This is the **accepted version** of the journal article:

Statistical predictors of the co-occurrence between gambling disorder and problematic pornography use

Gemma Mestre-Bach a,*, Marc N. Potenza b,c,d,e,f,g, Roser Granero h,i,j, Juan Carlos Uríszar k,l, Fernando Fern´andez-Aranda h,j,k,m, Susana Jim´enez-Murcia h,j,k,m,**

a Instituto de Investigaci´on, Transferencia e Innovaci´on, Universidad Internacional de La Rioja, La Rioja, Spain
b Department of Psychiatry, Yale University School of Medicine, New Haven, CT, USA
c Child Study Center, Yale University School of Medicine, New Haven, CT, USA
d Connecticut Mental Health Center, New Haven, CT, USA
e Connecticut Council on Problem Gambling, Wethersfield, CT, USA
f Department of Neuroscience, Yale University, New Haven, CT, USA
g Wu Tsai Institute, Yale University, New Haven, CT, USA
h Ciber Fisiopatología Obesidad y Nutrici´on (CIBERObn), Instituto de Salud Carlos III, Barcelona, Spain
i Departament de Psicobiologia i Metodologia de les Ciencies de la Salut, Universitat Autonoma de Barcelona, Barcelona, Spain
j Psychoneurobiology of Eating and Addictive Behaviors Group, Neuroscience Program, Bellvitge Biomedical Research Institute (IDIBELL), Barcelona, Spain
k Clinical Psychology Department, University Hospital of Bellvitge-IDIBELL, Barcelona, Spain
l Sub-Directorate General for the Regulation of Gambling, Directorate General for Taxation and Gambling, Secretariat of Finance, Ministry of the Economy and Finance, Generalitat de Catalunya, Barcelona, Spain
m Department of Clinical Sciences, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain

ABSTRACT

Co-occurrence between gambling disorder (GD) and other mental disorders is common, but its association with problematic pornography use (PPU) remains unexplored. This study aimed to investigate relationships between sociodemographic variables, personality measures, psychopathology, emotional regulation, and impulsivity and the co-occurrence of GD and PPU using structural equation modeling (SEM). The sample consisted of 359 adults seeking treatment for GD. The short version of the Problematic Pornography Consumption Scale (PPCS-6) identified patients with GD+PPU. Psychopathology, impulsivity, emotional regulation, and personality were also assessed. Higher impulsivity levels statistically predicted co-occurrence between GD and PPU. Impulsivity mediated the relationship between younger age, maladaptive personality features, and emotional dysregulation and co-occurrence. Psychopathological distress did not directly associate with GD+PPU co-occurrence. Impulsivity relates importantly to the co-occurrence of GD and PPU. Younger age, maladaptive personality, and emotional dysregulation contribute to increased impulsivity levels and co-occurrence. The findings highlight the importance of addressing impulsivity in understanding and treating co-occurring GD and PPU.

Keywords: gambling disorder, addictive behaviors, impulsive behaviors, compulsive behaviors, problematic pornography use, psychopathology, personality, emotion regulation

INTRODUCTION

Existing research on factors predicting the co-occurrence of different psychiatric conditions remains limited. Nonetheless, several potential predictors, encompassing sociodemographic, clinical, and genetic factors, have been identified (Abbar et al., 2001; Amerio et al., 2015; Fornaro et al., 2016; Gradus et al., 2022; Peris et al., 2017; Shnayder et al., 2022). Among these, age has garnered particular attention. For instance, age has been found to serve as both a predictor (Peris et al., 2017) and a moderator (Fornaro et al., 2016) of co-occurrence. Specifically, higher mean age has been associated with a lower likelihood of co-occurrence (Amerio et al., 2015). Additionally, the severity of mental disorders and male gender have also emerged as relevant statistical predictors of co-occurrence of certain disorders (Peris et al., 2017). Furthermore, genetic factors have been suggested as potential predictors for the co-occurrence of mental disorders (Abbar et al., 2001; Shnayder et al., 2022), adding another layer of complexity to the understanding of these relationships.

In the specific case of gambling disorder (GD), there is a high prevalence of co-occurrence with other mental disorders, with the most common being substance use, mood, anxiety, personality and impulse control disorders (Di Nicola et al., 2014; Moore & Grubbs, 2021; Potenza et al., 2019; Szerman et al., 2023; Theule et al., 2019). However, while the co-occurrence between GD and compulsive sexual behavior disorder has been explored in some studies (Cowie et al., 2019; Grant & Steinberg, 2005; Tang et al., 2020), its co-occurrence with problematic pornography use (PPU) remains unexplored. Both GD and PPU have been suggested as behavioral addictions and involve a pattern of persistent and repetitive engagement in gambling/pornography, which leads to adverse consequences in one's life and unsuccessful efforts to reduce or stop such behaviors (APA, 2013; Bőthe et al., 2021). Clinically, to optimize treatments, it is important to identify factors that may predict the co-occurrence of GD and PPU.

To address limitations in understanding, the primary aim of this study was to investigate relationships between various factors (sociodemographic variables, personality measures, psychopathology, emotional regulation, and impulsivity) on predicting co-occurring GD and PPU using structural equation modeling (SEM). It was hypothesized that a maladaptive personality profile, along with higher levels of psychopathology, emotional dysregulation, and impulsivity, would be direct statistical predictors of co-occurring GD and PPU. By exploring the interactions between sociodemographic variables, personality features, psychopathology, emotional regulation, and impulsivity, the present study should enhance the theoretical understanding of behavioral addictions and facilitate the development of more effective, tailored treatments for individuals with co-occurring GD and PPU.

METHODS

Participants and procedure

The research sample included 359 consecutive adults who sought treatment for GD at a Behavioral Addictions Unit in a University Hospital between January 2021 and December 2022. This public hospital is well-known as a specialized tertiary care center for addressing psychological addictive behaviors, with a particular focus on complex cases. The inclusion criteria consisted of being over 18 years of age, of any gender, and having sought treatment specifically for GD as their main mental health concern. Participants were excluded from the study if they had a history of brain injury or neurological disease or reported an organic medical illness or neurodegenerative condition.

