Received: 22 April 2021 | Revised: 9 July 2021 | Accepted: 17 July 2021

DOI: 10.1002/erv.2855

WILEY

RESEARCH ARTICLE

Executive functions in binge spectrum eating disorders with comorbid compulsive buying

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Funding information
CERCA Programme; Ministerio de Economía y Competitividad, Grant/Award Number: PSI2015-68701-R; Generalitat de Catalunya; Instituto de Salud Carlos III (ISCIII), Grant/Award Numbers: FIS PI17/01167, FIS PI20/132; Delegación del Gobierno para el Plan Nacional sobre Drogas, Grant/Award Number: 2017I067; FEDER funds/

Abstract

Objective: The aims were to explore if bulimic spectrum disorders (BSD) patients, who also present comorbid compulsive buying (CB), could represent a specific subtype considering its neuropsychological performance; to present a descriptive analysis of different clinical features; and to explore how these variables could influence treatment outcome. It was hypothesised that the comorbid group will present worse neuropsychological performance that will lead to a worse treatment outcome.

Method: The study has a longitudinal design. Women ($N = 75$) diagnosed with BSD, BSD + CB and Healthy Controls (HC); completed an evaluation of: cognitive flexibility, decision making, eating disorder (ED) symptomatology, psychopathological state and personality traits.

Abbreviations: ANOVA, analysis of variance; BA, behavioural addiction; BMI, body mass index; BN, bulimia nervosa; BSD, bulimic spectrum disorders; BSD + CB, bulimic spectrum disorder with comorbid compulsive buying; C, colour; CB, compulsive buying; CBT, cognitive behavioural therapy; CFI, Bentler's Comparative Fit Index; DSM-5, Diagnostic and Statistical Manual of Mental Disorders 5; ED, eating disorder; EDI-2, Eating Disorder Inventory-2; GSI, Global Severity Index; HC, healthy controls; ICD-11, International Classification of Diseases 11; IGT, Iowa Gambling Task; N, number; PSDI, Positive Symptom Distress Index; PST, Positive Symptoms Total; RMSEA, root mean square error of approximation; S, shape; SCL-90-R, Symptom Checklist-90 Items-Revised; SD, standard deviation; SEM, structural equation model; SRMR, standardised root mean square residuals; TCI-R, Temperament and Character Inventory–Revised; TLI, Tuker–Lewis Index; WCST, Wisconsin Card Sorting Test.

Lucero Munguía and Ignacio Lucas are co-first authors.

European Regional Development Fund (ERDF); Department of Health of the Generalitat de Catalunya, Grant/Award Number: PERIS-SLT006/17/00246; Consejo Nacional de Ciencia y TecnologÃ-a-CONACYT; Centro de Investigación Biomédica en Red-Fisiopatología de la Obesidad y Nutrición; PRIME (Prevention and Remediation of Insulin Multimorbidity in Europe) project, Grant/Award Number: ref. 847879; Ministerio de Educación, Cultura y Deporte, Grant/Award Number: FPU15/02911; Agencia de Gestió d'Ajuts Universitaris i de Recerca, Grant/Award Number: 2017 SGR 1247

Results: BSD + CB was the group with the most severe clinical profile, worst treatment outcome and higher neuropsychological impairment, than other groups. Path-analysis evidenced that deficits in decision making were associated with bad treatment outcome, while deficits in flexibility with the presence of the comorbidity. Self-directedness and novelty seeking were associated with the neuropsychological performance and the comorbidity.

Conclusion: BSD + CB exhibit a worse clinical and neuropsychological profile that seems to be related with the treatment outcome, which should be taken into account for the establishment of specific treatment approaches.

KEYWORDS
binge spectrum disorders, compulsive buying, eating disorders, executive functions

Highlights

- Bulimic spectrum disorders comorbid with compulsive buying present with the most severe clinical profile and the worst treatment outcome.
- The comorbid group exhibit more neuropsychological deficits than the non-comorbid one and the healthy controls.
- Deficits in decision making were directly and positively associated with bad treatment outcome, while deficits in flexibility with the comorbid presence of the disorders.
- Personality traits were associated with the neuropsychological performance and the comorbidity.

1 | INTRODUCTION

Impulsivity has been defined as a tendency to respond with little forethought, often with disregard to the negative consequences to the impulsive behaviour to the individual or others (Moeller et al., 2001). It has been related to psychopathological conditions, such as eating disorders (EDs) or behavioural addictions (BA) (Lee et al., 2019; Mallorquí-Bagué et al., 2020; Waxman, 2009).

ED subtypes that are associated with high impulsive traits usually present with binge eating behaviours. According to the taxonomy of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013), bulimia nervosa (BN) is characterised by recurrent episodes of binge eating (eating large amounts with loss of control) and compensatory behaviours to prevent weight gain, which can include self-induced vomiting, inappropriate use of medicines, fasting or extreme exercise, whereas binge eating disorder (BED) is characterised by distressing, recurrent episodes of binge eating, with fewer compensatory behaviours. These binge-related impulsive behaviours, BN and BED, are known as binge spectrum disorders (BSD) (Treasure et al., 2020). Likewise, BA have been defined referring to persistent and maladaptive behaviours, in spite of the negative later repercussions, implying loss of control, craving, onset of tolerance and abstinence (Grant et al., 2010). Therefore, impulsivity traits are also highly related to BA (Lee et al., 2019).

BSD diagnosis have usually showed comorbidity with BA (Fernández-Aranda et al., 2006, 2008). The aforementioned link between BSD, and BA has motivated research into the presence of common core factors between them, including aspects of biological, neurocognitive and psychological nature.

