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Factorial analysis and gender invariance of GPIUS2 scale and evaluation of Caplan's cognitive-behavioral model of problematic Internet use in adolescents

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Título: Análisis factorial e invarianza de género de la escala GPIUS2 y evaluación del modelo cognitivo-conductual de Caplan del uso problemático de Internet en adolescentes.

Resumen: El modelo cognitivo-conductual revisado de Caplan (2010) sobre el Uso Problemático de Internet (UPI) es uno de los marcos teóricos más prometedores sobre dicho comportamiento en la última década. La Escala Uso Problemático de Internet Generalizado (GPIUS2) (Caplan, 2010) ha sido adaptada y validada para su uso con adolescentes españoles, pero aún no se ha comprobado su invarianza de género en España. El presente estudio se centra en tres objetivos: confirmar la estructura factorial de la escala GPIUS2, analizar la invarianza de género de dicha escala y poner a prueba el modelo teórico de Caplan en una muestra de adolescentes españoles. Se realizó un estudio transversal. La muestra estuvo compuesta por 909 participantes de España, con edades comprendidas entre los 12 y los 18 años (Edad media = 14.2, *DT* = 1.6). Los resultados indicaron un buen ajuste de la estructura factorial del GPIUS2 e invarianza factorial en función del género. Además, el modelo cognitivo-conductual mostró un buen ajuste de los datos. La GPIUS2 tiene una muy buena estructura y presenta invarianza factorial para el género, lo que favorece su aplicación en la población adolescente española. Este estudio apoya el modelo cognitivo-conductual en el UPI.

Palabras clave: Uso problemático de Internet. GPIUS2. Invarianza factorial. Adolescentes. Medición.

Abstract: Caplan's (2010) revised cognitive-behavioral model of Problematic Internet Use (PIU) has become one of the most promising theoretical frameworks on such behavior in the last decade. The Generalized Problematic Internet Use Scale (GPIUS2) (Caplan, 2010) has been adapted and validated for use with Spanish adolescents, but gender invariance has not been tested yet in this country. The present study focuses on three objectives: to confirm the factorial structure of GPIUS2, to analyze gender invariance, and to test Caplan's theoretical model, in a sample of Spanish adolescents. A cross-sectional study was carried out. The sample was composed of 909 participants from Spain, aged between 12 and 18 years (Mean age = 14.2, *SD* = 1.6). The results indicated a good fit of the GPIUS2 factor structure and gender factorial invariance. Moreover, the cognitive-behavioral model fit the data. GPIUS2 has a very good structure and presents gender factorial invariance, which favors its application in Spanish adolescent population. This study supports the cognitive-behavioral model of PIU.

Keywords: Problematic Internet use. GPIUS2. Factorial invariance. Adolescents. Measurement.

Introduction

During the last two decades, research has tried to conceptualize and understand the impact that the use of the Internet has had on human beings. Since Young's (1998) influential conception of "internet addiction" to describe the impulse-control disorder that accompany the use of the Internet, different interchangeable terms have been proposed, such as "Internet dependence" (Scherer, 1997), "compulsive use of the Internet" (Greenfield, 1999), "pathological use of the Internet" (Morahan-Martin & Schumacher, 2000), or "generalized problematic Internet use" (Caplan, 2010).

According to Akhter & Khalek (2020), two main perspectives were emerged from the literature to measure problematic Internet use (PIU, onwards). Firstly, Internet addiction perspective, which refers to a clinical disorder or psychopathology and an impulse control disorder (Fioravanti et al., 2013; Pontes et al., 2016; Young, 1998). Most of these formulations consider a pattern similar to that of substance addictions (Echeburúa et al., 2010; Kim & Davis, 2009; Young et al., 2011), although the use of the term "addiction" is still controversial (Carbonell et al., 2012; Gámez-Guadix, Orue, & Calvete, 2013). Some authors criticized this approach on the ground that PIU should not be characterized as a clinical disorder or a disease (Pontes et al., 2016) or a psychological dependency on a substance (Davis, 2001) rather a distinct pattern of excessive Internet use related to cognitions and behaviors (Pontes et al. 2016). Thus, in most cases, it failed to measure problems and the consequences related to excessive Internet use and also missing theoretical framework in this regard (Fioravanti et al., 2013).

Secondly, multidimensional perspective which characterize PIU more than a behavioral addiction (Fioravanti et al., 2013). Davis (2001) introduced a cognitive-behavioral model of PIU, asserting PIU results from problematic cognitions coupled with behaviors that either intensify or maintain the maladaptive response, which result in negative life outcomes (Caplan 2002; Pontes et al. 2016). Davis further classified PIU as specific and generalized PIU. Drawing on the Davis' theory of cognitive behavior of generalized PIU Caplan (2010) developed a theory-driven, valid instrument to measure generalized PIU.

In the present study, Caplan's (2003, 2010) research line is followed, and the generalized problematic Internet use (GPIU) term is used to refer to the pattern that includes urgency to connect to the Internet, the need to be connected often, failed attempts to disconnect, the replacement of social and family relationships with time spent connected, using the Internet to avoid problems, and the appearance of negative outcomes in daily life due to Internet use. In sum-

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mary, it has been proposed, on the basis of this model, that problematic Internet use involves a set of cognitive processes (e.g., distortions or ruminative thoughts) and dysfunctional behaviors (such as Internet use to alleviate emotional distress or compulsive use) that result in a series of negative consequences in different aspects of individual life (Gámez-Guadix, Orue & Calvete, 2013).

Caplan (2010) updated the cognitive-behavioral model of problematic Internet use (Caplan, 2002, 2003; Davis, 2001) after integrating the research carried out up to that year, using four central components: the Preference for Online Social Interaction, which would influence Mood regulation through the Internet, and Deficient Self-Regulation, which is a second-order factor determined by Cognitive preoccupation and Compulsive Use. Such Deficient Self-Regulation will cause Negative outcomes of Internet use. The components of the model are described below.

