



## Original article

## Developmental trajectories of gambling severity after cognitive-behavioral therapy

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## ABSTRACT

**Aims:** To estimate trajectories of the gambling disorder (GD) severity for 12 months following a manualized cognitive-behavior-therapy (CBT) program, and to identify the main variables associated with each trajectory.

**Methods:** Latent Class Growth Analysis examined the longitudinal changes of  $n = 603$  treatment-seeking patients with GD.

**Results:** Five separate empirical trajectories were identified: T1 ( $n = 383$ , 63.5%) was characterized by the most highest baseline gambling severity levels and positive progress to recovery during the follow-up period; T2 ( $n = 154$ , 25.5%) featured participants with high baseline gambling severity and good progress to recovery; T3 ( $n = 30$ , 5.0%) was made up of patients with high gambling baseline severity and slow progress to recovery; T4 ( $n = 13$ , 2.2%) and T5 ( $n = 23$ , 3.8%) contained participants with high baseline gambling severity and moderate (T4) and poor (T5) progress in GD severity during the follow-up. Psychopathological state and personality traits discriminated between trajectories. Poor compliance with the therapy guidelines and the presence of relapses also differed between the trajectories.

**Conclusions:** Our findings show that patients seeking treatment for GD are heterogeneous and that trends in progress following treatment can be identified considering sociodemographic features, psychopathological state and personality traits. These results could be useful in developing more efficient interventions for GD patients.

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## 1. Introduction

Gambling disorder (GD) is characterized by repeated compulsive problematic gambling behavior accompanied by unsuccessful and uncontrollable urges to keep gambling, which leads to

considerable distress and impairment [1]. Risk factors for developing GD include male gender, poor school performance and cognitive distortions surrounding gambling [2,3]. Several distinct types of interventions exist to treat GD [4–7], with cognitive behavior therapy (CBT) being one of the most widely used approaches [8].

Multiple studies have assessed which factors are the most related to the effectiveness of CBT in GD patients, particularly when considering clinical state immediately after the end of the intervention and during the first months following the intervention [9,10]. Short-term effectiveness appears to be particularly related to psychopathological state at the beginning of the therapy

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(particularly lower depression and anxiety levels), followed by gender, older age, lower baseline gambling severity levels, lower comorbidity, and a more functional personality profile [11–13]. Long-term recovery has not been so widely studied, but it seems to be most associated with lower levels of psychopathology, sensation seeking and GD severity at the start of treatment [14,15].

Despite the evidence supporting the usefulness of CBT in the treatment of GD, some systematic reviews have underscored the paucity of evidence of effective treatment programs, and controversy has emerged in the interpretation of results [16,17]. The very definition of recovery remains unclear and many outcome measures incorporate broader domains extending beyond disorder-specific symptoms. Few long-term studies on gambling relapse have been conducted, the durability of the therapeutic gains is unknown and the evidence about the effects of benefits from integrative therapies has been obtained from few studies with limited sample sizes [18,19]. Moreover, although controlled studies have shown positive results in the treatment of GD, indicating the effectiveness of interventions, many of these studies had multiple limitations [5,11,20]. Namely, the lack of a single comprehensive scale to measure all aspects of gambling recovery hinders uniform reporting practices across the field [17] and the heterogeneity of populations markedly differ across studies, leading to discrepant results [4]. There is progress still yet to be made as approximately 50% of individuals affected by GD will continue to have symptoms throughout life [14,15].

The capacity of CBT to treat GD has been analyzed through variable-level techniques (such as the correlation models, regression techniques, analysis of variance or path analysis), which are focused on examining the relationships between the potential variables (in this case, predictors and therapy outcomes) by considering the individuals as a group. In this sense, variable-level analyses tend to isolate clinically significant features in which individuals differ, since they are centered on the analysis of the potential correlational structure of the variables, their stability over time, and their predictive capacity for predetermined criteria. Therefore, variable-level approaches do not provide information on person-specific, intra-individual clinical states, nor on person-specific intra-individual dynamics.

An alternative to variable-level approaches are person-centered approaches (such as mixed growth modeling or developmental trajectories). These techniques focus attention on the intra-individual structure of variables with the aim of identifying groups of individuals who share particular attributes or relationships among attributes, with the consequent advantage of conceiving the individuals as a whole and not as the sum of isolated features [21,22]. Although person-centered techniques have been used for exploring group differences in patterns of development, few studies have focused the study of GD based on developmental trajectories analyses [3,23–28]. To our knowledge only one study to date has been focused on GD trajectories after treatment [29]. This person-centered approach would be in the line of precision treatments, adapted to the specific needs of each patient, their risk factors and the phenotypic characteristics of the patient's disorder. This therapeutic perspective, based on the issue "which medication will work best for which patient" [30], is oriented to identify homogeneous subtypes of patients in order to predict response to treatment [31]. Thus, precision medicine is being extended to all areas of health, including mental health and addictions, improving prediction of response to treatment [32]. In this vein, Dowling et al. [3] identified several psychosocial risk factors associated with problem gambling such as sociodemographic variables, substance abuse, antisocial behavior, personality traits, the number of gambling activities and poor school performance. Moreover, other studies reported some variables associated with the poor treatment outcome failure as younger age [18], early age of onset and low school education [13], negative

urgency [15], high impulsivity levels [33], low coping skills, high sensation-seeking, low tolerance to boredom and craving [34]. Social support is also known to be associated with a positive response to therapy [35–37]. All these variables may contribute to the development of intervention programs based on precision medicine. As such, the aim of the present study was to estimate developmental trajectories of GD severity course during the 12 months following a manualized CBT program, and to identify the main variables associated with each trajectory.

This work used and integrate both person-centered and variable-level approaches: a) in the first stage, Latent Class Growth Analysis was used as a person-centered procedure, which aimed is to investigate how a single outcome variable (GD severity measured at multiple time points) defined a latent class model in which latent classes correspond to different growth curve shapes for the outcome variable; and b) in the second stage, the exploration of what sociodemographic and clinical variables were related with the previous empirical developmental trajectories based on analysis of variables procedures.