According to biological models, dopamine has been associated with addictive processes and BSD. BED patients have shown greater density and higher binding potential of the dopamine D2 receptor, both related with enhanced dopamine signalling. This condition may predispose to reward hypersensitivity (Davis et al., 2012) and changes in dopamine release, as predictors of binge eating (Wang et al., 2011). The same dopamine receptors (D2) have been found to be related with the control of reward-associated behaviours, as in substance use disorders (Baik, 2013; Volkow & Li, 2005). Related with neurocognition, patients diagnosed with BED have shown impaired response inhibition and cognitive planning (Grant & Chamberlain, 2020). In a similar way,

individuals with BA perform disadvantageously on decision-making tasks (Bechara, 2003), as well as presenting with a diminished performance on tests of inhibition, cognitive flexibility and planning tasks (Ko et al., 2010). Considering personality traits, in BN patients with a lifetime comorbid BA the presence of high impulsive tendencies, harm avoidance and novelty seeking, as well lower self-directedness, and lower cooperativeness have been found (Álvarez-Moya et al., 2007; Del Pino-Gutiérrez et al., 2017; Fischer & Smith, 2008; Jiménez-Murcia et al., 2013). Additionally, in ED patients, the presence of a BA is associated with greater severity of the eating symptomatology (Fernández-Aranda et al., 2006, 2008; Jiménez-Murcia et al., 2015), greater general psychiatric morbidity and psychopathology (Bulik et al., 2004; Fernández-Aranda et al., 2008; Mitchell et al., 2002) and poorer prognosis than those without comorbid BA (Fernández-Aranda et al., 2006, 2008). All these findings suggest that at the clinical level, BSD with comorbid BA could be a different subtype.

Among the BA that are usually found in BSD, higher rates of comorbidity have been found with compulsive buying disorder (CB) (Faber et al., 1995; Fernández-Aranda et al., 2006, 2008; Jiménez-Murcia et al., 2015; Mitchell et al., 2002). Even though the specific aetiology of CB is still unknown, it is a mental health condition characterised by the persistent, excessive, impulsive and uncontrollable purchase of products in spite of severe psychological, social, occupational, financial consequences which lead to distress (McElroy et al., 1994; Müller et al., 2015).

As well, it follows the same addictive process as other BA, as positive feelings are initially experienced while shopping and buying, but over time the shopping episodes are used to alleviate negative moods (Christenson et al., 1994; Kellett & Bolton, 2009), as well as a strategy to cope with stress, and other materialism values such as gaining social approval/recognition, and improve their self-image (Estévez et al., 2020; Lejoyeux & Weinstein, 2010; McQueen et al., 2014; Roberts et al., 2014). Even though studies on CB prevalence report diverse results (Harvanko et al., 2013; Mueller et al., 2011), women tend to present this dysfunctional behaviour with a higher percentage than men (Fernández-Aranda et al., 2019; Granero et al., 2016; Jiménez-Murcia et al., 2015; Maraz et al., 2016; Mueller et al., 2011). Although it has not been included in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013), several authors keep proposing that it should be included in the 11th revision of the International Classification of Diseases (ICD-11) (Müller et al., 2019). In concordance with the aforementioned, in the comorbid presence of CB and BSD high impulsivity, novelty seeking and eating symptomatology, as well as bad psychopathological state, have been found (Fernández-Aranda et al., 2019; Jiménez-Murcia et al., 2015).

The reinforcing effect of some impulsive behaviours, such as gambling, buying, binge eating and purging, support the hypothesis that these disorders are associated with dysfunctions in the brain's reward system (Fineberg et al., 2010; Probst & Van Eimeren, 2013). Consequently, people with CB usually present altered activity in the brain's reward system. When performing purchasing decisions, they show higher activation in the striatum than people without this disorder, specifically in the nucleus accumbens (Raab et al., 2011). This may be related to decreased activity in the ventromedial prefrontal cortex, which plays an important role in planning and decision making processes (Hiser & Koenigs, 2018; Wagar & Thagard, 2004). However, to the best of our knowledge, no study has explored if patients with comorbid BSD + CB show worse neuropsychological functioning than those BSD patients without the comorbidity.

Therefore, the aim of the present study was to explore if patients with comorbid BSD + CB, could represent a specific subtype, considering its neuropsychological performance. Additionally, to present a descriptive analysis of clinical features of patients with comorbid BSD + CB, and to explore how the mediation-interaction of these variables could influence treatment outcome. Attending the previous results, BSD patients, who are characterised by high impulsive traits, also report poor neurocognitive performance. Then, this impaired performance could be even worse in those patients who also present poor impulse control in other behaviours such as CB. Therefore, we hypothesised that the comorbid group will present worse neuropsychological performance, more maladaptive personality traits, higher ED symptomatology, worse psychopathological state and worse treatment outcome, than the patients without comorbidity.

The implications of the present study are that if a subtype of the comorbid presence of BSD and CB is identified, and is related with a bad treatment outcome, proper treatment approaches could be offered to the patients considering the characterisation of the comorbid subtype. This may be helpful considering that a progressive significant impairment of overall individual functioning has been found in both, BSD (American Psychiatric Association, 2013) and CB, in which patients may present feelings of regret/remorse over purchases, shame, guilt, legal and financial problems, and other interpersonal difficulties (Thege et al., 2015).

