Subtyping treatment-seeking gaming disorder patients

Roser Granero [a,b], Fernando Fernández-Aranda [a,c,d,e], Jesús Castro-Calvo [f], Joël Billieux [g,h], Susana Valero-Solís [c], Bernat Mora-Maltas [c], Sandra Rivas-Pérez [c], Eduardo Valenciano-Mendoza [c], Amparo del Pino-Gutiérrez [a,c,k], Mónica Gómez-Peña [c], Laura Moragas [c], Isabel Baenas [a,c], Teresa Mena-Moreno [c], Gemma Casalé-Salayet [c], Ester Codina [c], Vega González-Bueso [i], Juan Jose Santamaría [i], Marta Baño [i], José M. Menchón [c,d,e,j], Susana Jiménez-Murcia [a,c,d,e,*]

[a] *Ciber Fisiopatología Obesidad y Nutrición (CIBERObn), Instituto Salud Carlos III, Madrid, Spain*
[b] *Department of Psychobiology and Methodology, Autonomous University of Barcelona, Barcelona, Spain*
[c] *Department of Psychiatry, Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Spain*
[d] *Psychiatry and Mental Health Group, Neuroscience Program, Institut d'Investigació Biomèdica de Bellvtge - IDIBELL, L'Hospitalet de Llobregat, Spain*
[e] *Department of Clinical Sciences, School of Medicine, Universitat de Barcelona - UB, L'Hospitalet de Llobregat, Spain*
[f] *Department of Personality, Assessment, and Psychological Treatments, University of Valencia, Valencia, Spain*
[g] *Institute of Psychology, University of Lausanne, Lausanne, Switzerland*
[h] *Centre for Excessive Gambling, Addiction Medicine, Lausanne University Hospitals (CHUV), Lausanne, Switzerland*
[i] *Atención e Investigación en Socioadicciones (AIS), Mental Health and Addictions Network, Generalitat de Catalunya (XHUB), Barcelona, Spain*
[j] *Ciber Salut Mental (CIBERSam), Instituto de Salud Carlos III. Madrid, Spain*
[k] *Department of Public Health, Mental Health and Maternal-Child Nursing, School of Nursing, University of Barcelona, Barcelona, Spain*

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ABSTRACT

Background and aims: Gaming Disorder (GD) is characterized by a pattern of persistent and uncontrolled gaming behavior that causes a marked impairment in important areas of functioning. The evolution of the worldwide incidence of this disorder warrants further studies focused on examining the existence of different subtypes within clinical samples, in order to tailor treatment. This study explored the existence of different profiles of patients seeking treatment for GD through a data-driven approach.

Methods: The sample included $n = 107$ patients receiving treatment for GD (92% men and 8% women) ranging between 14 and 60 years old (mean age = 24.1, $SD = 10$). A two-step clustering analysis approach explored the existence of different underlying GD profiles based on a broad set of indicators, including sociodemographic features, clinical course of the condition (e.g., onset or evolution), psychopathological symptoms, and personality traits.

Results: Two GD profiles emerged. The first cluster grouped together patients who presented with a lower psychological impact ($n = 72$, 66.1%), whereas the second cluster comprised patients with a higher psychological impact ($n = 35$, 32.7%). Cluster comparisons revealed that those patients presenting the higher impact were older, with a later onset of pathological gaming patterns, and more pronounced psychopathological symptoms and dysfunctional personality profiles.

Conclusions: GD severity is influenced by specific demographic, clinical, and psychopathological factors. The identification of two separate profiles provides empirical evidence that contributes to the conceptualization of

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* Corresponding author at: Department of Psychiatry. Bellvitge University Hospital-IDIBELL and CIBERObn. c/ Feixa Llarga s/n, 08907, Hospitalet de Llobregat, Barcelona, Spain.

E-mail addresses: roser.granero@uab.cat (R. Granero), ffernandez@bellvitgehospital.cat (F. Fernández-Aranda), jesus.castro@uv.es (J. Castro-Calvo), Joel. Billieux@unil.ch (J. Billieux), bmora@bellvitgehospital.cat (B. Mora-Maltas), srivasp@bellvitgehospital.cat (S. Rivas-Pérez), edevalenciano@idibell.cat (E. Valenciano-Mendoza), adelpino@ub.edu (A. del Pino-Gutiérrez), monicagomez@bellvitgehospital.cat (M. Gómez-Peña), lmoragas@bellvitgehospital.cat (L. Moragas), ibaenas@bellvitgehospital.cat (I. Baenas), tmena@bellvitgehospital.cat (T. Mena-Moreno), gcasale@bellvitgehospital.cat (G. Casalé-Salayet), ecodina@bellvitgehospital.cat (E. Codina), vgonzalez@ais-info.org (V. González-Bueso), jsantamaria@ais-info.org (J.J. Santamaría), mbano@ais-info.org (M. Baño), jmenchon@bellvitgehospital.cat (J.M. Menchón), sjimenez@bellvitgehospital.cat (S. Jiménez-Murcia).

this disorder, as well as to the development of reliable and valid screening tools and effective intervention plans focused on the precise characteristics of the treatment-seeking patients.

1. Introduction

For most people, video games constitute a healthy leisure activity. What was previously used as a hobby (sometimes, with little social acceptance), has today been socially normalized to the point that there is a subculture that has turned this type of entertainment into a way of life (John et al., 2019). Parallel to this increased popularity, experts have emphasized the risks of the inappropriate use of video games (King, 2018), particularly among adolescents and young people, who are at increased risk of developing addictive-like symptoms (Sugaya et al., 2019). While research shows that video game involvement is for the great majority a playful and non-problematic activity (Chung, Vanderbilt, & Soares, 2015; Pallavicini, Ferrari, & Mantovani, 2018), a subgroup of vulnerable gamers with low social skills, low self-esteem, and self-efficacy may find in these games a way to avoid psychological distress (Blasi et al., 2019; Cudo et al., 2019). Among this vulnerable group, the preoccupation with gaming and the inability to set limits on how much time is spent gaming could lead to poor performance at school, work or household responsibilities, the neglect of other hobbies or friendships, and even a decline in personal hygiene or grooming (Chen & Chang, 2019).

In the progression from occasional gaming to problematic gaming, individuals demonstrate irritability, anxiety or anger when forced to stop gaming, as well as withdrawal-like physical and psychological symptoms (Mathews et al., 2019). When this scenario results in functional impairment, people usually require mental health counseling, and the first step of treatment is to identify the specific patient's characteristics with the aim of selecting the most effective interventions. Depending on the severity and course of the pathological gaming pattern, the associated psychiatric comorbidities, the severity of functional impairment, the personality profile, and the socio-contextual characteristics, some patients may require more intensive treatment programs (with increased supervision in a highly-structured environment) (Zajac et al., 2020). Unfortunately, studies conducted on treatment-seeking gamers are relatively scarce to date (Stevens et al., 2019).

