International Journal of Mental Health and Addiction
https://doi.org/10.1007/s11469-024-01296-y

ORIGINAL ARTICLE

Problematic Online Behaviours among University Students and Associations with Psychological Distress Symptoms and Emotional Role Limitations: A Network Analysis Approach

Magdalena Sánchez-Fernández[1] · Mercedes Borda-Mas[1] · Francisco Rivera[2] · Mark D. Griffiths[3]

Accepted: 30 March 2024

Abstract
Very little research has simultaneously explored the interactions between generalized problematic internet use (GPIU), problematic social media use (PSMU), problematic online gaming (POG), psychological distress, and emotional well-being among university students. Therefore, the present study aimed to determine (i) the associations between GPIU, PSMU, and POG symptoms, (ii) whether symptoms of these three problematic online behaviours form distinct entities, and (iii) whether there are associations between problematic online behaviours, psychological distress symptoms, and emotional role limitations using network analysis. A total of 807 Spanish university students participated (57.7% female; $M_{age} = 21.22$ years [SD = 3.68]). Two network models were computed. Network 1 showed a complex interaction of nodes, with particularly strong connections between analogous symptoms of GPIU and PSMU. Symptoms organised into distinct dimensions, featuring a unique dimension for POG symptoms, one that includes preoccupation and a conflict symptom of GPIU, and two other dimensions with symptoms of GPIU and PSMU. Network 2 showed significant connections between GPIU and depression, GPIU and emotional role limitations, PSMU and anxiety, PSMU and emotional role limitations, POG and depression, and POG and anxiety. The findings support the conceptualization of GPIU as a nonspecific disorder, the independence of PSMU and POG as distinct constructs, and aligning with perspectives that separate POG from the GPIU spectrum. The study reinforces the model of compensatory internet use and emphasizes the impact of problematic online behaviours on emotional well-being. The findings have practical implications for the assessment and intervention of problematic online behaviours.

Keywords Problematic online behaviours · Psychological distress · Emotional well-being · College students · Network analysis

Extended author information available on the last page of the article

Published online: 26 April 2024

Introduction

During the past two decades, there has been a marked increase in the number of internet users alongside the democratisation of internet access. While the internet has brought numerous advantages to society, for a small minority of users, its problematic use has emerged as a significant public health concern (World Health Organization, 2015). Such problematic use has become evident through a range of potentially problematic online activities such as online gaming, online gambling, social media use, online shopping, and online pornography use (Hussain & Starcevic, 2020; Lopez-Fernandez et al., 2016; Mauer-Vakil & Bahji, 2020; Mora-Salgueiro et al., 2021; Müller et al., 2021).

University students are a population of special interest with regard to these problems because they are 'digital natives', who have grown up surrounded by technology and have never known a world without the internet (Anderson et al., 2017), and need such technology for their optimal academic, personal, and social development (Sánchez-Caballé et al., 2020; Zhao et al., 2021). Previous research has reported a clear association between problematic use of online activities and health and functional impairment among students (e.g., Chang et al., 2022; Kwok et al., 2021; Wong et al., 2020).

Regarding the diagnostic criteria that have described these problem behaviours, Griffiths (2005) proposed a biopsychosocial model of addiction, common to substance and behavioural addictions (such as internet addiction), based on six components: salience, mood modification, tolerance, withdrawal, relapse, and conflict. This model has been tested not only for generalized problematic internet behaviour (Meerkerk et al., 2009), but also for specific behaviours such as social media use (Andreassen et al., 2012) and online videogame playing (Demetrovics et al., 2012).

More recently, applicable only to problematic behaviour associated with videogame playing, the latest (fifth) edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013) included within the section Emerging Measures and Models (Section III), 'internet gaming disorder' (IGD), with nine diagnostic criteria adapted from those used for substance use disorders: preoccupation, withdrawal, tolerance, loss of control, loss of previous interests, continuation despite problems, deception, mood modification, and jeopardization.

Similarly, the 11th revision of the International Classification of Diseases (ICD-11; World Health Organization, 2018) included 'gaming disorder' (GD), and proposed in its description the criteria of salience, loss of control, losing interest in and reducing other recreational activities, continuation of the playing behaviour despite negative consequences, and risking/losing relationships and opportunities. Although there is no official diagnostic recognition for other online problem behaviours (apart from 'gambling disorder' which can occur both online and/or offline), current research has focused on broadening the understanding of the nature and scope of these behaviours and determining whether they represent separate psychopathological conditions that merit further investigation and consideration in clinical practice (Baggio et al., 2022).

In terms of conceptualising these behaviours, much of the literature has used terms such as 'internet addiction', 'compulsive internet use' and 'problematic internet use' to refer to maladaptive online behaviour manifested through different problematic online behaviours associated with different activities (Fineberg et al., 2018). However, this conception has been subject to criticism supported by the idea that the internet is only a means to access different online activities (Griffiths, 2000; Meerkerk et al., 2009) and that online activities are not substituted for each other when individuals cannot perform their favourite activity

(Griffiths & Szabo, 2014; Pontes et al., 2015). As a possible solution to these criticisms, the spectrum hypothesis argues that problematic online behaviours can be defined as a spectrum of related but distinctive behaviours associated with common and specific aetiological factors (Billieux, 2012; Starcevic & Billieux, 2017).

Previous research has supported this last conceptualisation of problematic online behaviours, demonstrating these behaviours are correlated and the magnitude of this correlation is more pronounced between specific problematic behaviours (e.g., problematic social media use [PSMU] or problematic online gaming [POG]) and generalized problematic internet use (GPIU) than it is between individual behaviours themselves (Rigó et al., 2023; Sánchez-Fernández & Borda-Mas, 2024; Van Rooij et al., 2017). Moreover, studies have found similarities and differences in the impact of specific risk factors on different problematic online behaviours (Akbari et al., 2023; Chang et al., 2022; Naidu et al., 2023; Peris et al., 2020; Sayili et al., 2023; Van Rooij et al., 2017).

An effective way to test the spectrum hypothesis is through the network analysis approach. In this approach, disorders are considered complex networks where symptoms are represented as 'nodes' connected by 'edges' (Borsboom, 2017; Schmittmann et al., 2013). The strength of these connections reflects the probability that symptoms appear together, identifying the core and peripheral symptoms. This approach captures the complexity and dynamics of disorders and allows the analysis of relationships between them. Unlike the latent variable approach, where an underlying factor is assumed, network analysis considers the network itself as the main construct, exploring dynamic causal relationships without assumptions of local independence (Guyon et al., 2017). It also facilitates the identification of 'bridging symptoms' that connect seemingly distinct disorders (Baggio et al., 2016; Cramer et al., 2010), and therefore provides evidence for the spectrum hypothesis.

Following this approach, previous studies have analysed the relationships between symptoms of different problematic online behaviours and found that these form distinct entities (e.g., Baggio et al., 2018, 2022; Li et al., 2023b; Rozgonjuk et al., 2021; Zarate et al., 2022). However, to date, no studies have examined the relationship between GPIU, PSMU, and POG symptoms among the university student population using the network analysis approach. It is essential to advance research specifically within this population and these three behaviours to enable the development of targeted interventions.

In addition, this approach has been commonly used in recent research demonstrating the relationship between problematic online behaviours and various symptoms of psychological distress. For example, some studies showed that GPIU was related to depression symptoms (Cai et al., 2022; Zhao et al., 2023). Relationships have been reported between GPIU and suicidal ideation (Yang et al., 2023), and between GPIU and anxiety (Cai et al., 2021). Specific studies have shown that depression is strongly associated with PSMU and POG (Li et al., 2023b; Sit et al., 2023). Other relationships have been reported between PSMU and psychological distress (Peng & Liao, 2023; Tullett-Prado et al., 2023; Wang et al., 2022), and between PSMU and different psychopathological symptoms (Fournier et al., 2023). Focusing on the university student population, significant relationships have been reported between gaming disorder, depression, alexithymia, boredom and loneliness (Li et al., 2021), and between gaming disorder, rumination, and sleep quality (Li et al., 2023a, b).

However, to date, no previous study has analysed the relationships between different problematic online behaviours and psychological distress symptoms in the same network, which may have important implications for the treatment of these behaviours. If significant relationships are established, changes in these psychological distress variables can activate and/or inhibit problem behaviours in the network (Borsboom, 2017). Furthermore, although PIU has been shown to have a negative impact on well-being (Dienlin &

Johannes, 2022; Machimbarrena et al., 2019), no previous studies have examined the relationship between these variables using network analysis.

The Present Study

Based on the spectrum hypothesis and previous empirical evidence, the objectives of the present study were to survey a sample of university students and to determine (i) to what extent symptoms of online problem behaviours, such as GPIU, PSMU and POG, are associated with each other; (ii) whether symptoms of these three problematic online behaviours form distinct entities; and (iii) whether there is a relationship between problematic online behaviours, symptoms of psychological distress (i.e., stress, anxiety, depression), and an indicator of well-being (i.e., emotional role limitations). With regard to these objectives, the following hypotheses (H_s) were proposed. It was hypothesised that:

- The symptoms of GPIU, PSMU, and POG would be positively associated with each other (H_1).
- The symptoms of PSMU and POG would form distinct clusters of problematic online behaviour symptoms, and the umbrella constructs of GPIU would not constitute a specific disorder (H_2).
- GPIU, PSMU, and POG would be positively associated with depression, anxiety, stress and emotional role limitations (H_3).

Method and Materials

Participants and Procedure

Between October 2022 and May 2023, a cross-sectional survey study was conducted at a university in Andalusia, Spain. University students were recruited using convenience sampling. The surveys were distributed online by the university's teaching staff. The inclusion criteria were: (i) being older than 17 years, (ii) being enrolled in a degree programme at this university, (iii) having a smartphone or any other device with internet access, and (iv) giving informed consent to participate. Before completion of the survey, the participants were informed about the background and purpose of the study, along with instructions on an information sheet. No credit or course remuneration was given for participation. The study was approved by the Ethics Committee of the university of the first three authors and adhered to the Declaration of Helsinki.

A total of 807 students (330 males, 466 females, and 11 nonbinaries) participated in the survey. The mean age of the students was 21.22 years (SD = 3.68, range = 17–41 years). Table 1 shows the characteristics of the participants. The sample comprised a higher proportion of females, bachelor students, those under 20 years of age, engineering and architecture students, those with a medium economic level, and those living with a family member.

Measures

In addition to the sociodemographic information shown in Table 1, the following psychometric measures were included in the survey.