2 | MATERIALS AND METHODS

2.1 | Participants

Regarding the clinical groups, the participants consecutively referred for assessment and treatment at the Unit of Eating Disorders of the Department of Psychiatry of the University Hospital of Bellvige in Barcelona. From an initial sample of 97 BSD patients (51 with BN and 46 with BED) that conducted neuropsychological assessment, 25 patients presented CB (25.77%) life time, being the ones that was selected for the present study. For the same sample, 25 patients with only BSD, with the same age range and similar education level, were randomly selected. Following the same line, 25 healthy controls from the same geographic area were matched for age and education level, recruited via word-of-mouth and advertisements. To be eligible for the study, participants could not have a lifetime history of an eating disorder and current obesity or any behavioural addiction.

Therefore, the total sample comprised 75 women, 25 with BSD, 25 with BSD and comorbid CB and 25 healthy controls. All participants from the clinical groups included in the study were diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria (American Psychiatric Association, 2013).

2.2 | Psychological assessment

Temperament and Character Inventory–Revised (TCI-R) (Cloninger, 1999) is a 240-item questionnaire with a five-point Likert scale format. It measures four temperaments (harm avoidance, novelty seeking, reward dependence and persistence) and three character dimensions (self-directedness, cooperativeness and self-transcendence). This questionnaire has been validated in a Spanish adult population (Gutiérrez-Zotes et al., 2004). The Cronbach's alpha for the different scales in the current sample were into the good range, from $\alpha = 0.80$ (for novelty seeking) to $\alpha = 0.87$ (for harm avoidance).

Symptom Checklist-90 Items-Revised (SCL-90-R) (Derogatis, 1994) is a 90-item questionnaire used for assessing self-reported psychological distress and psychopathology. It evaluates nine primary symptom dimensions: somatisation, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism, as well as three global indices: Global Severity Index (GSI), Positive Symptom Total (PST), and Positive Symptom Distress Index (PSDI). This instrument has been validated in a Spanish population (Derogatis, 2002). The internal consistency for the global index in our sample was $\alpha = 0.97$.

Eating Disorder Inventory-2 (EDI-2) is a 91-item multidimensional self-report questionnaire that assesses psychological and behavioural characteristics relevant to eating disorders. The questionnaire consists of 11 subscales, answered on a six-point Likert scale: drive for thinness, body dissatisfaction, bulimia, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation and social insecurity. This instrument have been validated in a Spanish population (Garner, 1998). The internal consistency of the EDI-2 total score in our sample was $\alpha = 0.93$.

Compulsive buying assessment. We conducted a face to face semi-structured interview exploring buying attitudes, associated feelings, underlying thoughts and the extent of preoccupation with buying and shopping, as recommended (Müller et al., 2015). Diagnostic criteria were determined for CB in accordance with the guidelines set by McElroy et al. (1994). These criteria have received considerable acceptance in the research community, even though their validity and reliability have not yet been determined (Tavares et al., 2008).

Other measures. Additional information was collected through a semi-structured interview with the clinicians. This interview included sex, age and education level, as well as information regarding the presence or absence of impulsive behaviours (including alcohol abuse, drugs abuse, binge episodes, theft and kleptomania).

2.3 | Neuropsychological measures

Executive function performance was evaluated considering two subdomains: cognitive flexibility and decision-making.

The Wisconsin Card Sorting Test (WCST) (Heaton & PAR Staff, 2003) is a computerised set-shifting task for assessing cognitive flexibility. It includes 128 cards that vary according to three attributes: number (N), colour (C) and shape (S). The participant has to pile the cards beneath four reference cards that also vary along these same dimensions, and in order to succeed, they have to settle upon a predetermined sorting rule. The only feedback given to the participant is the word 'right' or 'wrong' after each sorting. Initially, C is the correct

sorting category, and positive feedback is given only if the card is placed in the pile with the same colour. After 10 consecutive correct sorts, the rule changes. Thus, the positive feedback is only given when the sorting matches the new category. By trial and error, the participant must learn to change the sorting categories according to the given feedback. There are up to six attempts to derive a rule, providing rule shifts in the following category sequence: C-S-N-C-S-N. Participants are not informed of the correct sorting principle and that the sorting principle shifts during the test. The test is completed when all 128 cards are sorted or after the six full categories are completed. The number of completed categories, the percentage of perseverative errors (i.e., failures to change sorting strategy after negative feedback) and the percentage of non-perseverative errors are recorded. Other measures include total trials, total errors, conceptual, perseverative responses and trials to complete first category.

The Iowa Gambling Task (IGT) (Bechara et al., 1994) is a computerised task to evaluate decision-making, which has also been proposed as a measure of choice impulsivity (Eisinger et al., 2016). It involves a total of 100 turns distributed across four decks of cards (A, B, C and D), and each time the participant selects a deck, a specified amount of play money is awarded. The interspersed rewards among these decks are probabilistic punishments (monetary losses with different amounts). Participants are instructed that the final aim of the task is to win as much money as possible and to avoid losing as much money as possible. Moreover, they may choose cards from any deck, and switch decks at any time. This test is scored by subtracting the number of cards selected from decks A and B from the number of cards selected from decks C and D. Decks A and B are not advantageous as the final loss is higher than the final gain; however, decks C and D are advantageous since the punishments are smaller. Higher scores indicate better performance on the task.

The IGT is divided into five blocks. The first blocks are supposed to assess the decision-making process under ambiguity conditions while the last blocks (after the 40th selection) are used to assess the decision-making capabilities under risk conditions due to the rules have been figured out at this point (Brand et al., 2006).

Several indices were used to analyse performance in the IGT: the total score for each block of 20 cards (the first block is thought through a measure of decision making under ambiguity); the IGT total score, which would be the difference among the total number of cards selected from the Decks A and B (disadvantageous ones) and those selected from the Decks C and D (advantageous ones); the IGT learning score, that is, the difference among the net score in the last two blocks and the net score in the first two; the IGT risk score, that is, the score of the last two blocks added together (a measure of decision making under risk or certainty) (Giannunzio et al., 2018).

