**Abstract**

In spite of the revived interest in compulsive buying disorder (CBD), its classification into the contemporary nosologic systems continues to be debated, and scarce studies have addressed heterogeneity in the clinical phenotype through methodologies based on a person-centered approach. **Objectives:** to identify empirical clusters of CBD employing personality traits, as well as patients' sex, age and the age of CBD onset as indicators. **Methods:** an agglomerative hierarchical clustering method defining a combination of the Schwarz Bayesian Information Criterion and log-likelihood was used. **Results:** three clusters were identified in a sample of $n$=110 patients attending a specialized CBD unit a) "male compulsive buyers" reported the highest prevalence of comorbid gambling disorder and the lowest levels of  reward dependence; b) "female low-dysfunctional" mainly included employed women, with the highest level of education, the oldest age of onset, the lowest scores in harm avoidance and the highest levels of persistence, self-directedness and cooperativeness; and c) "female highly-dysfunctional" with the youngest age of onset, the highest levels of comorbid psychopathology and harm avoidance, and the lowest score in self-directedness. **Conclusion:** sociodemographic characteristics and personality traits can be used to determine CBD clusters which represent different clinical subtypes. These subtypes should be considered when developing assessment instruments, preventive programs and treatment interventions.

## 1. Introduction

Compulsive buying disorder (CBD) is characterized by a repetitive, irresistible and overpowering urges to purchase goods which consequently generate severe distress or interference in social, financial or occupational areas [1]. The compulsive experience of buying is perceived by patients as an urgent, albeit senseless, need to buy, with repetitive loss of control over spending and negative feelings (depressed mood, anxiety or boredom) when not buying. Chronic and repetitive failure in self-regulation also is accompanied by feelings of guilt, shame and remorse [2]. The age of onset of the shopping related problems tends to be around the late teens and early adulthood [3,4].

Presently, behavioral addictions, including CBD, are increasingly being documented worldwide [5]. However, consensus has yet to be reached regarding the classification off this disorder. The current versions of the most used diagnostic classification taxonomies have considered that substance use is not required for the diagnosis of addiction and, for instance, the DSM-5 [6] has added gambling disorder in the group of "substance-related and addictive disorders" stating that this syndrome activates reward systems similarly to drugs of abuse, as well as reporting other similarities in terms of clinical, phenomenological and genetic characteristics [7].

Although CBD and other impulsive behaviors seem to share other common factors such as the use of positive reinforcement as a developing mechanism at the beginning of the problem behavior and negative reinforcement as a maintaining variable in the long-term maintenance of the behavior [4,8–10], the DSM-5 work group considered CBD to still be poorly understood and did not recognize this condition as an addiction [11]. Indeed, much of the presently available evidence is mostly descriptive, and while neurobiological and genetic findings in behavioral addictions draw parallels with substance use disorders (e.g. dysfunction activations in several brain regions, particularly the prefrontal cortex and striatum, and the

activation of the mesocorticolimbic system and the extended amygdale), empirical data based on animal models, genetic findings and neurotransmitter activity are limited and in their nascent stage [12–14]. As a consequence, researchers have often described CBD as an impulsive-compulsive spectrum disorder [9,15–18]. Describing CBD as an impulsive-compulsive spectrum disorder has been deemed to be most fitting as other studies have found that behavioral addictions are not best described as being either due to a bipolar episode [19], or a manifestation of obsessive-compulsive disorder (OCD) [20].

Prior research has provided imprecise and unreliable prevalence rates for CBD: epidemiological estimates in developed countries range from 1% to 20% depending on the origin of the samples, definitions and measurement instruments [21–25]. Existing epidemiological data for CBD have also shown that treatment-seeking patients with CBD usually suffer from multiple psychiatric conditions, with comorbid alcohol and/or other drugs use, eating disorders, mood disorders, anxiety, and other impulse control disorders being most common [26].

The study of clinical profiles and risk factors for CBD shows that gender-dependent differences exist, in the sense that risk, prevalence, and rates of initiation and frequency of misuse are higher for women [27]. Lower educational levels have also been considered a risk factor for the presence of CBD [28]. Moreover, low levels of self-esteem seem to be  a powerful predictor for the development and course of CBD, and researchers relate this lack of self-esteem with irrational beliefs such as "buying will make life better and/or will enhance my self-image" [29,30].

Risk-factor research has also addressed certain personality traits. As a whole, researchers have linked patients with CBD to individual-personality characteristics typical for other addictive behaviors. In the line of the five-factor model of personality, high extraversion levels, which are common in CBD, have been interpreted as a way to use shopping to uphold

patients' social status and sustain their attractiveness [31]. High scores on neuroticism scales have consistently linked shopping as a means of reducing negative emotional states [32], and low conscientiousness scores have been associated with impairments in patients' ability to be structured and responsible [33]. Other results involving personality traits have shown that compulsive buying is characterized by high impulsivity scores [34,35], high levels in both positive and negative urgency traits [36], high novelty seeking [37] and low scores in self-directedness and cooperativeness traits [38]. Notwithstanding, results relating to the characterization of personality traits in CBD have been inconsistent at times, and at least one study has concluded that shopping addicts are less adventurous, curious and employ less abstract thinking than their counterparts [39]. The paucity of available evidence and the aforementioned reported inconsistencies stress the need for additional empirical studies aimed to assess the predictive capacity of specific personality traits on the CBD construct and outcomes.