Despite the proliferation of research investigating the effects of video games, there is a lack of consensus on the appropriate diagnostic framework (operational definition and diagnostic criteria) for the conceptualization of excessive and problematic gaming as a mental disorder (Kardefelt-Winther et al., 2017; A. Musetti et al., 2019; Alessandro Musetti et al., 2016; Saunders, Degenhardt, & Farrell, 2017; van Rooij, Van Looy, & Billieux, 2017; Castro-Calvo et al., 2021). Previous research generally considered gaming disorder (GD) as an addictive disorder characterized by persistent, excessive, and uncontrolled gaming that results in significant functional impairment and psychological distress (causing conflict in family relationships, social isolation, declining academic performance, and even physical/emotional illness) (Rumpf et al., 2018; Saunders, Hao, et al., 2017; Weinstein, 2010). GD has also been approached from an understanding of a disorder based on a continuum, ranging from normative-recreational use (gaming behavior without related problems), to problematic use (gaming with some related problems) and pathological gaming (persistent gaming characterized by loss of control and significant functional impairment) (Starcevic & Billieux, 2017). From this perspective, it is crucial to distinguish between persistent but not problematic gaming and problematic gaming, in order to avoid over-diagnosis and pathologization of normal behavior (Billieux, Flayelle, Rumpf, & Stein, 2019). In fact, the lack of clear diagnostic boundaries is an important feature characterizing GD (André et al., 2020), but also much internet-based problematic behavior (which require to differentiate between engagement,

problematic use, and addiction) (di Carlo et al., 2021; Pettorruso et al., 2020). Further studies remain necessary to improve the assessment and diagnosis of GD (reliable screening and assessment tools) (King et al., 2020), as well as to develop and validate adequate-efficient treatment protocols (Costa & Kuss, 2019; King et al., 2017).

Although GD was not classified as a specific mental disorder in the DSM-5 (American Psychiatric Association, 2013), Internet Gaming Disorder is included in its section III ("Emerging Measures and Models"). In 2019, The World Health Organization included Gaming Disorder (GD) in the last revision of the International Classification of Diseases (ICD-11) within the section of disorders due to addictive behaviors. GD is defined as a "pattern of gaming behavior ("digital-gaming" or "video-gaming") characterized by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences" (WHO, 2020). For GD to be diagnosed, significant impairment in personal, family, social, educational, occupation or other relevant areas of functioning is required, for at least 12 months (Billieux et al., 2017). According to a recent international Delphi study in which 29 GD experts rated the diagnostic validity, clinical utility, and prognostic value of the DSM-5 Internet Gaming Disorder criteria and the ICD-11 GD clinical guidelines (Castro-Calvo et al., 2021), the latter were reported to adequately diagnose GD. In contrast, some DSM-5 criteria (e.g., escapism/mood regulation, tolerance) were regarded as incapable of distinguishing between problematic and non-problematic gaming, which could result in pathologizing intensive but non-problematic gaming patterns.

Regarding the presence of GD, recent systematic epidemiological reviews have reported a global incidence estimate in a broad range (between 0.2% and 25%, depending on the composition of the samples and the assessment tools used) (Darvesh et al., 2020; Feng et al., 2017), with higher rates in Central Eastern Europe and lower rates in Northern and Western Europe (Chia et al., 2020). A recent *meta*-analysis reported that the worldwide rate of problematic gaming can be estimated to be 1–2% (Stevens et al., 2021). Individuals with higher vulnerability/risk for the onset and progression of GD have also been identified (Pan et al., 2020; Stevens et al., 2021): male gender, adolescence and young adulthood stages, poorer subjective and environmental conditions, high computer skills, higher accessibility to the internet and/or gaming devices, and difficulties in social and school/work performance (Gentile, 2009; Griffiths & Meredith, 2009; Haagsma et al., 2012; Mentzoni et al., 2011; Mihara & Higuchi, 2017; Rehbein & Baier, 2013; Weinstein & Lejoyeux, 2010).

As regards the risk factors for GD, there is a large body of research illustrating the links between this condition and multiple bio-psycho-social features. The review by Griffiths and colleagues identified high levels of certain personality traits (e.g., narcissism, neuroticism, aggressiveness/hostility, avoidance, introversion and sensation seeking), low self-esteem, and social isolation as the main risk factors related to the onset and the course of this disorder (Griffiths, Kuss, & King, 2012). Other studies focused on personality traits also observed that patients with GD had higher levels of persistence and low levels of self-directedness (Jiménez-Murcia et al., 2014; Musetti et al., 2019), as well as a whole maladaptive personality profile (Gervasi et al., 2017). Past research also provided evidence of specific neural and cognitive impairment in GD (Palaus, Marron, Viejo-Sobera, & Redolar-Ripoll, 2017).

Other common aspects typically associated with GD include sleep deprivation, malnutrition, irritability, physical aggression, emotional disturbances, dysfunctional cognitions, and a range of social and school/

work problems (Przybylski, Weinstein, & Murayama, 2017). The systematic review conducted by Guglielmucci et al. (2019) also concluded that GD can be, for some patients, the result of a maladaptive coping strategy to escape from real-life problems, adverse emotions and disturbing mental states, with the consequence of dissociative symptoms reflecting the side effects of an alteration in consciousness. Cognitive distortions have also been reported among GD patients (Forrest et al., 2016; Hamonniere & Varescon, 2018), including persistent beliefs overvaluing game reward and tangibility, dysfunctional and inflexible rules about gaming behavior, over-reliance on gaming to perceive satisfactory self-esteem, and gaming as a way to obtain social acceptance (King & Delfabbro, 2014). In terms of psychopathological comorbidity, it has been observed that patients diagnosed with GD usually report problems in different domains, with the most typical being the presence of concurrent attention-deficit-hyperactivity (Dullur et al., 2021), depression (Colder Carras et al., 2020; Ostinelli et al., 2021), conduct problems (Richard et al., 2020), and other multiple psychopathological conditions (Männikkö et al., 2020; Stockdale & Coyne, 2018; Weinstein et al., 2014). However, the direction of these associations between GD and psychopathological symptoms has not yet been established (Laconi et al., 2017; Lee et al., 2017), mainly because the designs used to assess the presence and intensity of the comorbid relationships are cross-sectional in nature (González-Bueso et al., 2018).

Studies that aimed to determine the psychosocial and sociodemographic variables associated to problem gaming have been usually conducted on population-based samples. However, the significant increase in the demands for treatment due to the problems related to the excessive use of video games during the last decade has resulted in the publication of new studies within clinical samples, that aimed to assess the GD profile at baseline (prior to the treatment interventions). Male sex is one central characteristic of the GD profile (Chen, Oliffe, & Kelly, 2018), probably due to the fact that traditionally video games were designed by men for men, the marked male gamer stereotypes (negatively reflected on females), and highly visible figures in gaming culture related to male attributes (Lopez-Fernandez, Williams, & Kuss, 2019; Palaus, Marron, Viejo-Sobera, & Redolar-Ripoll, 2017; Vermeulen, Van Bauwel, & Van Looy, 2017). A number of studies also suggested that younger age (adolescence and emergent adults) is a key feature among GD patients (Adams et al., 2019). Treatment-seeking patients who met criteria for GD are also characterized by the presence of comorbid psychiatric conditions, including internalizing symptoms (around 45%, being the most frequent depression, social anxiety and generalized anxiety) and externalizing symptoms (around 50%, mostly ADHD and aggressive behaviors) (Martín-Fernández et al., 2016; van Rooij et al., 2014). A substantial part of GD patients consider that their involvement in videogames is a way to alleviate the negative affect and the discomfort arising from other psychological symptoms, and also from their problems with peer relationships (Király, Nagygyörgy, Griffiths, & Demetrovics, 2014). Some player vulnerabilities have been shown to increase the severity and the worse progression of the GD, including impulsivity, risk taking, and stronger gaming motivations (such as escapism and/or achievement) (King et al., 2019). Other characteristics of the GD profile are a high level of loneliness (potentially as a consequence of the long time frames of physical confinement at home), poor socio-familial functioning, deterioration of performance in the academic/working spheres, reduced self-satisfaction outside the video games (Bender & Gentile, 2019; Yau & Potenza, 2014).