2.4 | Treatment outcome

Patients with BSD received 16 weekly outpatient group therapies based on CBT, previously described (Fernández-Aranda & Turón-Gil, 1998), by an experienced psychologist. Patients were re-evaluated at discharge and categorised into three categories: 'full remission', 'partial remission' and 'non-remission'. Voluntary treatment discontinuation was categorised as 'dropout' (i.e., not attending treatment for three consecutive sessions was considered dropout). Following the guidelines of treatment outcome according to DSM-5 criteria (American Psychiatric Association, 2013), the working definition of a 'full remission' outcome was a total absence of symptoms meeting diagnostic criteria for at least four consecutive weeks, 'partial remission' was defined as substantial symptomatic improvement but the continued presence of residual symptoms for at least four consecutive weeks, finally, patients who presented 'non-remission' and dropout were labelled as poor outcome, these categories were previously used to assess treatment outcome in other published studies (Agüera et al., 2013, 2015; Lucas et al., 2021; Sauchelli et al., 2016; Steward et al., 2016). These categories were based on the consensus judgement of the senior clinical staff who considered all aspects of the patient's treatment outcome, such as normalisation of nutritional dietary patterns, frequency of binge episodes and compensatory behaviours (such as self-induced vomiting or laxative and diuretics misuse), weight restoration, improvement in attitudes regarding weight and shape and ED cognitions.

2.5 | Procedure

All participants in our sample voluntarily sought treatment for ED and were diagnosed according to the DSM-5 criteria (American Psychiatric Association, 2013) by clinical psychologists and psychiatrists with more than 15 years of experience in the field. They conducted two face-to-face clinical interviews, before and after a psychometric evaluation. The neuropsychological tests were selected to cover various aspects of executive functions and were administered by a trained psychologist in a single session, prior to treatment onset. The patients

included in this study did not receive any kind of compensation for their participation.

The present study was approved by the appropriate research committee, according to the Declaration of Helsinki. Written and signed informed consent was obtained from all participants.

2.6 | Statistical analysis

Statistical analysis was carried out with Stata16 for windows (Stata-Corp, 2019). Comparisons between the groups were based on chi-square tests (χ^2) for categorical variables and analysis of variance (ANOVA) for quantitative measures. Effect size for mean differences was estimated through the standardised Cohen's-*d* coefficient (it was considered null for $|d|<0.20$, low-poor for $|d|>0.20$, moderate-medium for $|d|>0.50$ and large-high for $|d|>0.80$). Effect size for proportion differences was obtained through Cohen's-*h* coefficient, based on the difference of the arcsine transformation of the rates obtained in the groups. The rule of thumb for the interpretation of the resulting coefficient is the same than Cohen's-*d* (cut of 0.20, 0.50 and 0.80 are interpreted as small effect, mild-medium effect size and high-large effect size, respectively) (Cohen, 1988).

In this work, two categorical-binary measures were calculated for measuring the presence of deficit in the decision making and flexibility areas. These two classifications were based in the normative data published in the manuals of each test. Percentile 16th was selected as the threshold (this cut-off is usually considered for identifying the high risk of impairing performance). Impairing decision making was assigned to participants with IGT total score under the percentile 16th, while impairing flexibility was assigned to participants with scores under the percentile 16th in any of the WCST scales perseverative errors, non-perseverative errors and number of categories completed.

Path analysis carried out through structural equation models (SEM) estimate the role/s, magnitude/s and significance of the associations between personality measures, deficit in the neuropsychological performance, diagnostic group and treatment outcome, obtained for the clinical subsamples (BSD and BSD + CB groups). Path analysis constitutes a multivariate procedure for testing direct, indirect and total effects (including mediational links). The model was adjusted with the maximum-likelihood estimation method of parameter estimation and goodness-of-fit was measured with χ^2 test, root mean square error of approximation (RMSEA), Bentler's Comparative Fit Index (CFI), Tuker–Lewis Index (TLI) and standardised root mean square residuals (SRMR) (adequate fitting was considered for non-significant result in the χ^2 test, RMSEA < 0.08, CFI > 0.95, TLI > 0.95 and SRMR < 0.08 (Barrett, 2007).

In this study, increase in the Type I error due to the multiple significance tests was controlled through the Finner-method (Finner & Roters, 2001), a Familywise error rate stepwise procedure which has proved more powerful than the classical Bonferroni correction.

3 | RESULTS

3.1 | Characteristics of the sample

The top block of Table 1 shows the sociodemographic descriptive data for the sample. The control group mainly included single subjects, with secondary or higher education and in an active work situation (the mean age of this group was 31.2 years old, *SD* = 10.2). BSD patients were mainly single or married, with primary studies levels and employed (mean age was 35.0, *SD* = 10.3). BSD + CB also grouped mainly single patients, with primary studies levels and unemployed (mean age was 34.2, *SD* = 10.6).

Regarding the clinical profiles (bottom part of Table 2), as expected the control group showed better psychopathological status (lower means in the ED severity and psychological distress) and less harm avoidance and higher self-directedness than the two clinical groups. BSD + CB was the group with the most impaired clinical profile (higher means in the ED severity and the psychological distress, as well as higher novelty seeking, higher harm avoidance and less self-directedness). BSD + CB also registered later age of onset of the eating related problems.