To identify patients with co-occurring GD and PPU, the short version of the Problematic Pornography Consumption Scale (PPCS-6; Bőthe et al., 2021) was used. GD patients who scored 20 or higher (out of 42) on this scale were categorized as having GD+PPU.

Measures

Patients were diagnosed with GD based on meeting four or more criteria outlined in the DSM-5 (APA, 2013). PPU was assessed through the Spanish validation (Jiménez-Murcia et al., 2023) of the short version of the PPCS-6 (Bőthe et al., 2021). In the study sample, internal consistency was α =.846. Psychopathology was assessed via the Spanish adapted version (Derogatis, 2002) of the Symptom Checklist-Revised (SCL-90-R; Derogatis, 1990). The internal consistency estimated in the study sample for the GSI was α= .983. The UPPS-P Impulsive Behavior Scale (Verdejo-García et al., 2010) was used to measure impulsive tendencies (internal consistency in the study sample was good, ranging from α =.752 in lack of perseverance to α =.924 in positive urgency). Emotion regulation was assessed using the Spanish adaptation (Hervás & Jódar, 2008) of the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The internal consistency of the questionnaire in our sample ranged from α =.750 to α =.933. Personality was evaluated through the Spanish revised version (Gutiérrez-Zotes et al., 2004) of the Temperament and Character Inventory-Revised (TCI-R; Cloninger, 1999). In the present study, internal consistency ranged from α =.701 to α =.869. Finally, a semi-structured face-to-face clinical interview (Jiménez-Murcia et al., 2006) was used to assess additional sociodemographic and clinical variables.

Statistical analysis

Statistical analysis was conducted with Stata18 for Windows. The mediational model testing the underlying relationships with co-occurring GD+PPU was performed through Structural Equation Models (SEMs). This procedure has been historically used as a confirmatory approach for testing well established, empirically supported theories/models, but studies also indicate that this statistical

analysis can also be employed as a very valuable technique for exploratory purposes; that is, mediational models through SEM allow both theory testing and theory development (Kline, 2005; MacCallum & Austin, 2000). This study used SEM for exploratory purposes given the lack of previous scientific research providing a rationale for concrete model specification. The following criteria were assumed for the SEM: (a) the parameters were free-estimated; (b) an initial model with all the potential relationships was defined, and next the parameters with no statistically significant contribution were deleted with the aim of avoiding over-fitting the model, and obtaining a final parsimonious model (having therefore increased statistical power); and (c) the maximum-likelihood estimation method of parameter estimation was used. Due to the large number of personality factors, a latent variable was defined for the TCI-R scores. The theoretical rationale for the model specification of the initial SEM was based on the cumulated empirical evidence (background in the introduction section), which provided the candidate pathways that should be tested to guaranteeing the clinical interpretability of the model. Regarding the rationale for this latent variable, despite the general support for dimensional models of personality, it is currently unclear which, and how many, factors the different taxonomies of this complex construct should include. The study of Gutiérrez and colleagues tested the potential hierarchical structure of different personality instruments, including the TCI-R questionnaire, to delineate the unified taxonomy of normal and abnormal personality (Gutiérrez et al., 2014). The authors obtained an entire hierarchy of personality crowned by a general factor/dimension that was next branched out into two factors of internalizing and externalizing content. The internalizing factor gave rise to a negative emotionality component, with high correlations with the TCI-R scales self-directedness and harm avoidance (both considered as distress-related variables). The internalizing factor also gave rise to an asociality scheme, reflected by the TCI-R reward dependence scale. In the other major branch, the externalizing factor reported high correlations with TCI-R scales persistence, self-transcendence, cooperativeness and novelty seeking.

For the impulsivity and the emotion regulation measures, the total scores obtained in the UPPS-P and the DERS questionnaires were included in the SEM, under this rationale: a) the inclusion of two additional latent variables with the impulsivity and the emotion regulation concrete dimensions generated a too complex SEM that provided poor goodness-of-fit; b) both, the UPPS-P and DERS tools versions used in the study, make sense of the composite score through factor analysis (excellent internal consistency was also obtained in this work for the total impulsivity and emotion (dys)regulation).

Adequate goodness-of-fit for the SEM was considered for root mean square error of approximation (RMSEA)<0.08, Bentler's Comparative Fit Index (CFI)>0.90, Tucker-Lewis Index (TLI)>0.90, and

standardized root mean square residual (SRMR)<0.10 (Barrett, 2007). The global predictive capacity of the model was estimated with the coefficient of determination (CD).

Ethics

The study procedures were conducted in accordance with the Declaration of Helsinki. The University Hospital Clinical Research Ethics Committee approved the study. All subjects were informed about the study, and all provided written informed consent.

RESULTS

Sample characteristics

Most participants were men (92.2%), had low education levels (51.3% primary and 39.8% secondary), were single (57.1%), and belonged to mean-low or low socio-economic position indexes (76.1%). Mean age was 39.5 years (SD=13.6), mean age of onset of GD was 28.3 years (SD=11.8) and mean duration of GD-related harms was 5.8 years (SD=6.5). Gambling preferences were: 39.3% only non-strategic, 42.6% only strategic and 18.1% mixed. Gambling activity was 50.4% offline, 27.9% online and 21.7% mixed.

The number of participants who achieved positive screening score on the PPCS-6 was 37, reflecting 10.31% of participants with GD (95% confidence interval: 7.16% to 13.45%). No association between GD+PPU co-occurrences was observed with participants' sex (χ^2 = 1.49, degrees of freedom [df] = 1, p = .222) or age (F = 0.21, df = 1/357, p = .641).

Structural analysis model

The final SEM diagram with the standardized coefficients is plotted in Figure 1 (the residual error terms were not included in the plot to achieve an easier graphical visualization of the relationships). Adequate goodness-of-fit was achieved (RMSEA=0.057 [95% confidence interval: 0.042 to 0.071], CFI=0.960, TLI=0.927 and SRMR=0.052). The global predictive capacity was around 15% (CD=0.154). The complete results for this final model are showed in Table S1 (supplementary material). The scheme with the initial complete SEM is also displayed in Figure S1 (supplementary material), as well as the fit statistics obtained for this first model. Table S2 (supplementary material) also displays the complete results with the robust MH estimator (no differences in the statistical significance were obtained with this estimator compared with the MH).