Firstly, Preference for Online Social Interaction (POSI) refers to the belief that relationships through the Internet are safer, more comfortable and more effective, and less threatening than face-to-face interactions, which would, in turn, be associated with a greater problematic use of the Internet (Caplan, 2003; Caplan & High, 2011). In this vein, various studies have found that people with poor social skills, social anxiety, or isolation are more likely to make an inappropriate use of the Internet (Caplan, 2007; Cheng et al., 2015; Meerkerk et al., 2010).

Secondly, Mood regulation through the Internet refers to the use of such a medium to reduce anxiety, feelings of isolation or negative feelings (Caplan, 2002). In this way, such use acts as a dysfunctional emotional regulator (Aranda et al., 2022; LaRose et al., 2003, Mc-Kenna et al., 2002; Spada et al., 2008). In fact, it has been reported that individuals who excessively use the Internet more often connect with other users to alleviate feelings of sadness, anxiety, or loneliness than those level of use is considered normal (Muñoz-Rivas et al., 2010).

Thirdly, Deficient self-regulation includes two distinct but closely related components: Cognitive preoccupation and compulsive Internet use (Caplan, 2010). Cognitive preoccupation refers to patterns of obsessive thinking in relation to Internet use. On the other hand, Compulsive use refers to the inability to control or regulate Internet connection behavior (Griffiths, 2000; Young, 2005). Numerous previous studies have found that both components of Deficient self-regulation are central aspects of problematic Internet use (Caplan, 2010; Caplan & High, 2006; Davis et al., 2002).

Finally, the model points towards the importance of the appearance of Negative outcomes. This component denotes the extent to which an individual experiences personal, social, academic or work problems as a result of a dysfunctional Internet use. At an empirical level, numerous studies have found that Internet addiction is associated with negative outcomes in personal life, such as academic and work deterioration or absenteeism, family or interpersonal problems, abandonment of offline social activities or physical or health problems (Caplan, 2007; Gámez-Guadix et al., 2015; Gámez-Gámez-Guadix, Orue, Smith et al., 2013; Greydanus & Greydanus, 2012; Morahan-Martin, 2007; Tokunaga, 2014; Young, 2005).

This increasingly problematic behavior has led to the development of various detection tools that measure the different aspects of Internet use, particularly Internet addiction. A review run out by Laconi et al. (2014) indicated that there are at least 45 assessment tools for Internet addiction, although most of them have certain limitations and require further study to confirm their psychometric properties. The main limitations of these instruments are based on a one-dimensional conception of the GPIU (e.g. Internet Addiction Test; Young, 1998) or not following a consensual GPIU model (e.g. Internet-Related Experiences Questionnaire, Beranuy et al., 2009). Laconi et al. (2014) pointed out that the Generalized Problematic Internet Use scale-2 (GPIUS-2; Caplan, 2010) is one of the most promising measures, as it has yielded good psychometric properties, including a very consistent 4-factor cognitive-behavioral model, with only 15 items. Caplan (2002) developed the Generalized Problematic Internet Use Scale (GPIUS) from the cognitive-behavioral model of the GPIU, and later proposed a revised version, the GPIUS2 (Caplan, 2010). The model fit the data well and variables in the model accounted for 27% of the variance in mood regulation scores, 65% of variance in participants' deficient self-regulation scores, and 61% of variance in the negative outcome scores. GPIUS2 sub-scales demonstrated good reliability ranging .82 to .87 in Cronbach's alpha index, whereas the overall reliability of the scale was .91.

Up to the present, GPIUS2 has been widely validated through different countries and cultures (Akhter & Khalek, 2020; Assunção & Matos, 2017; Barke et al., 2012; Casale et al., 2016; Fioravanti et al., 2013; Montag et al., 2015) showing robust psychometric properties for adults (ranging .86 to .94 in Cronbach's alpha index) and replicating Caplan's factorial structure. But these studies do not get deeper into gender differences.

Otherwise, studies in adolescent population are less frequent, when it comes to one of the most sensitive groups to this type of problematic use. Adolescents have been reported to be especially vulnerable to behavioral control, Gámez-Guadix et al. (2016) explained that this increased vulnerability is due to psychobiological and evolutionary factors, which favor the emergence of various risky behaviors (Romer, 2010; Steingerg, 2007).

Gámez-Guadix et al. (2012) analyzed the psychometric properties of the GPIUS2 with a Spanish speaking adolescents sample from Mexico. Among the first-order factors, internal consistency ranged from .74 (for the Negative outcomes subscale) to .81 (for the cognitive preoccupation subscale). For the second-order factor (Deficient self-regulation), the internal consistency was .88. The internal consistency of the entire scale was also adequate (.90). Regarding convergent validity, time spent using the Internet

was significantly associated with all of the subscales of the GPIUS2. More specifically, GPIUS2 revealed the strongest correlations for the time that adolescents spent on Facebook or other social networks (r^2 .44, $p < .001$) and the time they spent chatting or using Messenger (r^2 .34, $p < .001$). The analysis also showed a significant correlation with the scale of interference with daily life activities, and the measures of depression, anxiety, and impulsivity. In addition to the good results for convergent validity and internal consistency, the study revealed no significant differences between male and female adolescents.

Gámez-Guadix, Orue, & Calvete (2013) team validated an adaptation of this instrument on a Spanish adolescent population of the Basque Country, yielding good psychometric properties, but they did no analyze gender invariance. In this study, authors considered the factor Generalized and problematic Internet Use as a third order factor, in place of correlations between factors proposed by Caplan. Internal consistency was adequate for all scales, ranging from .78 to .85 for first order factors. For the second-order factor (Deficient self-regulation), internal consistency was .90. The internal consistency of the entire scale was also adequate (.91) as Caplan's original instrument (2010).

Attending to a review of recent research (Baloğlu et al., 2020), men are more susceptible to the generalized form of PIU. However, when the literature is investigated on the specific forms of PIU (e.g.: problematic social media use) recent studies found that women are at more risk and score higher than men. In the same line, Su et al. (2019) indicated that men were more likely to exhibit Internet Gaming Disorder than women and less likely to exhibit problematic social media use than women. Nevertheless, despite multiple studies indicate that men possibly have higher prevalence rates and behaviors of PIU, still more conclusive evidence is needed in terms of gender-based variations and its relationships with other variables (Baloğlu et al., 2020).