3.2 | Comparison of the neuropsychological measures

Table 2 contains the comparison between the groups for the neuropsychological measures analysed in the study. Regarding the IGT task, the BSD + CB condition registered the worse profile with the lowest scores in the Learning and the Risk constructs. Regarding the WCST, no differences between the groups were found. For the binary scores identifying the high risk of deficit (in the decision making and flexibility areas) the worse performance was registered for BSD + CB, followed by BSD, while HC registered the lowest risks of deficit.

TABLE 1 Descriptive for the sample

	HC (*n* = 25)		BSD (*n* = 25)		BSD + CB (*n* = 25)		BSD versus HC		BSD + CB versus HC		BSD + CB versus BSD	
	n	**%**	***n***	**%**	***n***	**%**	***p***	**|*h*|**	***p***	**|*h*|**	***p***	**|*h*|**
Marital status												
Single	20	80.0%	12	48.0%	17	68.0%	**0.045***	**0.68**[a]	0.591	0.28	0.167	0.41
Married	3	12.0%	10	40.0%	4	16.0%		**0.66**[a]		0.12		**0.55**[a]
Divorced/separated	2	8.0%	3	12.0%	4	16.0%		0.13		0.25		0.12
Education												
Primary	4	16.0%	12	48.0%	13	52.0%	**0.046***	**0.71**[a]	**0.024***	**0.79**[a]	0.927	0.08
Secondary	12	48.0%	8	32.0%	8	32.0%		0.33		0.33		0.00
University	9	36.0%	5	20.0%	4	16.0%		0.36		**0.51**[a]		0.10
Employment												
Unemployed	3	12.0%	11	44.0%	15	60.0%	**0.012***	**0.74**[a]	**0.001***	**1.06**[b]	0.258	0.32
Employed/student	22	88.0%	14	56.0%	10	40.0%						
	Mean	***SD***	**Mean**	***SD***	**Mean**	***SD***	***p***	**|*d*|**	***p***	**|*d*|**	***p***	**|*d*|**
Age (years)	31.20	10.23	34.96	10.31	34.20	10.56	0.204	0.37	0.310	0.29	0.796	0.07
Onset of ED (years)	–	–	22.00	8.86	32.20	21.43	–	–	–	–	**0.033***	**0.62**[a]
Duration of ED (years)	–	–	13.16	8.55	11.44	8.80	–	–	–	–	0.487	0.20
BMI (kg/m^2)	–	–	36.22	12.93	32.35	8.95	–	–	–	–		0.35
EDI-2 total	33.16	27.65	106.80	39.39	131.88	26.97	**0.001***	**2.16**[b]	**0.001***	**3.61**[b]	**0.007***	**0.74**[a]
SCL-90R GSI	0.63	0.41	1.67	0.79	2.21	0.61	**0.001***	**1.67**[b]	**0.001***	**3.05**[b]	**0.003***	**0.77**[a]
TCI-R novelty seeking	103.48	9.82	99.88	14.62	112.48	15.60	0.352	0.29	**0.022***	**0.69**[a]	**0.002***	**0.83**[b]
TCI-R harm avoidance	91.44	15.83	121.52	17.34	131.88	14.96	**0.001***	**1.81**[b]	**0.001***	**2.63**[b]	**0.026***	**0.64**[a]
TCI-R reward dep.	108.60	10.36	104.60	15.92	103.96	18.62	0.360	0.30	0.289	0.31	0.883	0.04
TCI-R persistence	114.64	23.55	100.56	15.28	103.44	20.79	**0.016***	**0.71**[a]	0.053	0.46	0.615	0.16
TCI-R self-directedness	143.72	17.61	119.12	20.24	99.80	16.25	**0.001***	**1.30**[b]	**0.001***	**2.59**[b]	**0.001***	**1.05**[b]
TCI-R cooperativeness	135.68	26.63	139.76	15.62	130.76	19.44	0.496	0.19	0.412	0.21	0.135	**0.51**[a]
TCI-R self-transcendence	67.80	22.71	63.04	13.49	67.04	14.71	0.338	0.25	0.878	0.04	0.421	0.28

Abbreviations: BMI, body mass index; BSD, bulimic spectrum disorder; BSD + CB, bulimic spectrum disorder with compulsive buying; HC, healthy control; SD, standard deviation.

[a]Bold: effect size into the medium range ($50 \leq |d| < 0.80$ or $50 \leq |h| < 0.80$).

[b]Bold: effect size into the large range ($|d| \geq 0.80$ or $|h| \geq 0.80$).

*Bold: significant comparison.

Figure 1 shows the performance learning curve in the IGT obtained in each group (mean IGT scores on the five consecutive blocks of the card draws). Dash lines represent the trend line with the best fit within each diagnostic condition (linear trend for HC and BSD, and polynomial cubic trend for BSD + CB). As expected, the best performance learning was achieved by HC controls, followed by BSD patients. BSD + CB group did not reach adequate performance in the learning task.