Regarding methodological approaches, the heterogeneity among individuals with CBD has mostly been studied through variable-level approaches (such as general and/or generalized linear models), which are centered on the description of the association between variables and consider potential risk factors as predictors of a subject's clinical features and competences. The application of this approach to psychological constructs isolates psychologically meaningful behavioral characteristics in which individuals reliably differ, and analyze their potential correlational structure, stability over time and predictive validity for the outcomes of individuals [40,41]. In contrast with the variable-level methods, person-centered approaches (such as latent profile analysis, latent class analysis, and cluster analytic techniques) start from the grouping of individuals according to their responses/scores on different features, and focus attention on the intra-individual structure of variables [42]. The advantage of these analyses is the conceptualization of subjects: they are conceived as a whole, and not as the

addition of isolated features. Research carried out with these methodologies concluded that risk profiles that show similarities and differences among individuals are especially useful for understanding psychopathology and adaptation, and that they are well suited for addressing questions that concern group differences in patterns of clinical profiles [43]. However, person-centered approaches have scarcely been used for behavioural addictions, ºand to our knowledge only a few studies have explored the existence of empirical clusters for CBD. In an early research, DeSarbo and Edwards [44] found two clusters in a sample of $n$=104 patients who underwent treatment for compulsive buying: internal (buying was perceived as the consequence of psychological features, such as anxiety, dependence and low self-esteem) versus external (buying was perceived as the consequence of environmental variables, such as social isolation or materialistic values). More recently, Mueller et al. [26] conducted a latent profile analysis in a sample of $n$=171 patients based on compulsive buying severity, and found that a 2-cluster solution was optimal (cluster 2 was composed of patients with more severe compulsive buying symptoms and higher prevalence for Axis I and impulse control disorders).

In short, CBD has increasingly been placed within the behavioral addiction theoretical construct during the last decades (particularly into the impulse-control and/or obsessive-compulsive disorder spectrum), but the categorization of the core criteria and components of compulsive buying require additional empirical evidence. This work explores the heterogeneity CBD phenotype among adult patients undergoing treatment for compulsive buying as a main problem or primary disorder, through a statistical method based on a person-centered approach. The specific objective was to identify empirical clusters of CBD employing individuals' personality traits as indicators. Due to the strong interrelationships evidenced in the literature between both CBD related variables and personality profile variables with the individuals' sex, age and onset of the disorder [9,26], these variables were

also considered as indicators. Based on the theoretical framework, we hypothesize that CBD is not conceptualized as a homogeneous group and that different cluster groups will emerge.

## 2. Methods

### 2.1. Participants

The sample consisted of *N*=110 patients treated at the Pathological Gambling and other Behavioral Addictions Unit at the Department of Psychiatry, at the Bellvitge University Hospital, in Barcelona (Spain). This public hospital is certified as a tertiary care center (high specialization) for the treatment of psychological addictive behaviors and oversees the treatment of very complex cases. The catchment area of the hospital includes over two million people in the south of the metropolitan area of Barcelona. Individuals were assessed by expert clinical psychologists and psychiatrists with more than 15 years of clinical experience in the field of addictive disorders. The current study was conducted between January, 2005 and September, 2015.

All the patients that arrived to the unit seeking treatment for a problem of compulsive buying were considered potential participants for this study. The exclusion criteria for the study were: having an intellectual disability and severe mental disorders (schizophrenia or other psychotic disorders, bipolar disorder, etc.).

### 2.2. Instruments

### 2.2.1. Compulsive Buying Disorder Diagnosis

The patients were assessed using a structured clinical face-to-face interview modeled after the SCID-I [45], covering the presence of impulsive control disorders, such as CBD. Diagnostic criteria for CBD were determined according the guidelines set by McElroy, Keck, Pope, Smith, Strakowski [46]. Although the reliability and validity of these criteria have not yet been determined, they have received wide acceptance in the research community [47]. It's

important to note that no formal diagnostic criteria for CBB have been accepted for the DSM or the ICD-10. At present, it is recommended that CBB be determined via detailed face-to-face interviews which explore "buying attitudes, associated feelings, underlying thoughts, and the extent of preoccupation with buying and shopping" and which determine that excessive buying behavior does not occur exclusively during episodes of mania or hypomania [24].

### 2.2.2. Personality and psychopathological status

#### 2.2.2.1. Temperament and Character Inventory-Revised (TCI-R) [48].

The TCI-R is a reliable and valid 240-item questionnaire which measures seven personality dimensions: four temperament (novelty seeking, harm avoidance, reward dependence and persistence) and three character dimensions (self-directedness, cooperativeness and self-transcendence). All items are measured on a 5-point Likert-type scale. A validated Spanish version was used [49]. The scales in the Spanish revised version showed adequate internal consistency (Cronbach's alpha $\alpha$ mean value of 0.87). In the study, consistency indicies were in the good ($\alpha$=.72 for novelty seeking) to excellent range ($\alpha$=.88 for self-directedness).