--- Insert Figure 1 ---

The variables defined for the latent variable with the personality profile achieved significant results, and the signal of the measurement coefficients indicated that higher levels in this latent construct were related to adverse personality profiles (higher scores in novelty seeking, harm avoidance and self-transcendence, and lower scores in reward dependence, persistence, self-directedness, and cooperativeness). To guarantee that obtain empirical evidence in the dataset analyzed in this study, we have carried out a test of the unidimensional factor structure of the measurement model specific to the TCI-R: a) significant coefficients were obtained (p<.05), being novelty seeking=0.227, harm avoidance=0.220, reward dependence=-0.227, persistence=-0.109, self-directedness=-0.731, cooperativeness=-0.574, and self-transcendence=0.373; b) adequate goodness-of-fit: RMSEA=0.059, CFI=0.950, TLI=0.906, and SRMR=0.064. We want to outline that latent variables in CFA allow both positive and negative loadings, just because factor loadings represent the strength and direction of the relationship between each observed variable and the latent factor. A positive loading simply indicates that the observed score increases as the latent factor score increases, while a negative loading indicates that the observed variable score decreases as the latent factor score increases. In our study, the loading sings obtained in the SEM are consistent with the theoretical expectations and are consistent attending to the correlation matrix expected for the TCI-R factor scores.

The likelihood of co-occurring GD and PPU increased for patients with higher impulsivity levels. Impulsivity was also a mediational link contributing to co-occurring GD and PPU. Younger age, more adverse personality profiles and emotion dysregulation contributed to increased impulsivity levels, and this path was subsequently associated with co-occurrence.

Global psychopathological distress was not associated with co-occurring GD and PPU, although it was increased for women, patients reporting more difficulties with emotion regulation and those with more adverse personality features.

DISCUSSION

The main objective of this study was to investigate factors statistically predicting co-occurring PPU among patients with GD. These factors included sociodemographic variables, personality features, psychopathology, emotional regulation, and impulsivity.

Individuals with higher impulsivity levels were more likely to report co-occurring GD and PPU. Impulsivity is a multidimensional construct that includes, among other aspects, disadvantageous decision-making and poor self-regulation. Therefore, individuals with higher levels of impulsivity may be more likely to engage in addictive behaviors that frequently co-occur, including GD and PPU. Impulsive individuals may more likely act without considering negative consequences associated

with behaviors such as maladaptive gambling and pornography use. This may explain why various prior studies have observed that individuals with co-occurring mental disorders have reported higher levels of impulsivity compared to those with a single disorder or control subjects (Çörekçioğlu et al., 2021; Rodríguez-Cintas et al., 2016; Walker et al., 2018).

Impulsivity also acted as a mediator. Younger age, a more dysfunctional personality profile and emotional dysregulation were associated with increased impulsivity, and increased impulsivity linked to GD/PPU co-occurrence. The relationships between impulsivity, younger age, and co-occurrence of GD and PPU may be related to developmental processes. Younger individuals often exhibit higher levels of impulsivity, which may decrease with age as cognitive control improves. Therefore, the co-occurrence might be more pronounced among younger individuals who are still developing self-regulation processes. In this vein, previous studies have observed that younger age is associated with a higher likelihood of co-occurrence of multiple mental disorders (Amerio et al., 2015). On the other hand, a maladaptive personality profile and difficulties in emotional regulation may lead to elevated levels of distress and intense negative emotions. Impulsivity may drive individuals to resort to gambling and pornography use as maladaptive coping mechanisms to reduce those negative emotions.

Finally, contrary to our hypothesis, psychopathological distress did not directly associate with co-occurring GD and PPU. This might reflect possible relief from distress through pornography use or that the relationship between co-occurring GD and PPU and psychopathological distress involves other factors not included in the present study. However, although specific patterns were observed. Notably, women, individuals with greater emotional dysregulation, and those with more maladaptive personality profiles experienced elevated levels of global psychopathological distress. Women with GD/PPU may experience greater stressors and societal pressures and stigma compared to men (Quigley, 2022), possibly leading to higher levels of psychopathological distress. Moreover, individuals who have difficulties in regulating their emotions and who show maladaptive personality profiles might be more susceptible to experiencing higher levels of psychopathological distress when faced with GD/PPU.

Limitations and future studies

The present study has some limitations. First, there are no standardized diagnostic criteria for PPU, which led to the use of the PPCS-6 for assessment, possibly introducing biases like desirability bias. Second, while all study variables were assessed using psychometrically sound instruments, which is a strength, the instruments may also have inherent biases. Future research should consider incorporating behavioral measures to complement self-report of clinician-administered assessments. Third, the study sample was mainly male, limiting the generalizability of the findings. Future studies should include more women and other sex and gender groups. Fourth, the sample consisted of

treatment-seeking individuals, limiting the generalizability of the results to those who do not seek treatment. Fifth, the study did not assess the sequence of onset for each condition, which may be relevant in treatment settings or for deeper understanding of mechanistic processes. And finally, the SEM employed in this work was used as an exploratory technique (due the lack of a solid theory to define the concrete model specification). This approach justified the setting procedure, based on an initial full structural model and next deleting the statistical non-significant parameters, to achieve a final parsimonious SEM, with adequate fitting indexes and good clinical interpretation. It would be useful that future research considers our model as a starting point and obtain new scientific evidence. New analyses with larger sample sizes (and therefore higher statistical power capacity) should also test alternative SEMs including the multidimensional structure of the impulsivity and the emotion regulation measures, which will provide a more precise picture of the relationships.

Clinical implications

This study has multiple clinical implications. The findings highlight the need to design interventions for the considerable proportion of people with GD with co-occurring PPU. For example, given that impulsivity may be both a direct predictor and mediator in this co-occurrence, it could represent a central therapeutic target. Likewise, given that women with GD+PPU experience higher levels of psychopathological distress highlights the need for gender-sensitive approaches. Therefore, the study emphasizes the importance of designing interventions that do not focus exclusively on reducing the symptoms of both conditions, but aim to improve overall mental health, including factors such as psychopathological distress and impulsivity.