3.3 | Therapy outcome

Table 3 contains the distribution of the therapy outcome in the clinical groups, as well as the results of the

TABLE 2 Comparison between the neuropsychological measures

	HC ($n = 25$)		BSD ($n = 25$)		BSD + CB ($n = 25$)		BSD versus HC		BSD + CB versus HC		BSD + CB versus BSD	
	Mean	***SD***	**Mean**	***SD***	**Mean**	***SD***	***p***	**|*d*|**	***p***	**|*d*|**	***p***	**|*d*|**
IGT: Block1	−1.20	7.14	−3.12	3.92	−1.53	4.85	0.219	0.33	0.832	0.05	0.308	0.36
IGT: Block2	0.40	7.90	−1.76	5.49	1.29	3.41	0.199	0.32	0.594	0.15	0.071	**0.67**[a]
IGT: Block3	1.84	9.07	−1.44	3.94	−0.35	6.12	0.088	0.47	0.252	0.28	0.568	0.21
IGT: Block4	1.68	9.99	−0.40	5.60	−2.00	7.12	0.348	0.26	0.099	0.42	0.470	0.25
IGT: Block5	2.08	10.34	0.08	5.55	−3.06	7.07	0.374	0.24	**0.025***	**0.58**[a]	0.165	**0.52**[a]
IGT: total	4.80	30.84	−6.64	15.28	−5.65	19.39	0.080	0.47	0.110	0.41	0.878	0.06
IGT: learning	4.56	16.56	4.56	8.71	−4.82	9.87	0.999	0.00	**0.008***	**0.69**[a]	**0.008***	**1.01**[b]
IGT: risk	3.76	16.51	−0.32	8.77	−5.06	10.05	0.243	0.31	**0.013***	**0.65**[a]	0.176	**0.50**[a]
WCST: trials	94.84	20.72	96.53	17.78	91.56	12.71	0.732	0.09	0.507	0.19	0.315	0.32
WCST: errors	26.36	24.30	28.47	20.61	25.78	14.43	0.713	0.09	0.919	0.03	0.639	0.15
WCST: conceptual	62.36	17.64	60.06	15.96	59.22	8.12	0.577	0.14	0.447	0.23	0.839	0.07
WCST: completed categ.	5.12	1.94	5.06	1.64	5.11	1.06	0.893	0.03	0.983	0.01	0.910	0.04
WCST: Persev.responses	14.56	13.96	14.65	10.74	15.50	12.21	0.980	0.01	0.789	0.07	0.808	0.07
WCST: persev.errors	13.28	12.21	13.53	9.06	14.33	9.76	0.933	0.02	0.723	0.10	0.787	0.09
WCST: non-persev. Errors	13.08	12.96	14.94	14.29	11.44	5.55	0.572	0.14	0.619	0.16	0.289	0.32
WCST: trials-first-category	25.60	34.99	27.76	31.41	20.33	10.03	0.784	0.07	0.504	0.20	0.347	0.32
	n	**%**	***n***	**%**	***n***	**%**	***p***	**|*h*|**	***p***	**|*h*|**	***p***	**|*h*|**
Deficit: decision making	10	40.0%	14	56.0%	17	68.0%	0.258	0.32	**0.047***	**0.57**[a]	0.382	0.25
Deficit: flexibility	6	24.0%	12	48.0%	18	72.0%	0.077	**0.51**[a]	**0.001***	**1.00**[b]	0.083	**0.50**[a]

Abbreviations: BSD, bulimic spectrum disorder; BSD + CB, bulimic spectrum disorder with compulsive buying; HC, healthy control; SD, standard deviation.

[a]Bold: effect size into the medium range ($50 \leq |d| < 0.80$ or $50 \leq |h| < 0.80$).

[b]Bold: effect size into the large range ($|d| \geq 0.80$ or $|h| \geq 0.80$).

*Bold: significant comparison.

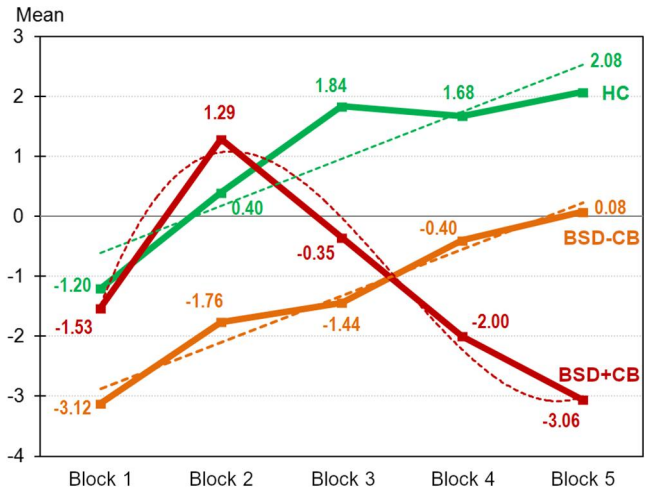

FIGURE 1 Performance learning curve in the IGT. BSD-CB, bulimic spectrum disorder without compulsive buying (n = 25); BSD + CB, bulimic spectrum disorder with compulsive buying (n = 25); HC, healthy control (n = 25)

TABLE 3 Therapy outcome and deficit in the neuropsychological performance in the study

	BSD; ($n = 25$)		BSD + CB; ($n = 23$)			
	n	**%**	***n***	**%**	***p***	**|*h*|**
Treatment outcome						
Dropout	3	12.0%	10	43.5%	**0.025***	**0.73**[a]
Non-remission	4	16.0%	1	4.3%		0.40
Partial-remission	5	20.0%	7	30.4%		0.24
Full-remission	13	52.0%	5	21.7%		**0.64**[a]

Abbreviations: BSD, bulimic spectrum disorder; BSD + CB, bulimic spectrum disorder with compulsive buying.

[a]Bold: effect size into the medium range ($50 \leq |d| < 0.80$ or $50 \leq |h| < 0.80$).

*Bold: significant comparison.

statistical comparison. Differences between the groups were obtained, being the comorbid BSD + CB associated to worse efficiency.