Based on the existing scientific evidence [3], we hypothesized that distinguishable GD trajectories would be latent in our sample, and that poor progress in gambling recovery would be related to poorer pre-treatment psychological state and more maladaptive personality profiles [38]. Cognitive distortions and higher levels of psychopathology have all been linked to greater levels of GD severity, and it is for these reasons we hypothesize that these very factors will distinguish our groups [2,39]. The identification of variables associated with the classification obtained in the latent class analysis could potentially allow for the development of more effective intervention programs for treatment-seeking patients.

## 2. Material and methods

### 2.1. Participants

The sample included consecutively admitted patients who met DSM-5 criteria for GD. Patients voluntarily sought outpatient treatment at a specialized Gambling Disorder Unit at Bellvitge University Hospital in Barcelona, Spain, and completed manualized a CBT intervention program between January-2007 and October-2017. Since the number of women was very low ( $n = 14$ ) and the high asymmetry in the distribution of the sex could bias results, only men were included in our analyses. Therefore, the final sample included  $n = 603$  treatment-seeking male patients, aged between 19 and 75.

Table 1 includes a description of the sample at the beginning of the study (pre-treatment, baseline state).

### 2.2. Psychological assessment

The assessment included specific measures of GD, global psychopathology and personality traits. Table 1 includes the Cronbach's alpha ( $\alpha$ ) coefficients estimated in the study sample for the questionnaires used.

#### 2.2.1. Diagnostic questionnaire for pathological gambling according to DSM criteria

This 19-item questionnaire assesses the DSM-IV [40] diagnostic criteria for pathological gambling. Then, all patient diagnoses were reassessed and recodified post hoc via a computerized system and, in our analysis, only patients who met DSM-5 criteria for GD were included. Convergent validity with the external gambling scores in the original version was very good ( $r = .77$  for representative samples and  $r = .75$  for gambling treatment groups [41]). Internal consistency in the Spanish adaptation used in this study was  $\alpha = .81$  for the general population and  $\alpha = .77$  for gambling treatment

**Table 1**  
Sample description at baseline (n=603).

Sociodemographic	n	%	Gambling variables	$\alpha$	Mean	SD	Psychopathology (SCL-90R)	$\alpha$	Mean	SD
<b>Civil status</b>										
Single	188	31.2	Age (years-old)		44.67	13.54	Somatization	.889	0.84	0.73
Married-partner	354	58.7	Age of GD onset (years-old)		30.10	11.67	Obsessive/comp.	.885	1.02	0.74
Separated-divorced	61	10.1	Duration of GD (years)		14.89	8.03	Interpersonal sensitivity	.839	0.89	0.73
<b>Education level</b>										
Primary	330	54.7	DSM-5 total criteria	.763	6.87	1.79	Depressive	.897	1.39	0.84
Secondary	242	40.1	SOGS-total score	.781	10.74	2.80	Anxiety	.873	0.89	0.71
University	31	5.1	Personality (TCI-R)				Hostility	.814	0.81	0.72
<b>Social status</b>										
High + mean-high	37	6.1	Novelty seeking	.757	107.80	14.32	Phobic anxiety	.773	0.37	0.55
Mean	76	12.6	Harm avoidance	.811	100.07	16.70	Paranoid Ideation	.754	0.78	0.70
Mean-low	216	35.8	Reward dependence	.772	98.94	14.81	Psychotic	.832	0.83	0.69
Low	274	45.4	Persistence	.864	108.53	19.73	GSI score	.975	0.95	0.62
<b>Employment</b>										
Unemployed	229	38.0	Self-directedness	.837	128.86	20.25	PST score	.975	43.98	20.22
Employed	374	62.0	Cooperativeness	.789	132.49	15.59	PSDI score	.975	1.82	0.54
<b>Origin</b>										
Spain	586	97.2	Self-Transcendence	.822	63.46	14.79				
Immigrant	17	2.8								

Note. SD: standard deviation.  $\alpha$ : Cronbach's alpha in the study sample.

samples [42]. In this study, the total number of DSM-5 criteria for GD was analyzed ( $\alpha = .76$  in the sample).

### 2.2.2. South Oaks Gambling Screen (SOGS)

This questionnaire is commonly used to evaluate gambling severity in research and clinical settings. It includes 20 items to assess cognitions and behaviors related to problem gambling. The validated Spanish version of the SOGS has shown high internal consistency (Cronbach's alpha  $\alpha = .94$ ) and good test-retest reliability ( $r = 0.98$ ) [43]. The internal consistency in the study sample was adequate ( $\alpha = .78$ ).

### 2.2.3. Symptom checklist-90 items-revised (SCL-90-R)

This is a 90-item self-report tool used to assess global psychopathology through nine primary symptom dimensions (obsessive-compulsive, depression, anxiety, hostility, interpersonal sensitivity, phobic anxiety, somatization, paranoid ideation and psychoticism) and three derived global indices [global severity index (GSI), positive symptom total (PST), and positive symptom distress index (PSDI)]. Good psychometrical properties were found in Spanish samples [44]. Internal consistency ranged between  $\alpha = .77$  for phobic anxiety to  $\alpha = .98$  for the global composite indexes in the study sample.

### 2.2.4. Temperament and character inventory-revised (TCI-R)

This is a 240-item tool used to measure four temperament dimensions (harm avoidance, novelty seeking, reward dependence and persistence) and three character scales (self-directedness, cooperativeness and self-transcendence) of personality. The adaptation of Spanish version of the questionnaire obtained good psychometrical properties [45]. Internal consistency ranged between  $\alpha = .76$  for novelty seeking and  $\alpha = .86$  for persistence in the study sample.

### 2.2.5. Other sociodemographic and clinical variables

Additional sociodemographic data were taken using a semi-structured, face-to-face clinical interview described elsewhere [46], including the following variables:

**2.2.5.1. Socio-demographic variables.** Sex, current marital status (single, married or with a stable partner, divorced or separated,

widowed), social status by means of Hollingshead [27], currently receiving personal income, currently in employment, receipt of social aid, number of co-inhabitants, presence of overcrowded living conditions (i.e., having to share a bedroom with a person who is not one's partner), age (in years), personal income (monthly average, in euros) and family income (monthly average, in euros).