To date, few studies have explored the existence of distinctive empirical profiles of GD treatment-seeking patients with different levels of psychological impact. A study by Billieux and colleagues tried to determine the existence of reliable subtypes of problematic video-gaming in a large community-based sample of Massively Multi-Player Online Role-Playing Games (MMORPG) gamers based on candidate psychological risk factors, and identified five subgroups presenting varying degrees of problematic gaming impact (Billieux et al., 2015). Another study performed a cluster analysis with the aim of identifying different subtypes of gamers in a population-based sample, considering the time spent using video games and their responses to a screening GD tool (Musetti et al., 2019). These authors identified four clusters ordered according to the intensity of the gaming activity (occasional, passionate, preoccupied, and disordered gamers), with differences in the expression of certain personality traits and psychopathological symptoms (the higher the gaming frequency and impairing gaming pattern the worse the psychopathological state). A recent study also aimed to explore sleep quality related to the video game activity, to determine the role of sociodemographic features, gaming duration and intensity, and mental and physical health, in a population-based sample through hierarchical clustering (Altintas et al., 2019). This last research identified two profiles of individuals based on the sleep quality (high versus low), which also differed in the intensity of the gaming behavior and the health outcomes. Finally, González-Bueso and colleagues identified two profiles through clustering analysis, using as predictor variables multiple personality domains within a sample of GD patients (González-Bueso et al., 2020). These two separate clusters were characterized by the personality traits, but also by the comorbid concurrence of general psychological symptoms.

On the whole, it thus appears that there is a paucity of evidence allowing researchers and clinicians to grasp a solid understanding of the differential subtypes of GD, particularly within clinical samples using data-driven classification approaches. In such a context, the aim of the present study was to determine the existence of empirical clusters in a sample of treatment-seeking GD patients who attended a hospital unit specialized in the treatment of behavioral addictions, using a large set of indicator-variables including sociodemographic features, psychopathological symptoms, and personality traits. Based on the available empirical evidence, we hypothesized that GD patients constitute a heterogeneous group in which separate profiles can be identified with different levels of gaming impact.

2. Method

2.1. Participants

The participants in this study were recruited from the Pathological Gambling Unit located in the Bellvitge University Hospital. A consecutive sampling was considered, including all patients who had sought treatment specifically in relation to their problematic gaming behavior in our unit between January 2005 and April 2019. Exclusion criteria were the presence of a concurrent neurological disorder (e.g., traumatic brain injury, neurodegenerative disorder such as Parkinson's disease) or intellectual disability (these conditions did not allow the use of the standardized assessment).

The sample included $n = 107$ patients (98 men, 91.6%), most of them with primary ($n = 50$, 46.7%) or secondary ($n = 49$, 45.8%) education levels, single ($n = 95$, 88.8%), unemployed ($n = 81$, 75.7%) and in mean-low to low socioeconomic position groups ($n = 90$, 84.1%). Patients were aged between 14 and 60 years old ($M = 24.1$, $SD = 10$), and the mean duration of gaming-related problems was 3.7 years ($SD = 2.9$).

This study included patients recruited for a long period of time. This was justified by the low frequency of patients attended in the treatment unit due to GD related problems compared to other behavioral addictions (such as gambling disorder). An extended period of time was needed to achieve a large enough sample for the segmentation statistical analyses. It must be outlined that the variables analyzed in this study were measured with the same assessment tools, and that all patients of the study met criteria for GD according to the same diagnostic framework (DSM). In addition, no differences were found comparing patients attended during three specific time frames (2005 to 2009, 2010 to 2014 and 2015 to 2019) with regard to sociodemographic features [sex ($\chi^2 = 1.02$, $p = .602$), education level ($\chi^2 = 6.92$, $p = .140$), marital status ($\chi^2 = 3.05$, $p = .550$), socioeconomic position ($\chi^2 = 6.09$, $p = .413$), employment status ($\chi^2 = 1.26$, $p = .533$), and age ($F = 0.02$, $p = .984$)]

and main clinical variables [age of onset of the GD ($F = 0.20$, $p = .821$), duration of the GD ($F = 0.09$, $p = .917$) and psychological distress (SCL-90R GSI, $F = 1.78$, $p = .174$)].

2.2. Measures

All the questionnaires used in the study had been previously translated and validated in Spanish-speaking samples. Table 1 briefly describes the psychometric scales used, as well as their internal consistency (Cronbach's alpha) in the current sample.

Symptom Checklist-Revised (SCL-90-R) (Derogatis, 1997), Spanish version (Gonzalez De Rivera et al., 1989). This self-report instrument measures the global psychological state through 90 items structured in nine primary (first order) dimensions (somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) and three global indices (global severity index [GSI], total positive symptoms [PST], and positive symptoms discomfort index [PSDI]). It is a widely-used and relatively brief questionnaire for screening current status in multiple dimensions of psychopathology and psychological distress. The internal reliability (Cronbach's alpha) in our sample was good to excellent (from $\alpha = 0.81$ for obsessive–compulsive scale to $\alpha = 0.98$ for the global indices).

Temperament and Character Inventory-Revised (TCI-R) (Cloninger et al., 1994), Spanish version (Gutiérrez-Zotes et al., 2004). This self-report questionnaire serves to measure personality traits through 240 items based on the Cloninger's multidimensional model. The model comprises 7 personality dimensions: 4 for temperament (novelty seeking, harm avoidance, reward dependence, and persistence) and 3 for character (self-directedness, cooperation, and self-transcendence). The internal consistency in the sample of the study was between adequate and good (from $\alpha = 0.70$ for reward dependence to $\alpha = 0.89$ for persistence).

Clinical criteria for GD. A semi-structured face-to-face clinical interview was used to assess the presence/absence of the nine proposed criteria for GD included in Section 3 (emerging conditions) of the DSM-5 (American Psychiatric Association, 2013; Petry et al., 2014): preoccupation or obsession, withdrawal, tolerance, loss of control, loss of interest, continued overuse, deceiving, escape from negative feelings and functional impairment. Rather than using the tentative cut-off proposed in the DSM-5 (5 out of 9 criteria are required to endorse the condition), we applied a more stringent approach where all 9 criteria are to be endorsed within a 12-month period to establish the diagnosis. This approach is consistent with recent research showing that laxer criteria are susceptible to pathologizing normal or persistent but not problematic gaming patterns (Billieux, Flayelle, Rumpf, & Stein, 2019; Deleuze et al., 2017). For cases assessed between 2005 and 2013 (i.e. before the releasing of DSM-5), GD was identified through a semi-structured interview adapted from DSM-III-R pathological gambling criteria (Griffiths & Hunt, 1998). As for DSM-5 criteria, a stringent approach was used where all criteria are to be endorsed within a 12-month period to establish the diagnosis.

Diagnostic Questionnaire for Pathological Gambling (according to DSM criteria) (Stinchfield, 2003), Spanish version (Jiménez-Murcia et al., 2009). This questionnaire was developed as a self-report tool with 19 items coded in a binary scale (yes–no), with the aim of assessing the diagnosis of GD according to the DSM-IV-TR (American Psychiatric Association, 2010). From 2013 onwards, this DSM-IV measure has been adapted to measure DSM-5 diagnostic criteria for GD (American Psychiatric Association, 2013) by removing the illegal acts criterion and using the cutoff score of 4 symptoms-criteria. This instrument was used to assess the comorbid presence of gambling disorder in the study. The internal consistency for this scale in the study sample was very good ($\alpha = 0.92$).

Other variables. A complementary semi-structured interview was used to collect additional data, including sociodemographic features

Table 1
Description of the psychometrical scales used in the study.