3.4 | Path analysis

Figure 2 includes the path diagram with the standardised coefficients obtained in the SEM. Continuous line represent significant coefficients ($p \leq 0.05$) and dash-lines non-significant coefficients. Adequate goodness-of-fit was obtained for the model: $\chi^2 = 3.82$ ($p = 0.80$), RMSEA = 0.002, CFI = 0.998, TLI = 0.999 and SRMR = 0.047. Lower scores in the self-directedness personality traits increased the risk of deficit in the decision making area and the presence of the comorbid condition BSD + CB. The concurrent presence of both disorders was also directly associated with higher scores in the novelty seeking personality trait and the presence of deficit in the flexibility cognitive area. Bad treatment outcome (considered in the study as dropout or non-remission) was directly related with the presence of deficit in decision making, and this neuropsychological score also mediated within the relationship between self-directedness and bad outcome (lower scores in the personality trait increased the risk of deficits in decision making, which predicted higher risk of bad therapy outcome).

4 | DISCUSSION

The present study compared the neuropsychological performance and psychological profiles of patients with BSD + CB comorbidity, BSD patients and HC participants. The objectives were to assess if BSD + CB comorbidity could be a specific subtype according to their neuropsychological functioning, present a descriptive analysis of different clinical features and to explore how the mediation-interaction of these variables could influence treatment outcome.

Regarding our first objective, we observed that patients with BSD + CB comorbidity presented poorer learning performance in the IGT than the patients without comorbidity and the HC group. Both BSD and HC groups showed a tendency to increase their selections from the advantageous decks with respect to the initial blocks. On the contrary, BSD + CB group showed the inverse trend, as they selected more cards from the disadvantageous decks as the task progressed. The initial blocks of the IGT represent a context of uncertainty, where the results cannot be predicted, and the decisions are made under ambiguity, whereas the last trials of the task represent decisions made under risk (Giannunzio et al., 2018). Therefore, the learning performance requires the participant to learn from previous experience in order to achieve better results. Also, the BSD + CB group presented with a higher percentage of impaired cognitive flexibility than the HC group. Our findings support the hypothesis that the BSD + CB comorbidity is associated with a poorer performance in a neuropsychological task related with decision making and cognitive flexibility.

The results agree with previous research that pointed towards an impaired executive planning in patients with binge-eating behaviours (Grant & Chamberlain, 2020), and also with those that indicated a poorer performance in decision making and cognitive flexibility of patients diagnosed with a BA (Bechara, 2003; Ko et al., 2010). These neurocognitive variables may influence in part the tendency toward the comorbidity. However, to the best of our knowledge, this is the first approximation that confirms this neurocognitive profile in BSD with comorbid CB patients.

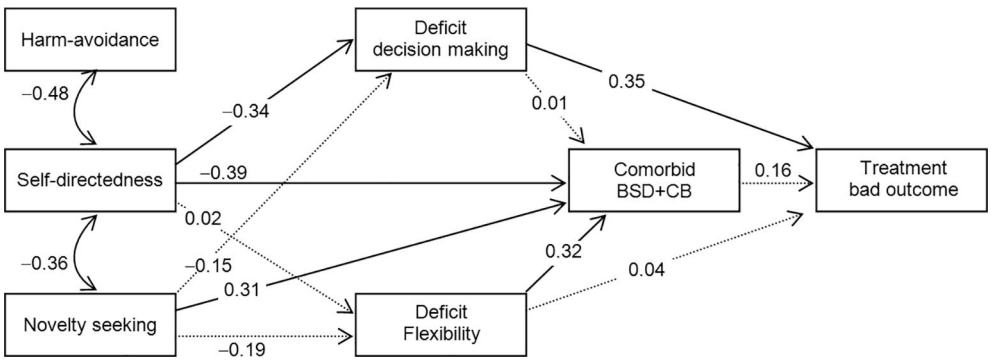

FIGURE 2 Path-diagram with the standardised coefficients. Continuous line: significant coefficient. Dash-line: non-significant coefficient. Sample: clinical conditions (BSD and BSD + CB groups, $n = 48$). BSD, bulimic spectrum disorder; BSD + CB, bulimic spectrum disorder with compulsive buying

The second aim of this study was to present a descriptive clinical characterisation of BSD + CB population. The comorbid group presented with a more severe profile than the patients with only BSD, considering higher general psychopathology and severity of the ED symptomatology; as well as predominant personality traits usually associated with more dysfunctional behaviour, called higher novelty seeking and harm avoidance and lower self-directedness (Álvarez-Moya et al., 2007; Del Pino-Gutiérrez et al., 2017; Jiménez-Murcia et al., 2013). According to the literature, a comorbid BA in ED patients has been already associated to these results (Fernández-Aranda et al., 2006, 2008; Jiménez-Murcia et al., 2015), which also seems to influence a poor treatment response (Fernández-Aranda et al., 2006, 2008), as was found in the present study by the comorbid group whom presented more dropouts and less full-remission indices than the non-comorbid one.

In relation to the aim of identifying if our target population (BSD + CB) could be a different subtype, we hypothesised that the neuropsychological performance would be determinant in this respect. However, even if this group present a worse performance in the neuropsychological tasks than the no comorbid one, the personality traits were the variables that had a mediation and predictive role to present the comorbidity. Novelty seeking was positively associated to present with the comorbidity, while self-directedness was negatively associated. Both variables may be related with the impulsive behaviours found in BSD and other BA (Álvarez-Moya et al., 2007; Del Pino-Gutiérrez et al., 2017; Jiménez-Murcia et al., 2013) including CB (Fernández-Aranda et al., 2019; Jiménez-Murcia et al., 2015). Interestingly, only a low self-directedness was significantly associated with more deficits in decision making, and this low neuropsychological performance mediated the relationship between self-directedness and bad outcome. Self-directedness indicates the ability to regulate and adapt behaviour to the demands of a situation in order to achieve personally chosen goals and values (Cloninger, 1999), which, according our results, influences the decision making process, and, as has been mentioned in the literature, it is related with difficulties in following therapy goals and achieving a good treatment outcome in BSD and other BA (Fernández-Aranda et al., 2021; Granero et al., 2020; Wagner et al., 2015). Also, the path-analysis showed that deficits in cognitive flexibility were positively associated with the presence of the comorbidity. People with BSD + CB seem to act impulsively despite its negative consequences, and they also show less cognitive flexibility that could relate to the repetition and maintenance of their unadjusted behaviours (Tchanturia et al., 2012).