Consequently, there is a need for knowledge in terms of testing the robustness of a cognitive-behavioral model-based instrument that may be suitable for evaluating problematic Internet use in all types of samples of adolescents, in Spanish language, and regardless of gender, validated to Spanish population. The objective of the present study is threefold: on the one hand, it aims to confirm the factorial structure of the GPIUS2 instrument among an adolescent population from a province of the east of Spain, comparing the original proposal with the proposal of Gámez-Guadix, Orue, & Calvete (2013). Secondly, an analysis of the gender factorial invariance of the instrument is sought, for the first time with a Spanish sample. Finally, Caplan's theoretical model is tested for the aforementioned sample. The starting hypotheses are the following: 1) the factorial structure of the GPIUS2 will show a good fit; 2) gender invariance of GPIUS2 will be confirmed, without significant differences in metric and scalar invariance measures between boys and girls; and 3) Caplan's model will be confirmed.

Method

Participants

The sample consisted of 909 students belonging to 7 Secondary Education centers in the province of Alicante, Spain, and aged between 12 and 18 years. Out of the total sample, 538 were boys (59.2%). The total mean age was 14.2 (*SD* = 1.6). All individuals in the sample were enrolled in one of the courses included between 1st year of Compulsory Secondary Education (CSE) and up to 2nd year of Bachiller (Spanish Baccalaureate)[1].

A 16.9% of the respondents presented a score at risk of suffering from generalized problematic Internet use (1 *SD* above the mean) and 4% of individuals obtained a score of up to 2 *SD* above the mean use of their group.

Measurements

Generalized problematic Internet use. The *Generalized and Problematic Internet Use Scale 2* (GPIUS2; Caplan 2010) was used in its translated version, which was validated on the Spanish population (Gámez-Guadix, Orue, & Calvete, 2013). The GPIUS2 assesses different components of the problematic and generalized use of the Internet from a cognitive-behavioral perspective. It consists of 15 items grouped into four differentiated subscales: 1) Preference for online social interaction (POSI) (three items, e.g., "I feel more comfortable communicating with others online than doing it face to face"); 2) Mood regulation through the Internet (three items, e.g., "I have used the Internet to feel better when I have been sad"); 3) Negative outcomes (three items, e.g., "My use of the Internet has created problems in my life") and 4) a second order factor called Deficient self-regulation, which includes a Cognitive preoccupation subscale (three items; e.g. "When I do not connect to the Internet for a while, I start to worry about connecting") and a Compulsive Internet use subscale (three items, e.g., "I have difficulty controlling the amount of time I am connected to the Internet"). The responses are scored on a 6-point Likert- type format, from 1 (Totally disagree) to 6 (Totally agree). The internal consistency of the scale in previous studies (Caplan, 2010; Gámez-Guadix, Orue, & Calvete, 2013) was $\alpha = .91$.

Procedure

Permission from the Regional Education and Research Secretary office was requested to carry out this project. Afterwards, the management teams of each of the 11 centers included in the proposal (convenience sampling) were contacted, 7 of which agreed to participate. Subsequently, the students wishing to participate in the research were asked to

[2] Spanish Baccalaureate is a pre-university education qualification after having obtained the CSE (Compulsory Secondary Education Qualification).

submit an informed consent form signed by one of their parents, with which the ethical guarantees were covered.

For the application of the test, the DetectaWeb platform for the detection of mental health disorders among children and adolescents was used (see complete protocol in Piqueras et al., 2017; for more information, see http://www.detectaweb.com/blog/). The recruited students were instructed in their respective centers to complete the questionnaire in their computer rooms. The tutors responsible for the groups were previously trained in the application of the test, and received telematic guidance.

Data Analyses

The analyses were carried out using the SPSS 22 and EQS 6.2 statistical programs.

Firstly, descriptive measures (*M* and *SD*) were included. Secondly, the scale's factor model was tested with the EQS 6.2 program. The contrasted model included the following four general factors, taking into consideration that they were correlated: Preference for Online Social Interactions (POSI), Mood Regulation, the second order factor Deficient Self-Regulation (which includes Cognitive preoccupation and Compulsive use) and Negative Outcomes.

The analyses were carried out using the robust maximum likelihood (ML Robust) method. For the fit analyses, the following indexes were used: *Chi-square* χ^2, *Satorra Bentler chi-square S-B* χ^2, *Robust Root Mean Square Error of Approximation* (*R-RMSEA*), *Robust Comparative Fit Index*, (*R-CFI*), *Standardized Root Mean Square Residual* (*SRMR*). For *RMSEA*, values lower than .08 indicate that the model is good, and values equal to or lower than .05 indicate an optimal model (Schumacker & Lomax, 2004). The *CFI* value indicates a good fit with values greater than or equal to .95 (Bentler, 1990), while the *SRMR* index is considered good when its values are lower than .08, with values closer to .00 being more acceptable.

In order to verify the best structure for the instrument, following to Anderson & Gerbin (1988), different alterative models were tested. Model 1 will test the original structure of the GPIUS2; Model 2 will group all items with one factor; Model 3 will try the original structure but without factors correlations; Model 4 will analyze no items relations with any factor; Model 5 will test the structure found by Gámez-Guadix, Orue, & Calvete (2013) with GPIUS as a main factor having direct effect to POSI, Mood Regulation, Negative Consequences and Deficient Self-Regulation, with no correlations between factors. After verifying the adjustment of the instrument, the values of total reliability and of each factor are given by McDonald's omega index (1999).

Thirdly, through EQS 6.2, the factorial equivalence was analyzed progressively with the calculation of Factorial Invariance (FI) using the procedure suggested by Dimitrov (2010), whereby the Measurement Invariance refers to: (a) metric invariance (equality of factor loadings between groups) and (b) scalar invariance (equality of intercepts between groups). When a strong invariance measure is reached, the comparison of latent means is justified. Following, calculations were carried out to compare latent means between sexes.

Fourthly, Caplan's theoretical model, which contains the variables measured with GPIUS2, was tested.

Results

Factorial structure analysis of the GPIUS2

Table 1 presents the descriptive statistics (means and standard deviations) for the variables that compose GPIUS2.

Table 1
Descriptive characteristics.