Table 1 Characteristics of the study participants ($N = 807$)

Characteristics	Frequency	%
Gender		
Male	330	40.9
Female	466	57.7
Non-binary	11	1.4
Age (years)		
< 20	313	38.8
20–22	305	37.8
22–24	93	11.5
> 24	96	11.9
Educational degree (currently enrolled)		
Bachelor	720	89.2
Master	58	7.2
Doctoral	29	3.6
Field of knowledge		
Sciences	130	16.1
Sciences Health sciences	124	15.4
Social sciences	196	24.3
Arts and humanities	88	10.9
Engineering and Architecture	269	33.3
Income level[a]		
Low	174	21.5
Medium	385	47.7
High	248	30.7
Residence		
With a family member	458	56.6
In a student residence/flat	287	35.8
With a couple/alone	622	7.6

[a]Levels determined based on an item (*"Considering your household income level"*) with three response options: *"We struggle to make ends meet or barely manage without additional expenses"* (low), *"We live comfortably but without luxuries"* (medium), and *"We are financially comfortable"* (high)

Compulsive Internet Use Scale (CIUS-14)

The CIUS-14 (Meerkerk et al., 2009; Spanish version: Lopez-Fernandez et al., 2019) was used to assess GPIU. The scale comprises 14 items focussing on lack of control, intrapersonal and interpersonal conflicts, cognitive and behavioural preoccupation, impaired mood, and withdrawal symptoms. Items (e.g., *"Do you think you should use the internet less often?"*) are responded to on a five-point Likert scale from 0 (*never*) to 4 (*very frequently*). Higher scores refer to a greater severity of GPIU. Items and associated symptoms can be found in Table S1 of the Supplementary Material. The CIUS-14 has been translated into many languages and has used in cross-cultural research showing robust psychometric qualities (Lopez-Fernandez et al., 2019). In the present study, CIUS-14 showed high levels of internal consistency ($\alpha = 0.89$, $\omega = 0.89$) and an adequate fit ($\chi^2 = 393.12$, $df = 76$; $\chi^2/df = 5.17$; $CFI = 0.98$; $IFI = 0.98$; $NFI = 0.97$; $TLI = 0.97$; $RMSEA = 0.07$).

Bergen Social Media Addiction Scale (BSMAS)

The BSMAS (Andreassen et al., 2016; Spanish version: Vallejos-Flores et al., 2018) was used to assess PSMU over the past year. The scale comprises six items reflecting core addiction elements (i.e., salience, mood modification, tolerance, withdrawal, conflict, and relapse) proposed by Griffiths (2005). Items (e.g., *"Do you feel an urge to use social media more and more?"*) are responded to on a five-point Likert scale ranging from 1 (*very rarely*) to 5 (*very often*). Higher scores refer to a greater severity of PSMU. Items and associated symptoms can be found in Table S1 of the Supplementary Material. Its robust psychometric properties have been verified in different language versions (e.g., Andreassen et al., 2016; Monacis et al., 2017; Pontes et al., 2016; Zarate et al., 2023). In the present study, BSMAS showed high levels of internal consistency ($\alpha = 0.81$, $\omega = 0.81$) and an adequate fit ($\chi^2 = 15.70$, df = 8; $\chi^2/df = 1.96$; CFI = 1.00; IFI = 1.00; NFI = 0.99; TLI = 0.99; RMSEA = 0.03).

Internet Gaming Disorder Scale–Short Form (IGDS9-SF)

The IGDS9-SF (Pontes & Griffiths, 2015; Spanish version: Beranuy et al., 2020) was used to assess POG over the past year. The scale comprises nine items based on the criteria for internet gaming disorder in the DSM-5 (American Psychiatric Association, 2013). Items (e.g., *"Do you feel preoccupied with your gaming behavior?"*) are responded to on a five-point Likert scale from 1 (*never*) to 5 (*very often*). Higher scores refer to a higher severity of POG. Items and associated symptoms can be found in Table S1 of the Supplementary Material. The IGDS9-SF has been found to have excellent psychometric properties in different languages (Poon et al., 2021). The Spanish IGDS9-SF has been shown to have robust psychometric properties (Beranuy et al., 2020; Maldonado-Murciano et al., 2020; Sánchez-Iglesias et al., 2020). In the present study, IGDS9-SF showed high levels of internal consistency ($\alpha = 0.87$, $\omega = 0.87$) and an adequate fit ($\chi^2 = 76.16$, df = 27; $\chi^2/df = 2.82$; CFI = 1.00; IFI = 1.00; NFI = 0.99; TLI = 0.99; RMSEA = 0.05).

Depression, Anxiety, and Stress Scale-21 (DASS-21)

The DASS-21 (Lovibond & Lovibond, 1995; Spanish version: Daza et al., 2002) was used to assess psychological distress. The 21-item scale comprises three subscales, each containing seven items related to depression (DASS-D), anxiety (DASS-A), and stress (DASS-S). Items (e.g., *"I felt that life was meaningless"*) are responded to on a four-point scale from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). A higher score indicates greater symptoms of psychological distress. The Spanish DASS-21 has been shown to have robust psychometric properties (Daza et al., 2002). In the present study, the three DASS-21 subscales showed high levels of internal consistency (depression: $\alpha = 0.90$, $\omega = 0.90$; anxiety: $\alpha = 0.88$, $\omega = 0.88$; stress: $\alpha = 0.88$, $\omega = 0.88$) and an adequate fit (depression: $\chi^2 = 27.69$, df = 14, χ^2 / df = 1.98, CFI = 1.00; IFI = 1.00; NFI = 1.00; TLI = 1.00; RMSEA = 0.04; anxiety: $\chi^2 = 14.41$, df = 14; $\chi^2/df = 1.03$; CFI = 1.00; IFI = 1.00; NFI = 1.00; TLI = 1.00; RMSEA = 0.03; stress: $\chi^2 = 23.10$, df = 14; $\chi^2/df = 1.65$; CFI = 1.00; IFI = 1.00; NFI = 0.99; TLI = 1.00; RMSEA = 0.04).

Short Form 36 Health Survey (SF-36) (Ware and Sherbourne, 1992)

The SF-36 (Ware and Sherbourne, 1992; Spanish version: Vilagut et al., 2005) comprises 36 items and assesses physical and mental health. In the present study, the three-item emotional role limitations (ER) subscale was used. Items (e.g., *"Accomplished less than you would like"*) are responded to on a five-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). A higher score indicates a higher level of emotional role limitations. The psychometric properties of SF-36 has been found to have robust psychometric properties among general populations (Su et al., 2014), university students (Zhang et al., 2012), and Spanish populations (Giraldo-Rodríguez and López-Ortega, 2024). In the present study, the ER subscale of the SF-36 showed high levels of internal consistency ($\alpha = 0.92$, $\omega = 0.93$) and an adequate fit ($\chi^2 = 393.12$, df = 76; $\chi^2/df = 5.17$; CFI = 1.00; IFI = 1.00; NFI = 1.00; TLI = 1.00; RMSEA = 0.04).

Assessment criteria

Table 2 shows the criteria used in the assessment of problematic online behaviours (GPIU, PSMU, and POG). Parallels can be seen between the first five criteria (i.e., loss of control relapse, conflict/jeopardization, preoccupation/salience, mood modification, and withdrawal) in all three cases and between the first six criteria (the previous five and the addition of tolerance) in the case of PSMU and POG. The scale used to assess POG includes three further criteria (i.e., loss of interests, continuation despite problems, and deception).

Statistical Analysis

Descriptive and bivariate data analysis were performed in Jeffreys' Amazing Statistics Program (JASP) version 0.17.1 (Intel) statistical software (JASP Team, 2023). Network data analysis was performed with R version 4.3.0 (R Core Team, 2023). For the distribution of variables, the absolute values of skewness ranged from 0.24 (ER) to 2.69 (POG), and the kurtosis values of kurtosis ranged from 0.16 (GPIU) to 9.38 (POG). Given the

Table 2 Assessment tools and criteria used for generalized problematic internet use, problematic social media use and problematic online gaming

GPIU	PSMU	POG
Compulsive Internet Use Scale (CIUS-14)	Bergen Social Media Addiction Scale (BSMAS)	Internet Gaming Disorder Scale–Short Form (IGDS9-SF)
Loss of control	Relapse	Loss of control
Conflict	Conflict	Jeopardization
Preoccupation	Salience	Preoccupation
Coping or mood modification	Mood modification	Mood modification
Withdrawal	Withdrawal	Withdrawal
	Tolerance	Tolerance
		Loss of interests
		Continuation despite problems
		Deception

GPIU: generalized problematic internet use, PSMU: problematic social media use, POG: problematic online gaming

criteria of absolute skewness ≤ 2.0 and absolute kurtosis ≤ 7.0 (Kim, 2013), the distribution can be considered normal for all variables except for POG. First, means, standard deviations, range, reliabilities (Cronbach's alphas and McDonald's omegas), confirmatory factor analysis (CFA), and correlations between study variables were calculated. Multiple criteria were used to evaluate the CFA fit: $\chi^2/df \leq 2$ (Cole, 1987), the comparative fit index (CFI) ≥ 0.90, an incremental fit index (IFI) ≥ 0.90, normed fit index (NFI) ≥ 0.90, Tucker Lewis index (TLI) ≥ 0.90, and the root-mean-square error of approximation (RMSEA) < 0.08 (Kline, 2015). As χ^2 is a sensitive sample size, the interpretation of the fit of the model was based on an overall assessment of the general pattern of all fit indices (Alavi et al., 2020). Pearson's correlations were used for all variables except POG, which used Spearman's correlation. The following cut-off points were used to interpret the strength of the associations: small < 0.3, medium > 0.3, and large > 0.5 (Hemphill, 2003).

To examine the relationships between the problematic online behaviours studied, a network model was calculated with the 14 GPIU symptoms present in CIUS-14, the six PSMU symptoms present in BSMAS, and the nine POG symptoms present in IGDS9-SF (Network 1). To examine the relationship between GPIU, PSMU, and POG, psychological distress, and emotional role limitations, a second network model was generated (Network 2). To simplify the model, the sum scores of CIUS-14, BSMAS, IGDS9-SF, three DASS subscales and the ER subscale of SF-36 were used instead of the symptoms scores.

The *qgraph* package (Epskamp et al., 2023) was applied to network visualisation and analysis. A Gaussian graphical model was computed using Least Absolute Shrinkage and Selection Operator (GLASSO) based on the Extended Bayesian Information Criterion (EBIC). GLASSO reduces spurious connections between nodes (symptoms in Network 1 and variables in Network 2) by minimising small correlations to zero. The EBIC is a goodness of fit metric for model selection, which is adjusted by a hyperparameter γ. This hyperparameter was set to 0.5 to achieve an optimal balance between sensitivity and specificity (Foygel & Drton, 2010). The 'Exclude pairwise method' was used to manage missing data.

Network visualisation followed the Fruchterman–Reingold algorithm (Fruchterman & Reingold, 1991). Symptoms (Network 1) and variables (Network 2) were represented by 'nodes' and the relationships between them by 'edges'. Blue edges indicate positive links, while red edges indicate negative links. Moreover, the strength of the link between nodes is presented through the thickness and colour density of the connecting edge, where thicker and denser lines indicate stronger weights. In addition, the distance between the nodes showed the relationship between them. Finally, the centre of the network holds the nodes with higher correlations, whereas the edges of the network have the nodes with lower correlations.

In addition, edge weights and centrality of nodes were used to describe the network. The strength of the relationship between the nodes is indicated by an edge weight. The minimum absolute value of the edge weight of 0.03 is deemed interpretable (Isvoranu et al., 2017). Centrality describes the relative significance of the various nodes within a network. A central node is closely related to other nodes, and, when activated, other symptoms are likely to be affected as well. On the other hand, a low centrality symptom has fewer links to other nodes and less impact on the network. Strength, betweenness, closeness, and expected influence are frequently cited measures of centrality (Opsahl et al., 2010).

Following this, the edge accuracy and the stability of the centrality coefficients of Network 1 were evaluated using the *bootnet* package (Epskamp, 2023). The accuracy of edge weights was examined using bootstrap 95% non-parametric confidence intervals (CIs). Narrower CIs imply a more accurate estimate of the edge (Epskamp et al., 2018). The stability of the centrality indices was estimated using case-dropping bootstrapping (Epskamp

& Fried, 2018). This coefficient reflects the correlation between the original centrality indices (based on the full data) and the correlation obtained from the subset of data representing different percentages of the overall sample. Epskamp et al. (2018) suggested that the correlation stability coefficient should not be below 0.25, and preferably it should be above 0.5. In the present study, the stability of the centrality indices and the edge accuracy of the network were examined using the aforementioned procedures. Both procedures were estimated with 1000 bootstraps.