**2.2.5.2. Current state of physical and mental health.** Current treatment for physical health problems, smoking habit, alcohol consumption, consumption of illegal substances, regular consumption of non-prescription medication, current treatment for psychological problems, past treatment history for psychological problems, presence of close relatives who have or have had psychological problems requiring treatment

**2.2.5.3. Gambling profile.** Main gambling activity was identified and for each gambling activity, the following were measured: age of initiation, duration, frequency, bets (average and maximum), current treatment for gambling behavior, previous life history for gambling behavior treatment.

**2.2.5.4. Gambling behavior.** Total past debts accumulated by the subject due to gambling, total current debts accumulated by the subject due to gambling, cognitive distortions attributable to gambling (gambling expectations, illusion of control, predictive control, interpretative bias).

## 2.3. Procedure

All participants were assessed in two face-to-face clinical interviews by expert clinical psychologists with more than 15 years of experience in the field of behavioral addictions, who also guided the administration of questionnaires. In the first clinical interview, the psychologists or psychiatrists who attended the patient proposed participation in the project, providing informed consent, which was signed in the case of acceptance. The decision on participation in the study was autonomous and voluntary. The head of the project (SJM) ensured that the care or services they would receive at the hospital would not be affected regardless of their decision. In addition, if the patient decided to withdraw from the study once participation had begun and/or wanted to

withdraw their data from the database, they could do so by contacting the head of the project. The therapist leading the CBT group gave the patients a calendar with all the scheduled sessions (including follow-up sessions) at the beginning of the treatment program. The same clinical psychologist (who did the first interview and the assessment) carried out the CBT therapy intervention and weekly case discussions were held between the therapists and the rest of the team at the Unit.

The present study was approved by the Ethics Committee of Bellvitge University Hospital and all patients provided signed informed consent. Psychological measures were obtained by experienced clinical psychologists at the Department of Psychiatry of Bellvitge University Hospital.

Data analyzed in this study correspond to data taken at the start of the CBT program, immediately following CBT, and measures obtained during the 12 months following the end of the program (data was obtained 1, 3, 6 and 12 months after the completion of the CBT program).

The Cognitive-behavioral therapy (CBT) intervention utilized in this study was carried out in a group format (averaging approximately 10 patients-per-group). It consisted of 16 weekly outpatient sessions lasting about 45 min each. The aim of the intervention was to train patients to implement CBT strategies in order to attain full recovery (defined as the absence of gambling episodes). The general topics addressed in the program included psychoeducation regarding GD (its onset and course, vulnerability factors, diagnostic criteria, bio-psychosocial models, etc.), stimulus control (such as money management and the avoidance of potential triggers), response prevention strategies (alternative and compensatory behaviors), the acquisition of new, healthy behaviors to replace GD, cognitive restructuring focused on illustrating and rectifying false beliefs of control over gambling, reinforcement and self-reinforcement, skills training and relapse prevention techniques. The therapists who conducted the groups are the same clinical psychologists who performed the first interviews and evaluations. These three therapists share the same background in CBT training, extensive experience in motivational interviewing, as well as a deep knowledge of the manualized treatment protocol used at the unit. In relation to adherence to treatment, the variables considered are compliance with guidelines, self-monitoring, etc. and three categories of compliance were established: good, regular and bad, depending on the level of fulfillment of the instructions provided by the therapist.

A full description of this CBT program has been previously published [47] and its short- and long-term effectiveness has been described elsewhere [15,48,49].

#### 2.4. Statistical analyses

Statistical analyses were carried out with MPlus8 for Windows. The trajectories were estimated using the SOGS-total scores obtained during the first year after completion of the CBT, which was defined as a measure of gambling problem severity. Due to the strong association between the decreases in severity and the initial (baseline) gambling severity, estimation was carried out including baseline SOGS-total scores as a covariate. Latent Class Growth Analysis (LCGA) was used, defining the robust maximum likelihood (MLR) estimator in the *Analysis* command (full information on this method is presented in: [50,51] and using Lo-Mendell-Rubin [52] as a measure to determine the number of classes. LCGA constitute a special type of Growth Mixture Modeling, with the peculiar consideration that individuals within a class are homogenous and therefore variance and covariance estimates for the growth factors within each class are set to zero [53,54]. TYPE = MIXTURE in MPlus syntax was defined and the MODEL command set at 0, 1,

2, 3 and 4 the time scores for the slope growth factor to define a linear growth model with equidistant time points (at post-therapy and at months 3–6–9–12 of the follow-up). In the estimation procedure, solutions with quadratic and cubic components were tested, but they were rejected because these potential solutions did not provide substantively better statistical adjustment and/or models with better clinical interpretation, and therefore simpler solutions with linear components were selected for the sake of parsimony. The selection of the number of trajectories was based on [55]: a) the lowest Akaike (AIC) and Bayesian information criterion (BIC) indexes for the model (compared with other solutions); b) entropy (measure of the model's discriminative capacity, that is, its ability to identify individuals following the different trajectories) above .80; c) high on-diagonal average values (around .80) in the matrix containing the probabilities of membership (that is, high average latent class probabilities for most likely latent class membership by latent class); d) enough sample size in a class/trajectory to allow for statistical comparisons; and e) adequate clinical interpretability.

The distribution of the characteristics of participants (socio-demographic, personality and psychopathological levels) across the identified trajectories was examined with chi-square tests for categorical variables and analysis of variance (ANOVA) for quantitative variables. The list of features examined included the sociodemographic variables measured at the beginning of the study, gambling related variables at baseline, psychopathology and personality at baseline, psychopathology at the end of the therapy program, adherence to the therapy program and the presence of relapses during the program and during the follow-up episodes (relapses were defined as the presence of gambling episodes). Cohen's-*d* coefficient measured effect size for pairwise comparisons ( $|d| > 0.20$  was considered low effect size,  $|d| > 0.50$  moderate effect size and  $|d| > 0.80$  good effect size [56]). Increase in Type-I error due to multiple statistical comparisons was controlled with Simes' correction method, a familywise error rate stepwise procedure which offers more powerful test than the classical Bonferroni correction [57].