CONCLUSIONS

Impulsivity emerged as a key direct statistical predictor of the co-occurrence of GD and PPU. Moreover, impulsivity also acted as a mediator, linking younger age, maladaptive personality features, and emotional dysregulation to increased impulsivity levels, which in turn linked to GD/PPU co-occurrence. The findings underscore the importance of impulsivity in both GD and PPU, with individuals prone to acting without considering negative consequences more likely to engage in maladaptive gambling and pornography use.

Ethics

The study procedures were conducted in accordance with the Declaration of Helsinki. The University Hospital Clinical Research Ethics Committee approved the study. All subjects were informed about the study, and all provided written informed consent.

Declaration of competing interest

Dr. Potenza discloses that he has consulted for and advised Game Day Data, Addiction Policy Forum, AXA, Idorsia, Baria-Tek, Boehringer Ingelheim, and Opiant Therapeutics; been involved in a patent application with Yale University and Novartis; received research support from the Mohegan Sun Casino, Children and Screens and the Connecticut Council on Problem Gambling; consulted for or advised legal and gambling entities on issues related to impulse control, internet use and addictive behaviors; provided clinical care related to impulsecontrol and addictive behaviors; performed grant reviews; edited journals/journal sections; given academic lectures in grand rounds, CME events, and other clinical/scientific venues; and generated books or chapters for publishers of mental health texts. Drs. Fern´andez-Aranda and Susana Jimenez-Murcia received consultancy/speaker honoraria from Novo Nordisk. The other authors have no conflicts of interest with respect to the content of this manuscript.

REFERENCES

Abbar, M., Courtet, P., Bellivier, F., Leboyer, M., Boulenger, J. P., Castelhau, D., Ferreira, M., Lambercy, C., Mouthon, D., Paoloni-Giacobino, A., Vessaz, M., Malafosse, A., & Buresi, C. (2001). Suicide attempts and the tryptophan hydroxylase gene. *Molecular Psychiatry*, *6*(3), 268–273. https://doi.org/10.1038/sj.mp.4000846

Amerio, A., Stubbs, B., Odone, A., Tonna, M., Marchesi, C., & Ghaemi, S. N. (2015). The prevalence and predictors of comorbid bipolar disorder and obsessive–compulsive disorder: A systematic review and meta-analysis. *Journal of Affective Disorders*, *186*, 99–109. https://doi.org/10.1016/j.jad.2015.06.005

APA. (2013). *Diagnostic and Statistical Manual of Mental Disorders 5 edition (DSM-5)*. American Psychiatric Association.

Barrett, P. (2007). Structural equation modelling: Adjudging model fit. *Personality and Individual Differences*, *42*(5), 815–824. https://doi.org/10.1016/j.paid.2006.09.018

Bőthe, B., Tóth-Király, I., Demetrovics, Z., & Orosz, G. (2021). The Short Version of the Problematic Pornography Consumption Scale (PPCS-6): A Reliable and Valid Measure in General and Treatment-Seeking Populations. *Journal of Sex Research*, *58*(3), 342–352. https://doi.org/10.1080/00224499.2020.1716205

Cloninger, C. R. (1999). The temperament and character inventory revised. *St. Louis,MO: Center for Psychobiology of Personality*.

Çörekçioğlu, S., Cesur, E., & Devrim Balaban, Ö. (2021). Relationship between impulsivity, comorbid anxiety and neurocognitive functions in bipolar disorder. *International Journal of Psychiatry in Clinical Practice*, *25*(1), 62–72. https://doi.org/10.1080/13651501.2020.1833040

Cowie, M. E., Kim, H. S., Hodgins, D. C., McGrath, D. S., Scanavino, M. D. T., & Tavares, H. (2019). Demographic and psychiatric correlates of compulsive sexual behaviors in gambling disorder. *Journal of Behavioral Addictions*, *8*(3), 451–462. https://doi.org/10.1556/2006.8.2019.35

Derogatis, L. (1990). *SCL-90-R. Administration, scoring and procedures manual* (Clinical P).

Derogatis, L. R. (2002). *SCL-90-R. Cuestionario de 90 síntomas-Manual*. TEA Editorial.

Di Nicola, M., De Risio, L., Pettorruso, M., Caselli, G., De Crescenzo, F., Swierkosz-Lenart, K., Martinotti, G., Camardese, G., Di Giannantonio, M., & Janiri, L. (2014). Bipolar disorder and gambling disorder comorbidity: Current evidence and implications for pharmacological treatment. *Journal of Affective Disorders*, *167*, 285–298.

https://doi.org/10.1016/j.jad.2014.06.023

Fornaro, M., Orsolini, L., Marini, S., De Berardis, D., Perna, G., Valchera, A., Gananca, L., Solmi, M., Veronese, N., & Stubbs, B. (2016). The prevalence and predictors of bipolar and borderline personality disorders comorbidity: Systematic review and meta-analysis. *Journal of Affective Disorders*, *195*, 105–118. https://doi.org/10.1016/j.jad.2016.01.040

Gradus, J. L., Rosellini, A. J., Szentkúti, P., Horváth-Puhó, E., Smith, M. L., Galatzer-Levy, I., Lash, T. L., Galea, S., Schnurr, P. P., & Sørensen, H. T. (2022). Pre-trauma predictors of severe psychiatric comorbidity 5 years following traumatic experiences. *International Journal of Epidemiology*, *51*(5), 1593–1603. https://doi.org/10.1093/ije/dyac030

Grant, J. E., & Steinberg, M. A. (2005). Compulsive Sexual Behavior and Pathological Gambling. *Sexual Addiction & Compulsivity*, *12*(2–3), 235–244. https://doi.org/10.1080/10720160500203856

Gratz, K. L., & Roemer, L. (2004). Multidimensional Assessment of Emotion Regulation and Dysregulation: Development, Factor Structure, and Initial Validation of the Difficulties in Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment*, *26*(1), 41–54. https://doi.org/10.1023/B:JOBA.0000007455.08539.94

Gutiérrez-Zotes, J. A., Bayón, C., Montserrat, C., Valero, J., Labad, A., Cloninger, C. R., & Fernández-Aranda, F. (2004). Temperament and Character Inventory Revised (TCI-R). Standardization and normative data in a general population sample. *Actas Españolas de Psiquiatria*, *32*(1), 8–15.