Age: *M* (*SD*)	14.18 (1.61)
Gender (boys / girls)	59.2% /40.8%
School course	
1st Secondary Education (12/13 years old)	15%
2nd Secondary Education (13/14 years old)	31.6%
3rd Secondary Education (14/15 years old)	23.1%
4th Secondary Education (15/16 years old)	9.8%
1st High School (16/17 years old)	15%
2nd High School (17/18 years old)	5.4%
Education Level of Parents	
Mother	
Primary Education	7.3%
Secondary Education	33.3%
High school or technical degree	37.9%
Bachelor's degree	6.5%
Master's degree	15%
Father	
Primary Education	8.1%
Secondary Education	33.3%
High school or technical degree	42.8%
Bachelor's degree	5%
Master's degree	10.8%
GPIUS2 (*M*)	
Preference for online social interactions	1.78
Mood regulation	2.68
Deficient self-regulation	2.36
Cognitive preoccupation	2.22
Compulsive use	2.49
Negative outcomes	1.69
Total GPIUS2	2.13

A confirmatory factorial analysis was performed, using the robust estimation method of maximum likelihood (ML Robust), as the Mardia index yielded a value of 117.88, indicating lack of normality in the data. For this reason, when comparing models, the comparative index was adjusted using the *Satorra-Bentler Chi-square* (*S-B* χ^2) values. Regarding the treatment of cases, there were no missing values as the questionnaire administration was online and the answers were compulsory for all items.

Different models were tested (see table 2). Model 1, which presents the original structure of the GPIUS2 showed the best fit. The fit of the data to the model 1 was adequate: S-B χ^2 (82) = 356.07, $p < .001$, *SRMR* = .046, *R-RMSEA* =

.066, *CI* [.054, .067], *NNFI* = .91, *R-CFI* = .93. Figure 1 shows the standardized values of the factorial loadings of the model. The factor loadings varied between .55 and .88 ($p <$ .001). Likewise, the correlations between latent variables were above .43 and were statistically significant ($p < .001$).

Figure 1
Factorial structure for the GPIUS2 questionnaire. Standardized values.

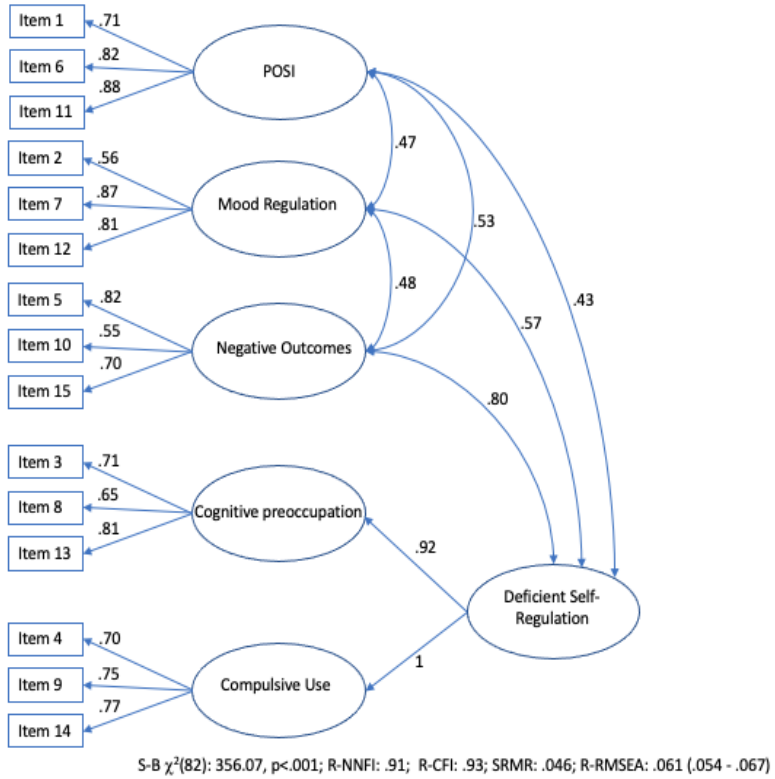

Table 2
Goodness of fit of the alternative models

Model	*SBχ²*	*df*	*R-CFI*	*SRMR*	*NNFI*	*R-RMSEA (90% CI)*
M1. GPIUS2	356.97	82	.93	.046	.91	.061 (.054 - .067)
M2. One factor	1396.35	90	.67	.100	.62	.126 (.121 - .132)
M3. Uncorrelated	1054.46	105	.76	.262	.71	.110 (.104 - .116)
M4. Null Model	4044.99	104	.01	.710	.00	.204 (.199 - .210)
M5. GPIUS2(M.F.)	371.01	82	.93	.056	.91	.062 (.056- .069)

Note. SBχ2 = Satorra–Bentler scaled chi-square; *R-CFI* = robust comparative fit index; *SRMR* = standardized root mean square residual; *R-NNFI* = robust Non-Normed Fit Index; *R-RMSEA* = robust root mean square error of approximation; CI = confidence interval; (M.F): Generalized and problematic Internet use as main factor (third order factor, Gámez-Gaudix, Orue & Calvete, 2013)

McDonald's omega index (1999) was used to estimate the internal consistency of each of the subscales, as it is a more reliable measure than Cronbach's alpha (Dunn et al., 2014), all of which were adequate: Preference for online social interactions: Ω = .86; Mood regulation: Ω = .84; Cognitive preoccupation: Ω = .82; Compulsive use: Ω = .84; and Negative outcomes: Ω = .82. For the second-order factor (Deficient self-regulation), the internal consistency was Ω = .89. The internal consistency of the total scale was also adequate (Ω = .90).

Factorial invariance analysis

The factorial equivalence of Caplan's instrument (2010) (GPIUS2) was evaluated according to gender. In order to begin to evaluate the FI, the Mardia test, which indicates the non-normality of the data, was analyzed, thus, a robust estimation method was used: The Maximum Likelihood (Robust ML). Afterwards, the fit of the model for both samples was calculated, showing an adequate adjustment in both cases (Table 3) and good factorial loadings (Table 4).

Table 3
Adjustment of the GPIUS according to sex.