Scale		Description	α
SCL-90R questionnaire			
Somatization		Bodily perceptions of complaints reflecting potential physical illness, focused on cardiovascular, gastrointestinal, respiratory and other systems with automatic mediation	0.895
Obsessive-compulsive		Thoughts, impulses and actions perceived as irresistible but of unwanted nature	0.811
Interpersonal sensitivity		Feelings of personal inadequacy and inferiority in comparison with others, and discomfort during interpersonal interactions	0.894
Depression		Dysphoric mood and affect, signs of withdrawal, lack of motivation, and loss of vital energy	0.929
Anxiety		Nervousness, tension, trembling, terror, panic and somatic correlates of anxiety	0.873
Hostility		Behaviors related to negative state of anger, such as aggression, irritability, rage and resentment	0.865
Phobic anxiety		Persistent fear response to specific places, objects, situations, leading to avoidance/escape beh.	0.837
Paranoid ideation		Projective thinking, hostility, suspiciousness, grandiosity, centrality, loss of autonomy and delusions	0.830
Psychotic		Schizoid lifestyle, first-rank schizophrenia symptoms, withdrawal and isolation	0.843
Global severity Index (GSI)		Psychopathological distress status	0.979
Positive Symptom Total (PST)		Number of total symptoms endorsed to any degree	0.979
Positive Symptom Distress (PSDI)		Intensity measure and distress style	0.979
TCI-R questionnaire			
Novelty seeking	Low score	Rigid, frugal, reserved, stoical	0.713
	High score	Impulsive decision making, exploratory, thrill seeking, novelty preference	
Harm avoidance	Low score	Vigorous, daring, optimistic, outgoing	0.724
	High score	Fearful, doubtful, pessimistic, fatigable, shy, excessive worrying	
Reward dependence	Low score	Independent, critical, detached	0.704
	High score	Warm, open, sentimental, sympathetic	
Persistence	Low score	Underachiever, pragmatist, apathetic, spoiled,	0.889
	High score	Enthusiasm, perfectionist, work hardened, ambitious, diligent, determined	
Self-directedness	Low score	Aimless, blaming, inept, lack of goal direction, inertia, self-striving, incongruent	0.838
	High score	Purposefulness, resourceful, self-accepting, congruent, responsible, purposefulness	
Cooperativeness	Low score	Intolerant, hostile, social disinterest, revengeful, prejudiced, insensitive	0.711
	High score	Helpful, empathic, compassionate, reasonable, empathic	
Self-transcendence	Low score	Practical, objective, undiscerning, empirical, unimaginative, self-isolation	0.812
	High score	Transpersonal identification, spiritual, intuitive, inventive, idealistic, self-forgetful	

Note. SCL-90R: Symptom Checklist-Revised.
TCI-R: Temperament and Character Inventory-Revised.
α: Cronbach-alpha in the study.

(sex, education level, employment status and marital status), the socioeconomic position index according to Hollingshead's scale (which provides a global measurement based on the participant's profession and level of education) (Hollingshead, 2011), and other GD-related

variables (such as age of onset of the gaming activity and duration of gaming-related problems). The presence of substance use (tobacco, alcohol and other illegal drugs) was also clinically assessed. This tool was developed by the research team, and it has been routinely used in the treatment unit for the assessment at baseline. This instrument has been described elsewhere (Jiménez-Murcia et al., 2006) and it is available on request from the corresponding author (the Spanish version is available).

2.3. Procedure

The study was approved by the Ethics Committee of the Bellvitge University Hospital (Barcelona) (Ref: PR241/11), and patients who agreed to participate in the study were asked to provide signed informed consent. Participants did not receive financial compensation for their participation. All data were collected by qualified clinical psychologists. Data were collected through a single assessment session of approximately 90 min.

2.4. Statistical analysis

The statistical analysis was carried out with SPSS24 for windows (IBM-Corp, 2016). We decided to rely on data clustering analysis to identify profiles of GD patients. Data grouping was accomplished through a two-step cluster analysis. This procedure serves to explore the existence of natural groupings within a dataset which includes both categorical and continuous variables, using an agglomerative hierarchical clustering algorithm with automatic selection of the optimal number of groups. In this study, the log-likelihood distance and the Schwarz Bayesian Information Criterion (BIC) were employed to determine the optimal model (based on choosing a solution with a reasonably large ratio of Schwarz Bayesian Information Criterion and a large ratio of distance measures). The variables used to create the clusters included sociodemographic variables registered in the study, age of onset of the gaming-related problems, psychopathological distress (SCL-90R GSI), personality traits (TCI-R scores), and the presence of a comorbid diagnosis of gambling disorder. The Silhouette index was used to assess the global consistency of the cluster solution. This index ranges from − 1 to + 1, and is considered as a measure of cohesion/separation (i.e., how similar individuals are to their own cluster compared to other clusters) (Rousseeuw, 1987): values lower than 0.30 are considered as poor fits, between 0.30 and 0.50 as fair, and higher than 0.50 as good (in practice, fair and good indexed are interpreted as adequate matching in one's own cluster and of poor matching in other clusters).

Chi-square tests (χ^2) were used to compare categorical variables between the empirical clusters, and T-tests were employed to compare quantitative measures. The effect sizes for the mean differences were measured with the standardized Cohen's-d coefficient, considering poor-low effect size for $|d|>0.20$, moderate-medium for $|d|>0.5$ and large-high for $|d|>0.80$ (Kelley & Preacher, 2012). For the proportion differences, the effect size was estimated through Cohen's-h coefficient (Cohen, 1988), which is interpreted similar to Cohen's-d measure and calculated as the difference of the arcsine transformation for the two proportions estimated in each group [with the transformation being: 2*arcsin*square_root(p)]. In addition, an increase in the Type-I error due to the multiple statistical procedures was controlled for with Finner's method (a stepwise familywise error rate procedure which provides a more powerful test than the classical Bonferroni correction) (Finner, 1993).

3. Results

3.1. Clustering procedure

The auto-clustering results are displayed in Table 2, with the fitting coefficients used to automatically select the optimal model. The number of clusters chosen by the system was two: this solution achieved the highest measure of cohesion/separation (Silhouette = 0.40) and the largest ratio of distance measures (1.853). This solution was selected as the most suitable for our study since it also obtained good clinical interpretation (other candidate solutions with a higher number of clusters were rejected since they achieved poorer fitting indexes and did not facilitate better clinical interpretation).

Fig. 1 displays the ordered bar-chart with the relative relevance weight of each predictor (indicator variable) in the clustering process. The relative relevance ranges between 1 (maximum relevance) and 0 (minimum relevance), and each predictor is interpreted as a measure of the discriminative capacity of the variable (the greater the relevance of the indicator, the less likely it is that changes between clusters for said variable are attributable to chance). In this study, the variable with the largest discriminative relevance was psychopathological distress (SCL-90R GSI), while the poorest discriminative capacity was achieved by reward dependence, novelty seeking, self-transcendence, social position index, education level, and persistence.

3.2. Comparison between clusters

Table 3 displays the results of the sociodemographic comparison between clusters, while Table 4 shows the comparison for the clinical profiles. Cluster 1 comprised two quarters of the sample ($n = 72, 66.1\%$). This group included mostly single (97.2%) and unemployed (86.1%) men (98.6%). The patients within this cluster were younger (M age = 21 years), reported an earlier onset age of the problematic gaming (M = 17.8 years), a shorter duration of the disorder (M = 3.5 years), better psychopathological state (all the means in the SCL-90R scales were lower), and more functional personality traits (participants in this cluster scored lower in sensation seeking, harm avoidance, and self-transcendence, and higher in reward-dependence, self-directedness, and cooperativeness).