Gutiérrez, F., Vall, G., Peri, J. M., Gárriz, M., & Garrido, J. M. (2014). A hierarchical model of normal and abnormal personality up to seven factors. *Comprehensive Psychiatry*, *55*(2), 326–335. https://doi.org/10.1016/j.comppsych.2013.08.022

Hervás, G., & Jódar, R. (2008). Adaptación al castellano de la Escala de Dificultades en la Regulación Emocional. *Clínica y Salud*, *19*(2), 139–156.

Jiménez-Murcia, S., Aymamí-Sanromà, M Gómez-Peña, M., Álvarez-Moya, E., & Vallejo, J. (2006). Protocols de tractament cognitivoconductual pel joc patològic i d'altres addiccions no tòxiques [Cognitive-behavioral treatment protocols for pathological gambling and other non-toxic addictions. *Barcelona, Spain: Hospital Universitari de Bellvitge, Departament de Salut, Generalitat de Catalunya.*

Jiménez-Murcia, S., Granero, R., Testa, G., Tarragón, E., Potenza, M. N., Bőthe, B., Demetrovics, Z., Uríszar, J. C., Chiclana Actis, C., Fernández-Aranda, F., & Mestre-Bach, G. (2023). Clinical

validation of the Problematic Pornography Consumption Scale – Short Form (PPCS-6). *Addictive Behaviors*, *Submitted*.

Kline, R. (2005). *Principles and Practice of Structural Equation Modeling (2 Edition)*. The Guilford Press.

MacCallum, R., & Austin, J. (2000). Applications of Structural Equation Modeling in Psychological Research. *Annual Review of Psychology*, *51*, 201–226.

Moore, L. H., & Grubbs, J. B. (2021). Gambling Disorder and comorbid PTSD: A systematic review of empirical research. *Addictive Behaviors*, *114*, 106713. https://doi.org/10.1016/j.addbeh.2020.106713

Peris, T. S., Rozenman, M., Bergman, R. L., Chang, S., O'Neill, J., & Piacentini, J. (2017). Developmental and clinical predictors of comorbidity for youth with obsessive compulsive disorder. *Journal of Psychiatric Research*, *93*, 72–78. https://doi.org/10.1016/j.jpsychires.2017.05.002

Potenza, M. N., Balodis, I. M., Derevensky, J., Grant, J. E., Petry, N. M., Verdejo-Garcia, A., & Yip, S. W. (2019). Gambling disorder. *Nature Reviews Disease Primers*, *5*(1). https://doi.org/10.1038/s41572-019-0099-7

Quigley, L. (2022). Gambling Disorder and Stigma: Opportunities for Treatment and Prevention. *Current Addiction Reports*, *9*(4), 410–419. https://doi.org/10.1007/s40429-022-00437-4

Rodríguez-Cintas, L., Daigre, C., Grau-López, L., Barral, C., Pérez-Pazos, J., Voltes, N., Braquehais, M. D., Casas, M., & Roncero, C. (2016). Impulsivity and addiction severity in cocaine and opioid dependent patients. *Addictive Behaviors*, *58*, 104–109. https://doi.org/10.1016/j.addbeh.2016.02.029

Shnayder, N. A., Novitsky, M. A., Neznanov, N. G., Limankin, O. V., Asadullin, A. R., Petrov, A. V., Dmitrenko, D. V., Narodova, E. A., Popenko, N. V., & Nasyrova, R. F. (2022). Genetic Predisposition to Schizophrenia and Depressive Disorder Comorbidity. *Genes*, *13*(3), 457. https://doi.org/10.3390/genes13030457

Szerman, N., Basurte-Villamor, I., Vega, P., Mesías, B., Martínez-Raga, J., Ferre, F., & Arango, C. (2023). Is there such a thing as gambling dual disorder? Preliminary evidence and clinical profiles. *European Neuropsychopharmacology*, *66*, 78–91. https://doi.org/10.1016/j.euroneuro.2022.11.010

Tang, K. T. Y., Kim, H. S., Hodgins, D. C., McGrath, D. S., & Tavares, H. (2020). Gambling disorder and comorbid behavioral addictions: Demographic, clinical, and personality correlates.

Psychiatry Research, *284*, 112763. https://doi.org/10.1016/j.psychres.2020.112763

Theule, J., Hurl, K. E., Cheung, K., Ward, M., & Henrikson, B. (2019). Exploring the Relationships Between Problem Gambling and ADHD: A Meta-Analysis. *Journal of Attention Disorders*, *23*(12), 1427–1437. https://doi.org/10.1177/1087054715626512

Walker, J., Bountress, K. E., Calhoun, C. D., Metzger, I. W., Adams, Z., Amstadter, A., Thomas, S., & Danielson, C. K. (2018). Impulsivity and Comorbid PTSD and Binge Drinking. *Journal of Dual Diagnosis*, *14*(2), 89–95. https://doi.org/10.1080/15504263.2018.1439212

Wolz, I., Agüera, Z., Granero, R., Jiménez-Murcia, S., Gratz, K. L., Menchón, J. M., & Fernández-Aranda, F. (2015). Emotion regulation in disordered eating: Psychometric properties of the difficulties in emotion regulation scale among spanish adults and its interrelations with personality and clinical severity. *Frontiers in Psychology*, *6*(JUN). https://doi.org/10.3389/fpsyg.2015.00907