To investigate the communities between the different symptoms of PIU, exploratory graph analysis (EGA) (Golino and Epskamp, 2017) was used. This network analytic approach allows the implementation of a community detection algorithm, facilitating the empirical identification of clusters in multidimensional data (Christensen, 2020). The Louvain community detection algorithm was used since it has been shown to perform well with ordinal data (Christensen, 2020). The *EGAnet* package (Golino & Christensen, 2023) was used to replicate EGA networks 1,000 times with random sample permutation. The *qgraph* package was used to visualise the median EGA network.

Finally, to examine the bridge centrality between PIU symptoms, the *networktools* package (Jones, 2023) was used to estimate the bridge strength and bridge expected influence (both 1-step and 2-step).

Results

Descriptive Statistics

Table 3 presents descriptive statistics and bivariate correlations between the psychological variables. GPIU, PSMU, and POG were positively correlated, with a very strong correlation between GPIU and PSMU, a medium correlation between GPIU and POG, and a small correlation between PSMU and POG. GPIU and PSMU showed positive medium correlations with all three subscales of psychological distress and with emotional role limitations.

Table 3 Means, standard deviations (SDs) and Pearson/Spearman correlations of the study variables ($N = 807$)

Variable		1	2	3	4	5	6	7
1. GPIU		—						
2. PSMU		0.72***	—					
3. POG		0.36***	0.21***	—				
4. Dep		0.38***	0.33***	0.16***	—			
5. Anx		0.33***	0.37***	0.08*	0.68***	—		
6. Str		0.32***	0.34***	0.07*	0.71***	0.81***	—	
7. ER		0.38***	0.38***	0.06	0.60***	0.57***	0.58***	—
	M	17.67	11.66	11.61	5.99	5.94	8.23	8.23
	SD	9.85	4.68	4.44	5.07	5.14	4.90	4.03
	Rg	0 – 52	6 – 30	9—42	0—21	0—21	0—21	3—15

GPIU: generalized problematic Internet use, PSMU: problematic social media use, POG: problematic online gaming, Dep: depression, Anx: anxiety, Str: stress, ER: emotional role functioning, α: Cronbach's alpha coefficient, ω: omega coefficient, M: mean, SD: standard deviation, Rg: range. *$p < 0.05$ **$p < 0.01$ ***$p < 0.001$ (2-tailed)

POG showed positive and small correlations with the three subscales of psychological distress. The correlation between POG and emotional role limitations was not significant.

Network 1: Network Analysis of the Symptoms of GPIU, PSMU, and POG

With 29 nodes, the maximum number of edges in this network was 406. However, the EBICglasso estimation used in the analysis reduced the number of non-zero edges that were estimated to be 187 (46.1%). The GPIU, PSMU and POG symptom communities were visualised based on their original symptom groups in the GPIU, PSMU, and POG network structure in Fig. 1.

The weights matrix between the CIUS-14, BSMAS, and IGDS9-SF nodes of the network analysis is shown in Table S2 of the Supplementary Material. The mean weight was 0.033. A total of 121 edges (29.8%) had an absolute value greater than or equal to 0.03, and 109 edges (26.8%) had a positive value greater than or equal to 0.03. Some of the positive stronger edges, in decreasing order, were between: GPIU12 (coping or mood modification) and GPIU13 (coping or mood modification); GPIU1 (loss of control) and GPIU2 (loss of control); GPIU6 (preoccupation) and GPIU7 (preoccupation); GPIU14 (withdrawal) and PSMU5 (withdrawal); GPIU9 (loss of control) and PSMU4 (relapse); PSMU1 (salience)

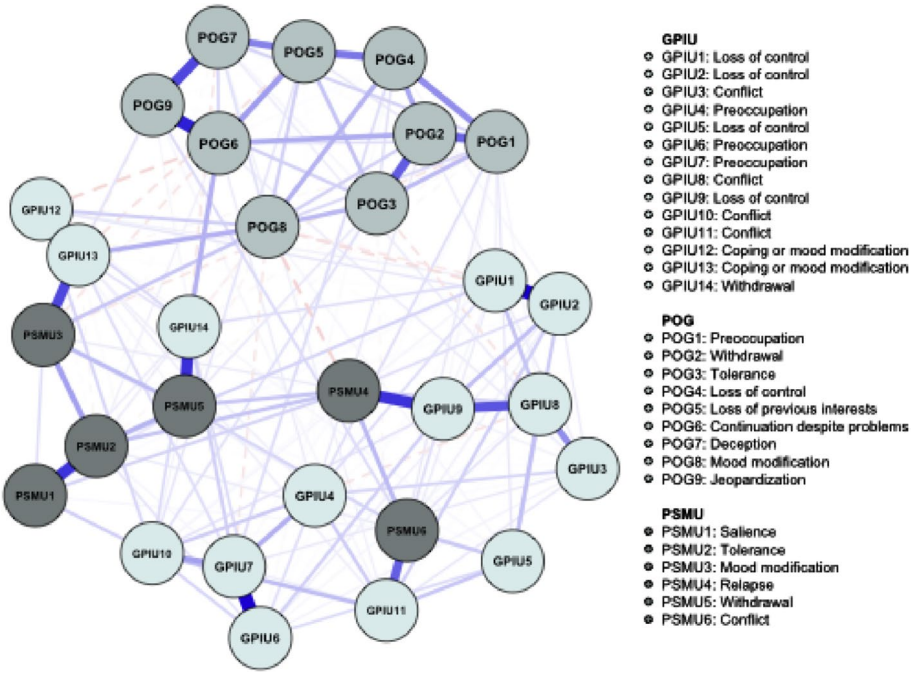

Fig. 1 Network of the GPIU, PSMU, and POG symptoms, based in CIUS-14, BSMAS, and IGDS9-SF items, respectively. Note. GPIU: Generalized problematic internet use, PSMU: Problematic social media use, POG: Problematic online gaming. Symptoms are represented by nodes and connections are represented by edges. Blue edges indicate positive links, and red edges indicate negative links. The strength of the link between nodes is presented through the thickness and colour density of the connecting edge. The distance between the nodes showed the relationship between them. The centre of the network holds the nodes with higher correlations

and PSMU2 (tolerance); and GPIU13 (coping or mood modification) and PSMU3 (mood modification).

The negative stronger edges, in decreasing order, were between: PSMU4 (relapse) and POG8 (mood modification); GPIU2 (loss of control) and POG8 (mood modification); GPIU13 (coping or mood modification) and POG5 (loss of previous interests); GPIU4 (preoccupation) and GPIU8 (conflict); GPIU8 (conflict) and POG3 (tolerance); PSMU3 (mood modification) and POG6 (continuation despite problems); and GPIU14 (withdrawal) and POG7 (deception).

Figure 2 presents the stability of the edge, which was calculated using 1000 bootstrap iterations and represented by 95% non-parametric confidence intervals (CIs). It was apparent that specific edge weights exhibited higher accuracy, indicated by narrower bands. Additionally, the majority of edges closer to 0 appeared to lack significance, as they crossed the 0 line in the bootstrapped samples.

The plots for the centrality indices (betweenness, closeness, strength, and expected influence) in terms of z-scores are shown in Fig. 3 (see Table S1 in the Supplemental Materials for the exact values). In general, higher values of centrality indices suggest greater centrality. Considering strength, the nodes with the highest sum of absolute edge weights were GPIU13 (coping or mood modification), GPIU7 (preoccupation) and POG6 (continuation despite problems). In contrast, the three nodes with the lowest strength centrality values were GPIU3 (conflict), GPIU5 (loss of control), and PSMU1 (salience). Taking into account the closeness, the nodes with the highest inverse sum of the shortest paths were GPIU14 (withdrawal) and PSMU5 (withdrawal). In contrast, the three nodes with the lowest centrality values of closeness were GPIU3 (conflict), GPIU4 (preoccupation), and GPIU5 (loss of control). Considering betweenness, the nodes with the shortest distance

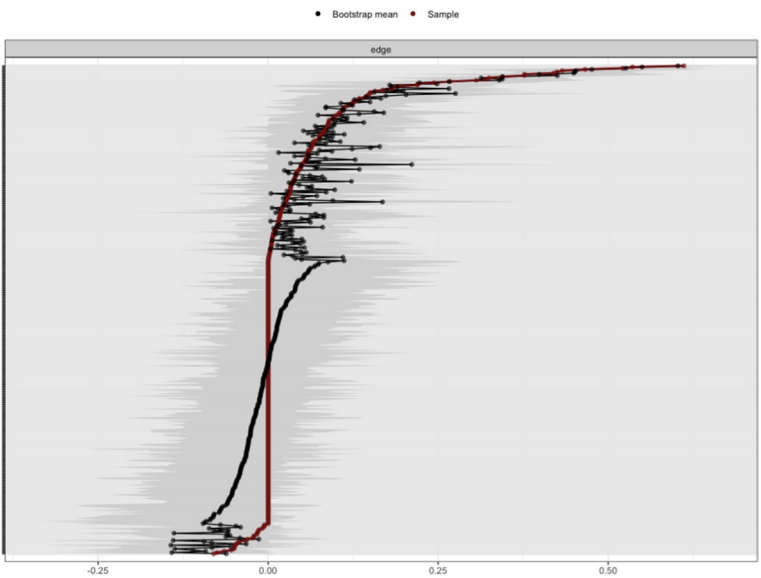

Fig. 2 Estimation of edge stability using a non-parametric bootstrapped estimate (1000 bootstraps). Note. The edges are represented by the x-axis, and each line on the y-axis corresponds to a particular edge. The grey bars represent the 95% confidence intervals for the estimates, while the red line is the estimate of edge stability

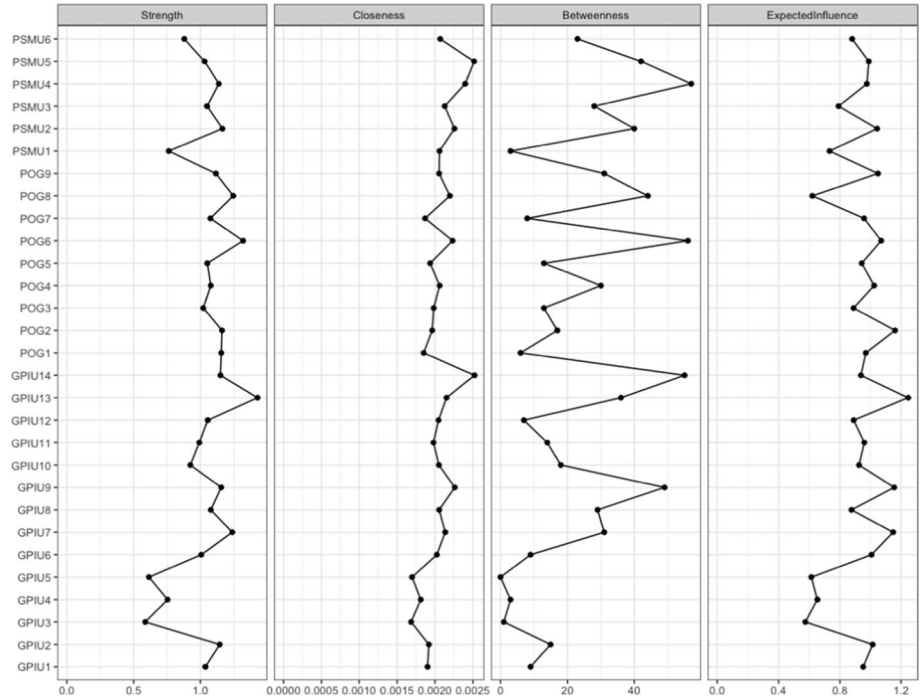

Fig. 3 Centrality plots for the association in the network of each node in standardized z values. Note. Values shown on the x-axis are standardized z-scores. GPIU: Generalized problematic internet use, PSMU: Problematic social media use, POG: Problematic online gaming

relative to other nodes were PSMU4 (relapse), POG6 (continuation despite problems) and GPIU14 (withdrawal).