Model	*SB*χ^2	*df*	*R-CFI*	*SRMR*	*NNFI*	*R-RMSEA* (90% CI)
Boys	255.31	82	.920	.096	.900	.063 (.054-.071)
Girls	202.58	82	.951	.060	.915	.063 (.052–.074)

Note. SBχ2 = Satorra–Bentler scaled chi-square; *R-CFI* = robust comparative fit index; *SRMR* = standardized root mean square residual; *R-NNFI* = robust Non-Normed Fit Index; *R-RMSEA* = robust root mean square error of approximation; *CI* = confidence interval

Table 4
Standardized values for items (boys and girls).

	Item	Boys	Girls
POSI	1	.71	.71
	6	.85	.76
	11	.84	.96
Mood Regulation	2	.56	.56
	7	.85	.89
	12	.81	.81
Negative Outcomes	5	.81	.84
	10	.56	.53
	15	.72	.68
Cognitive Preoccupation (CP)	3	.65	.77
	8	.59	.69
	13	.81	.82
Compulsive Use (CU)	4	.64	.77
	9	.70	.82
	14	.75	.78
Deficient Self-Regulation	CP	.94	.91
	CU	1	.99

The next step was to test the metric invariance or equivalence of factorial loadings between the two groups (weak invariance). For this reason, the unrestricted multi-group model (Ma) was first calculated. Next, the model was calculated by establishing equality of factorial loadings of the two samples (Mb). Table 5 shows that there were no significant differences in the increase of *S-B* χ^2 between (Ma) and (Mb). Therefore, the analysis of scalar invariance (intercepts of equivalent items between groups) was carried out (Mc). The comparison between the *S-B* χ^2 values indicated that there were significant differences between the two models. Although these differences are not appreciated in the value of *R-CFI*, which decreased .008, it was decided to observe the changes proposed through the modification indexes calculated with the Lagrange Test.

This test suggested, first of all, releasing the equivalence of the intercept of item 13. With this release, the differences between the previous model (Mb) and the current model remained significant, thus the equivalence between intercepts of item 2 (Mc1) was also released. In this second case, the differences between models were not significant (p = .08). Following to Dimitrov (2010), there is no strict rule as to what degree of partial invariance is acceptable, however less than 20% freed parameters seem acceptable in practical applications. This author considers that if *CFI* decrease less than .01, and the increase of *S-B* χ2 is not significant, invariance can be considered. In the present study, both conditions were fulfilled. Therefore, it can be stated that there is metric and scalar invariance, there is strong invariance and it is justified to perform the comparison of latent means.

Table 5
Goodness of fit indexes of the models of invariance by gender.

Model	χ^2	*SB*χ^2	*df*	*R-CFI*	*R-RMSEA* (90% CI)	*SRMR*	*SB*$\Delta\chi^2$	Δdf	*p*
Ma	650.12	490.02	148	.950	.056 (.049-.063)	.054			
Mb	662.63	365.10	158	.951	.054 (.046–.061)	.055	9.04	10	.99
Mc	704.49	433.46	178	.943	.046 (.049-.063)	.055	329.64	20	.00
Mc1	694.55	398.92	177	.949	.053 (.046-.059)	.055	27.57	19	.08

SBχ^2 = Satorra–Bentler scaled chi-square; *R-CFI* = robust comparative fit index; *R-RMSEA* = robust root mean square error of approximation; CI = confidence interval; *SRMR* = standardized root mean square residual; Δ*SB*χ^2 = adjusted *SB*χ^2 difference; Ma = free model (baseline); Mb = Ma with invariant slopes; Mc = Mb with invariant intercepts; Mc1= Mb with partial invariant intercepts (freed intercept Item2 and item 13).

The results of the observed mean for each factor as a function of gender are presented in Table 6. However, the comparison of latent means was better than those observed, as the former are not associated with measurement errors (Brown, 2006).

The EQS 6.2 was used to compare latent means. This program allows to set the values of the intercepts of the factors of one of the groups to 0, thus establishing a base model on which the possible differences between the two groups are calculated. The equivalence between the intercepts of the items is also imposed. In this case, the values of the group of boys were set to 0.

Table 6
Observed Means and standard deviations (SD) for each factor according to gender.

	Gender	*Mean*	*SD*
POSI	Boys	1.81	1.07
	Girls	1.75	1.00
Mood_Regulation	Boys	2.61	1.38
	Girls	2.79	1.45
Deficient_self-regulation	Boys	2.26	1.04
	Girls	2.49	1.21
Negative Outcomes	Boys	1.71	0.94
	Girls	1.66	0.91

The resulting model showed adequate adjustment values *SB*χ^2 (175) = 440.36*; R-CFI* = .94; *NNFI* = .90; *SRMR* =

.055; *R-RMSEA* = .058 (.051- .065). As can be seen in Table 7, the comparison between the results of the two groups showed that there are only significant differences in deficient self-regulation, with their values being higher in girls (0 vs 1.2).

Table 7
Structured Mean Differences Across Gender on GPIUS2.

	Components			
	POSI	MR	DSR	NO
Boys (Reference)	.00	.00	.00	.00
Girls				
Mean estimate (*ME*)	-1.273	1.042	1.2	-.353
Standard error (*SE*)	.058	.069	.030	.082
Test statistic (*TS*)	-1.266	-1.043	12.25*	-.353

POSI (Preference for online social interaction). MR (Mood Regulation). DSR (Deficient Self-Regulation). NO (Negative Outcomes). *P<.001

Figure 2
Results of the application of Caplan's theoretical model (2010). Standardized values (total, boys and girls).