Figure 1 SEM diagram with the standardized coefficients obtained in the study
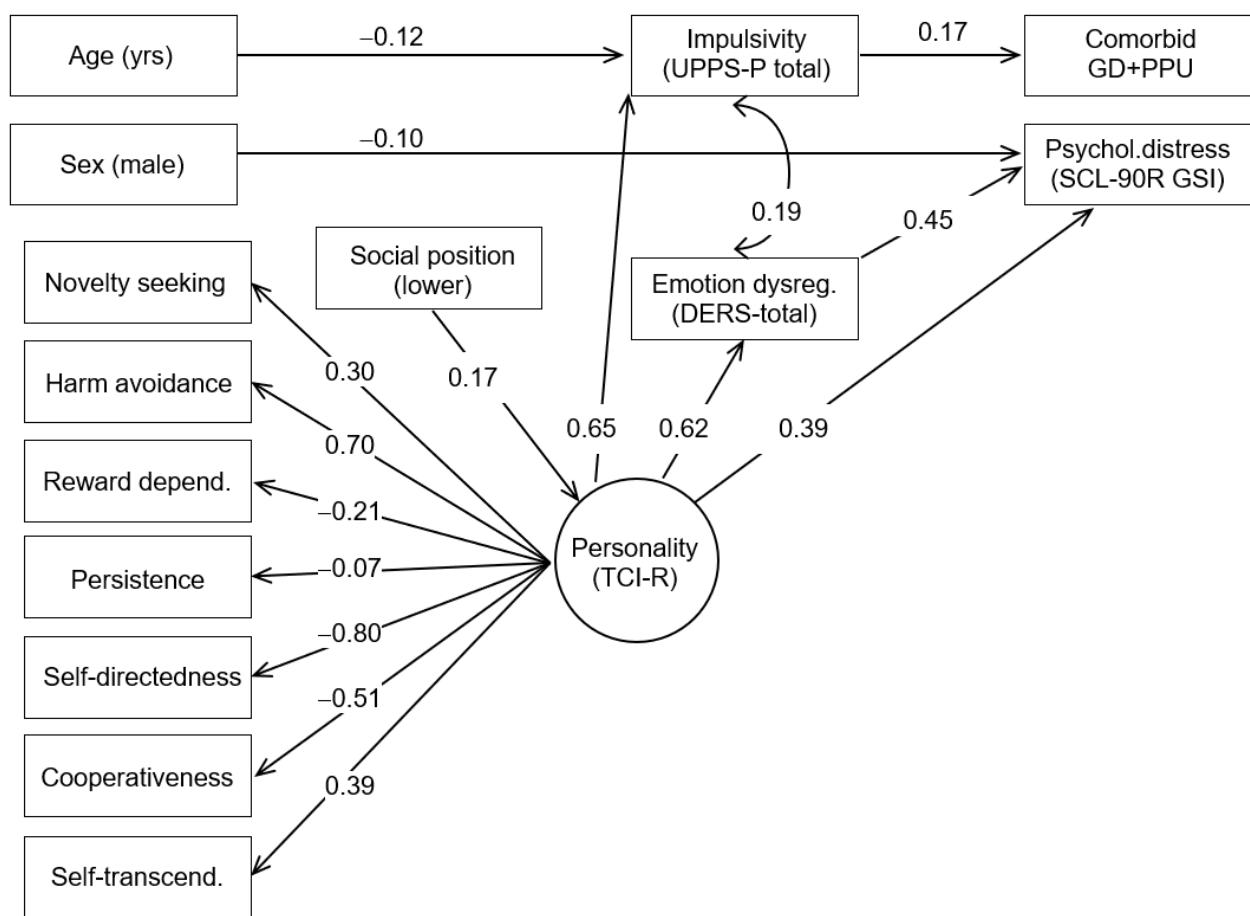
Note. DERS: *Difficulties in Emotion Regulation Scale; GD: gambling disorder; PPU: problematic pornography use; Psychol. distress: psychological distress; TCI-R: Temperament and Character Inventory-Revised; SCL-90R: Symptom Checklist-Revised; UPPS-P: Impulsive Behavior Scale.*

Table S1 (supplementary) Test for direct, indirect and total effects of the SEM (ML estimator)

