projects are emerging, particularly among younger people (Joo & Park, 2010; Mun & Lee, 2015), the data are limited, and a more thorough assessment of the effectiveness of these projects is required (Vondráčková & Gabrhelík, 2016).

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Problematična upotreba Interneta i Fejsbuka i igranje online igara kod studenata: Eksplorativna studija

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Tehnološki napredak je postavio nove izazove i probleme pred zakonodavce i istraživače. U naučnoj literaturi je u toku diskusija oko toga da li se zavisnosti od Interneta, Fejsbuka i onlajn kompjuterskih igara mogu smatrati poremećajima koji spadaju u grupu pravih poremećaja zavisnosti, ili se radi o manifestacijama opštije zavisnosti od informacionih tehnologija. Cilj ovog istraživanja je da ispita polne razlike u odnosu na problematičnu upotrebu Interneta, Fejsbuka i onlajn igara, kao i (međusobnu, prim. prev.) nezavisnost ovih fenomena. Uzorak se sastojao od 500 studenata koji su popunili sociodemografski upitnik, Test zavisnosti od Interneta (eng. the Internet Addiction Test), Bergensku skalu zavisnosti od Fejsbuka (eng. Bergen Facebook Addiction Scale) i Skalu onlajn igranja (eng. Online Gaming Scale). Mladići su imali više problema sa online igranjem i više problematične upotrebe Interneta i Fejsbuka. Bifaktorski model sa jednim opštim i tri specifična faktora – problematično onlajn igranje, problematična upotreba Interneta i problematična upotreba Fejsbuka je pokazao

najbolje uklapanje u podatke. Međutim, količina specifične varijanse objašnjene faktorima problematične upotrebe Interneta i Fejsbuka je bila niska, dok je količina specifične varijanse objašnjene faktorom problematičnog onlajn igranja bila visoka. Shodno tome, izgleda da problematično onlajn igranje ima posebnije karakteristike nego druga dva ispitivana oblika bihejvioralne zavisnosti.

Ključne reči: Problematična upotreba Interneta, Problematična upotreba Fejsbuka, poremećaj igranja komjuterskih igara, bifaktorsko modelovanje, digitalne bihejvioralne zavisnosti

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Appendix

Table A
Measurement invariance between males and females without error covariances

Model	MLR $\chi^2(df)$	CFI	TLI	RMSEA	90% CI RMSEA	SRMR	BIC	$\Delta SB{-}\chi^2(df)$	ΔCFI	ΔRMSEA
Problematic online gaming										
Males	186.49 (77)***	.901	.883	.087	[.072, .104]	.038	6903.911	-	-	-
Females	240.90 (77)***	.875	.852	.082	[.071, .094]	.051	10641.993	-	-	-
Model 0: Configural	433.46 (154)***	.885	.864	.085	[.076, .095]	.047	17606.975	-	-	-
Model 1: Metric	468.52 (168)***	.876	.866	.085	[.076, .094]	.101	17583.193	33.334 (14)**	.009	.000
Model 2: Scalar	502.84 (182)***	.868	.868	.084	[.075, .093]	.094	17523.237	27.096 (14)*	.008	.001
Problematic internet use										
Males	484.82 (170)***	.810	.788	.100	[.089, .110]	.078	10213.730	-	-	-
Females	593.99 (170)***	.866	.850	.089	[.081, .097]	.063	16116.541	-	-	-
Model 0: Configural	1075.92 (340)***	.847	.829	.093	[.087, .099]	.069	26417.515	-	-	-
Model 1: Metric	1103.55 (360)***	.845	.837	.091	[.085, .097]	.072	26305.078	12.654 (20)	.002	.002
Model 2: Scalar	1160.31 (380)***	.838	.838	.091	[.085, .097]	.079	26236.240	55.326 (20)***	.007	.000

Note. CFI = Comparative Fit Index; TLI=Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; BIC = Bayesian Information Criterion; $\Delta SB{-}\chi^2$ = Satorra–Bentler scaled chi-square difference test.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table B
Model fit for the testing of independence of problematic online gaming, Internet and Facebook use without error covariances

Model	MLR χ^2 (*df*)	CFI	TLI	RMSEA	90% CI RMSEA	SRMR	BIC
Model 1: Correlated three-factor model	2267.38 (737)***	.865	.858	.064	[.061, .067]	.051	49950.855
Model 2: Correlated two-factor model	2469.67 (739)***	.848	.839	.068	[.065, .071]	.054	50239.240
Model 3: One-factor model	5857.65 (740)***	.550	.526	.118	[.115, .120]	.137	55061.456
Model 4: Bifactor model	1757.31 (700)***	.907	.896	.055	[.052, .058]	.037	49453.709

Note. CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; BIC = Bayesian Information Criterion. ***$p < .001$.