#### 2.2.2.2. Symptom Checklist-Revised (SCL-90-R) [50].

The SCL-90-R evaluates a broad range of psychological problems and psychopathological symptoms. This questionnaire contains 90 items and measures nine primary symptom dimensions: somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. It also includes three global indices: 1) a global severity index (GSI), designed to measure overall psychological distress; 2) a positive symptom distress index (PSDI), to measure the intensity of the symptoms; and 3) a positive symptom total (PST), which reflects self-reported symptoms. A validated Spanish version was used [51]. The Spanish validation scale obtained

good psychometrical indexes, with a mean internal consistency of 0.75 (Cronbach's alpha). In the sample of this study, consistence indices were in the excellent range (between $\alpha=.80$ for paranoid ideation to $\alpha=.98$ for global indexes).

*2.2.2.3. Alcohol Use Disorders Identification Test (AUDIT)* [52].

This test was developed as a simple screening method for excessive alcohol consumption. AUDIT consists of 10 questions about the level of consumption, symptoms of dependence and alcohol-related consequences. Internal consistency has been found to be high, and rest-retest data have suggested a high reliability (0.86) and sensitivity around 0.90; specificity in different settings and for different criteria averages 0.80 or more. Three groups were considered for this study, based on the ranges defined by Reinert [53]: null-low, abuse and risk of dependence.

### 2.2.3. Other sociodemographic and clinical variables

Additional demographic, clinical, and social/family variables related to gambling were measured using a semi-structured face-to-face clinical interview described elsewhere [54]. Some of the CBD behavior variables covered included the age of onset of CBD, the mean and maximum monetary investment in a single episode of shopping, and the total accumulated debts.

### 2.3. Procedure

The present study was carried out in accordance with the latest version of the Declaration of Helsinki. The University Hospital of Bellvitge Ethics Committee of Clinical Research approved the study, and written informed consent was obtained from all

participants. Experienced psychologists and psychiatrists conducted the two face-to-face clinical interviews.

*2.4. Statistical analysis*

Statistical analysis was carried out with SPSS20 for Windows. Firstly, the TwoStep Clustering Component was used to generate the empirical clusters, utilizing the seven personality trait scores measured on the TCI-R questionnaire, sex, age and onset of the disorder as indicators. This procedure constitutes a scalable cluster analysis algorithm designed to handle large datasets including both continuous and categorical variables. In the first step, subjects are pre-clustereed into many small sub-clusters according to a sequential clustering approach. In the second step, resulting sub-clusters are considered as inputs and grouped into the desired number of clusters according to the agglomerative hierarchical clustering method. By default, the TwoStep algorithm uses a combination of the Schwarz Bayesian Information Criterion and log-likelihood distance in autodetermining the final number of clusters, choosing a solution with a reasonably large ratio of Schwarz Bayesian Information Criterion changes and a large ratio of distance measures. The log-likelihood measure is computed by using the normal density for continuous variables and the multinomial probability mass function for categorical variables. In this study, we compared as finalistic candidate solutions the automatic number of clusters selected by the TwoStep Clustering Component procedure, and two additional models: the autodetermined number of clusters minus one, and the autodetermined number plus one. The final chosen model was based on [55]: a) the highest cohesion and separation index; b) adequate number of individuals in each group (to allow statistical comparisons); and c) the best clinical interpretability.

The comparison of the sociodemographical, clinical and personality measures between the derived empirical clusters was based on chi-square tests ($\chi^2$) for categorical variables and

analysis of variance (ANOVA) for quantitative measures. Cohen's-$d$ measured the effect size of pairwise comparisons (for $|d|>0.50$ was considered moderate effect size and $|d|>0.80$, high effect size). Bonferroni-Finner's correction controlled the inflation in Type-I error due to multiple statistical comparison for variables measuring clinical state.

## 3. Results

### 3.1. Cluster composition: description for the cluster indicators

The 3-cluster solution was selected as being the most optimal. This solution corresponded to the autodetermined number deemed most appropriate by the TwoStep Clustering procedure. The 2-cluster solution was rejected since it achieved lower cohesion/separation fitting and worse clinical interpretation. The 4-cluster solution did not allow higher cohesion-separation fit, did not improve clinical interpretation and created groups with low sample sizes.

For the final 3-cluster solution, Silhouette measure of cohesion and separation was into the fair range (average Silhouette=0.3), which indicates moderate evidence of cluster structure in the data. The ratio of cluster sizes comparing the largest ($n$=46, 41.8%) to the smallest ($n$=32, 29.1%) was 1.44. Figure A.1 summarizes the final 3-cluster model for the variables entered in the cluster analysis as indicators. Firstly, it is displays the relative indicator importance in estimating the model, which report how well each variable can differentiate the different derived clusters (the higher the importance measure, the less likely it is that the variation for the variable between clusters is due to chance and the more likely it is due to some underlying difference). In this study, the patients' sex achieved the highest importance for clustering, followed by the personality traits self-directedness, harm avoidance and cooperativeness. The personality traits of novelty seeking and self-transcendence obtained the poorest relevance. Figure A.1 also contains clusters profiles for the variables

used as cluster indicators (centroids, mean values for the quantitative variables and the percentage for the binary variable sex).