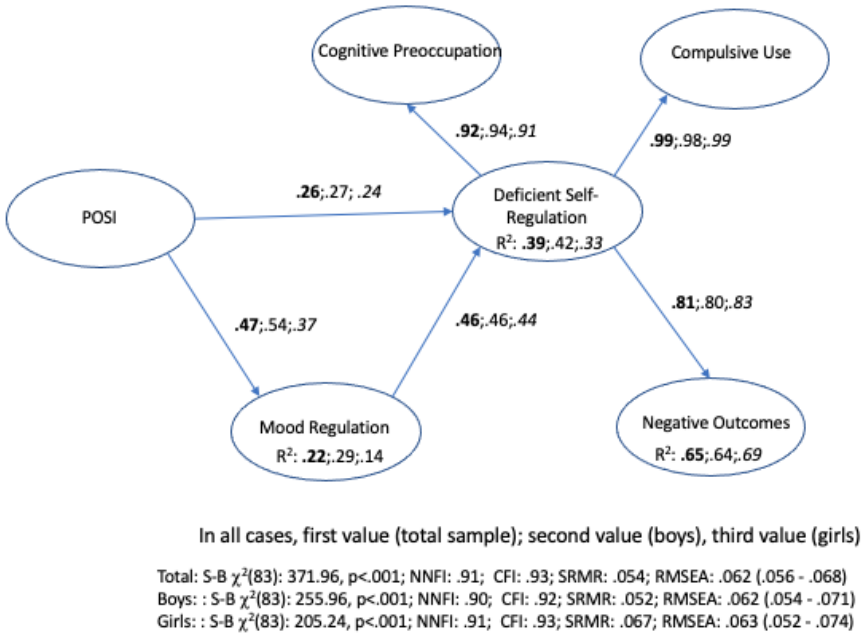

Table 8
Indirect Effects.

	F3	F4	F5	F6
F1	**.22**	**.44**	**.46**	**.38**
→	.25	.49	.52	.42
	.17	*.37*	*.40*	*.34*
F2	.	**.42**	**.45**	**.37**
→		.37	.45	.37
		.40	*.44*	*.37*

First value (bold): total sample. Second value: Boys. Third Value (*cursive*): Girls

The model explained 22% of the variance of mood regulation (R^2 = .22), 39% of the variance of deficient self-regulation (R^2 = .39), 65% of the variance of negative outcomes (R^2 = .65).

Caplan´s theoretical model

Figure 2 shows the direct standardized coefficients of Caplan's theoretical model for the general population, boys and girls. The fit for this model was adequate: *S-B* χ^2 (83) = 371.96, p < .001, *SRMR* = .054, *R-RMSEA* = .062, *CI* [.056, .068], *NNFI* = .91, *R-CFI* = .93. Indirect effects are offered in Table 8.

Discussion

In the present article, the factorial structure of the GPIUS2 instrument was analyzed on an adolescent sample from the province of Alicante. The results confirmed hypothesis 1, showing that the GPIUS2 exhibits a good internal consistency (Caplan, 2010; Fioravanti et al., 2013; Gámez-Guadix et al., 2012). Even the structure proposed by Gámez-Guadix, Orue, & Calvete (2013) has very similar fit indices to Caplan (2010) original structure, in order to better comparison with other studies, original structure is preferred. Moreover, the adjustment of the theoretical model proposed by Caplan is adequate (hypothesis 3), as has been confirmed in previous studies (Caplan, 2010; Fioravanti et al., 2013; Gámez-Guadix et al., 2012).

It has also been shown that this instrument is equally valid for boys and girls, presenting good adjustment indexes (gender invariance). This result confirms hypotheses 2.

Only one difference between gender in Deficient self-regulation has been found, being greater in girls. It is plausible that this difference is due to the greater probability of girls presenting obsessive-compulsive responses at a community level (Martínez-González et al., 2011; Piqueras et al., 2009; Rodríguez-Jiménez et al., 2014). Machimbarrena et al. (2019), in their study, with 12285 participants (11-18 years old), found that girls had higher scores at cognitive preoccupation, compulsive use, mood regulation and negative consequences. These results are contrary to Bernal-Ruiz et al. (2017), they found that boys had significant higher score in Compulsive Internet Use and in Negative Outcomes. Must be considered that in their study sample is older (16-23), and smaller (132 boys / 178 girls), moreover they only analyzed differences in observed means, rather latent means. With these results, more research is needed in this area.

Regarding the limitations of the study, the type of sampling carried out (convenience sampling and limited to the same geographic area) and the absence of other measures apart from the self-report, should be noted as the main limitations, which hinders any generalization of the results.

It would be of interest hereafter to design longitudinal studies that account for the problematic and generalized use of the Internet in relation to other personality or transdiagnostic variables. Such information is essential when developing predictive models and prevention programs from a community level perspective.

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References

Akhter, M., & Khalek, M. (2020). Association Between Psychological Well-Being and Problematic Internet Use Among University Students of Bangladesh. *Journal of Technology in Behavioral Science,* 5, 357–366. https://doi.org/10.1007/s41347-020-00142-x

Anderson, J.C., & Gerbin, D.W. (1988) Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. *Psychological Bulletin,* 103, 3, 411-423

Aranda, M., García, M., Fuentes, V., & Linares, R. (2022). Emotional intelligence and adult attachment: Effects on problematic smartphone usage. *Anales de Psicología / Annals of Psychology, 38*(1), 36–45. https://doi.org/10.6018/analesps.463101

Assunção, R., & Mena, P. (2017) The Generalized Problematic Internet Use Scale 2: Validation and test of the model to Facebook use. *Journal of Adolescence*, 54, 51-59. https://doi.org/10.1016/j.adolescence.2016.11.007.

Baloğlu, M., Şahin, E., & Arpaci, I. (2020) A review of recent research in problematic internet use: gender and cultural differences, *Current Opinion in Psychology*, 36, 124-129. https://doi.org/10.1016/j.copsyc.2020.05.008

Barke, A., Nyenhuis, N., & Kröner-Herwig, B. (2012). The German version of the Internet Addiction Test: A validation study. *Cyberpsychology, Behavior and Social Networking*, 15, 534–542. https://doi.org/10.1089/cyber.2011.0616

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Beranuy, M., Chamarro, A., Graner, C., & Carbonell, X. (2009) Validación de dos escalas breves para evaluar la adicción a Internet y el abuso de móvil [Validation of two brief scales for Internet addiction and mobile phone problem use]. *Psicothema,* 21, 3, 480-485.