Finally, a multinomial logistic regression was performed to model the predictive contribution of the measures at the beginning of the study (defined as independent variables) on membership in the 5 groups obtained in the LCGA (defined as the dependent variable). The multinomial regression is a generalization of logistic regression to multiclass problems (i.e. categorical criteria with more than two levels), and therefore it allows for the prediction of the probabilities of the different levels of a categorically distributed dependent variable considering a set of independent variables. In this study, due to the large set of independent variables, three separate models were obtained: a) for the sociodemographic variables (civil status, education level, social position index, employment status and origin of the sample); b) for gambling related variables and global psychopathological state (patients' age, GD duration, DSM-5 total criteria for GD, debts due to gambling and SCL-90R GSI); and c) for personality traits (TCI-R scores). The final models presented in this study retained only those independent variables with a significant contribution on the criterion.

### 3. Results

#### 3.1. GD course trajectories

Table 2, contains the goodness-of-fit and the mean estimates for the candidate models obtained in the LCGA, with a number of trajectories ranging from 2 to 5 groups. Solution models for more than 5 trajectories were not considered due to small group size to allow for subsequent statistical comparisons (for example, the 6-

**Table 2**  
Goodness-of-fit indexes for LCGA candidate solutions.

Model <sup>d</sup> #trajec.	Akaike AIC	Bayesian BIC	<sup>a</sup> Adjusted BIC	<sup>b</sup> LMR- LRT	<sup>c</sup> Boost. BLRT	Entro- phy		Count-size		On-diagonal posterior prob.	Estimated means (SOGS-total score)					
								n	%		Pre	Post	3-month	6-month	9-month	12-month
1-tr	13324.5	13395.0	13344.2	—	—	1.00	T1	603	100%	1.00	10.74	2.76	2.71	2.63	2.55	2.47
2-tr	13031.2	13123.6	13056.9	294.18 (.040)	−6646.3 (<.001)	.860	T1	551	91.4%	.996	10.71	2.44	2.44	2.44	2.44	2.45
							T2	52	8.6%	.824	11.05	6.25	5.60	4.64	3.67	2.70
3-tr	12853.7	12968.2	12885.6	181.75 (<.001)	−6494.6 (<.001)	.812	T1	393	65.2%	.924	11.55	2.47	2.48	2.49	2.50	2.52
							T2	51	8.5%	.927	11.01	6.27	5.62	4.65	3.69	2.72
							T3	159	26.4%	.879	8.80	2.38	2.36	2.33	2.30	2.27
4-tr	12743.5	12880.0	12781.6	116.54 (.728)	−6400.9 (<.001)	.814	T1	24	4.0%	.847	11.18	3.92	4.63	5.71	6.79	7.87
							T2	388	64.3%	.901	11.53	2.50	2.42	2.40	2.33	2.28
							T3	37	6.1%	.938	11.04	6.66	5.85	4.63	3.40	2.18
							T4	154	25.5%	.874	8.83	2.20	2.22	2.16	2.20	2.15
5-tr	12,633.1	12,791.5	12,677.2	161.66 (.183)	−6363.9 (<.001)	.877	T1	383	63.5%	.868	11.50	2.47	2.42	2.33	2.25	2.16
							T2	154	25.5%	.870	8.84	2.20	2.10	2.00	2.00	2.00
							T3	30	5.0%	.917	11.32	6.85	5.91	4.50	3.09	1.69
							T4	13	2.2%	.862	11.54	2.95	3.30	3.60	3.90	4.10
							T5	23	3.8%	.869	10.92	4.38	5.02	5.97	6.93	8.00
6-tr	12625.5	12805.9	12675.8	38.80 (.969)	−6291.7 (<.001)	.859	T1	15	2.5%	.803	11.32	5.65	6.10	6.79	7.48	8.16
							T2	19	3.2%	.931	11.19	7.06	5.96	4.33	2.69	1.05
							T3	147	24.4%	.817	8.78	2.29	2.28	2.25	2.23	2.21
							T4	3	0.5%	.999	11.68	10.65	9.03	6.60	4.17	1.74
							T5	65	10.8%	.866	11.13	4.26	3.94	3.46	2.98	2.50
							T6	354	58.7%	.914	11.49	2.26	2.28	2.32	2.36	2.40

Note.

<sup>a</sup> Sample-size adjusted BIC.

<sup>b</sup> Lo-Mendell-Rubin Adjusted Likelihood Ratio Test: value (significance).

<sup>c</sup> Boostrapped Likelihood Ratio Test (BLRT): loglikelihood ivalue (significance).

<sup>d</sup> Number of trajectories.

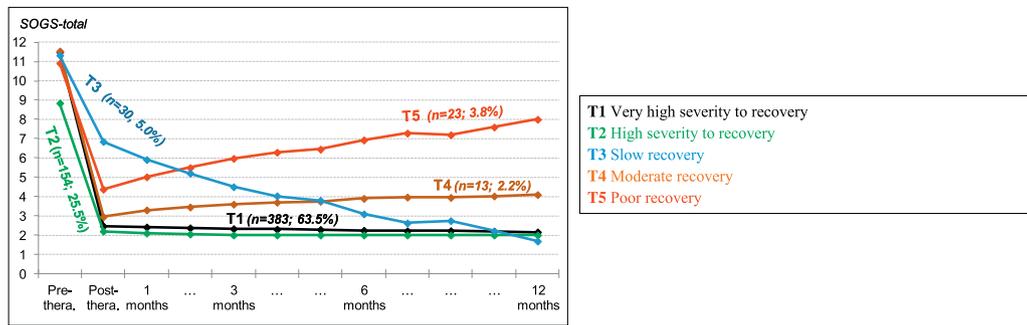


Fig. 1. Course trajectories: from pre-treatment to 12-months following the CBT program (n = 603).

classes model included a group with only 3 participants). The final model selected was the 5-trajectory solution (Fig. 1 includes the shapes for the SOGS evolution from baseline to the year following treatment). This model yielded the lowest AIC-BIC indexes (AIC = 12633.1, BIC = 12,791.5 and adjusted sample-size BIC = 12,677.2), excellent entropy (.877), very high on-diagonal values in the matrix with the average latent class probabilities (between .868 and .917), and good clinical interpretability.