--- Insert Fig. A.1 ---

Table A.1 includes the statistical comparison for the variables utilized as indicators in the clustering. All variables achieved significant differences, except for age, novelty seeking and self-transcendence.

--- Insert Fig. A.2 ---

--- Insert Table A.1- ---

*3.2. Comparison between the clusters in sociodemographic and external clinical variables*

Tables A.2 and A.3 contains the distribution of the main sociodemographic and clinical variables of the study, and the statistical comparison between clusters. Figure A.2 graphically summarizes (through a radar-chart) the clinical and the personality profile for the 3-cluster solution in the most relevant variables of the study (being that the plotted variables have different ranges, t-scores standardized in the own sample were represented to facilitate the comparison between clusters and the clinical interpretation). According to this set of results, clusters will be named as follows: cluster 1 "type 1, male compulsive buyers", cluster 2 "type II, female low-dysfunctional", and cluster 3 "type III, female high-dysfunctional". Type I (male compulsive buyers: $n$=32, 29.1%) is completely composed of men, obtained the highest prevalence of a comorbid gambling disorder and the lowest mean in the personality trait reward-dependence. Type II (women low-dysfunctional: $n$=32, 29.1%) includes mainly women, with the highest level of education, high employment levels, with the oldest age of CBD onset, the lowest mean for harm avoidance and the highest means for persistence, self-directedness and cooperativeness. Type III (women high-dysfunctional: $n$=46, 41.8%)

includes only women, obtained the youngest age of CBD onset, the highest levels in comorbid psychological symptoms (SCL-90-R scores), the highest mean in the harm avoidance personality trait and the lowest mean in the self-directedness trait.

--- Insert Tables A.1-A.2 ---

--- Insert Fig. A.2 ---

### 3.3. Distribution of the clusters during the time of sample recruitment

Figure A.3 shows the percentage frequency distribution of the clusters during the years of the study (from 2005 to 2015), as well as the prevalence of patients attending the specialized unit for treatment due to CBD in comparison to other behavioral addictions (gambling disorder, sex addiction, videogame addiction or internet addiction). The prevalence of CBD consultations increased from 2.48% in 2005 to 5.53% in 2015, achieving a significant linear trend ($\chi^2$=17.3, $df$=1, $p$=.006) and no significant deviation from linearity ($\chi^2$=7.27, $df$=9, $p$=.609). The three clusters also tended to increase their presence in the recent years, but the linear trend was not significant for any type ($p$>.05 in polynomial contrast tests) and a prominent common decrease for the years 2010 and 2013 was found.

--- Insert Fig. A.3 ---

## 4. Discussion

This work explores the existence of empirical clusters for CBD starting from the patients' age, age of onset of compulsive buying, and personality trait scores, using a methodology based on the person-centered approach. Three clusters were derived: type I "male compulsive buyers", type II "female low-dysfunctional" and type III "female high-dysfunctional". Patients' sex was the variable with the highest importance for the clustering, followed by self-directedness, harm avoidance and cooperativeness, while novelty seeking and self-transcendence obtained the poorest relevance for discriminating between the groups.

Sex was the most relevant variable in the clustering process. Men and women display differences in their emotions in response to environmental and social stimuli, and seem to express diverse susceptibility factors to mental diseases [56]. The frequency distribution for the participants' gender in this study (67.3% of women versus 32.7% of men) is consistent with results from the literature showing that compulsive buying behavior is more typical in women than in men [27,57]. In the present study, cluster type I is composed exclusively of men, and this composition should explain how this group obtained the highest prevalence of comorbid gambling disorder (which is strongly gender-related, with males being highly represented; [58]) and the lowest score in the personality trait reward-dependence. To this end, men usually obtain lower scores compared to women on this scale, especially in the presence of addictive disorders [57]. It should be noted the similarity between this cluster and the pathological gambling dimensional personality profile found in other studies [59].

Cluster type II principally included women and cluster type III, women exclusively. The main differences in the clustering variables between both clusters were the age of CBD onset (the lowest mean was registered in cluster type III) and the mean scores in the personality traits harm avoidance (higher scores for type III), self-directedness (lower scores for type III), persistence (lower scores for type III) and cooperativeness (lower score for type III). Previous studies show that the personality profile for compulsive buying is characterized by high levels of impulsivity and novelty seeking, and by low levels in self-directedness and cooperativeness [60]. In line with these results, the functionality level of both these clusters (type II and III) was, as a whole, dependent on its own composition: type III was the most dysfunctional (obtaining the highest scores on the SCL-90R scales), probably due to the fact that it included patients with the lowest mean age of onset, higher means on the harm avoidance scale and lowers means on self-directedness and cooperativeness scales.

Literature about personality traits and CBD suggests that high scores in impulsivity and novelty seeking and low scores in self-directedness and cooperativeness constitute risk factors for this disorder. In this study, however, novelty seeking obtained low relevance for clustering, and no difference between empirical groups emerged. A possible explanation for this result is the own distribution of the novelty seeking scale in the sample: the mean score in the study sample (114.4) corresponds to the 85th percentile compared to the general Spanish population [49].