Bernal-Ruiz, C., Rosa-Alcázar, A.I., González-Calatayud, V., & Rosa-Alcázar, E. (2017) Is there a relationship between problematic Internet use and responses of social anxiety, obsessive-compulsive and psychological well-being among adolescents? *Anales de Psicología / Annals of Psychology, 33*(2), 269-276. http://dx.doi.org/10.6018/analesps.33.2.265831

Brown, T. (2006) *Confirmatory factor analysis for applied research*. Guilford Press.

Caplan, S. E. (2007). Relations among loneliness, social anxiety, and problematic Internet use. *Cyberpsychology & Behavior, 10*(2), 234–242. https://doi.org/10.1089/cpb.2006.9963

Caplan, S. E. (2002). Problematic Internet use and psychosocial well-being: Development of a theory-based cognitive-behavioral measurement instrument. *Computers in Human Behavior, 18(5)*, 553-575. https://doi.org/10.1016/S0747-5632(02)00004-3

Caplan, S. E. (2003). Preference for Online Social Interaction: A Theory of Problematic Internet Use and Psychosocial Well-Being. *Communication Research, 30*(6), 625–648. https://doi.org/10.1177/0093650203257842

Caplan, S. E. (2010). Theory and measurement of generalized problematic Internet use: A two-step approach. *Computers in Human Behavior*, *26(5)*, 1089-1097. https://doi.org/10.1016/j.chb.2010.03.012

Caplan, S. E., & High, A. C. (2006). Beyond excessive use: the interaction between cognitive and behavioral symptoms of problematic Internet use. *Communication Research Reports, 23(4)*, 265-271. https://doi.org/10.1080/08824090600962516

Caplan, S. E., & High, A. C. (2011). Online social interaction, psychosocial well-being, and problematic Internet use. In K.S. Young & C.N. de Abreu (Eds.), *Internet addiction: A handbook and guide to evaluation and treatment* (pp. 35-53). Wiley & Sons.

Carbonell, X., Fúster, H., Chamarro, A., & Oberst, U. (2012). Adicción a Internet y móvil: una revisión de estudios empíricos españoles [Internet and mobile addiction: a review of Spanish empirical studies]. *Papeles del Psicólogo, 33(2)*, 82-89.

Casale, S., Primi, C., & Fioravanti, G. (2016). Generalized Problematic Internet Use Scale 2: Update on the psychometric properties among Italian young adults. In G. Riva, B. K. Wiederhold & P. Cipreso (Coords.), *The psychology of social networking: personal experience and online communities* (pp. 202-216). De Gruyter Open Sp. https://www.doi.org/10.1515/9783110473858-016

Cheng, C., Sun, P., & Mak, K. K. (2015). Internet Addiction and Psychosocial Maladjustment: Avoidant Coping and Coping Inflexibility as Psychological Mechanisms. *Cyberpsychology, Behavior and Social Networking, 18*(9), 539-546. https://doi.org/10.1089/cyber.2015.0121

Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Computers in Human Behavior, 17(2)*, 187-195. https://doi.org/10.1016/S0747-5632(00)00041-8

Davis, R. A., Flett, G. L., & Besser, A. (2002). Validation of a new scale for measuring problematic internet use: implications for pre-employment screening. *Cyberpsychology & Behavior, 5*(4), 331–345. https://doi.org/10.1089/109493102760275581

Dimitrov, D. M. (2010). Testing for factorial invariance in the context of construct validation. *Measuring and Evaluation in Counseling and Development,* 43, 121. https://doi.org/10.1177/0748175610373459

Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From alpha to omega: a practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology, 105*(3), 399–412. https://doi.org/10.1111/bjop.12046

Echeburúa, E., Labrador, F., & Becoña, E. (2010). *Adicción a las nuevas tecnologías [Addiction to new technologies]*. Pirámide.

Fioravanti, G., Primi, C., & Casale, S. (2013). Psychometric evaluation of the Generalized Problematic Internet Use Scale 2 in an Italian sample. *Cyberpsychology, Behavior and Social Networking, 16*(10), 761–766. https://doi.org/10.1089/cyber.2012.0429

Gámez-Guadix, M., Borrajo, E., & Almendros, C. (2016). Risky online behaviors among adolescents: Longitudinal relations among problematic Internet use, cyberbullying perpetration, and meeting strangers online. *Journal of Behavioral Addictions*, *5*(1), 100–107. https://doi.org/10.1556/2006.5.2016.013

Gámez-Guadix, M., Calvete, E., Orue, I., & Las Hayas, C. (2015). Problematic Internet use and problematic alcohol use from the cognitive-behavioral model: a longitudinal study among adolescents. *Addictive Behaviors, 40*, 109–114. https://doi.org/10.1016/j.addbeh.2014.09.009

Gámez-Guadix, M., Orue, I., & Calvete, E. (2013). Evaluation of the cognitive-behavioral model of generalized and problematic Internet use in Spanish adolescents. *Psicothema, 25*(3), 299–306. https://doi.org/10.7334/psicothema2012.274

Gámez-Guadix, M., Orue, I., Smith, P. K., & Calvete, E. (2013). Longitudinal and reciprocal relations of cyberbullying with depression, substance use, and problematic internet use among adolescents. *Journal of Adolescent Health, 53*(4), 446-452. https://doi.org/10.1016/j.jadohealth.2013.03.030

Gámez-Guadix, M., Villa-George, F. I., & Calvete, E. (2012). Measurement and analysis of the cognitive-behavioral model of generalized problematic internet use among Mexican adolescents. *Journal of Adolescence, 35*(6), 1581–1591. https://doi.org/10.1016/j.adolescence.2012.06.005

Greenfield, D. N. (1999). Psychological characteristics of compulsive internet use: a preliminary analysis. *Cyberpsychology & Behavior, 2*(5), 403-412. https://doi.org/10.1089/cpb.1999.2.403

Greydanus, D. E., & Greydanus, M. M. (2012). Internet use, misuse, and addiction in adolescents: current issues and challenges. *International Journal of Adolescent Medicine and Health, 24*(4), 283–289. https://doi.org/10.1515/ijamh.2012.041

Griffiths, M. (2000). Does Internet and computer "addiction" exist? Some case study evidence. *CyberPsychology & Behavior, 3(2)*, 211-218. https://doi.org/10.1089/109493100316067