Therefore, even the executive functions could be compromised in the comorbid group, it is a higher impulsivity which seems to have an important role in the characterisation of the BSD + CB profile, and could explain the co-occurrence of both disorders, as happens in other BA comorbid to ED (Jiménez-Murcia et al., 2013; Von Ranson et al., 2013). These results may be taken into account in considering an adequate treatment approach, in order to offer a precise therapy to those patients that present with this comorbidity. Considering the characteristics of the comorbid group, therapies that improve impulsive response, motivation and adherence to treatment, as well as cognitive process may be helpful. Mindfulness has shown positive results improving impulse behaviours motivated by planning capacity deficits (Korponay et al., 2019), as well as in the reduction of compulsive eating behaviours (Radin et al., 2019). Serious games may be another valuable tool for this comorbid group due to the fact that it may help to improve the motivation, help to develop positive relationships between patients and therapists, in this way dismissing the dropout rates and reinforcing the adherence to treatment (Tárrega et al., 2015).

4.1 | Limitations and future directions

The following limitations of this study need to be considered. Aspects such as: the sample size, the inclusion of only female, adult participants and from a specific geographic area, limits the generalisation of the results. Future studies should aim to use larger, more balanced samples in order to overcome this drawback. It is also important to consider that the present study only explored neuropsychological performance in patients with comorbid BSD and CB, future studies focusing on other behavioural addictions, rather than only CB, could be important in order to define a possible subtype of BSD and behavioural addictions. As well, other cognitive process, such as memory and attention, will be of interest to be explored in this population.

5 | CONCLUSIONS

According to our results, people with this high impulsive profile would also present more deficits in decision making and cognitive flexibility as well as worse treatment outcome. These results could indicate that the high impulsive traits and subsequent impaired neuropsychological performance are features that directly influence the presence of the comorbid BSD + CB, as well as relate to poor treatment outcomes of the people who present

this comorbidity. This study may represent a first exploration of the neurocognitive profile in BSD with comorbid CB patients, and it could be possible to hypothesise that the comorbidity may be a specific subtype of BSD, but further research should be performed in order to be able to establish it.

ACKNOWLEDGMENTS

The authors would like to thank CERCA Programme/Generalitat de Catalunya for institutional support. This manuscript and research was supported by grants from the Ministerio de Economía y Competitividad (PSI2015-68701-R), the Delegación del Gobierno para el Plan Nacional sobre Drogas (2017I067), the Instituto de Salud Carlos III (ISCIII) (FIS PI17/01167 and PI20/132), Agencia de Gestió d'Ajuts Universitaris i de Recerca (2017 SGR 1247), the PERIS-SLT006/17/00246 grant, funded by the Department of Health of the Generalitat de Catalunya by the call 'Acció instrumental de programes de recerca orientats en l'àmbit de la recerca i la innovació en salut', and co-funded by FEDER funds/European Regional Development Fund (ERDF), a way to build Europe. CIBERObn is an initiative of ISCIII. Lucero Munguía is supported by a postdoctoral Grant of the Mexican Institution Consejo Nacional de Ciencia y Tecnología-CONACYT (Science and Technology National Counsel). María Lozano-Madrid is supported by a predoctoral grant of the Ministerio de Educación, Cultura y Deporte (FPU15/02911). Bernat Mora-Maltas is supported by a PRIME (Prevention and Remediation of Insulin Multimorbidity in Europe) project (ref. 847879). The funders had no role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

CONFLICT OF INTERESTS

Fernando Fernández-Aranda received consultancy honoraria from Novo Nordisk and editorial honoraria as EIC from Wiley. The other authors declare that there are no conflict of interests.

AUTHOR CONTRIBUTIONS

Lucero Munguía, Ignacio Lucas, Susana Jiménez-Murcia and Fernando Fernández-Aranda contributed to the development of the study concept and design. Roser Granero performed the statistical analysis. Romina Miranda-Olivos, Bernat Mora-Maltas, Guilia Testa, Isabel Sánchez, María Lozano-Madrid, aided with data collection. Lucero Munguía, Ignacio Lucas, Susana Jiménez-Murcia, Bernat Mora-Maltas and Fernando Fernández-Aranda aided with interpretation of data and the writing of the manuscript. Robert Turton aided with supervision, review and editing of the manuscript.

DATA AVAILABILITY STATEMENT

The datasets generated during and/or analysed during the current study are not publicly available due to ethical restrictions in order to protect the confidentiality of the participants, but are available from the corresponding author on reasonable request.

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How to cite this article: Munguía, L., Lucas, I., Jiménez-Murcia, S., Mora-Maltas, B., Granero, R., Miranda-Olivos, R., Sánchez, I., Testa, G., Lozano-Madrid, M., Turton, R., Menchon, J. M., & Fernández-Aranda, F. (2021). Executive functions in binge spectrum eating disorders with comorbid compulsive buying. *European Eating Disorders Review*, 1–14. https://doi.org/10.1002/erv.2855