Closer perusal of our results found that, across the years of study, the incidence of patients seeking treatment for CBD has progressively increased. This is consistent with other studies which have also found an increase in the prevalence of CBD in developing countries [61]. The influence of advertising, new means of shopping (eg. on the internet), an increase in materialism serving as a sign of success and social prestige, or even as a form of identity, are understood to be risk factors which have contributed to increased rates of CBD [1,62,63]. On the other hand, our results point to a drop in CBD rates between the years of 2010 and 2013, coinciding with the worst years of the economic crisis in Europe, and, more specifically, in Spain. Moreover, this decrease is consistent with results from other behavioral addictions requiring substantial amounts of money. In the case of gambling disorder, a significant drop in prevalence was also found during the European economic crisis [58], especially in 2010.

Future research should analyze the comorbidity of CBD and other disorders, as this topic has been studied in other behavioral addictions such as gambling disorder [19].

**5. Conclusions**

Problematic buying behavior is a growing social issue in developed countries. There is ongoing debate as to how best classify compulsive buying and its related dysfunctional consequences and clinical correlates, but there are no established criteria and current operational definitions rely on similarities with other substance use disorders or behavioral addictions, such as gambling disorder and other impulsive-compulsive spectrum disorders (sex addiction, internet gaming addiction, food addiction, etc.). Available evidence outlines that CBD is a complex disorder with interacting factors involving neurobiological systems, personality traits, environmental variables and stress responsivity.

This study aimed to explore the heterogeneity of the disorder and the existence of differentiated subgroups in a sample of CBD patients, based on sex, age, onset of problematic buying behavior and personality. Our results suggest that this group of variables appears to be useful in determining clusters which represent different clinical subtypes. Such differences among problematic compulsive buyers imply that the experience of buying may diverge between patients, and therefore targeting at-risk buyers or CBD patients without considering these specific dependent effects may have limited success for clinical research, for developing assessment instruments with discriminative capacity and for planning efficient prevention programs. Moreover, present treatment data for CBD are limited: no standard therapy exists and intervention programs are often addressed to comorbid conditions. These include cognitive behavioral therapy accompanied by family-financial counseling [10] and, in some cases, pharmacologic intervention [64]. To this end, the existence of different empirical CBD clusters should be considered when developing specific and flexible treatment interventions.

## 6. Acknowledgements

**7. References**

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## 8. Appendices

Table A.1. Statistical comparison between clusters for variables used as cluster indicators.

| | | Proportions (%) | | | Tests and Pairwise comparisons (*p* and Cohen's-d) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\chi^2$ tests | | C1 vs C2 | | C1 vs C3 | | C2 vs C3 | |
| | | *Total* | C1 | C2 | C3 | | | | | | | |
| | | *n=110* | *n=32* | *n=32* | *n=46* | $\chi^2_2$ | *p* | $^1p$ | $|d|$ | $^1p$ | $|d|$ | $^1p$ | $|d|$ |
| Sex | *Female* | 67.3 | 0 | 87.5 | 100 | 94.10 | **<.001** | **<.001** | **3.74\*** | --- | --- | **.014** | **0.53\*** |
| | *Male* | 32.7 | 100 | 12.5 | 0 | | | | | | | | |

| | | Means | | | | ANOVA | | C1 vs C2 | | C1 vs C3 | | C2 vs C3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Total* | C1 | C2 | C3 | $F_{2;107}$ | $^1p$ | $^1p$ | $|d|$ | $^1p$ | $|d|$ | $^1p$ | $|d|$ |
| Age (years) | | 43.2 | 43.3 | 45.9 | 41.3 | 1.62 | .434 | .607 | 0.22 | .623 | 0.17 | .239 | 0.45 |
| Age of CBD onset (years) | | 39.4 | 39.4 | 43.1 | 36.8 | 2.57 | .287 | .607 | 0.28 | .617 | 0.20 | **.026** | **0.60\*** |
| TCI-R: Novelty seeking | | 114.4 | 115.8 | 111.4 | 115.4 | 0.88 | .468 | .282 | 0.27 | .949 | 0.02 | .328 | 0.28 |
| TCI-R: Harm avoidance | | 110.0 | 107.1 | 93.7 | 123.5 | 31.29 | **<.001** | **.005** | **0.74\*** | **<.001** | **0.90\*** | **<.001** | **2.14\*** |
| TCI-R: Reward depend. | | 104.2 | 96.8 | 108.3 | 106.6 | 5.03 | **.014** | **.009** | **0.75\*** | **.021** | **0.57\*** | .656 | 0.11 |
| TCI-R: Persistence | | 108.1 | 106.5 | 115.5 | 104.0 | 3.21 | .061 | .107 | 0.43 | .710 | 0.11 | **.026** | **0.65\*** |
| TCI-R: Self-directedness | | 124.1 | 121.9 | 148.1 | 109.0 | 44.37 | **<.001** | **<.001** | **1.49\*** | **.007** | **0.66\*** | **<.001** | **2.33\*** |
| TCI-R: Cooperativeness | | 136.0 | 129.9 | 150.5 | 130.1 | 20.43 | **<.001** | **<.001** | **1.48\*** | .971 | 0.01 | **<.001** | **1.44\*** |
| TCI-R: Self-Transcend. | | 66.5 | 64.3 | 65.3 | 68.8 | 0.74 | .481 | .812 | 0.06 | .411 | 0.26 | .434 | 0.20 |

*Note.* CBD: compulsive buying disorder. Bold: significant comparison (.05 level). *Bold: effect size into the range moderate ($|d|>0.50$) to high ($|d|>0.80$).