Kim, H. K., & Davis, K. E. (2009). Toward a comprehensive theory of problematic Internet use: Evaluating the role of self-esteem, anxiety, flow, and the self-rated importance of Internet activities. *Computers in Human Behavior, 25*(2), 490-500. https://doi.org/10.1016/j.chb.2008.11.001

Laconi, S., Rodgers, R. F., & Chabrol, H. (2014). The measurement of Internet addiction: A critical review of existing scales and their psychometric properties. *Computers in Human Behavior, 41*, 190-202. https://doi.org/10.1016/j.chb.2014.09.026

LaRose, R., Lin, C.A., & Eastin, M.S. (2003). Unregulated Internet usage: Addiction, habit, or deficient self-regulation? *Media Psychology, 5*(3), 225-253. https://doi.org/10.1207/S1532785XMEP0503_01

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

Martínez-González, A. E., Piqueras, J. A., & Marzo, J. C. (2011). Validación del inventario de obsesiones y compulsiones revisado (OCI-R) para su uso en población adolescente española [Validation of the Obsessive-Compulsive Inventory Revised (OCI-R) for Spanish adolescent population]. *Anales de Psicología / Annals of Psychology, 27*(3), 763-773.

McDonald, R. P. (1999). *Test theory: A unified approach*. Erlbaum.

McKenna, K. Y. A., Green, A.S. & Gleason, M. E. J. (2002). Relationship formation on the Internet: What's the big attraction? *Journal of Social Issues, 58*, 9.

Meerkerk, G. J., van den Eijnden, R. J. J. M., Franken, I.H.A., & Garretsen, H.F.L. (2010). Is compulsive internet use related to sensitivity to reward and punishment, and impulsivity? *Computers in Human Behavior, 26(4)*, 729-735. https://doi.org/10.1016/j.chb.2010.01.009

Montag, C., Bey, K., Sha, P., Li, M., Chen, Y. F., Liu, W. Y., … 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. *Asia-Pacific Psychiatry*, 7(1), 20–26. https://doi.org/10.1111/appy.12122

Morahan-Martin, J. (2007). Internet use and abuse and psychological problems. In A. J. Johnson, K. McKenna, T. Postmes, & U. D. Reips (Eds.), *Oxford Handbook of Internet Psychology* (pp. 331-345). Oxford University Press.

Morahan-Martin, J., & Schumacher, P. (2000). Incidence and correlates of pathological Internet use among college students. *Computers in Human Behavior, 16*(1), 13-29. https://doi.org/10.1016/S0747-5632(99)00049-7

Muñoz-Rivas, M. J., Fernández, L., & Gámez-Guadix, M. (2010). Analysis of the indicators of pathological Internet use in Spanish university students. The *Spanish Journal of Psychology, 13*(2), 697–707. https://doi.org/10.1017/s1138741600002365

Piqueras, J.A., Garcia-Olcina, M., Rivera-Riquelme, M., Rodríguez-Jiménez, T., Martínez-González, A., & Cuijpers, P. (2017) DetectaWeb Project: study protocol of a web-based detection of mental health of children and adolescents. *BMJ Open* 7:e017218. https://doi.org/10.1136/bmjopen-2017-017218

Piqueras, J. A., Martínez, A. E., Hidalgo, M. D., Fullana, M. A., Mataix, D., & Rosa, A. I. (2009). Psychometric properties of the Obsessive-Compulsive Inventory-Revised in a non-clinical sample of late adolescents. *Behavioral Psychology / Psicología Conductual, 17*(3), 561–572.

Pontes, H. M., Caplan, S. E., & Griffiths, M. D. (2016). Psychometric validation of the Generalized Problematic Internet Use Scale 2 in a Portuguese sample. *Computers in Human Behavior*, 63, 823–833. https://doi.org/10.1016/j.chb.2016.06.015

Rodríguez-Jiménez, T., Blasco, L., & Piqueras, J. A. (2014). Relación entre subtipos de sintomatología obsesivo compulsiva y de perfeccionismo en adolescentes [Relationship between subtypes of obsessive-compulsive symptomatology and those of perfectionism in adolescents]. *Behavioral Psychology / Psicología Conductual,* 22(2), 203–217.

Romer, D. (2010). Adolescent risk taking, impulsivity, and brain development: Implications for prevention. *Developmental Psychobiology*, 52, 263–276. https://doi.org/10.1002/dev.20442

Scherer, K. (1997). College life on-line: Healthy and unhealthy Internet use. *Journal of College Student Development, 38*(6), 655-665.

Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling*. Psychology Press.

Spada, M. M., Langston, B., Nikčević, A. V., & Moneta, G. B. (2008). The role of metacognitions in problematic Internet use. *Computers in Human Behavior, 24*(2), 2325-2335. https://doi.org/10.1016/j.chb.2007.12.002

Steinberg, L. (2007). Risk taking in adolescence new perspectives from brain and behavioral science. *Current Directions in Psychological Science,* 16(2), 55–59. https://doi.org/10.1111/j.1467-8721.2007.00475.x

Su, W., Han,X., Jin, C., Yan, Y., & Potenza (2019) Are males more likely to be addicted to the Internet than females? A meta-analysis involving 34 global jurisdictions. *Computers in Human Behavior*, 99 (2019), pp. 86-100, https://doi.org/10.1016/j.chb.2019.04.021

Tokunaga, R. S. (2014). A Unique Problem or the Manifestation of a Preexisting Disorder? The Mediating Role of Problematic Internet Use in the Relationships Between Psychosocial Problems and Functional Impairment. *Communication Research, 41*(4), 531-560. https://doi.org/10.1177/0093650212450910

Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior, 1*(3), 237-244. http://doi.org/10.1089/cpb.1998.1.237

Young, K. S. (2005). Clasificación de los subtipos, consecuencias y causas de la adicción a Internet [Classification of subtypes, consequences and causes of Internet Addiction]. *Psicología Conductual, 13*(3), 463-480.

Young, K.S., Yue, X.D., & Ying, L. (2011). Prevalence estimates and etiologic models of Internet addiction. In K. S. Young & C. N. de Abreu (Eds.), *Internet addiction: A handbook and guide to evaluation and treatment* (pp. 3-17). Wiley & Sons.