| Direct effects			Coeff.	SE	z-stat	p	Std.Coeff.
Structural	UPPS-P total	TCI-R	48.1078	7.1078	6.77	0.001	0.6229
		Age (years)	-0.2074	0.0724	-2.86	0.004	-0.1185
	GD+PPU	UPPS_Total	0.0021	0.0007	3.18	0.001	0.1646
	DERS total	TCI	48.5094	6.6101	7.34	0.001	0.6385
	TCI-R	Social position	0.0450	0.0168	2.68	0.007	0.1635
	SCL-90R GSI	DERS total	0.0144	0.0017	8.52	0.001	0.4406
		TCI-R	1.0000	(constr.)			0.4014
		Sex	-0.2694	0.0981	-2.75	0.006	-0.0942
Measurement		Novelty seeking	18.7050	4.2986	4.35	0.001	0.4496
		Harm avoidance	30.0133	5.3285	5.63	0.001	0.5413
		Reward dependence	-10.2652	2.9098	-3.53	0.001	-0.2236
		Persistence	-4.2629	3.5214	-1.21	0.226	-0.0696
		Self-directedness	-57.4578	8.5849	-6.69	0.001	-0.8787
		Cooperativeness	-27.5204	4.5474	-6.05	0.001	-0.5233
		Self-transcendence	20.1564	3.7322	5.40	0.001	0.3972
Indirect effects			Coeff.	SE	z-stat	p	Std.Coeff.
Structural	UPPS-P total	Social position	2.1672	0.7599	2.85	0.004	0.1018
	GD+PPU	TCI-R	0.1013	0.0348	2.91	0.004	0.1026
		Age (years)	-0.0004	0.0002	-2.13	0.033	-0.0195
		Social position	0.0046	0.0022	2.12	0.034	0.0168
	DERS total	Social position	2.1853	0.7682	2.84	0.004	0.1044
	SCL-90R GSI	TCI-R	0.7009	0.1582	4.43	0.001	0.2813
		Social position	0.0766	0.0267	2.87	0.004	0.1116
Measurement	Novelty seeking	Social position	0.8426	0.2992	2.82	0.005	0.0735
	Harm avoidance	Social position	1.3520	0.4759	2.84	0.005	0.0885
	Reward depend.	Social position	-0.4624	0.1971	-2.35	0.019	-0.0366
	Persistence	Social position	-0.1920	0.1731	-1.11	0.267	-0.0114
	Self-directedness	Social position	-2.5884	0.8619	-3.00	0.003	-0.1437
	Cooperativeness	Social position	-1.2397	0.4352	-2.85	0.004	-0.0856
	Self-transcendence	Social position	0.9080	0.3329	2.73	0.006	0.0649
Total effects			Coeff.	SE	z-stat	p	Std.Coeff.
Structural	UPPS-P total	TCI-R	48.1078	7.1078	6.77	0.001	0.6229
		Age (years)	-0.2074	0.0724	-2.86	0.004	-0.1185
		Social position	2.1672	0.7599	2.85	0.004	0.1018
	PPCS6bin	UPPS_Total	0.0021	0.0007	3.18	0.001	0.1646
		TCI-R	0.1013	0.0348	2.91	0.004	0.1026
		Age (years)	-0.0004	0.0002	-2.13	0.033	-0.0195
		Social position	0.0046	0.0022	2.12	0.034	0.0168
	DERS_TOTAL	TCI-R	48.5094	6.6101	7.34	0.001	0.6385
		Social position	2.1853	0.7682	2.84	0.004	0.1044
	TCI	Social position	0.0450	0.0168	2.68	0.007	0.1635
	SCLgsi	DERS_TOTAL	0.0144	0.0017	8.52	0.001	0.4406
		TCI-R	1.7009	0.1582	10.75	0.001	0.6827
		Sex	-0.2694	0.0981	-2.75	0.006	-0.0942
		Social position	0.0766	0.0267	2.87	0.004	0.1116
Measurement	Novelty seeking	TCI-R	18.7050	4.2986	4.35	0.001	0.4496
		Social position	0.8426	0.2992	2.82	0.005	0.0735
	Harm avoidance	TCI-R	30.0133	5.3285	5.63	0.001	0.5413
		Social position	1.3520	0.4759	2.84	0.005	0.0885
	Reward depend.	TCI-R	-10.2652	2.9098	-3.53	0.001	-0.2236
		Social position	-0.4624	0.1971	-2.35	0.019	-0.0366
	Persistence	TCI-R	-4.2629	3.5214	-1.21	0.226	-0.0696
		Social position	-0.1920	0.1731	-1.11	0.267	-0.0114
	Self-directedness	TCI-R	-57.4578	8.5849	-6.69	0.001	-0.8787
		Social position	-2.5884	0.8619	-3.00	0.003	-0.1437
	Cooperativeness	TCI-R	-27.5204	4.5474	-6.05	0.001	-0.5233
		Social position	-1.2397	0.4352	-2.85	0.004	-0.0856
	Self-transcendence	TCI-R	20.1564	3.7322	5.40	0.001	0.3972
		Social position	0.9080	0.3329	2.73	0.006	0.0649

Note. SE: standard error. Std.Coeff: standardized coefficient.

Table S2 (supplementary) Test for direct, indirect and total effects (robust ML estimator)

Direct effects			Coeff.	SE	z-stat	p	Std.Coeff.
Structural	UPPS-P total	TCI-R	48.1078	8.4224	5.71	0.000	0.6229
		Age (years)	-0.2074	0.0721	-2.88	0.004	-0.1185
	GD+PPU	UPPS_Total	0.0021	0.0007	3.15	0.002	0.1646
	DERS total	TCI	48.5094	7.4636	6.50	0.000	0.6385
	TCI-R	Social position	0.0450	0.0182	2.48	0.013	0.1635
	SCL-90R GSI	DERS total	0.0144	0.0019	7.56	0.000	0.4406
		TCI-R	1.0000	(constr.)			0.4014
		Sex	-0.2694	0.0888	-3.03	0.002	-0.0942
Measurement		Novelty seeking	18.7050	5.0655	3.69	0.000	0.4496
		Harm avoidance	30.0133	5.4152	5.54	0.000	0.5413
		Reward dependence	-10.2652	3.1725	-3.24	0.001	-0.2236
		Persistence	-4.2629	4.0035	-1.06	0.287	-0.0696
		Self-directedness	-57.4578	9.0694	-6.34	0.000	-0.8787
		Cooperativeness	-27.5204	5.0793	-5.42	0.000	-0.5233
		Self-transcendence	20.1564	4.0019	5.04	0.000	0.3972
Indirect effects			Coeff.	SE	z-stat	p	Std.Coeff.
Structural	UPPS-P total	Social position	2.1672	0.8572	2.53	0.011	0.1018
	GD+PPU	TCI-R	0.1013	0.0381	2.66	0.008	0.1026
		Age (years)	-0.0004	0.0002	-2.27	0.023	-0.0195
		Social position	0.0046	0.0025	1.92	0.047	0.0168
	DERS total	Social position	2.1853	0.8804	2.48	0.013	0.1044
	SCL-90R GSI	TCI-R	0.7009	0.1813	3.87	0.000	0.2813
		Social position	0.0766	0.0294	2.60	0.009	0.1116
Measurement	Novelty seeking	Social position	0.8426	0.3164	2.66	0.008	0.0735
	Harm avoidance	Social position	1.3520	0.5588	2.42	0.016	0.0885
	Reward depend.	Social position	-0.4624	0.2322	-1.99	0.046	-0.0366
	Persistence	Social position	-0.1920	0.2111	-0.91	0.363	-0.0114
	Self-directedness	Social position	-2.5884	0.9447	-2.74	0.006	-0.1437
	Cooperativeness	Social position	-1.2397	0.5018	-2.47	0.013	-0.0856
	Self-transcendence	Social position	0.9080	0.3713	2.45	0.014	0.0649
Total effects			Coeff.	SE	z-stat	p	Std.Coeff.
Structural	UPPS-P total	TCI-R	48.1078	8.4224	5.71	0.000	0.6229
		Age (years)	-0.2074	0.0721	-2.88	0.004	-0.1185
		Social position	2.1672	0.8572	2.53	0.011	0.1018
	PPCS6bin	UPPS_Total	0.0021	0.0007	3.15	0.002	0.1646
		TCI-R	0.1013	0.0381	2.66	0.008	0.1026
		Age (years)	-0.0004	0.0002	-2.27	0.023	-0.0195
		Social position	0.0046	0.0025	1.82	0.047	0.0168
	DERS_TOTAL	TCI-R	48.5094	7.4636	6.50	0.000	0.6385
		Social position	2.1853	0.8804	2.48	0.013	0.1044
	TCI	Social position	0.0450	0.0182	2.48	0.013	0.1635
	SCLgsi	DERS_TOTAL	0.0144	0.0019	7.56	0.000	0.4406
		TCI-R	1.7009	0.1813	9.38	0.000	0.6827
		Sex	-0.2694	0.0888	-3.03	0.002	-0.0942
		Social position	0.0766	0.0294	2.60	0.009	0.1116
Measurement	Novelty seeking	TCI-R	18.7050	5.0655	3.69	0.000	0.4496
		Social position	0.8426	0.3164	2.66	0.008	0.0735
	Harm avoidance	TCI-R	30.0133	5.4152	5.54	0.000	0.5413
		Social position	1.3520	0.5588	2.42	0.016	0.0885
	Reward depend.	TCI-R	-10.2652	3.1725	-3.24	0.001	-0.2236
		Social position	-0.4624	0.2322	-1.99	0.046	-0.0366
	Persistence	TCI-R	-4.2629	4.0035	-1.06	0.287	-0.0696
		Social position	-0.1920	0.2111	-0.91	0.363	-0.0114
	Self-directedness	TCI-R	-57.4578	9.0694	-6.34	0.000	-0.8787
		Social position	-2.5884	0.9447	-2.74	0.006	-0.1437
	Cooperativeness	TCI-R	-27.5204	5.0793	-5.42	0.000	-0.5233
		Social position	-1.2397	0.5018	-2.47	0.013	-0.0856
	Self-transcendence	TCI-R	20.1564	4.0019	5.04	0.000	0.3972
		Social position	0.9080	0.3713	2.45	0.014	0.0649