Table A.2. Description of the total sample and comparison between clusters at baseline: categorical variables.

| | | Descriptives: proportions (%) | | | | Group/cluster Chi-square tests | | | Pairwise comparisons: *p-values* and Cohen's-d | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | C1 | C2 | C3 | | | | C1 vs C2 | | C1 vs C3 | | C2 vs C3 | |
| | | $n$=110 | $n$=32 | $n$=32 | $n$=46 | $\chi^2$ | $df$ | $p$ | $p$ | $|d|$ | $p$ | $|d|$ | $p$ | $|d|$ |
| Origin | Spanish | 97.3 | 96.9 | 96.9 | 97.8 | 0.09 | 2 | .955 | 1 | 0.00 | .794 | 0.06 | .794 | 0.06 |
| | Immigrant | 2.7 | 3.1 | 3.1 | 2.2 | | | | | | | | | |
| Education level | Primary | 37.5 | 36.7 | 30.0 | 43.2 | 6.70 | 4 | .153 | .107 | 0.14 | .742 | 0.13 | .119 | 0.28 |
| | Secondary | 41.3 | 50.0 | 33.3 | 40.9 | | | | | 0.34 | | 0.18 | | 0.16 |
| | University | 21.2 | 13.3 | 36.7 | 15.9 | | | | | **0.56*** | | 0.07 | | **0.50*** |
| Civil status | Single | 32.1 | 29.0 | 22.6 | 40.9 | 5.63 | 4 | .228 | .267 | 0.15 | .340 | 0.25 | .214 | 0.40 |
| | Married - in couple | 50.9 | 45.2 | 64.5 | 45.5 | | | | | 0.40 | | 0.01 | | 0.39 |
| | Divorced - separated | 17.0 | 25.8 | 12.9 | 13.6 | | | | | 0.33 | | 0.31 | | 0.02 |
| Employm. | Unemployed | 47.2 | 56.3 | 29.0 | 53.3 | 5.99 | 2 | **.050** | **.029** | **0.57*** | .800 | 0.06 | **.036** | **0.51*** |
| | Employed | 52.8 | 43.8 | 71.0 | 46.7 | | | | | | | | | |
| Smoke use | No | 61.8 | 40.6 | 84.4 | 60.9 | 13.01 | 2 | **.001** | **<.001** | **1.01*** | .078 | 0.41 | **.025** | **0.55*** |
| | Yes | 38.2 | 59.4 | 15.6 | 39.1 | | | | | | | | | |
| Alcohol (AUDIT) | Low | 93.6 | 90.6 | 96.9 | 93.3 | 1.05 | 2 | .592 | .302 | 0.26 | .662 | 0.10 | .490 | 0.16 |
| | Abuse | 6.4 | 9.4 | 3.1 | 6.7 | | | | | | | | | |
| | Risk of dependence | 0 | 0 | 0 | 0 | | | | | | | | | |
| Drugs use-abuse | No | 96.3 | 93.8 | 100 | 95.6 | 1.84 | 2 | .398 | .157 | 0.37 | .725 | 0.08 | .234 | 0.30 |
| | Yes | 3.7 | 6.3 | 0 | 4.4 | | | | | | | | | |
| Comorbid GD | No | 80.9 | 65.6 | 87.5 | 87.0 | 6.83 | 2 | **.033** | **.039** | **0.53*** | **.025** | **0.52*** | .944 | 0.02 |
| | Yes | 19.1 | 34.4 | 12.5 | 13.0 | | | | | | | | | |

*Note.* Bold: significant comparison (.05 level). *Bold: effect size into the range moderate ($|d|$>0.50) to high ($|d|$>0.80); GD: gambling disorder.

Table A.3. Comparison between clusters at baseline: quantitative variables.