Cluster 2 ($n = 35, 32.7\%$) included a higher proportion of women,

Table 2
Results of the auto-clustering.

Number of clusters	BIC	[a]BIC Change	[b]Ratio BIC Changes	[c]Ratio Distance	n Participants-by-cluster	Silhouette	
1	2451.825						
2	2300.583	−151.242	1.000	1.853	72;35	0.40	(fair)
3	2320.033	19.450	-0.129	1.371	66;22;19	0.30	(fair)
4	2393.645	73.612	-0.487	1.851	36;32;20;19	0.20	(poor)
5	2534.371	140.725	-0.930	1.007	32;24;19;18;14	0.20	(poor)
6	2675.621	141.251	-0.934	1.266	31;24;19;13;10;10	0.20	(poor)
7	2833.359	157.738	−1.043	1.170	31;24;17;13;10;10;2	0.20	(poor)
8	3000.086	166.726	−1.102	1.082	24;20;17;13;11;10;10;2	0.20	(poor)

Note. BIC: Schwarz's Bayesian Criterion.
[a] The changes are from the previous number of clusters in the table.
[b] The ratios of changes are relative to the change for the two cluster solution.
[c] The ratios of distance measures are based on the current number of clusters against the previous number of clusters
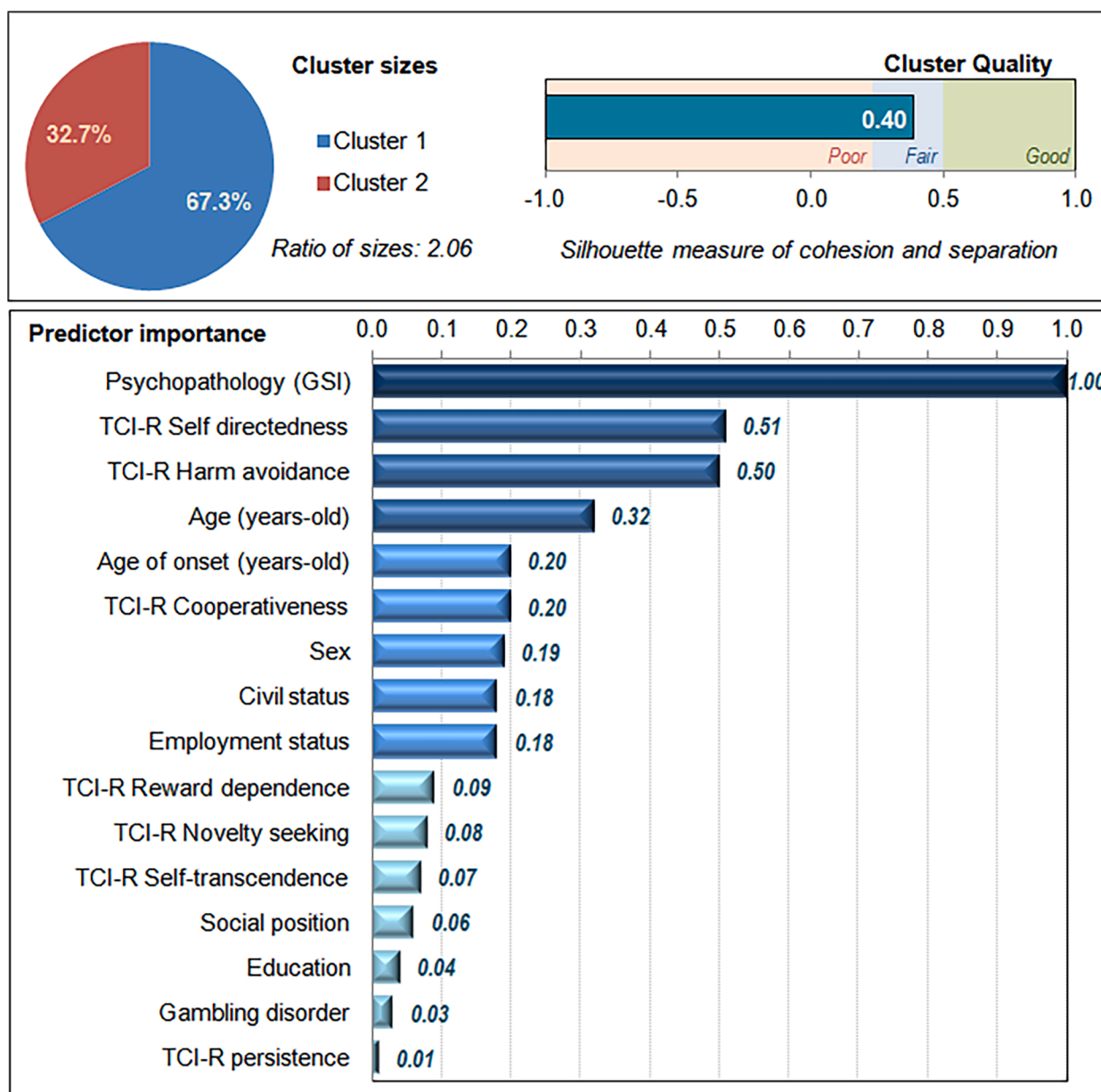
Fig. 1. Results of the clustering procedure.

not-single, and employed. Participants in this cluster were also older (*M* age = 30.7 years), reported a later age of onset of the gaming-related problems (*M* = 24.5 years) and a longer progression of the problematic behaviors (*M* = 4.1 years). These patients also reported worse psychopathological and more maladaptive personality traits (higher means in sensation seeking, harm avoidance and self-transcendence, and lower means in reward-dependence, self-directedness, and cooperativeness). This cluster was also related to higher risk of alcohol use-abuse. Differences between both clusters in these variables (in particular, for psychopathological variables measured by the SCL-90-R) reached extremely large effect sizes (|*d*| between 0.70 and 2.41).

The main differences between the clusters are plotted in the radar-chart displayed in Fig. 2, which represents a visual summary of the composition of the clusters obtained. This chart (also known as spider-chart or star-chart) is particularly useful for displaying multivariate data, and it consists in a sequence of axes (radii, each one representing a concrete variable) and a plot of polygonal shapes over all the axes (each one representing a concrete group). Proportions for the categorical variables and z-standardized means for the quantitative variables are

plotted (z-standardized values are shown, since the original scale differs for each variable and makes interpretation difficult). Based on the set of results in this study, cluster 1 was labeled *"lower psychological impact"* and cluster 2 was labeled *"higher psychological impact"*. Note that the labels *"lower"* versus *"higher"* are used in the basis of the composition of the two empirical groups identified in this work (no comparison with an external criteria such as normative data from a population-based sample was conducted). In addition, the label is based on the clinical profile related to each cluster, and not on the sociodemographic features associated to each empirical group.

4. Discussion

In the present study, we explored GD heterogeneity in treatment-seeking patients through clustering analysis considering a large set of indicators (including sociodemographic features, clinical course of the condition, psychological state, and personality traits). Two patient profiles were identified, the reliability of which was based on a cohesion-separation rate within the fair/moderate range and with a

Table 3
Comparison between clusters for the sociodemographics.