Note. SE: standard error. Std.Coeff: standardized coefficient.

Figure S1 (supplementary) SEM diagram with the standardized coefficients obtained in the study
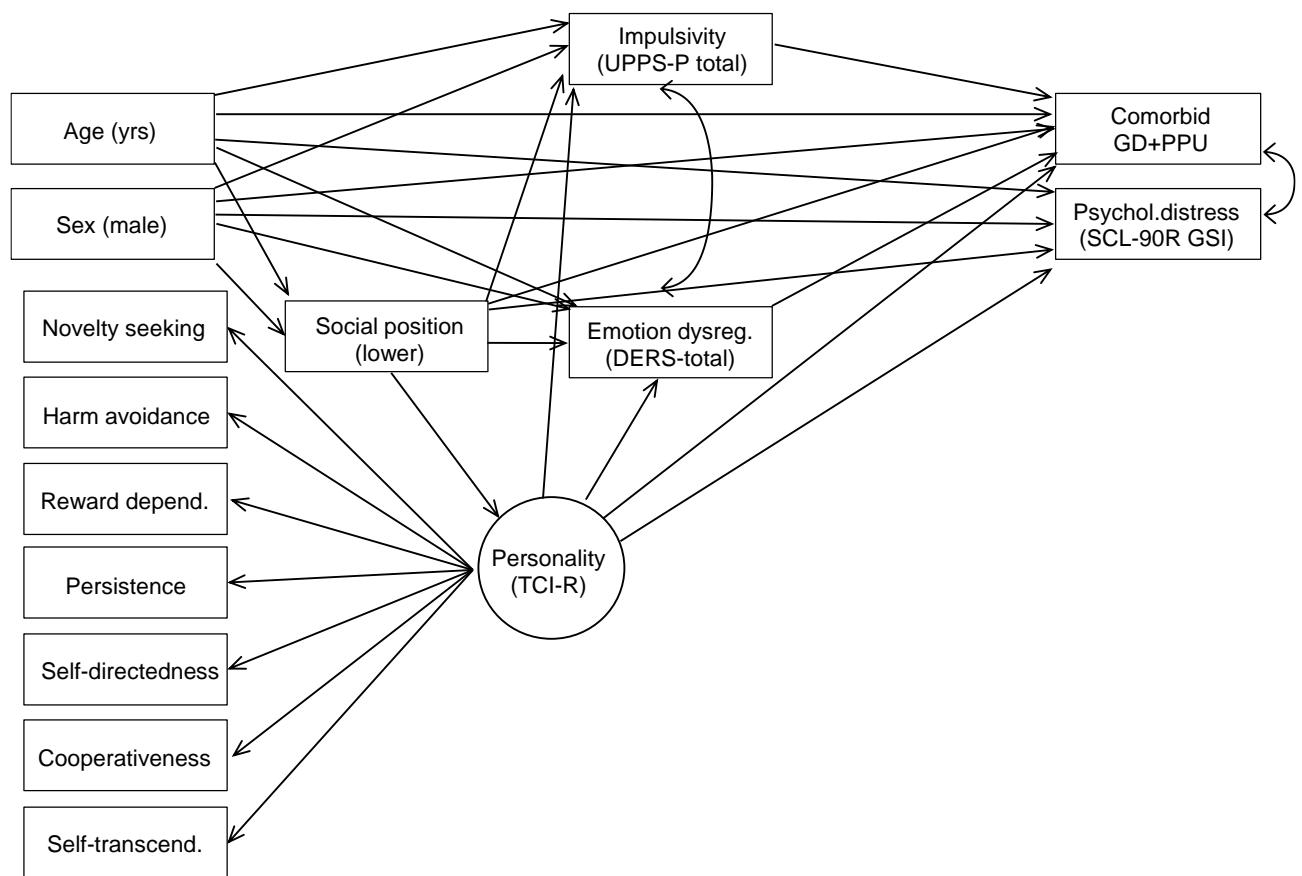
Note. DERS: Difficulties in Emotion Regulation Scale; GD: gambling disorder; PPU: problematic pornography use; Psychol. distress: psychological distress; TCI-R: Temperament and Character Inventory-Revised; SCL-90R: Symptom Checklist-Revised; UPPS-P: Impulsive Behavior Scale. Fit statistics: (RMSEA=0.065 [95% confidence interval: 0.048 to 0.081], CFI=0.960, TLI=0.903; SRMR=0.049; CD=0.112).