### 3.2. Comparison between trajectories at baseline

Tables 3 and 4 include the comparison between trajectories in terms of sociodemographic and clinical variables taken at the start of the CBT program (at the beginning of the study).

Trajectory T1 (n = 383, 63.5%) represented patients with very high GD severity at baseline (mean SOGS = 11.5) and good progress to recovery (mean SOGS = 2.5 at post-treatment and 2.2 at the end of the follow-up period). This group was characterized by the high scores in psychopathology (as determined by the SCL-90-R) and high scores in novelty seeking at baseline.

Trajectory T2 (n = 154, 25.5%) represented patients with high GD severity at baseline (mean SOGS = 8.8) and good progress to recovery (mean SOGS = 2.2 at the end of the treatment and 2.0 at the end of the follow-up period). This class is characterized by the lowest scores in psychopathology state at baseline, low scores in novelty seeking and harm avoidance and high scores in reward dependence, persistence, self-directedness and cooperativeness. Trajectory T2 also included the highest proportion of patients that were married or living with a stable partner, but the lowest proportion of patients with debts due to gambling behavior.

Trajectory T3 (n = 30, 5.0%) represented patients with high levels of GD severity at baseline (mean SOGS = 11.3) and slow progress to recovery (mean SOGS = 6.85 at post-therapy and 1.7 at the end of the follow-up period). This trajectory included patients with moderate levels of psychopathology and high scores in novelty seeking and reward dependence at baseline.

Trajectory T4 (n = 13, 2.2%) represented patients with very high GD severity at baseline (mean SOGS = 11.5) and moderate progress in obtaining recovery (mean SOGS = 3.0 at post-CBT and 4.1 at the 12-month follow-up). This trajectory grouped patients with worse psychopathological state at baseline, high scores in harm avoidance and low scores in persistence. Trajectory T4 also included the highest proportion patients that were single, as well as the highest percentage of patients with debts due to gambling behavior.

Trajectory T5 (n = 13, 2.2%) represented patients with very high GD severity at baseline (mean SOGS = 10.9) and poor progress at the end of the follow-up period (mean SOGS = 4.4 at post-treatment and 8.0 at the 12-month follow-up). This class

agglomerated patients with moderate psychopathological impairment and low scores in reward dependence and persistence.

Fig. 2 contains a radar-chart to graphically illustrate the main differences between trajectories for the psychological variables registered at baseline (z-standardized means have been plotted to allow for easier interpretation due to the different scale ranges).

### 3.3. Comparison between trajectories considering therapy outcomes

The top of Table 5 includes comparisons between trajectories considering compliance with the therapy guidelines and the presence of gambling episodes (relapses) during CBT. Trajectories T1 and T2 did not differ in these two outcomes, and they were characterized by a high proportion of participants with good compliance and a low presence of relapses. Contrarily, trajectories T3-T4-T5 featured a high proportion of participants with moderate to bad compliance with therapy guidelines and a higher proportion of relapses.

The middle of Table 5 includes comparisons between trajectories in psychopathology at the end of the CBT program. T2 obtained the lowest means compared with all the other trajectories on many SCL-90-R scales, followed by trajectories T1 and T5. The highest levels of psychopathology were found in T3 and T4.

Finally, the bottom of Table 5 contains the presence of relapses during the 12-month follow-up period. T2 registered the lower proportion of patients who reported the presence of gambling episodes during this period (5.2%), closely followed by trajectory T1 (9.7%). The presence of relapse for trajectory T3 (20.0%) was statistically higher than the relapses registered for T1 and T2, and statistically lower than the presence of relapses obtained for T4 (46.2%) and T5 (47.8%).

### 3.4. Predictive model

Table 6 includes the results of the final multinomial logistic regressions. The final model for the sociodemographic variables retained only civil status as a significant predictor of the membership in the developmental trajectories classification. Results indicate that being single (versus being married or separated/divorced) increased the odds of being classified in trajectories 1, 4 or 5 versus being classified in trajectory 2. Regarding model 2 (which initially included patients' age, gambling related variables and psychopathological state), significant predictors retained in the final model were the number of DSM-5 criteria for GD and SCL-90R GSI scores. This model indicates that higher gambling severity at baseline (higher number of DSM-5 criteria) decreases the odds of being classified in trajectory 1 or in trajectory 2 compared with being in the other trajectories, and that worse psychopathological state (higher GSI score) decreases the odds of being classified in trajectory 2 compared with being in any



**Table 4**  
Comparison between trajectories in clinical state (gambling variables, psychopathology and personality) at baseline.