In contrast, the three nodes with the lowest betweenness centrality values were GPIU3 (conflict), GPIU4 (preoccupation), and GPIU5 (loss of control). Taking into account the expected influence, the nodes with the highest sum of edge weights that accounted for both positive and negative relationships were GPIU13 (coping or mood modification), GPIU9 (loss of control), GPIU7 (preoccupation) and POG2 (withdrawal). In contrast, the three nodes with the lowest expected influence centrality values were GPIU3 (conflict), GPIU5 (loss of control), and POG8 (mood modification).

Figure 4 illustrates the evaluation of the stability of the four centrality indices by using case-dropping bootstrapping. It is recommended that the centrality coefficients should be not less than 0.25 and preferably exceed 0.5. All centrality coefficients were above 0.25, and expected influence and strength coefficients were greater than 0.5. Therefore, the centrality coefficients can be confidently interpreted, particularly strength and expected influence coefficients.

The results of bootstrapped EGA showed that a network with four dimensions/clusters was the most prevalent (n.Boots = 1000, median dimensions = 4, SE = 0.434; 4-dimensional solution occurred in 76.7% of replica networks). A median EGA network is included in Fig. 5. Dimension 1 grouped the nodes GPIU1, GPIU2, GPIU5 and GPIU9 (loss of control), GPIU3, GPIU 8, and GPIU11 (conflict), PSMU4 (relapse), and PSMU6 (conflict). Dimension 2 included nodes GPIU4, GPIU6, GPIU7 (preoccupation), and GPIU10

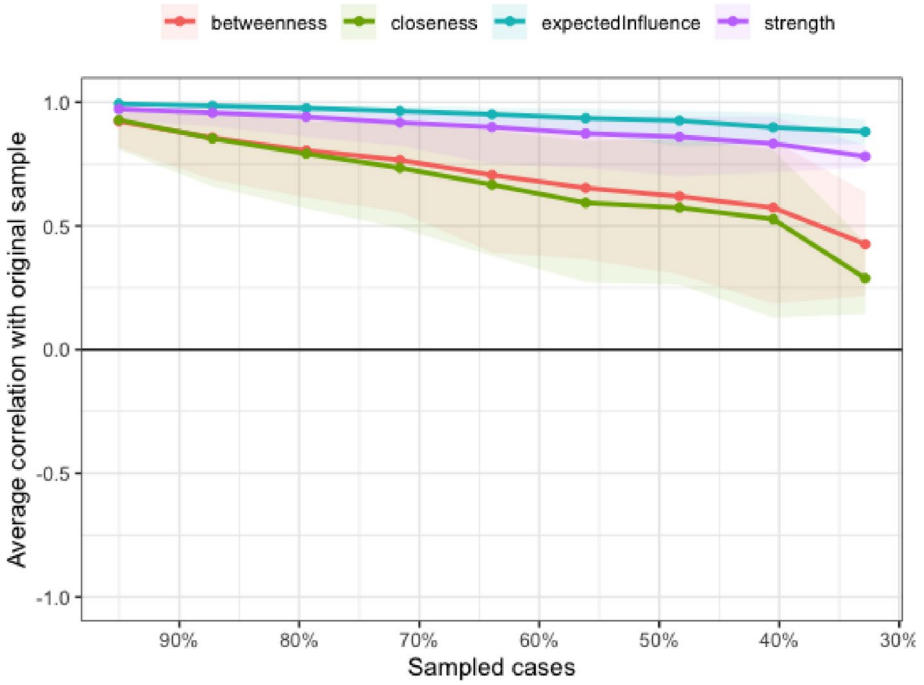

Fig. 4 Stability of centrality measures

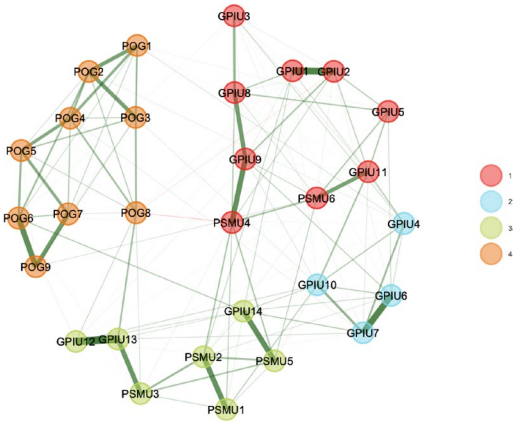

Fig. 5 Median bootstrapped exploratory graph analysis (EGA) network. Note. GPIU: Generalized problematic internet use, PSMU: Problematic social media use, POG: Problematic online gaming. Each colour corresponds to one of the four dimensions

(conflict). Dimension 3 grouped the nodes PSMU1 (salience), PSMU2 (tolerance), PSMU5 (withdrawal), GPIU14 (withdrawal), GPIU12 (coping or mood modification), GPIU13 (coping or mood modification), and PSMU3 (mood modification). Dimension 4 included the nine nodes of POG.

According to the bridge centrality metrics of the nodes (1-step bridge expected to influence, 2-step bridge expected influence, and bridge strength), GPIU11 (conflict) of Dimension 1, GPIU7 (preoccupation) of Dimension 2, GPIU13 (coping or mood modification) of

Dimension 3, and POG6 (continuation despite problems) of Dimension 4 were the bridge symptoms (symptoms that connect the different dimensions).

Network 2: Combined GPIU, PSMU, POG, Depression, Anxiety, Stress, and Emotional Role Limitations Network

Figure 6 shows a visualisation of the network of problematic online behaviours together with the depression, anxiety, stress, and emotional role limitations variables, after controlling for age, gender, and field of knowledge. With 10 nodes, the maximum number of edges in this network was 45. However, the EBICglasso estimation used in the analysis reduced the number of nonzero edges that were estimated to 30 (66.7%). It was noticed that connectivity was stronger between the problematic online behaviour nodes and between the depression, anxiety, stress, and emotional role limitations nodes.

The weights matrix between the total score of CIUS-14, BSMAS, IGDS9-SF, DASS-D, DASS-A, DASS-S, SF-36-RE from the network analysis is shown in Table S3 of the Supplementary Material. The mean weight was 0.051. A total of 13 edges (61.9%) had an absolute value greater than or equal to 0.03. For the four external variables, the edges of depression and anxiety, depression and stress, and depression and emotional role were positive. The edge weights were 0.21, 0.32, and 0.25, respectively. The edges for anxiety and stress, and anxiety and emotional role were positive, with edge weights of 0.56 and 0.11, respectively. The edge for stress and emotional role was positive, with edge weights of 0.12. GPIU was positively associated with depression (0.091) and emotional role (0.080).

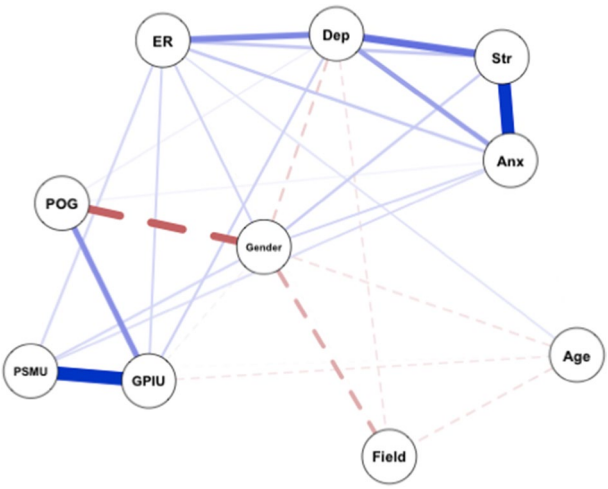

Fig. 6 Network of GPIU, PSMU, POG, depression, anxiety, stress and emotional role limitations, based in CIUS-14, BSMAS, IGDS9-SF, DASS-D, DASS-A, DASS-S, SF-36-RE total score, respectively, after controlling for age, gender, and field of knowledge. Note. GPIU: Generalized problematic Internet use, PSMU: Problematic social media use, POG: Problematic online gaming, Dep: depression, Anx: anxiety, Str: stress, ER: emotional role limitations. Variables are represented by nodes and connections are represented by edges. Blue edges indicate positive links, and red edges indicate negative links. The strength of the link between nodes is presented through the thickness and colour density of the connecting edge. The distance between the nodes showed the relationship between them. The centre of the network holds the nodes with higher correlations

PSMU was positively associated with anxiety (0.065) and emotional role (0.088). POG was positively associated with depression (0.036).

The strength centrality indices for depression, anxiety, stress, and emotional role limitations were 0.683, 0.710, 0.886, and -0.059, respectively. Therefore, apart from the emotional role limitations, the other variables can be considered central motivation nodes in the combined problematic online behaviour—psychological distress—emotional role limitations network.

Discussion

In the present study, an item-level network analytic approach, combined with a community detection algorithm, was implemented among a sample of university students to (i) determine to what extent symptoms of GPIU, PSMU, and POG may be associated with each other, and (ii) test whether symptoms of these three problematic online behaviours form distinct entities. The resulting network structure exhibited satisfactory stability and accuracy indices. Finally, a total scores level network analysis was conducted to (iii) examine whether there is a relationship between these problematic online behaviours, psychological symptoms (i.e., depression, anxiety, and stress), and a well-being-related variable (i.e., emotional role limitations).

All variables (GPIU, PSMU, POG, stress, anxiety, depression, and emotional role limitations) were associated with each other in the bivariate correlational analysis conducted, with the exception of POG and emotional role limitations. However, it should be noted that the effect sizes of the associations ranged from small (the lowest correlation was $r=0.07$ between POG and stress) to large (the highest correlation was $r=0.72$ between GPIU and PSMU).

Focusing on problematic online behaviours, in addition to the high correlations between GPIU and PSMU, the correlations were small between POG and PSMU ($r=0.21$) and medium between POG and GPIU ($r=0.36$). These findings align with the hypothesis that problematic behaviours on the internet are interconnected through overarching pathways (Billieux, 2012; Brand et al., 2019). Furthermore, the fact that there were higher correlations of the two specific behaviours with GPIU is in line with the spectrum hypothesis according to which GPIU would encompass the set of internet-mediated problem behaviours (Starcevic & Billieux, 2017). Lower correlations between PSMU and POG could be interpreted by different preferences in the choice of online activities that serve as predisposing variables for one or the other specific problem behaviour (Brand et al., 2019). The results of the present study are strongly related to recent empirical research (Tereshchenko et al., 2022; Wong et al., 2020).