	Cluster 1 ; n = 72(lower psychological impact)		Cluster 2; n = 35 (higher psychological impact)			
	n	%	n	%	p	|h|
Sex						
Female	1	1.4%	8	22.9%	**<0.001***	**0.70**[†]
Male	71	98.6%	27	77.1%		
Education						
Primary or less	38	52.8%	12	34.3%	0.163	0.38
Secondary	30	41.7%	19	54.3%		0.25
University	4	5.6%	4	11.4%		0.21
Civil status						
Single	70	97.2%	25	71.4%	**<0.001***	**0.76**[†]
Married – couple	2	2.8%	7	20.0%		**0.56**[†]
Divorced – separated	0	0.0%	3	8.6%		0.43
Social status						
Mean-high to high	1	1.4%	2	5.7%	0.080	0.24
Mean	6	8.3%	8	22.9%		0.41
Mean-low	23	31.9%	7	20.0%		0.27
Low	42	58.3%	18	51.4%		0.14
Employment						
Unemployed	62	86.1%	19	54.3%	**<0.001***	**0.74**[†]
Employed	10	13.9%	16	45.7%		

Note. *Bold: significant comparison (0.05 level).
[†] Bold: effect size into the mean-moderate ($|h|$>0.50) to high-large ($|h|$>0.80) range.

suitable clinical interpretation. The differences in the mental distress and other psychological measures between the empirical profiles have implications for the etiology, conceptualization, assessment, and treatment of this clinical condition.

The two profiles identified in this study displayed differences in sociodemographic and clinical features. Cluster 1, with a lower psychological impact, was associated to younger age, earlier age of onset and shorter duration of the addictive disorder, male sex, being single, unemployed status, better psychopathological state, and less dysfunctional personality traits. Cluster 2, with a higher psychological impact, was more strongly related to not-single status, being employed, female sex, older age, later onset and a longer duration of the gaming-related problems, worse psychopathological symptoms and more dysfunctional personality profile. As a whole, these results are consistent with previous research, which also obtained two separate profiles in problematic gamers samples, characterized by different levels of comorbid symptoms and personality functioning (Gervasi et al., 2017; González-Bueso et al., 2020; Griffiths, Kuss, & King, 2012; Musetti et al., 2019). Latent class analysis and regression procedures within population-based samples have also identified distinct groups of gamers with different severity in gaming-related problems (Colder Carras & Kardefelt-Winther, 2018).

Regarding sociodemographic characteristics and clinical course of the condition, chronological age and duration of problematic gaming, the results obtained in our study suggest that the impact of the GD may be less severe in younger patients (for example, in the 20 s), single and unemployed (or studying) than in older patients, married and employed. This is expected since, in married and/or employed people, spending a high number of hours playing video games will have a greater impact on family and/or job productivity. The link between age of initiation into gaming and GD has not been clearly established, but available studies suggest that more years playing games may be associated with increased severity of the disorder (Mihara & Higuchi, 2017), which appears to converge with the results obtained here. In this same vein, since we found individuals with the longest duration of GD tend to be the oldest patients, it is not surprising that older age was also related to the most impairing profile. In any case, results should be considered with caution, since previous studies have noted that GD severity is positively related to younger ages (Anand et al., 2018; Tang, Koh, & Gan, 2017), while others

Table 4
Comparison between clusters for the clinical profile.

	Cluster 1 ; n = 72 (lower psychological impact)		Cluster 2; n = 35 (higher psychological impact)			
Age and evolution	*Mean*	*SD*	*Mean*	*SD*	*p*	|d|
Age (years-old)	20.96	5.16	30.69	13.73	**<0.001***	**0.94**[†]
Age of onset (years-old)	17.78	4.07	24.46	12.90	**<0.001***	**0.70**[†]
Duration addiction (years)	3.52	2.54	4.07	3.60	0.360	0.18
Psychopathloogy (SCL-90-R)	*Mean*	*SD*	*Mean*	*SD*	*p*	|d|
Somatization	0.35	0.32	1.26	0.89	**<0.001***	**1.38**[†]
Obsessive-compulsive	0.76	0.47	1.73	0.76	**<0.001***	**1.54**[†]
Interpersonal sensitivity	0.64	0.51	2.04	0.88	**<0.001***	**1.95**[†]
Depression	0.63	0.50	2.13	0.86	**<0.001***	**2.13**[†]
Anxiety	0.39	0.33	1.45	0.78	**<0.001***	**1.78**[†]
Hostility	0.63	0.61	1.70	1.03	**<0.001***	**1.27**[†]
Phobic anxiety	0.15	0.22	0.99	0.93	**<0.001***	**1.23**[†]
Paranoid ideation	0.62	0.54	1.91	0.99	**<0.001***	**1.63**[†]
Psychotic	0.30	0.31	1.39	0.77	**<0.001***	**1.87**[†]
Global severity Index (GSI)	0.45	0.30	1.65	0.64	**<0.001***	**2.41**[†]
Positive Symptom Total (PST)	28.78	14.47	58.94	14.46	**<0.001***	**2.09**[†]
Positive Symptom Distress Index (PSDI)	1.39	0.52	2.45	0.59	**<0.001***	**1.91**[†]
Personality (TCI-R)	*Mean*	*SD*	*Mean*	*SD*	*p*	|d|
Novelty seeking	101.71	12.11	108.11	16.87	**0.027***	0.44
Harm avoidance	95.53	12.92	117.60	19.28	**<0.001***	**1.34**[†]
Reward dependence	95.93	15.91	87.66	18.84	**0.019***	0.47
Persistence	94.99	15.72	93.74	26.70	0.763	0.06
Self-directedness	137.68	18.24	109.94	19.88	**<0.001***	**1.45**[†]
Cooperativeness	134.22	14.69	120.31	21.24	**<0.001***	**0.76**[†]
Self-transcendence	57.18	13.50	63.31	16.06	**0.041***	0.41
Other comorbid addictions	*n*	*%*	*n*	*%*	*p*	|h|
Gambling disorder	8	11.1%	7	20.0%	0.214	0.25
Tobacco	21	29.2%	7	20.0%	0.312	0.21
Alcohol	0	0.0%	2	5.7%	**0.041***	0.35
Other illegal drugs	4	5.6%	1	2.9%	0.535	0.13

Note. SD: standard deviation.
*Bold: significant comparison (0.05 level).
[†] Bold: effect size into the range mean-moderate ($|d|$>0.50 or $|h|$>0.50) to high-large ($|d|$>0.80 or $|h|$>0.80).

suggest that age may only indirectly affect problem gaming severity via other factors including psychological distress or even the frequency of other online activities (ElSalhy et al., 2019; López-Fernández, Williams, Griffiths, & Kuss, 2019; López-Fernández, Williams, & Kuss, 2019; Stockdale & Coyne, 2018).