	T1		T2		T3		T4		T5		Pairwise comparisons																			
	n = 383		n = 154		n = 30		n = 13		n = 23		T1vsT2		T1vsT3		T1vsT4		T1vsT5		T2vsT3		T2vsT4		T2vsT5		T3vsT4		T3vsT5		T4vsT5	
	M	SD	M	SD	M	SD	M	SD	M	SD	p	d	p	d	p	d	p	d	p	d	p	d	p	d	p	d	p	d	p	d
<i>Gambling variables</i>																														
Age (years-old)	44.4	13.4	45.9	14.1	44.4	12.2	43.2	8.9	42.2	15.8	.262	0.11	.986	0.00	.757	0.10	.442	0.15	.580	0.11	.502	0.22	.224	0.25	.801	0.11	.560	0.16	.822	0.08
Age of onset (years-old)	29.4	11.4	31.5	12.3	29.8	10.9	31.0	9.0	31.8	13.7	.067	0.28	.872	0.03	.629	0.16	.360	0.19	.465	0.15	.881	0.05	.910	0.02	.752	0.12	.542	0.16	.844	0.07
Duration (years)	15.4	8.1	14.3	8.1	15.2	7.0	12.9	8.9	10.5	6.5	.165	0.13	.868	0.03	.267	0.29	<b>.006<sup>†</sup></b>	<b>0.68<sup>†</sup></b>	.610	0.11	.539	0.17	<b>.038<sup>†</sup></b>	<b>0.53<sup>†</sup></b>	.399	0.28	<b>.041<sup>†</sup></b>	<b>0.70<sup>†</sup></b>	.386	0.31
DSM-5 total criteria	7.74	1.08	4.62	1.23	7.20	1.61	7.08	1.50	7.00	1.71	<b>.001<sup>†</sup></b>	<b>2.70<sup>†</sup></b>	<b>.016<sup>†</sup></b>	0.40	<b>.048<sup>†</sup></b>	<b>0.51<sup>†</sup></b>	<b>.004<sup>†</sup></b>	<b>0.52<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.81<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.80<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.60<sup>†</sup></b>	.755	0.08	.544	0.12	.852	0.05
SOGS-total score	11.6	2.5	8.5	2.3	11.4	3.4	11.3	3.1	10.7	2.1	<b>.001<sup>†</sup></b>	<b>1.29<sup>†</sup></b>	.707	0.06	.700	0.10	.083	0.41	<b>.001<sup>†</sup></b>	<b>1.00<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.01<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.98<sup>†</sup></b>	.911	0.03	.277	0.27	.446	0.25
	n	%	n	%	n	%	n	%	n	%	p	d	p	d	p	d	p	d	p	d	p	d	p	d	p	d	p	d	p	d
Debts due to gambling (yes)	185	48.3	53	34.4	17	56.7	10	76.9	10	43.5	<b>.003<sup>†</sup></b>	0.28	.377	0.17	<b>.042<sup>†</sup></b>	<b>0.62<sup>†</sup></b>	.653	0.10	<b>.022<sup>†</sup></b>	<b>0.52<sup>†</sup></b>	<b>.002<sup>†</sup></b>	<b>0.95<sup>†</sup></b>	.397	0.19	.207	0.44	.341	0.27	<b>.048<sup>†</sup></b>	<b>0.73<sup>†</sup></b>
<i>Gambling</i>																														
Non-strategic	302	78.9	134	87.0	24	80.0	11	84.6	17	73.9	.080	0.22	.818	0.03	.837	0.15	.673	0.12	.354	0.19	.800	0.07	.134	0.34	.938	0.12	.871	0.14	.759	0.27
Strategic	51	13.3	14	9.1	3	10.0	1	7.7	3	13.0	0.13	0.10	0.10	0.18	0.01	0.01	0.03	0.05	0.03	0.05	0.13	0.08	0.08	0.08	0.10	0.10	0.10	0.18		
Both	30	7.8	6	3.9	3	10.0	1	7.7	3	13.0	0.17	0.17	0.08	0.01	0.01	0.17	0.17	0.24	0.16	0.16	0.33	0.08	0.08	0.10	0.10	0.10	0.18			
<i>Psychopath. (SCL-90R)</i>																														
Somatization	1.01	0.76	0.40	0.41	0.82	0.73	0.92	0.58	0.86	0.70	<b>.001<sup>†</sup></b>	<b>1.00<sup>†</sup></b>	.156	0.25	.651	0.14	.287	0.21	<b>.003<sup>†</sup></b>	<b>0.71<sup>†</sup></b>	<b>.015<sup>†</sup></b>	<b>1.03<sup>†</sup></b>	<b>.003<sup>†</sup></b>	<b>0.80<sup>†</sup></b>	.694	0.14	.861	0.05	.805	0.10
Obsessive/comp.	1.22	0.71	0.49	0.47	0.99	0.73	1.33	0.70	1.14	0.91	<b>.001<sup>†</sup></b>	<b>1.22<sup>†</sup></b>	.085	0.31	.591	0.16	.583	0.10	<b>.001<sup>†</sup></b>	<b>0.82<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.41<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.90<sup>†</sup></b>	.159	<b>0.53<sup>†</sup></b>	.436	0.18	.442	0.23
Interpersonal sensitivity	1.10	0.73	0.34	0.37	0.90	0.75	1.21	0.66	0.86	0.69	<b>.001<sup>†</sup></b>	<b>1.33<sup>†</sup></b>	.112	0.28	.588	0.16	<b>.076<sup>†</sup></b>	0.35	<b>.001<sup>†</sup></b>	<b>0.96<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.63<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.93<sup>†</sup></b>	.180	0.44	.803	0.06	.135	<b>0.53<sup>†</sup></b>
Depressive	1.67	0.81	0.70	0.48	1.49	0.71	1.64	0.92	1.15	0.73	<b>.001<sup>†</sup></b>	<b>1.46<sup>†</sup></b>	.203	0.24	.882	0.04	<b>.001<sup>†</sup></b>	<b>0.67<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.29<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.28<sup>†</sup></b>	<b>.006<sup>†</sup></b>	<b>0.74<sup>†</sup></b>	.566	0.18	.109	0.46	<b>.047<sup>†</sup></b>	<b>0.58<sup>†</sup></b>
Anxiety	1.09	0.71	0.37	0.33	0.99	0.81	1.24	0.69	0.79	0.73	<b>.001<sup>†</sup></b>	<b>1.28<sup>†</sup></b>	.440	0.13	.445	0.21	<b>.033<sup>†</sup></b>	0.41	<b>.001<sup>†</sup></b>	<b>1.00<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.59<sup>†</sup></b>	<b>.004<sup>†</sup></b>	<b>0.73<sup>†</sup></b>	.280	0.33	.273	0.26	<b>.049<sup>†</sup></b>	<b>0.63<sup>†</sup></b>