Regarding the first hypothesis (H_1), it was expected that the symptoms of GPIU, PSMU, and POG would be positively associated with each other. The results showed that H_1 was partially supported. The network of symptoms of the problematic online behaviours evaluated was moderately sparse, and only 46.1% of the symptoms showed connections with another symptom, and 29.8% of them had a significant absolute value (≥ 0.03). The strongest associations were between items that assessed the same symptoms of coping or mood modification, loss of control, and preoccupation of GPIU. Next, were between GPIU and PSMU items that evaluated the same symptom of withdrawal control/relapse, respectively. Furthermore, in the case of POG, the strongest associations were found between pairs of items that assessed the different symptoms of this construct.

On the other hand, negative connections were found between the POG items and some GPIU and PSMU items. The more pronounced connection between GPIU and PSMU, compared to these two forms of PIU and POG, could indicate that, despite the presence of shared elements between these problematic behaviours (Brand et al., 2019; Epskamp et al., 2018), there is some variability between them. This assertion is further supported by H_2. Regarding the associations between the different symptoms of each of the disorders, the strongest connections were established between the symptoms of loss control/relapse and conflict, and between the symptoms of withdrawal and mood modification in GPIU and PSMU, between the symptoms of salience and tolerance in PSMU, and between withdrawal and tolerance, preoccupation and withdrawal, loss of control and loss of previous interests, loss of previous interests and deception, and preoccupation and loss of control in POG. These findings suggest that there are greater similarities between GPIU and PSMU than between them and POG.

On the other hand, the assessment of centrality indices showed the relative importance of the different symptoms of GPIU, PSMU, and POG within the broader network of the three analysed behaviours (Epskamp et al., 2018). Symptoms with more frequent connections and shorter trajectories included: *"Use the internet to escape from your sorrows or get relief from negative feelings"* (coping or mood modification), *"Feel restless, frustrated, or irritated when you cannot use the internet"* (withdrawal), *"Look forward to your next internet session"* (preoccupation) in GPIU, *"Tried to cut down on the use of social media without success"* (relapse) and *"Become restless or troubled if you have been prohibited from using social media"* (withdrawal) in PSMU, and *"Continued your gaming activity despite knowing it was causing problems between you and other people"* (continuation despite problems) in POG.

These symptoms are more frequently and strongly connected to other symptoms of problematic online behaviours and may increase the risk of current symptomatology, while increasing the likelihood of developing further problem behaviours (Fried et al., 2017). Moreover, even the less impactful symptoms of problematic online behaviours in the overall network could offer meaningful insights. For example, the less influential symptoms identified in the present study included *"Do others (e.g., partner, children, parents) say you should use the internet less"* (conflict) and *"Are you short of sleep because of the internet"* (loss of control) in GPIU, and *"Spent a lot of time thinking about social media or planned use of social media"* (salience) in PSMU. This means that these symptoms may be more peripheral than in the core of their disorder (West & Brown, 2013).

It was also hypothesised that each specific problematic behaviour investigated in the study would form distinct clusters of symptom severity at the item-level responses, while the umbrella constructs of GPIU would not constitute a specific disorder (H_2). The community detection algorithm showed the existence of four clusters. One of them corresponded to the nine items of the POG scale, another corresponded to the preoccupation items and one of the conflict items of the GPIU, while two other communities had mixed items from the GPIU and PSMU scales, one focussing on the items of loss of control/relapse and conflict, and the others on salience, tolerance, withdrawal, and mood modification. These findings indicate that H_2 was partially supported. First, it was shown that the PSMU and POG items formed distinctive clusters. This result demonstrates that although the specific problematic online behaviours analysed were associated with each other, they were independent psychopathological entities, which is also in line with previous research using the same methodological approach (Li et al., 2023b; Rozgonjuk et al., 2021; Zarate et al., 2022).

Furthermore, the finding of two clusters consisting of GPIU and PSMU items also supports the spectrum hypothesis by suggesting that GPIU and PSMU are not separate entities,

with the former acting as a nonspecific disorder. This result supports the idea that problematic online behaviours are specific (Brand et al., 2019; Montag et al., 2015) and that the internet is only the medium that facilitates them (Griffiths, 2000; Meerkerk et al., 2009; Shaffer et al., 2000; Starcevic & Billieux, 2017). The identification of a cluster containing GPIU-specific items (Dimension 2) requires an explanation. It might have been expected that the preoccupation symptoms of GPIU would align with the salience symptoms of PSMU, given their analogous nature as discussed in the literature (e.g., Griffiths, 2000, 2005; Meerkerk et al. (2009). However, the formulation of these items differs, possibly referring to related but distinct symptoms.

On the other hand, by identifying a specific cluster with POG items, the results provide evidence to affirm that POG is a disorder independent of GPIU. This result is in line with the authors who consider these disorders as separate constructs (Griffiths, 2018; Király et al., 2014; Pontes & Griffiths, 2014), as well as with previous evidence using the network analysis approach (Baggio et al., 2018; Li et al., 2023b). Overall, these results suggest that GPIU being a generic concept that includes other specific behaviours such as PSMU (Billieux, 2012; Starcevic & Billieux, 2017), POG would not be included among them. Therefore, GPIU and POG, while showing significant connections between some of their symptoms, are different entities.

Symptoms with the highest bridge centrality indices were continuation despite problems for POG and symptoms associated with conflict, preoccupation, coping, and mood modification for GPIU. These symptoms could heighten the chances of adopting cross-problematic online behaviours and/or adopting a new form of problematic behaviour while disengaging from a preexisting one (Zarate et al., 2022).

Finally, it was hypothesised that GPIU, PSMU, and POG would be positively associated with depression, anxiety, stress, and emotional role limitations (H_3). The results showed that H_3 was partially supported. Network 2 was reasonably dense, with 61.9% of the nodes showing significant connections with other nodes. In terms of significantly connected nodes, (i) GPIU was positively associated with depression and emotional role limitations, (ii) PSMU was positively associated with anxiety and emotional role limitations; and (iii) POG was positively associated with depression. In addition, the nodes for depression, anxiety, and stress were connected to each other and to the node for emotional role limitations. Furthermore, it was found that the nodes corresponding to the variables of depression, anxiety, and stress were central in the network, while emotional role limitations had a low value in the strength centrality coefficient.

With these results and theoretical models that explain the development of problematic online behaviours (e.g., Brand et al., 2019; Kardefelt-Winther, 2014), it could be interpreted that an increase in emotional distress would be associated with the risk of problematic use of different internet activities, with depressive symptoms associated with GPIU and POG and anxiety symptoms with PSMU (Chang et al., 2022; Lai et al., 2023; Liu et al., 2021). GPIU and PSMU would, in turn, be associated with the emotional role as an indicator of mental health (Machimbarrena et al., 2019). Social relationships are predictors of positive development at this stage of life (O'Connor et al., 2011). Therefore, emotional health could be affected when they are mainly located in the virtual context. Furthermore, the finding of a connection of emotional role limitations with GPIU and PSMU, but not POG, could also be related to the nature of the activity.

In their habitual connection to social networks, students often engage passively, which has been shown to have a more pronounced impact on mental health than active use (Verduyn et al., 2021). On the contrary, many videogame genres require significant cognitive

resources (Dale et al., 2020), posing challenges to meet these demands within specific daily contexts, such as professional or academic settings, which could act as protective factors for emotional well-being.

Limitations

The present study has several limitations that should be considered when interpreting the results. First, the sample used, although relatively large in size, came from a single Spanish university. This university has specific characteristics (i.e., large size, public teaching, bilingual Spanish–English instruction), and is situated within a specific demographic context (i.e., urban population concentration, a high proportion of young residents, significant national and international migration, widespread access to tertiary education, and medium socioeconomic backgrounds), that make it serve as a representative example of institutions sharing similar sociocultural features. However, the limitations related to the generalisability of the results make it advisable to replicate the study among samples of university students from other regions with different sociocultural characteristics. For example, future studies could investigate similar relationships within populations with distinct characteristics, such as rural communities. In these settings, individuals may employ different coping mechanisms to deal with negative emotional states, which diverge from the reliance on the internet and its functions. Moreover, to address the limitations associated with convenience sampling, future studies could employ more rigorous sampling methods, such as random sampling or a combination of multiple sampling techniques to enhance the representativeness of the sample.

Second, only self-report instruments were used to collect the data. These techniques may have some limitations related to insufficiency and confusion in the understanding of the questions, social desirability, distortion of the truth, and/or memory bias (Ibáñez Aguirre, 2016). For future research, qualitative methods, such as interviews and focus groups, are recommended, which could improve the completeness of the variables' assessments, by providing a nuanced and contextual understanding of experiences, perceptions, and meanings associated with the studied variables. Furthermore, the assessment of variables could benefit from the use of daily logs to reduce recall bias. Moreover, considering the tendency to normalise problematic online behaviour, it is recommended that future studies complement self-report assessments with an external evaluation. For example, the perspective of a roommate or partner could offer additional insights, facilitating the cross-verification of the information provided by the individual in question.

Third, in the present study, only one variable assessing well-being (i.e., emotional role limitations) was considered. Future research could examine the relationships between problematic online behaviours and other potentially-related mental health variables such as life satisfaction, perceived social support, or self-esteem.

Fourth, network analysis embraces a formative perspective in understanding mental disorders. Consequently, the connections between variables are interpreted as causal systems (van Borkulo et al., 2015). However, given the use of cross-sectional data in the present study, the assumption of causality is precluded. Subsequent investigations may seek to tackle this issue by utilising longitudinal or experimental designs. This would facilitate the examination of directionality in the relationships among problematic online behaviour symptoms and psychological variables. For example, future research could investigate the relationships between PIU symptoms and mental health variables at various points in time,

spanning from childhood to university years, in order to establish the temporal sequence between them.

Finally, three problematic online behaviours were assessed, which, although they are the most studied in the university student population, are not the only ones on the spectrum. Future studies could include the analysis of other behaviours such as problematic online gambling, shopping, or pornography.

Theory-Based Implications

The present study makes important theoretical contributions to the field of online problem behaviours. The application of the network analysis approach to the symptoms of three problematic online behaviours provided support for conceptions that argue that GPIU is a nonspecific disorder, encompassing the entire spectrum of online problem behaviours (Fineberg et al., 2018). The present study also supports the idea that PSMU and POG are independent constructs that, although they share the same medium (i.e., the internet), they possess distinctive characteristics that make them worthy of detailed analysis (Billieux, 2012; Starcevic & Billieux, 2017).

The present study also provided additional evidence for conceptions that separate POG from the PIU spectrum (Király et al., 2014). Although GPIU and POG are disorders that share elements, such as the common elements of addictive disorders (Griffiths, 2005), gaming is an activity that does not need the online component to be realised, and its problematic use develops from different motivations and processes. Moreover, the similarities between GPIU and PSMU may reflect greater overlaps between these problematic behaviours. That is, the functions that social media enable (e.g., maintaining social relationships) are one of the main reasons why individuals use the internet (Statista, 2024), so it may be that when answering CIUS-14, when assessing their internet problem behaviour, they had social media networks largely in mind. For all these reasons, for future research, abandoning the study of generalised behaviour in favour of the analysis of specific behaviours is advocated.

Practice-Based Implications

The findings have practical implications for the assessment and intervention of these problem behaviours. In terms of assessment, the results suggest that although these behaviours have common elements (Griffiths, 2005), they need to be specifically assessed, both in research and in clinical practice. Therefore, it is recommended, for future diagnostic manuals, to include different internet-mediated behaviours, as they present characteristics that make them distinctive.