| | Means | | | | ANOVA and Pairwise comparisons ($p$ and Cohen's-d) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | *Total* | C1 | C2 | C3 | Cluster | | C1 vs C2 | | C1 vs C3 | | C2 vs C3 | |
| | *n=110* | *n=32* | *n=32* | *n=46* | $F_{2;107}$ | $^1p$ | $^1p$ | $\|d\|$ | $^1p$ | $\|d\|$ | $^1p$ | $\|d\|$ |
| Duration of CBD (years) | 4.1 | 4.4 | 3.3 | 4.5 | 0.61 | .601 | .607 | 0.21 | .964 | 0.02 | .418 | 0.27 |
| Maximum spend/episode (€) | 1029.2 | 1085.9 | 597.6 | 1290.0 | 0.36 | .696 | .641 | 0.20 | .898 | 0.05 | .466 | 0.19 |
| Mean spend/episode (€) | 118.0 | 24.5 | 44.7 | 234.1 | 1.47 | .410 | .894 | 0.35 | .396 | 0.32 | .363 | 0.29 |
| Cumulate debts (€) | 28818 | 21984 | 45109 | 22239 | 0.76 | .587 | .607 | 0.24 | .990 | 0.00 | .418 | 0.21 |
| # addictive behaviours | 1.18 | 1.41 | 1.13 | 1.07 | 2.61 | .287 | .507 | 0.33 | .186 | 0.34 | .699 | 0.16 |
| SCL-90: Somatization | 1.4 | 0.8 | 1.0 | 2.1 | 21.72 | **<.001** | .525 | 0.32 | **<.001** | **1.46\*** | **<.001** | **1.05\*** |
| SCL-90: Obsess./compuls. | 1.7 | 1.4 | 1.1 | 2.5 | 29.59 | **<.001** | .474 | 0.38 | **<.001** | **1.24\*** | **<.001** | **1.69\*** |
| SCL-90: Interpers. sensit. | 1.5 | 1.2 | 0.9 | 2.0 | 14.58 | **<.001** | .525 | 0.26 | **<.001** | **0.83\*** | **<.001** | **1.26\*** |
| SCL-90: Depressive | 2.0 | 1.6 | 1.5 | 2.7 | 22.18 | **<.001** | .667 | 0.12 | **<.001** | **1.26\*** | **<.001** | **1.34\*** |
| SCL-90: Anxiety | 1.5 | 1.1 | 0.9 | 2.1 | 23.13 | **<.001** | .534 | 0.21 | **<.001** | **1.21\*** | **<.001** | **1.37\*** |
| SCL-90: Hostility | 1.2 | 1.1 | 0.7 | 1.7 | 13.20 | **<.001** | .474 | **0.52\*** | **.003** | **0.67\*** | **<.001** | **1.17\*** |
| SCL-90: Phobic anxiety | 0.9 | 0.5 | 0.3 | 1.4 | 17.67 | **<.001** | .525 | 0.31 | **<.001** | **0.96\*** | **<.001** | **1.25\*** |
| SCL-90: Paranoid Ideation | 1.3 | 1.1 | 0.8 | 1.8 | 15.03 | **<.001** | .474 | 0.45 | **.001** | **0.73\*** | **<.001** | **1.31\*** |
| SCL-90: Psychotic | 1.1 | 0.9 | 0.7 | 1.6 | 10.96 | **<.001** | .525 | 0.22 | **.001** | **0.81\*** | **<.001** | **0.97\*** |
| SCL-90: GSI score | 1.5 | 1.1 | 1.0 | 2.1 | 26.90 | **<.001** | .525 | 0.22 | **<.001** | **1.30\*** | **<.001** | **1.51\*** |
| SCL-90: PST score | 53.9 | 46.8 | 40.0 | 68.3 | 23.83 | **<.001** | .474 | 0.32 | **<.001** | **1.15\*** | **<.001** | **1.54\*** |
| SCL-90: PSDI score | 2.3 | 2.0 | 2.0 | 2.7 | 17.18 | **<.001** | .912 | 0.03 | **<.001** | **1.08\*** | **<.001** | **1.22\*** |

*Note.* CBD: compulsive buying disorder. Bold: significant comparison (.05 level). *Bold: effect size into the range moderate ($|d|>0.50$) to high ($|d|>0.80$).

Fig. A.1. Predictor importance and cluster profiles (centroids).

Predictor importance:



| | | | | | | |
|---|---|---|---|---|---|---|
| | 0,00 | 0,20 | 0,40 | 0,60 | 0,80 | 1,00 |
| Sex | | | | | | 1,00 |
| Self-directed. | | | | | 0,69 | |
| Harm-avoidance | | | | 0,52 | | |
| Cooperativeness | | | 0,37 | | | |
| Reward-depend. | 0,10 | | | | | |
| Persistence | 0,07 | | | | | |
| Age of onset | 0,05 | | | | | |
| Age | 0,03 | | | | | |
| Novelty seeking | 0,02 | | | | | |
| Self-transcend. | 0,02 | | | | | |