The percentage of women in our study was very low compared to men. This is consistent with epidemiological and clinical data, which show that GD is traditionally more common among males (López-Fernández, Williams, & Kuss, 2019). In fact, numerous video games have been developed based on stereotypical male characteristics, such as being overly self-confident and aggressive (Paaßen, Morgenroth, & Stratemeyer, 2017), and it seems that women are less encouraged to play video games due to the social negative expectations based on gender (Kaye & Pennington, 2016). Nevertheless, females were over-represented in the cluster with worse psychology state. This result is consistent with a narrative literature review suggesting that female problematic gamers tend to experience more severe psychopathological symptoms than male ones, which might be driven by a gender imbalance regarding work-life balance and roles (López-Fernández, Williams, Griffiths, & Kuss, 2019; Wang et al., 2019). Other studies have also stated that multiple interactive reasons could contribute to this
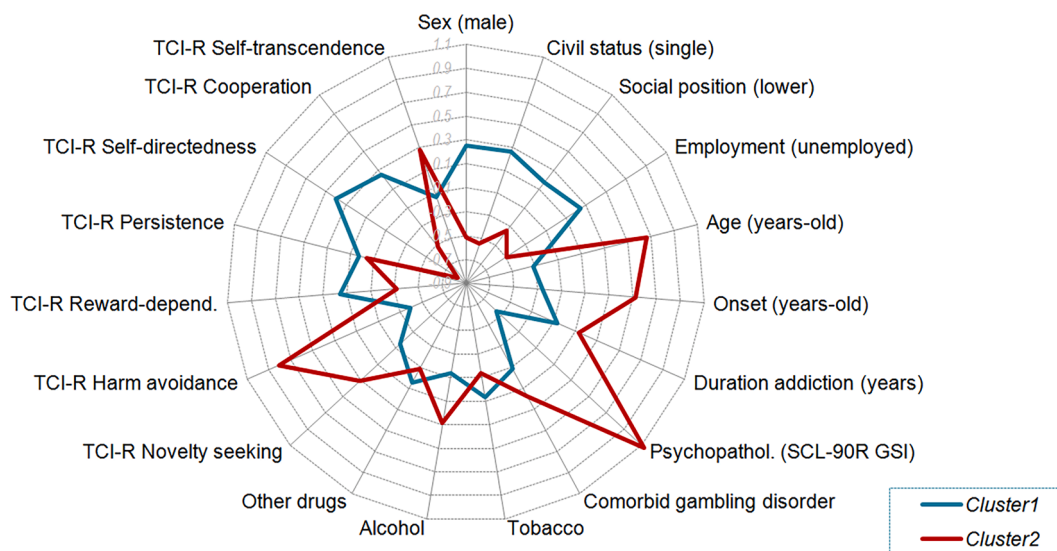
Fig. 2. Radar-chart with the main variables which achieved differences between the clusters.

association, such as the fact that women are interested in things which are not necessarily included in game designs, which might contribute to their frustration (Gestos, Smith-Merry, & Campbell, 2018; McLean & Griffiths, 2019). Furthermore, studies on the neuro-biological mechanisms underlying problematic gaming have also reported cortical thickness abnormalities combined with higher addiction severity in women, suggesting that females might be more vulnerable to GD than men (Wang et al., 2016). Gender-related neurocognitive differences have also been found in the study by Dong and colleagues (2018), who observed that women with recreational gaming display better executive control than men, but with the progression of GD, the executive control is more impaired in women (Dong et al., 2018).

The personality profile associated to the cluster with higher impact (higher novelty seeking, harm avoidance and self-transcendence, lower reward dependence, lower self-directedness and cooperativeness) is typical of patients with higher negative affectivity and disinhibition, impulsive behavior and with a preference for immediate rewards. These aspects have been identified as core features of addictive disorders (like gambling disorder) and constitute precipitants and maintaining factors (Brand et al., 2019). Although the relationships between behavioral addictions and maladaptive personality traits have been evidenced, few studies have investigated how a specific maladaptive profile (integrating multiple domains) impacts on the onset and evolution of GD within clinical samples, or how it could affect the results of treatment. Published studies have observed that these relationships seem complex, with additional factors moderating or mediating the associations (Kayiş et al., 2016; Laier, Wegmann, & Brand, 2018). It has been reported that maladaptive personality traits could be linked to the risk of neurological soft signs, defined as minor neurological abnormalities (including diverse expressions of simple sensory integration, motor coordination, disinhibition signs, and complex motor sequencing) (Galindo et al., 2016; Mechri et al., 2010; Zhao et al., 2014). In relation with the impact of personality traits on GD, our results are consistent with previous empirical studies, which have suggested that maladaptive personality traits could represent a vulnerability risk factors for the onset and progression of problematic and disordered gaming (Gervasi et al., 2017; Mallorquí-Bagué et al., 2017; Müller, Beutel, Egloff, & Wölfling, 2014; Musetti et al., 2019; Seong, Hong, Kim, Kim, & Han, 2019). The specific presence of GD has been related to higher levels of impulsivity, sensation seeking and self-transcendence (Billieux et al., 2015; Laier, Wegmann, & Brand, 2018; Norbury & Husain, 2015; Starcevic & Aboujaoude, 2017), and to lower levels of extraversion, conscientiousness, and openness (Müller et al., 2015; Wang et al., 2015). Studies have also linked the

severity of gaming problems to maladaptive personality traits (Braun et al., 2016). The role of personality traits in the etiology of GD is however complex, and mixed results have been obtained regarding the mediational links between the different personality domains/levels, gaming motivations, gaming preferences, and the onset/progression/ severity of the GD (Tang et al., 2020; Throuvala et al., 2019). To date there is no robust theoretical understanding as to whether GD is the consequence of a dysfunctional emotion-focused strategy to avoid negative emotional states, or on the contrary, the disorder is the result of a more generally comprised emotional-social functioning. In either case, based on the studies reporting that maladaptive personality traits are associated to poor quality of life among GD (Müller, Werthmann, Beutel, Wölfling, & Egloff, 2021; Wölfling et al., 2019), the development of intervention plans for these patients need to be tailored accordingly. Concretely, specific intervention strategies targeting cognitive restructuring of biased beliefs might be useful in correcting dysfunctional learning experiences regarding the expected effects of the gaming activity. Strategies that aim to improve emotion regulation skills and affective skills trainings seem also particularly desirable for GD patients presenting with heightened scores of detachment and negative affectivity.

Finally, this study outlines the strong association between GD impact and the comorbid psychopathological symptoms: patients within the higher psychological impact reported a worse mental state with higher mean scores in all the SCL-90R scales (effect sizes were in the large range for all these measures). This result is also consistent with previous research supporting the association between GD and psychopathological symptoms (González-Bueso et al., 2018). Previous studies have also evidenced moderate to large relationships using different questionnaires [such as the SCL-90R or the Brief Symptom Inventory (BSI)] (Jiménez-Murcia et al., 2014; Kim et al., 2016; Laconi, Pirès, & Chabrol, 2017; Na, Lee, Choi, & Kim, 2017; Panagiotidi, 2017; Pearcy, McEvoy, & Roberts, 2017; Yen et al., 2017). Studies have also observed that co-occurrence between GD symptoms and mental health states can be attributed to common underlying factors (including genetics, personality characteristics, and social competence) (Hygen et al., 2020; Wichstrøm, Stenseng, Belsky, von Soest, & Hygen, 2019). The associations between the intrinsic features of GD and their multiple correlates (including comorbid psychopathologies) are however complex, and the pathways of the multiple relationships are not obvious (mainly due to disproportionate reliance on cross-sectional designs). Future longitudinal studies should contribute towards clarifying the temporal linearity of GD and comorbid disorders, to unveil whether the presence of

psychopathological symptoms leads to the onset of GD, or if an individual with GD later develops comorbid disorders as a consequence of the negative gaming-related impairments. In fact, there may be a reciprocal association in which the presence of one of the conditions exacerbates the occurrence of the other. For example, difficulties in social relationships, loneliness or the need to escape from negative affect can contribute to the onset and/or intensification of the gaming activity, and the subsequent increasing gaming behaviors reciprocally promote various negative consequences and increase the d global psychological distress (Wartberg, Kriston, Zieglmeier, Lincoln, & Kammerl, 2019; Wichstrøm, Stenseng, Belsky, von Soest, & Hygen, 2019).