Hostility	0.96	0.75	0.38	0.40	0.93	0.88	1.11	0.72	0.71	0.75	<b>.001<sup>†</sup></b>	<b>0.97<sup>†</sup></b>	.794	0.04	.493	0.19	.084	0.34	<b>.001<sup>†</sup></b>	<b>0.80<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.24<sup>†</sup></b>	<b>.033<sup>†</sup></b>	<b>0.54<sup>†</sup></b>	.464	0.22	.254	0.27	.113	<b>0.54<sup>†</sup></b>
Phobic anxiety	0.45	0.57	0.12	0.27	0.44	0.69	0.71	0.78	0.47	0.80	<b>.001<sup>†</sup></b>	<b>0.74<sup>†</sup></b>	.958	0.01	.105	0.39	.886	0.02	<b>.003<sup>†</sup></b>	<b>0.62<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.02<sup>†</sup></b>	<b>.004<sup>†</sup></b>	<b>0.58<sup>†</sup></b>	.155	0.37	.884	0.03	.205	0.31
Paranoid ideation	0.94	0.73	0.37	0.40	0.85	0.78	1.02	0.79	0.57	0.56	<b>.001<sup>†</sup></b>	<b>0.99<sup>†</sup></b>	.468	0.12	.726	0.09	<b>.007<sup>†</sup></b>	<b>0.58<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.78<sup>†</sup></b>	<b>.002<sup>†</sup></b>	<b>1.03<sup>†</sup></b>	.177	0.41	.483	0.21	.123	0.42	<b>.042<sup>†</sup></b>	<b>0.65<sup>†</sup></b>
Psychotic	1.03	0.70	0.33	0.33	0.86	0.69	0.95	0.71	0.80	0.68	<b>.001<sup>†</sup></b>	<b>1.28<sup>†</sup></b>	.179	0.24	.662	0.12	.083	0.34	<b>.001<sup>†</sup></b>	<b>0.99<sup>†</sup></b>	<b>.002<sup>†</sup></b>	<b>1.11<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.87<sup>†</sup></b>	.716	0.12	.697	0.10	.514	0.21
GSI score	1.14	0.60	0.44	0.29	0.99	0.63	1.20	0.61	0.88	0.61	<b>.001<sup>†</sup></b>	<b>1.50<sup>†</sup></b>	.157	0.24	.737	0.09	<b>.023<sup>†</sup></b>	0.44	<b>.001<sup>†</sup></b>	<b>1.13<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.61<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.93<sup>†</sup></b>	.285	0.33	.448	0.19	.106	<b>0.53<sup>†</sup></b>
PST score	51.3	17.6	25.0	13.7	46.3	18.3	55.5	19.4	39.2	17.0	<b>.001<sup>†</sup></b>	<b>1.67<sup>†</sup></b>	.113	0.28	.383	0.22	<b>.001<sup>†</sup></b>	<b>0.70<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.32<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>1.82<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.92<sup>†</sup></b>	.100	<b>0.50<sup>†</sup></b>	.125	0.40	<b>.005<sup>†</sup></b>	<b>0.89<sup>†</sup></b>
PSDI score	1.92	0.53	1.55	0.42	1.88	0.51	1.85	0.61	1.85	0.74	<b>.001<sup>†</sup></b>	<b>0.78<sup>†</sup></b>	.666	0.08	.666	0.12	.541	0.11	<b>.002<sup>†</sup></b>	<b>0.70<sup>†</sup></b>	<b>.049<sup>†</sup></b>	<b>0.58<sup>†</sup></b>	<b>.009<sup>†</sup></b>	<b>0.51<sup>†</sup></b>	.893	0.04	.868	0.04	.998	0.00
<i>Personality (TCI-R)</i>																														
Novelty seeking	110.1	14.0	102.0	14.1	110.8	12.7	106.7	10.7	104.8	14.5	<b>.001<sup>†</sup></b>	<b>0.58<sup>†</sup></b>	.806	0.05	.401	0.28	.082	0.37	<b>.002<sup>†</sup></b>	<b>0.66<sup>†</sup></b>	.260	0.38	.377	0.20	.392	0.35	.129	0.44	.705	0.15
Harm avoidance	102.3	16.5	92.5	15.5	104.2	16.4	107.4	15.8	103.9	13.6	<b>.001<sup>†</sup></b>	<b>0.61<sup>†</sup></b>	.527	0.12	.278	0.32	.644	0.11	<b>.001<sup>†</sup></b>	<b>0.73<sup>†</sup></b>	<b>.002<sup>†</sup></b>	<b>0.95<sup>†</sup></b>	<b>.002<sup>†</sup></b>	<b>0.78<sup>†</sup></b>	.567	0.20	.942	0.02	.545	0.24
Reward dependence	97.5	14.8	103.2	14.1	100.4	13.8	97.0	17.0	94.5	14.9	<b>.001<sup>†</sup></b>	0.40	.301	0.20	.915	0.03	.364	0.20	.340	0.20	.157	0.40	<b>.010<sup>†</sup></b>	<b>0.60<sup>†</sup></b>	.501	0.22	.159	0.41	.640	0.15
Persistence	108.8	19.9	110.1	19.2	106.5	19.3	99.4	22.8	101.3	18.3	.491	0.07	.550	0.12	.105	0.44	.082	0.39	.369	0.19	<b>.071<sup>†</sup></b>	<b>0.51<sup>†</sup></b>	<b>.048<sup>†</sup></b>	<b>0.47<sup>†</sup></b>	.294	0.34	.346	0.28	.793	0.09
Self-directedness	123.8	18.7	142.9	17.5	125.9	19.1	128.2	13.7	125.3	23.9	<b>.001<sup>†</sup></b>	<b>1.06<sup>†</sup></b>	.550	0.11	.418	0.27	.701	0.07	<b>.001<sup>†</sup></b>	<b>0.93<sup>†</sup></b>	<b>.009<sup>†</sup></b>	<b>0.94<sup>†</sup></b>	<b>.001<sup>†</sup></b>	<b>0.84<sup>†</sup></b>	.722	0.14	.912	0.03	.669	0.15
Cooperativeness	130.2	15.7	139.0	13.3	129.1	16.0	133.5	16.7	130.8	16.0	<b>.001<sup>†</sup></b>	<b>0.60<sup>†</sup></b>	.708	0.07	.463	0.20	.872	0.03	<b>.001<sup>†</sup></b>	<b>0.67<sup>†</sup></b>	.228	0.36	<b>.018<sup>†</sup></b>	<b>0.56<sup>†</sup></b>	.402	0.27	.703	0.10	.616	0.17
Self-Transcendence	64.5	14.8	61.6	14.3	62.9	13.8	64.3	17.0	59.6	16.8	.058	0.20	.594	0.11	.963	0.01	.134	0.31	.657	0.10	.550	0.17	.552	0.13	.795	0.09	.424	0.22	.380	0.28