In the framework of the intervention, the results of the present study may be beneficial in the treatment of problematic online behaviours among university students. More specifically, based on the results presented and taking into account the applications in the network approach field (Borsboom, 2017), it is necessary to treat symptomatology, focusing on symptoms of coping or mood modification, withdrawal and preoccupation of GPIU, relapse and withdrawal in PSMU, and continuation despite problems in POG, as they are central in the network. Additionally, to avoid comorbidity and transmission of symptoms from one form to another, it is recommended to treat bridging symptoms, continuation despite problems for POG, and symptoms associated with conflict, preoccupation, and

coping/mood modification for GPIU. Finally, evidence of relationships between problematic online behaviours and symptoms of depression, anxiety, and stress, as well as the centrality of these variables in the joint network, suggests that treatment of these symptoms could have positive effects on these problematic behaviours. The ultimate purpose would be to contribute to the well-being of these students.

Conclusion

The present study identified a network of interrelated nodes between the symptoms of GPIU, PSMU, and POG, with the most pronounced associations observed between the analogous symptoms of GPIU and PSMU. These symptoms were grouped into four distinct dimensions, including one exclusive to the nine symptoms of POG, another that comprised preoccupation and a conflict symptom of GPIU, a dimension that comprised loss of control/relapse and conflict symptoms of GPIU and PSMU, and a final dimension that comprised salience and tolerance symptoms of PSMU and withdrawal and mood modification symptoms of GPIU and PSMU. Finally, relevant connections between depression and both GPIU and POG, anxiety and PSMU, and emotional role limitations and both GPIU and PSMU were established.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11469-024-01296-y.

Author Contribution **Magdalena Sánchez-Fernández**: Conceptualization, Methodology, Formal analysis, Investigation, Writing—Original Draft, Funding acquisition. **Mercedes Borda-Mas**: Conceptualization, Methodology, Investigation, Writing—Review & Editing, Supervision; **Francisco Rivera:** Methodology, Formal analysis, Writing—Review & Editing; **Mark D. Griffiths**: Conceptualization, Writing—Review & Editing, Supervision.

Funding Funding for open access publishing: Universidad de Sevilla/CBUA. This study was funded by a research grant from the "VI Plan Propio de Investigación y Transferencia" of the Universidad de Sevilla (VI-PPITUS) awarded to the first author (MSF).

Data Availability Data available on request due to privacy/ethical restrictions.

Declarations

Competing Interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. MDG has received research funding from *Norsk Tipping* (the gambling operator owned by the Norwegian government). MDG has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling and gambling treatment from *Gamble Aware* (formerly the *Responsibility in Gambling Trust*), a charitable body which funds its research program based on donations from the gambling industry. MDG undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling.

Ethical Approval The study was approved by the University of Seville Research Ethics Committee (Comité de Ética de Investigación de la Universidad de Sevilla, CEIUS) and adhered to the tenets of the Declaration of Helsinki (Internal code: 1346-N-22; Date of approval: 28 September 2022).

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

References

Akbari, M., Bahadori, M. H., Khanbabaei, S., Milan, B. B., Horvath, Z., Griffiths, M. D., & Demetrovics, Z. (2023). Metacognitions as a predictor of problematic social media use and internet gaming disorder: Development and psychometric properties of the metacognitions about social media use scale (MSMUS). *Addictive Behaviors, 137*, 107541. https://doi.org/10.1016/j.addbeh.2022.107541

Alavi, M., Visentin, D. C., Thapa, D. K., Hunt, G. E., Watson, R., & Cleary, M. (2020). Chi-square for model fit in confirmatory factor analysis. *Journal of Advanced Nursing, 76*(9), 2209–2211. https://doi.org/10.1111/jan.14399

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5)*. American Psychiatric Publishing.

Anderson, E. L., Steen, E., & Stavropoulos, V. (2017). Internet use and problematic internet use: A systematic review of longitudinal research trends in adolescence and emergent adulthood. *International Journal of Adolescence and Youth, 22*(4), 430–454. https://doi.org/10.1080/02673843.2016.1227716

Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports, 110*(2), 501–517. https://doi.org/10.2466/02.09.18.PR0.110.2.501-517

Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., & Pallesen, S. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study. *Psychology of Addictive Behaviors, 30*(2), 252–262. https://doi.org/10.1037/adb0000160

Baggio, S., Gainsbury, S. M., Berchtold, A., & Iglesias, K. (2016). Co-morbidity of gambling and internet use among internet and land-based gamblers: Classic and network approaches. *International Gambling Studies, 16*(3), 500–517. https://doi.org/10.1080/14459795.2016.1242148

Baggio, S., Starcevic, V., Studer, J., Simon, O., Gainsbury, S. M., Gmel, G., & Billieux, J. (2018). Technology-mediated addictive behaviors constitute a spectrum of related yet distinct conditions: A network perspective. *Psychology of Addictive Behaviors, 32*(5), 564–572. https://doi.org/10.1037/adb0000379

Baggio, S., Starcevic, V., Billieux, J., King, D. L., Gainsbury, S. M., Eslick, G. D., & Berle, D. (2022). Testing the spectrum hypothesis of problematic online behaviors: A network analysis approach. *Addictive Behaviors, 135*, 107451. https://doi.org/10.1016/j.addbeh.2022.107451

Beranuy, M., Machimbarrena, J. M., Vega-Osés, M. A., Carbonell, X., Griffiths, M. D., Pontes, H. M., & González-Cabrera, J. (2020). Spanish validation of the Internet Gaming Disorder - Short Form (IGDS9-SF): Prevalence and relationship with online gambling and quality of life. *International Journal of Environmental Research and Public Health, 17*(5), 1562. https://doi.org/10.3390/ijerph17051562

Billieux, J. (2012). Problematic use of the mobile phone: A literature review and a pathways model. *Current Psychiatry Reviews, 8*(4), 299–307. https://doi.org/10.2174/157340012803520522

Borsboom, D. (2017). A network theory of mental disorders. *World Psychiatry, 16*(1), 5–13. https://doi.org/10.1002/wps.20375

Brand, M., Wegmann, E., Stark, R., Müller, A., Wölfling, K., Robbins, T. W., & Potenza, M. N. (2019). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neuroscience & Biobehavioral Reviews, 104*, 1–10. https://doi.org/10.1016/j.neubiorev.2019.06.032

Cai, H., Xi, H. T., An, F., Wang, Z., Han, L., Liu, S., ... & Xiang, Y. T. (2021). The association between internet addiction and anxiety in nursing students: a network analysis. *Frontiers in Psychiatry*, *12*, 723355. https://doi.org/10.3389/fpsyt.2021.723355

Cai, H., Bai, W., Sha, S., Zhang, L., Chow, I. H., Lei, S. M., ... & Xiang, Y. T. (2022). Identification of central symptoms in Internet addictions and depression among adolescents in Macau: A network analysis. *Journal of Affective Disorders*, *302*, 415–423. https://doi.org/10.1016/j.jad.2022.01.068

Chang, C. W., Huang, R. Y., Strong, C., Lin, Y. C., Tsai, M. C., Chen, I. H., ... & Griffiths, M. D. (2022). Reciprocal relationships between problematic social media use, problematic gaming, and psychological distress among university students: a 9-month longitudinal study. *Frontiers in Public Health*, *10*, 858482. https://doi.org/10.3389/fpubh.2022.858482

Christensen, A. P. (2020). *Towards a network psychometrics approach to assessment: Simulations for redundancy, dimensionality, and loadings*. [Doctoral dissertation, University of North Carolina at Greensboro]. Retrieved November 17, 2023, from https://www.proquest.com/dissertations-theses/towards-network-psychometrics-approach-assessment/docview/2428552190/se-2?accountid=14744

Cole, D. A. (1987). Utility of confirmatory factor analysis in test validation research. *Journal of Consulting and Clinical Psychology, 55*(4), 584–594. https://doi.org/10.1037/0022-006X.55.4.584

Cramer, A. O., Waldorp, L. J., Van Der Maas, H. L., & Borsboom, D. (2010). Comorbidity: A network perspective. *Behavioral and Brain Sciences, 33*(2–3), 137–150. https://doi.org/10.1017/S0140525X09991567

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*(1), 16–29.

Dale, G., Joessel, A., Bavelier, D., & Green, C. S. (2020). A new look at the cognitive neuroscience of video game play. *Annals of the New York Academy of Sciences, 1464*(1), 192–203. https://doi.org/10.1111/nyas.14295

Daza, P., Novy, D. M., Stanley, M. A., & Averill, P. (2002). The Depression Anxiety Stress Scale-21: Spanish translation and validation with a Hispanic sample. *Journal of Psychopathology and Behavioral Assessment, 24*, 195–205. https://doi.org/10.1023/A:1016014818163

Demetrovics, Z., Urbán, R., Nagygyörgy, K., Farkas, J., Griffiths, M. D., Pápay, O., ... & Oláh, A. (2012). The development of the Problematic Online Gaming Questionnaire (POGQ). *PloS One*, *7*(5), e36417. https://doi.org/10.1371/journal.pone.0036417

Dienlin, T., & Johannes, N. (2022). The impact of digital technology use on adolescent well-being. *Dialogues in Clinical Neuroscience, 22*(2), 135–142. https://doi.org/10.31887/DCNS.2020.22.2/tdienlin

Epskamp, S., & Fried, E. I. (2018). A tutorial on regularized partial correlation networks. *Psychological Methods, 23*(4), 617. https://doi.org/10.1037/met0000167

Epskamp, S., Borsboom, D., & Fried, E. I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. *Behavior Research Methods, 50*, 195–212. https://doi.org/10.3758/s13428-017-0862-1

Epskamp, S., Costantini, G., Haslbeck, J., & Isvoranu, A. (2023). *Qgraph: Graph plotting methods, psychometric data visualization and graphical model estimation.* (Version 1.9.5) [R package]. https://cran.r-project.org/web/packages/qgraph/index.html. Accessed 17 Nov 2023

Epskamp, S. (2023). *Bootnet: bootstrap methods for various network estimation routines.* (Version 1.5.5) [R package]. https://cran.r-project.org/web/packages/bootnet/index.html. Accessed 17 Nov 2023

Fineberg, N., Demetrovics, Z., Stein, D. J., Ioannidis, K., Potenza, M. N., Grünblatt, E., Brand, M., Billieux, J., Carmi, L., King, D. L., Grant, J. E., Yücel, M., Dell'Osso, B., Rumpf, H. J., Hall, N., Hollander, E., Goudriaan, A., Menchon, J., Zohar, J., ... Chamberlain, S. (2018). Manifesto for a European research network into problematic usage of the internet. *European Neuropsychopharmacology, 28*(11), 1232–1246. https://doi.org/10.1016/j.euroneuro.2018.08.004

Fournier, L., Schimmenti, A., Musetti, A., Boursier, V., Flayelle, M., Cataldo, I., ... & Billieux, J. (2023). Deconstructing the components model of addiction: An illustration through "addictive" use of social media. *Addictive Behaviors*, *143*, 107694. https://doi.org/10.1016/j.addbeh.2023.107694

Foygel, R., & Drton, M. (2010). Extended Bayesian information criteria for Gaussian graphical models. In: J. Lafferty, C. Williams, J. Shawe-Taylor, R. Zemel, & A. Culotta (Eds.), *Advances in Neural Information Processing Systems 23 (NIPS 2010)* (Vol. 1, pp. 604–612).