Cluster profiles: centroids

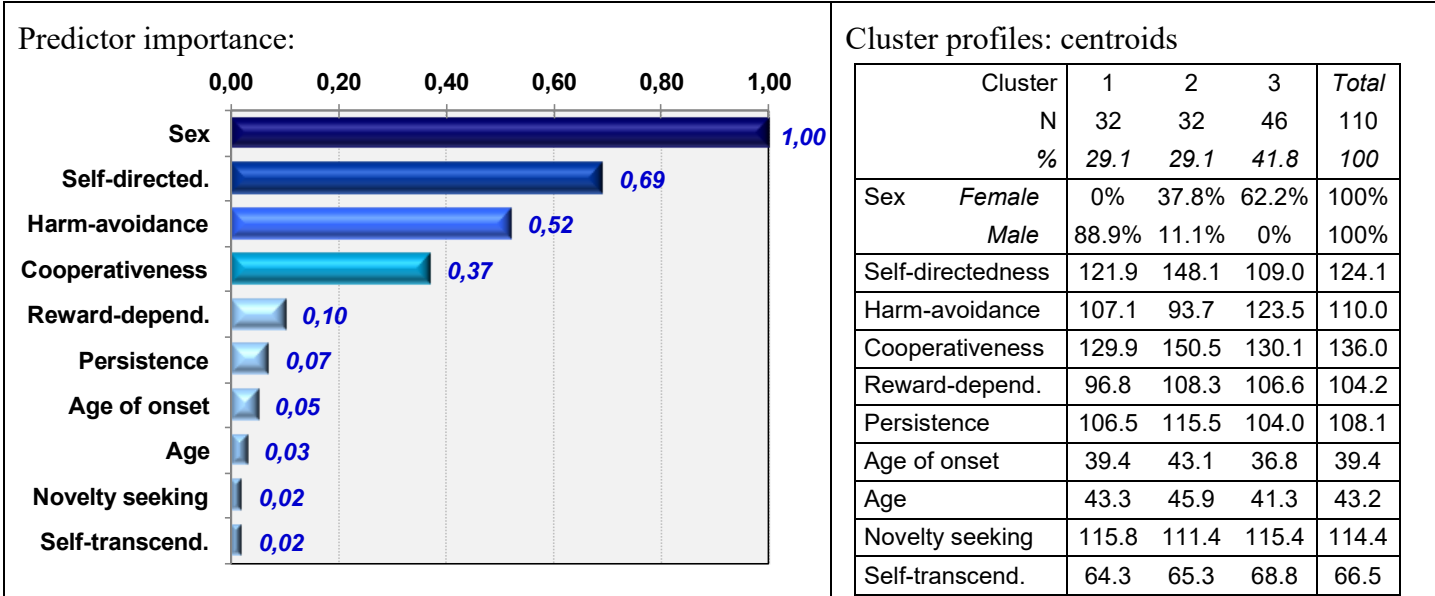| | Cluster | 1 | 2 | 3 | Total |
|---|---|---|---|---|---|
| | N | 32 | 32 | 46 | 110 |
| | % | 29.1 | 29.1 | 41.8 | 100 |
| Sex | Female | 0% | 37.8% | 62.2% | 100% |
| | Male | 88.9% | 11.1% | 0% | 100% |
| Self-directedness | | 121.9 | 148.1 | 109.0 | 124.1 |
| Harm-avoidance | | 107.1 | 93.7 | 123.5 | 110.0 |
| Cooperativeness | | 129.9 | 150.5 | 130.1 | 136.0 |
| Reward-depend. | | 96.8 | 108.3 | 106.6 | 104.2 |
| Persistence | | 106.5 | 115.5 | 104.0 | 108.1 |
| Age of onset | | 39.4 | 43.1 | 36.8 | 39.4 |
| Age | | 43.3 | 45.9 | 41.3 | 43.2 |
| Novelty seeking | | 115.8 | 111.4 | 115.4 | 114.4 |
| Self-transcend. | | 64.3 | 65.3 | 68.8 | 66.5 |

Fig. A.2. Radiar-charts for the distribution of the clinical-psychopathology profile (age of onset and SCL-90R) and the personality profile (TCI-R).
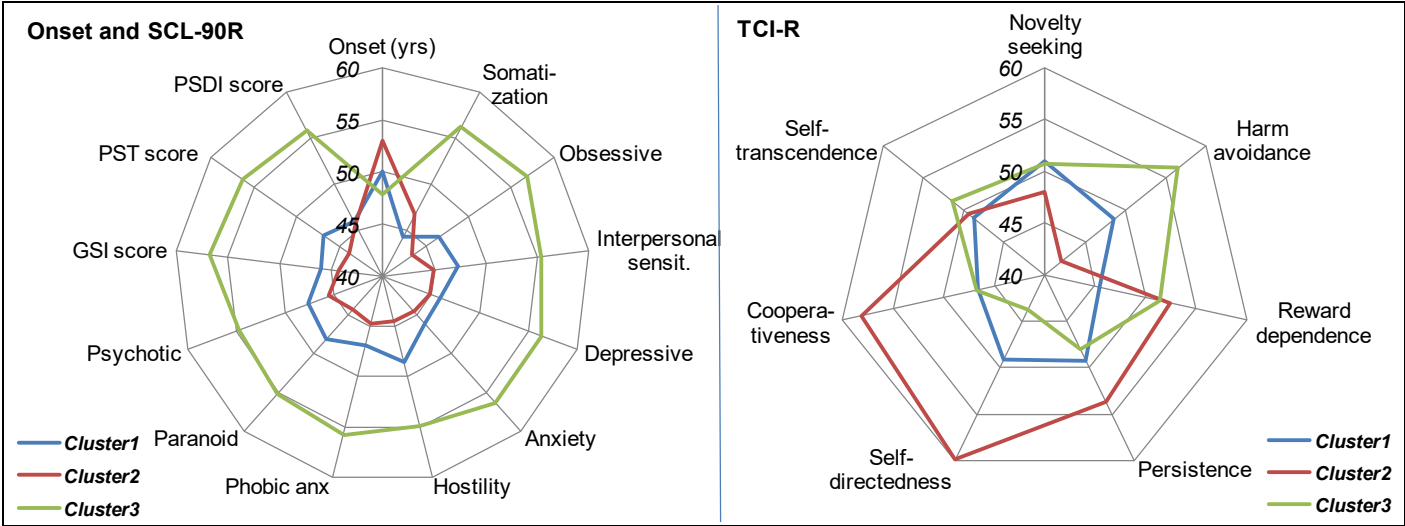


Fig. A.3. Frequency distribution of the clusters (in percentage) throughout the years of the study.