Note. M: mean. SD: standard deviation.

\* Bold: significant comparison (.05 level).

† Bold: effect size in the moderate ( $|d|>0.50$ ) to good range ( $|d|>0.80$ ).

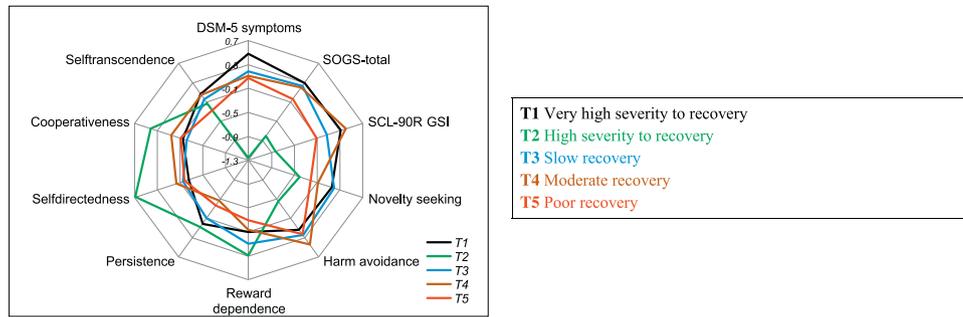


Fig. 2. Radar chart with the main psychological variables differing between the trajectories (at baseline) ( $n=603$ ).

other trajectory. Finally, model 3 (which initially included all the TCI-R scores), retained novelty seeking (higher levels predict lower odds of being in trajectory 2 compared to trajectories 1 and 3), harm avoidance (higher levels predict lower odds of being in trajectory 2 compared to being in trajectories 1, 3 and 4) and self-directedness (higher levels predict higher odds of being in trajectory 2 compared to being in trajectories 1 and 5) as significant predictors.

#### 4. Discussion

This study used LCGA to obtain an empirical classification for a sample of patients who met clinical criteria for GD, based on gambling severity during the 12 months following a CBT program. SOGS total score was selected as a measure of change in the GD severity because it provides a wider range of scores based on scalar measures and this attribute statistically facilitated the identification of developmental trajectories with better fitting. T1 and T2 included the largest number of participants (in total  $n=537$ , 89% of the sample), and were defined by high to severe gambling severity at baseline and good progress to recovery during the follow-up. Trajectory T3 ( $n=30$ , 5.0%) included also participants with initial severe affectation and slow evolution to recovery. T4 and T5 included the least number of participants (in total  $n=36$ , 6%), characterized by severe baseline gambling severity and poor progress during the follow-up period.

The trajectories obtained discriminative capacity in terms of psychopathology levels, personality traits at baseline, the degree of compliance with the therapy guidelines during the CBT program, and the presence of relapses during CBT and during the 12-month follow-up. T3 included patients with a severe baseline psychopathology, but with good progress during recovery (although these clinical improvements were slowly obtained). These patients may have benefited from a more intense treatment plan in order to attain complete gambling abstinence more quickly (for example, treatment plans with a greater number of sessions). Trajectories T4 and T5 had the lowest duration of the gambling problem, high psychopathology at baseline and low scores in reward dependence and persistence. They also obtained the highest proportion of participants with poor compliance during treatment and relapses were the highest for these groups. As a whole, these results seem consistent with a recent systematic review highlighting the pre-treatment predictors of short- and long-term GD treatment outcomes. This review found shows that less psychopathology at intake (mainly depression and anxiety levels) were the most consistent predictors of success after treatment across multiple time points, followed by older age, lower gambling severity at intake, education levels, and personality traits [11].

Another important aspect to consider is the course of the disorder. The results of the present study suggest that shorter GD duration is associated with poorer treatment outcomes, as

described in previous studies [16,58]. A possible explanatory hypothesis to these findings would be related to the awareness of disorder and motivation to deal with the gambling problem [59]. It could be that the patients with the worse therapeutic evolution had undergone less negative consequences for their gambling behavior and, therefore, had less intrinsic motivation to change. It is possible that the goal of our program to obtain complete abstinence from all types of gambling may be too ambitious for patients with shorter GD duration [60,61]. In addition, taking into account that therapeutic goals may change throughout treatment. In this vein, Stea, Hodgins & Fung [61] showed that half of subjects following a treatment program based on a brief motivational intervention modified their therapeutic goals as therapy progressed. The majority began the recovery process by assuming definitive abstinence from all types of gambling, however later on, more than 25% expressed their willingness to give up their problematic type of gambling, 10% bet in a controlled manner and only 20% continued with the decision to abandon all types of gambling. In fact, patients often return to gambling, to a greater or lesser extent, after having undergone treatment for their disorder and, more specifically, at 12 months of follow-up [62]. Although this does not always means therapy was a failure or a worsening of their gambling problem [14]. Also at a 12-month follow-up, another study identified that 41.6% of subjects treated with an inpatient treatment program maintained complete abstinence from all types of gambling, while 29.2% of patients still met diagnostic criteria for GD, although another 29.2% still had some form of gambling, but did not meet diagnostic criteria [14]. Considering this issue, some studies have explored the effectiveness of programs oriented to controlled gambling [60,61,63–66]. Actually, it seems that in the community, most individuals who have had gambling problems end up recovering without having totally abstained from gambling behavior, during the process [25]. Therefore, although abstinence is the most common therapeutic goal in treatment programs [67], it could be timely to explore other alternatives such as controlled gambling, in the context of personalized therapeutic approaches, discussing with the patient their own goals and objectives [14,68]. However, focusing on T4 and T5, it is necessary to bear in mind that other associated factors may be personality traits such as lower reward dependence and low persistence. These traits could be defined as the presence of less interest in pleasing others, social withdrawal, detachment and distance in interpersonal interactions [11–13]. Likewise, they may show a tendency to easily abandon their goals at the slightest setback and or sign of frustration. Taking all these results together, we could consider that, perhaps, these patients could benefit from motivational interventions, as the systematic review and meta-analysis by Yakovenko et al [69] demonstrated in terms of improvement of gambling problems at 1, 3 and 12 months of follow-up. Therefore, motivational interviews could help to improve their awareness of their condition, to make their





## Declarations of interest

None.

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