Fried, E. I., van Borkulo, C. D., Cramer, A. O., Boschloo, L., Schoevers, R. A., & Borsboom, D. (2017). Mental disorders as networks of problems: A review of recent insights. *Social Psychiatry and Psychiatric Epidemiology, 52*, 1–10. https://doi.org/10.1007/s00127-016-1319-z

Fruchterman, T. M., & Reingold, E. M. (1991). Graph drawing by force-directed placement. *Software: Practice and Experience, 21*(11), 1129–1164. https://doi.org/10.1002/spe.4380211102

Giraldo-Rodríguez, L., & López-Ortega, M. (2024). Validation of the Short-Form 36 Health Survey (SF-36) for use in Mexican older persons. *Applied Research in Quality of Life, 19*(1), 269–292. https://doi.org/10.1007/s11482-023-10240-6

Golino, H., & Christensen, A. (2023). *EGAnet: Exploratory graph analysis – a framework for estimating the number of dimensions in multivariate data using network psychometrics*. (Version 2.0.1) [R package]. https://cran.r-project.org/web/packages/EGAnet/index.html. Accessed 17 Nov 2023

Golino, H. F., & Epskamp, S. (2017). Exploratory graph analysis: A new approach for estimating the number of dimensions in psychological research. *PloS One, 12*(6), e0174035. https://doi.org/10.1371/journal.pone.0174035

Griffiths, M. D. (2000). Internet addiction - Time to be taken seriously? *Addiction Research, 8*, 413–418. https://doi.org/10.3109/16066350009005587

Griffiths, M. D. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance Use, 10*(4), 191–197. https://doi.org/10.1080/14659890500114359

Griffiths, M. D. (2018). Conceptual issues concerning internet addiction and internet gaming disorder: Further critique on Ryding and Kaye (2017). *International Journal of Mental Health and Addiction, 16*, 233–239. https://doi.org/10.1007/s11469-017-9818-z

Griffiths, M. D., & Szabo, A. (2014). Is excessive online usage a function of medium or activity? An empirical pilot study. *Journal of Behavioral Addictions, 3*(1), 74–77. https://doi.org/10.1556/jba.2.2013.016

Guyon, H., Falissard, B., & Kop, J. L. (2017). Modeling psychological attributes in psychology–an epistemological discussion: network analysis vs. latent variables. *Frontiers in Psychology, 8*, 798. https://doi.org/10.3389/fpsyg.2017.00798

Hemphill, J. F. (2003). Interpreting the magnitudes of correlation coefficients. *American Psychologist, 58*(1), 78–79. https://doi.org/10.1037/0003-066X.58.1.78

Hussain, Z., & Starcevic, V. (2020). Problematic social networking site use: A brief review of recent research methods and the way forward. *Current Opinion in Psychology, 36*, 89–95. https://doi.org/10.1016/j.copsyc.2020.05.007

Ibáñez Aguirre, C. (2016). *Técnicas de autoinforme en evaluación psicológica: La entrevista clínica*. Universidad del País Vasco.

Isvoranu, A. M., Boyette, L. L., Guloksuz, S., Borsboom, D., Tamminga, C. A., Ivleva, E. I., ... & van Os, J. (2017). Symptom Network models of psychosis. In: Tamminga, C. A., Ivleva, E. I., Reininghaus, U., & van Os, J. (Eds.), *Psychotic disorders: Comprehensive conceptualization and treatments* (pp. 70–78). Oxford University Press.

JASP Team (2023). JASP (Version 0.16.4) [Computer software]. https://jasp-stats.org/. Accessed 10 Nov 2023

Jones, P. (2023). *Networktools: Tools for identifying important nodes in networks* (Version 1.5.1) [R package]. https://cran.r-project.org/web/packages/networktools/index.html. Accessed 17 Nov 2023

Kardefelt-Winther, D. (2014). A conceptual and methodological critique of internet addiction research: Towards a model of compensatory internet use. *Computers in Human Behavior, 31*, 351–354. https://doi.org/10.1016/j.chb.2013.10.059

Kim, H. Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics, 38*(1), 52–54. https://doi.org/10.5395/rde.2013.38.1.52

Király, O., Griffiths, M. D., Urbán, R., Farkas, J., Kökönyei, G., Elekes, Z., ... & Demetrovics, Z. (2014). Problematic internet use and problematic online gaming are not the same: Findings from a large nationally representative adolescent sample. *Cyberpsychology, Behavior, and Social Networking, 17*(12), 749–754. https://doi.org/10.1089/cyber.2014.0475

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Press.

Krämer, N., Schäfer, J., & Boulesteix, A. L. (2009). Regularized estimation of large-scale gene association networks using graphical Gaussian models. *BMC Bioinformatics, 10*, 384. https://doi.org/10.1186/1471-2105-10-384

Kwok, C., Leung, P. Y., Poon, K. Y., & Fung, X. C. (2021). The effects of internet gaming and social media use on physical activity, sleep, quality of life, and academic performance among university students in Hong Kong: A preliminary study. *Asian Journal of Social Health and Behavior, 4*(1), 36–44. https://doi.org/10.4103/shb.shb_81_20

Lai, W., Wang, W., Li, X., Wang, H., Lu, C., & Guo, L. (2023). Longitudinal associations between problematic Internet use, self-esteem, and depressive symptoms among Chinese adolescents. *European Child & Adolescent Psychiatry, 32*(7), 1273–1283. https://doi.org/10.1007/s00787-022-01944-5

Li, L., Niu, Z., Griffiths, M. D., Wang, W., Chang, C., & Mei, S. (2021). A network perspective on the relationship between gaming disorder, depression, alexithymia, boredom, and loneliness among a sample of Chinese university students. *Technology in Society, 67*, 101740. https://doi.org/10.1016/j.techsoc.2021.101740

Li, L., Liu, L., Niu, Z., Zhong, H., Mei, S., & Griffiths, M. D. (2023a). Gender differences and left-behind experiences in the relationship between gaming disorder, rumination and sleep quality among a

sample of Chinese university students during the late stage of the COVID-19 pandemic. *Frontiers in Psychiatry, 14*, 1108016. https://doi.org/10.3389/fpsyt.2023.1108016

Li, Y., Mu, W., Xie, X., & Kwok, S. Y. (2023b). Network analysis of internet gaming disorder, problematic social media use, problematic smartphone use, psychological distress, and meaning in life among adolescents. *Digital Health, 9*, 20552076231158036. https://doi.org/10.1177/20552076231158036

Liu, Y., Gong, R., Yu, Y., Xu, C., Yu, X., Chang, R., ... & Cai, Y. (2021). Longitudinal predictors for incidence of internet gaming disorder among adolescents: The roles of time spent on gaming and depressive symptoms. *Journal of Adolescence*, *92*, 1–9. https://doi.org/10.1016/j.adolescence.2021.06.008

Lopez-Fernandez, O., Kuss, D., Pontes, H., & Griffiths, M. (2016). Video game addiction: Providing evidence for internet gaming disorder through a systematic review of clinical studies. *European Psychiatry, 33*(S1), S306. https://doi.org/10.1016/j.eurpsy.2016.01.1047

Lopez-Fernandez, O., Griffiths, M. D., Kuss, D. J., Dawes, C., Pontes, H. M., Justice, L., ... & Billieux, J. (2019). Cross-cultural validation of the compulsive internet use scale in four forms and eight languages. *Cyberpsychology, Behavior, and Social Networking*, *22*(7), 451–464. https://doi.org/10.1089/cyber.2018.0731

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-U

Machimbarrena, J. M., González-Cabrera, J., Ortega-Barón, J., Beranuy-Fargues, M., Álvarez-Bardón, A., & Tejero, B. (2019). Profiles of problematic internet use and its impact on adolescents' health-related quality of life. *International Journal of Environmental Research and Public Health, 16*(20), 3877. https://doi.org/10.3390/ijerph16203877

Maldonado-Murciano, L., Pontes, H. M., Griffiths, M. D., Barrios, M., Gómez-Benito, J., & Guilera, G. (2020). The Spanish version of the Internet Gaming Disorder - Short Form (IGDS9-SF): Further examination using item response theory. *International Journal of Environmental Research and Public Health, 17*(19), 7111. https://doi.org/10.3390/ijerph17197111

Mauer-Vakil, D., & Bahji, A. (2020). The addictive nature of compulsive sexual behaviours and problematic online pornography consumption: A review. *Canadian Journal of Addiction, 11*(3), 42–51. https://doi.org/10.1097/CXA.0000000000000091

Meerkerk, G. J., Van Den Eijnden, R. J., Vermulst, A. A., & Garretsen, H. F. (2009). The Compulsive Internet Use Scale (CIUS): Some psychometric properties. *Cyberpsychology & Behavior, 12*(1), 1–6. https://doi.org/10.1089/cpb.2008.0181

Monacis, L., De Palo, V., Griffiths, M. D., & Sinatra, M. (2017). Social networking addiction, attachment style, and validation of the Italian version of the Bergen Social Media Addiction Scale. *Journal of Behavioral Addictions, 6*(2), 178–186. https://doi.org/10.1556/2006.6.2017.023

Montag, C., Bey, K., Sha, P., Li, M., Chen, Y.-F., Liu, W.-Y., Zhu, Y.-K., Li, C.-B., Markett, S., Keiper, J., & Reuter, M. (2015). Is it meaningful to distinguish between generalized and specific Internet addiction? Evidence from a cross-cultural study from Germany, Sweden, Taiwan and China: Specific forms of Internet addiction. *Asia-Pacific Psychiatry, 7*(1), 20–26. https://doi.org/10.1111/appy.12122

Mora-Salgueiro, J., García-Estela, A., Hogg, B., Angarita-Osorio, N., Amann, B. L., Carlbring, P., ... & Colom, F. (2021). The prevalence and clinical and sociodemographic factors of problem online gambling: A systematic review. *Journal of Gambling Studies*, *37*(3), 899–926. https://doi.org/10.1007/s10899-021-09999-w

Müller, A., Laskowski, N. M., Wegmann, E., Steins-Loeber, S., & Brand, M. (2021). Problematic online buying-shopping: Is it time to considering the concept of an online subtype of compulsive buying-shopping disorder or a specific internet-use disorder? *Current Addiction Reports, 8*, 494–499. https://doi.org/10.1007/s40429-021-00395-3

Naidu, S., Chand, A., Pandaram, A., & Patel, A. (2023). Problematic internet and social network site use in young adults: The role of emotional intelligence and fear of negative evaluation. *Personality and Individual Differences, 200*, 111915. https://doi.org/10.1016/j.paid.2022.111915

O'Connor, M., Sanson, A., Hawkins, M. T., Letcher, P., Toumbourou, J. W., Smart, D., ... & Olsson, C. A. (2011). Predictors of positive development in emerging adulthood. *Journal of Youth and Adolescence*, *40*, 860–874. https://doi.org/10.1007/s10964-010-9593-7

Opsahl, T., Agneessens, F., & Skvoretz, J. (2010). Node centrality in weighted networks: Generalizing degree and shortest paths. *Social Networks, 32*(3), 245–251. https://doi.org/10.1016/j.socnet.2010.03.006

Peng, P., & Liao, Y. (2023). Six addiction components of problematic social media use in relation to depression, anxiety, and stress symptoms: A latent profile analysis and network analysis. *BMC Psychiatry, 23*(1), 321. https://doi.org/10.1186/s12888-023-04837-2