Regarding the concurrence of psychological conditions with GD, it must be outlined that previous studies have related the presence and severity of the comorbid symptoms with worse treatment outcomes in GD (Stevens et al., 2019; Zajac et al., 2017). Therefore, it is crucial that clinical settings assess the presence of diverse symptoms among patients with GD and tailor treatment accordingly. Compared to treatment targeting a single disorder, evidence-based integrative interventions have proved to contribute towards alleviating both primary psychopathologies and secondary concurrent psychiatric conditions with the result of impacting in multiple functional areas (Krueger & Eaton, 2015). These healing-oriented holistic programs specifically developed for GD should include strategies to increase self-control and reduce impulsivity (such as training in working memory and response inhibition), to improve emotional regulation, to increase social skills, to prevent-reduce chronic stress, and (if possible) to attenuate environmental influences that negatively affect the patients' health. Furthermore, since comorbid psychopathological symptoms could explain specific gaming motivations (e.g., social motives in introverts or socially anxious gamers), multifaceted therapeutic plans should take into account these specificities to achieve treatment goals and avoid relapses. With regard to the proposed treatment approach, it has been showed that GD patients with higher levels of externalizing symptoms tend to present a better response to interventions with fewer sessions, and that changes take place three months after the beginning of the treatments, while patients with higher levels of internalizing symptoms tend to present slower improvements and require more comprehensive approaches in which the focus on dysfunctional social relationships is central (King & Delfabbro, 2014).

4.1. Limitations

The main limitation of the study is its cross-sectional design, which hinders to analyze the progression of the of GD over a period of time, or to determine the prognosis associated to each of the two classes evidenced in the current study. Second, it is important to note that the clustering procedure used in the study is only one example of a categorization/segmentation procedure, and that other methods may yield different results. Third, although a number of dimensions were analyzed in the study (sociodemographic features, psychopathology and other clinical variables, personality and substances use), no assessment of specific harm and/or functioning was available. Fourth, the low number of women in the sample also affects the generalizability of findings, since no guarantee exists regarding the representative distribution of the female population in this study. It should be considered, however, that the number of women in treatment for problematic gaming or GD is very low. We decided to retain female participants in the statistical analysis since this group constituted all the women seeking treatment in our unit, and their characteristics could be related to a particular profile.

Finally, in relation to the sample size and the statistical power, it is worth noting that there are no rules-of-thumb for cluster analysis, and while some authors have indicated that 2^m can be used (where m = number of clustering variables) (Formann, 1984), others suggested that the minimum sample size should range between 5 and 10 times the number of variables included in the segmentation procedure multiplied by the number of obtained clusters (Qiu & Joe, 2006). This suggests that the sample size should be determined according to the number of input

variables in the clustering. This study analyzed data recruited from n = 107 patients, 16 measures were considered for the segmentation and two empirical clusters was the optimal solution, which is compatible with the guidelines provided by Qiu and Joe (2006). On the other hand, studies have also pointed out that the minimum recommended ratio between the number of subjects, the number of variables and the number of empirical clusters are dependent on specific criteria, including goodness-of-fit statistics or sound theoretical and clinical interpretation (Saccenti & Timmerman, 2016). The fair Silhouette value achieved in the study indicated that these n = 107 patients, who met criteria for GD, represents a heterogeneous group, thus calling for a clustering approach. The identification of variables with discriminative capacity on clusters-groups and the adequate clinical interpretation of the results provide additional evidence about the reliability-validity of our statistical procedure.

4.2. Strengths

One of the strengths of the study is the large set of variables assessed including sociodemographic characteristics, clinical course of the condition, psychopathological symptoms and personality traits. Our study is also among the first ones using a segmentation procedure in a clinical sample of treatment-seeking GD, as a very limited number of similar studies have been published, especially in European countries. The use of a data-driven approach (cluster analysis) is also a strength. This person-centered modeling approach identifies empirical classes rather than using groups that are pre-defined according to single variables (such as gender, age, or a risk score). According to Eshghi et al. (2011), advantages of this person-centered method over classical variable-centered techniques include: a) the consideration of subgroups (or individuals) that deviate from means such as outliers; b) the identification of empirical profiles of individuals based on a large set of variables (instead of comparing each variable separately); and c) the possibility to account for potentially inconsistent results across studies or spurious relationships between variables by classifying individuals into naturally occurring profiles.

The present study explored clusters among a sample of GD treatment patients recruited from a treatment unit at the Bellvitge University Hospital, which oversees the outpatient treatment of different forms of behavioral addictions (such as gambling disorder, compulsive buying disorder, compulsive sexual behavior disorder and GD). This unit has the recognition of tertiary care center, which in Spain consist in a level of health care carried out by highly specialized equipment and experts in large hospitals. Patients attended in our unit are referred from primary and secondary care centers, from a catchment area including over 2 million people in the metropolitan area of Barcelona. Therefore, the sample of this work should be considered highly representative of the general population with GD related problems. The long period of recruitment (between 2005 and 2019) probably promoted variations in terms of gaming preferences, types of videogames played, values/beliefs regarding gaming, or help-seeking attitudes. Yet, this level of heterogeneity in the participants should be interpreted as a characteristic contributing to the high external validity and generalizability of our findings (our study relies on both many different types of patients and situations and a large sample size).

5. Conclusion

A large number of studies have analyzed the positive and negative impact of video games on players' cognitive and emotional skills, as well as on their physical and mental health. Most of these researches have been conducted on population-based samples, but little evidence exists regarding problematic gaming and/or GD in clinical samples. Our work focused on the study of the multiple sources explaining the heterogeneity of GD within a sample of treatment-seeking patients, with the aim of reducing the complexity of the empirical clinical profiles associated

with this disorder. The two clusters identified, characterized by different sociodemographic and clinical features, revealed two distinct and clinically relevant GD subtypes. These results provide several directions for future studies in this research field. Firstly, knowing the characteristics of the diverse empirical profiles could contribute to the study of the moderator effect of individual differences and the game types on the onset and progression of the disorder (King, Delfabbro, & Griffiths, 2011; 2019). Secondly, knowledge of the variability within GD treatment-seeking samples could contribute to the development of proper standardized screening and assessment tools, as well as reliable evidence-based tailored interventions focused on the specific patient's needs. The scientific literature on treatments for this clinical condition reveals diverse methodological flaws which prevent robust and valid conclusions about the efficacy of any therapy (Perrochon et al., 2019; Zajac et al., 2020), outlining the need for additional well-designed trials using common standardized metrics to take into account the heterogeneity of GD.

6. Role of funding sources

7. Author Agreement Statement

The manuscript has been read and approved by all authors and there are no other persons who satisfied the criteria for authorship but are not listed.

CRediT authorship contribution statement

Roser Granero: Conceptualization, Formal analysis, Writing - original draft. **Fernando Fernández-Aranda:** Conceptualization. **Jesús Castro-Calvo:** Writing - review & editing. **Joël Billieux:** Writing - review & editing. **Susana Valero-Solís:** Investigation. **Bernat Mora-Maltas:** Investigation. **Sandra Rivas-Pérez:** Investigation. **Eduardo Valenciano-Mendoza:** Investigation. **Amparo del Pino-Gutiérrez:** Investigation. **Mónica Gómez-Peña:** Investigation. **Laura Moragas:** Investigation. **Isabel Baenas:** Investigation. **Teresa Mena-Moreno:** Investigation. **Gemma Casalé-Salayet:** Investigation. **Ester Codina:** Investigation. **Vega González-Bueso:** Writing - review & editing. **Juan José Santamaría:** Writing - review & editing. **Marta Baño:** Investigation. **José M. Menchón:** Writing - review & editing. **Susana Jiménez-Murcia:** Conceptualization, Writing - original draft.

Conflict of Interest Statement

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

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