Peris, M., de la Barrera, U., Schoeps, K., & Montoya-Castilla, I. (2020). Psychological risk factors that predict social networking and internet addiction in adolescents. *International Journal of Environmental Research and Public Health, 17*(12), 4598. https://doi.org/10.3390/ijerph17124598

Pontes, H. M., & Griffiths, M. D. (2014). Internet addiction disorder and internet gaming disorder are not the same. *Journal of Addiction Research & Therapy, 5*(4), e124. https://doi.org/10.4172/2155-6105.1000e124

Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior, 45*, 137–143. https://doi.org/10.1016/j.chb.2014.12.006

Pontes, H. M., Szabo, A., & Griffiths, M. D. (2015). The impact of Internet-based specific activities on the perceptions of Internet addiction, quality of life, and excessive usage: A cross-sectional study. *Addictive Behaviors Reports, 1*, 19–25. https://doi.org/10.1016/j.abrep.2015.03.002

Pontes, H. M., Andreassen, C. S., & Griffiths, M. D. (2016). Portuguese validation of the bergen facebook addiction scale: An empirical study. *International Journal of Mental Health and Addiction, 14*(6), 1062–1073. https://doi.org/10.1007/s11469-016-9694-y

Poon, L. Y., Tsang, H. W., Chan, T. Y., Man, S. W., Ng, L. Y., Wong, Y. L., ... & Pakpour, A. H. (2021). Psychometric properties of the Internet Gaming Disorder - Short Form (IGDS9-SF): Systematic review. *Journal of Medical Internet Research*, *23*(10), e26821. https://doi.org/10.2196/26821

R Core Team (2023). *R: A language and environment for statistical computing* (4.3.0). https://www.r-project.org/. Accessed 17 Nov 2023

Rigó, A., Tóth-Király, I., Magi, A., Eisinger, A., Griffiths, M. D., & Demetrovics, Z. (2023). Morningness-eveningness and problematic online activities. *International Journal of Mental Health and Addiction*. https://doi.org/10.1007/s11469-023-01017-x

Rozgonjuk, D., Schivinski, B., Pontes, H. M., & Montag, C. (2021). Problematic online behaviors among gamers: The links between problematic gaming, gambling, shopping, pornography use, and social networking. *International Journal of Mental Health and Addiction, 21*, 240–257. https://doi.org/10.1007/s11469-021-00590-3

Sánchez-Caballé, A., Gisbert Cervera, M., & Esteve-Mon, F. M. (2020). The digital competence of university students: A systematic literature review. *Aloma: Revista de Psicologia, Ciències de l'Educació i de l'Esport, 38*(1), 63–74. http://hdl.handle.net/10234/191134. Accessed 6 Oct 2023

Sánchez-Fernández, M., & Borda-Mas, M. (2024). Motor impulsivity and problematic online behaviours among university students: the potential mediating role of coping style. *Current Psychology*. Advance online publication. https://doi.org/10.1007/s12144-024-05766-3

Sánchez-Iglesias, I., Bernaldo-de-Quirós, M., Labrador, F. J., Puig, F. J. E., Labrador, M., & Fernández-Arias, I. (2020). Spanish validation and scoring of the internet gaming disorder scale-short-form (IGDS9-SF). *Spanish Journal of Psychology, 23*, e22. https://doi.org/10.1017/SJP.2020.26

Sayili, U., Pirdal, B. Z., Kara, B., Acar, N., Camcioglu, E., Yilmaz, E., ... & Erginoz, E. (2023). Internet addiction and social media addiction in medical faculty students: Prevalence, related factors, and association with life Satisfaction. *Journal of Community Health, 48*, 189–198. https://doi.org/10.1007/s10900-022-01153-w

Schmittmann, V. D., Cramer, A. O., Waldorp, L. J., Epskamp, S., Kievit, R. A., & Borsboom, D. (2013). Deconstructing the construct: A network perspective on psychological phenomena. *New Ideas in Psychology, 31*(1), 43–53. https://doi.org/10.1016/j.newideapsych.2011.02.007

Shaffer, H. J., Hall, M. N., & Vander Bilt, J. (2000). "Computer addiction": A critical consideration. *American Journal of Orthopsychiatry, 70*(2), 162–168. https://doi.org/10.1037/h0087741

Sit, H. F., Chang, C. I., Yuan, G. F., Chen, C., Cui, L., Elhai, J. D., & Hall, B. J. (2023). Symptoms of internet gaming disorder and depression in Chinese adolescents: A network analysis. *Psychiatry Research, 322*, 115097. https://doi.org/10.1016/j.psychres.2023.115097

Starcevic, V., & Billieux, J. (2017). Does the construct of Internet addiction reflect a single entity or a spectrum of disorders? *Clinical Neuropsychiatry, 14*(1), 5–10.

Statista (2024). *Most popular reasons for using the internet worldwide as of 3rd quarter 2023.* https://www.statista.com/statistics/1387375/internet-using-global-reasons/#:~:text=As%20of%20the%20third%20quarter,shows%2C%20or%20movies%20ranked%20third. Accessed 8 Mar 2024

Su, C.-T., Ng, H.-S., Yang, A.-L., & Lin, C.-Y. (2014). Psychometric evaluation of the short form 36 health survey (SF-36) and the world health organization quality of life scale brief Version (WHO-QOL-BREF) for patients with schizophrenia. *Psychological Assessment, 26*(3), 980–989. https://doi.org/10.1037/a0036764

Tereshchenko, S., Kasparov, E., Semenova, N., Shubina, M., Gorbacheva, N., Novitckii, I., ... & Lapteva, L. (2022). Generalized and specific problematic internet use in central Siberia adolescents: A school-based study of prevalence, age–sex depending content structure, and comorbidity with psychosocial problems. *International Journal of Environmental Research and Public Health*, *19*(13), 7593. https://doi.org/10.3390/ijerph19137593

Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society: Series B (Methodological), 58*(1), 267–288. https://doi.org/10.1111/j.2517-6161.1996.tb02080.x

Tullett-Prado, D., Doley, J. R., Zarate, D., Gomez, R., & Stavropoulos, V. (2023). Conceptualising social media addiction: A longitudinal network analysis of social media addiction symptoms and their relationships with psychological distress in a community sample of adults. *BMC Psychiatry, 23*(1), 509. https://doi.org/10.1186/s12888-023-04985-5

Vallejos-Flores, M. Á., Copez-Lonzoy, A., & Capa-Luque, W. (2018). Is there anyone online?: Validity and reliability of the spanish version of the Bergen Facebook Addiction Scale (BFAS) in university students. *Health and Addictions, 18*(2), 175–184. https://doi.org/10.21134/haaj.v18i2.394

van Borkulo, C., Boschloo, L., Borsboom, D., Penninx, B. W., Waldorp, L. J., & Schoevers, R. A. (2015). Association of symptom network structure with the course of depression. *JAMA Psychiatry, 72*(12), 1219–1226. https://doi.org/10.1001/jamapsychiatry.2015.2079

Van Rooij, A. J., Ferguson, C. J., Van de Mheen, D., & Schoenmakers, T. M. (2017). Time to abandon Internet Addiction? Predicting problematic internet, game, and social media use from psychosocial well-being and application use. *Clinical Neuropsychiatry, 14*(1), 113–121.

Verduyn, P., Gugushvili, N., & Kross, E. (2021). The impact of social network sites on mental health: Distinguishing active from passive use. *World Psychiatry, 20*(1), 133–134. https://doi.org/10.1002/wps.20820

Vilagut, G., Ferrer, M., Rajmil, L., Rebollo, P., Permanyer-Miralda, G., Quintana, J. M., ... & Alonso, J. (2005). El Cuestionario de Salud SF-36 Español: Una década de experiencia y nuevos desarrollos. *Gaceta Sanitaria*, *19*, 135–150.

Wang, Z., Yang, H., & Elhai, J. D. (2022). Are there gender differences in comorbidity symptoms networks of problematic social media use, anxiety and depression symptoms? Evidence from network analysis. *Personality and Individual Differences, 195*, 111705. https://doi.org/10.1016/j.paid.2022.111705

Ware Jr, J. E., & Sherbourne, C. D. (1992). The MOS 36-item Short-Form Health Survey (SF-36): I. Conceptual framework and item selection. *Medical Care, 30*(6), 473–483.

West, R., & Brown, J. (2013). *Theory of addiction* (1st ed.). UK: Wiley-Blackwell. https://doi.org/10.1002/9781118484890

Wong, H. Y., Mo, H. Y., Potenza, M. N., Chan, M. N. M., Lau, W. M., Chui, T. K., ... & Lin, C. Y. (2020). Relationships between severity of internet gaming disorder, severity of problematic social media use, sleep quality and psychological distress. *International Journal of Environmental Research and Public Health*, *17*(6), 1879. https://doi.org/10.3390/ijerph17061879

World Health Organization. (2015). *Public health implications of excessive use of the Internet, computers, smartphones and similar electronic devices: Meeting report.* World Health Organization. Retrieved June 10, 2023, from https://www.who.int/publications/i/item/9789241509367

World Health Organization (2018). *ICD-11: International classification of diseases (11th revision).* World Health Organization. Retrieved September 5, 2023, from https://icd.who.int/

Yang, Y., Zhang, E. L., Liu, Y., Ge, X., Su, Z., Cheung, T., ... & Xiang, Y. T. (2023). Network analysis of suicidality and internet addiction symptoms among Chinese primary and secondary school students. *Journal of Affective Disorders*, *339*, 145–152. https://doi.org/10.1016/j.jad.2023.07.030

Zarate, D., Ball, M., Montag, C., Prokofieva, M., & Stavropoulos, V. (2022). Unravelling the web of addictions: A network analysis approach. *Addictive Behaviors Reports, 15*, 100406. https://doi.org/10.1016/j.abrep.2022.100406

Zarate, D., Hobson, B. A., March, E., Griffiths, M. D., & Stavropoulos, V. (2023). Psychometric properties of the Bergen Social Media Addiction Scale: An analysis using item response theory. *Addictive Behaviors Reports, 17*, 100473. https://doi.org/10.1016/j.abrep.2022.100473

Zhang, Y., Bo, Q. U., Lun, S. S., Guo, Y., & Liu, J. (2012). The 36-item Short-Form Health Survey: Reliability and validity in Chinese medical students. *International Journal of Medical Sciences, 9*(7), 521. https://doi.org/10.7150/ijms.4503

Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education, 168*, 104212. https://doi.org/10.1016/j.compedu.2021.104212

Zhao, Y., Qu, D., Chen, S., & Chi, X. (2023). Network analysis of internet addiction and depression among Chinese college students during the COVID-19 pandemic: A longitudinal study. *Computers in Human Behavior, 138*, 107424. https://doi.org/10.1016/j.chb.2022.107424

Authors and Affiliations

Magdalena Sánchez-Fernández[1] · Mercedes Borda-Mas[1] · Francisco Rivera[2] · Mark D. Griffiths[3]

✉ Magdalena Sánchez-Fernández
magdalenasanchez@us.es

✉ Mercedes Borda-Mas
mborda@us.es

[1] Department of Personality, Assessment and Psychological Treatment, University of Seville (Universidad de Sevilla), Seville, Spain

[2] Department of Experimental Psychology, University of Seville (Universidad de Sevilla), Seville, Spain

[3] International Gaming Research Unit, Psychology Department, Nottingham Trent University, Nottingham, UK