

RESEARCH ARTICLE

Cognitive and clinical gender-related differences among binge-spectrum eating disorders: Analysis of therapy response predictors

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Abstract

Objective: This study assessed gender-related differences in executive functions (decision-making, inhibitory control and cognitive flexibility), personality traits and psychopathological symptoms in binge-spectrum eating disorders (EDs). Secondly, we aimed to separately explore the predictive value of gender and executive functions in treatment outcome.

Method: A battery of self-reported and neurocognitive measures were answered by a sample of 85 patients (64 females) diagnosed with a binge-spectrum ED (41 BN; 44 binge eating disorder).

Results: Data showed gender-related differences in executive functioning, displaying women lower inhibitory control and lower cognitive flexibility than men. Regarding personality traits and psychopathology symptoms, women presented higher reward dependence and cooperativeness, as well as more drive for thinness, body dissatisfaction, bulimia, and somatisation symptoms than men. Finally, worse executive functioning, particularly having lower ability in concept formation seems to predict worse treatment outcomes and dropout in these patients.

Conclusions: We described gender specific neuropsychological, personality and psychopathological impairments in patients with binge-spectrum EDs. Moreover, difficulties in executive functioning might have an impact on treatment response, since patients with a lower ability in concept formation are less likely to benefit from treatment. The present results can help

Abbreviations: AN, Anorexia nervosa; ANCOVA, Analysis of covariance; BED, Binge eating disorder; BMI, Body Mass Index; BN, Bulimia nervosa; DSM-5, Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition; EDI-2, Eating Disorders Inventory-2; EDs, Eating disorders; IGT, Iowa Gambling Task; SCL-90-R, Symptom Checklist-90 Revised; SCWT, Stroop Colour and Word Test; TCI-R, Temperament and Character Inventory-Revised; WCST, Wisconsin Card Sorting Test.

Núria Mallorquí-Bagué and María Lozano-Madrid Shared first authorship.

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improving current treatment approaches by tackling gender and individual differences.

KEYWORDS

binge-spectrum, eating disorders, executive function, gender, personality, treatment, treatment outcome

Highlights

- This is the first study assessing gender and executive functions as therapy response predictors in patients suffering from binge-spectrum eating disorders (EDs).
- This study is also pioneer in the study of gender-related differences in executive functioning, clinical and personality traits.
- Women with binge-spectrum EDs present more neuropsychological deficits and psychopathological symptoms than men.
- binge-spectrum ED patients with higher deficits in executive functioning display poorer therapy response.

1 | INTRODUCTION AND AIMS

Binge-spectrum eating disorders (EDs) encompasses those mental health conditions which are mainly characterised by recurrent binge eating episodes, this is bulimia nervosa (BN) and binge eating disorder (BED) (Agüera et al., 2019; American Psychiatric Association, 2013). During the last decades different studies have explored clinical and neuropsychological domains in this clinical population, and showed that individuals with binge-spectrum EDs frequently present psychological comorbidities, specific personality traits (Hudson et al., 2007; Welch et al., 2016) and executive impairments (Kittel et al., 2015; Perpiñá et al., 2017).

It has to be noted that on account of the low prevalence of EDs in males (Smink et al., 2012), most studies have only analysed female populations. Nevertheless, there are some studies that compared males and females with EDs, finding no major differences regarding general and eating psychopathology (Núñez-Navarro et al., 2012; Zayas et al., 2018). Studies which have explored executive impairments in men with EDs are scarce and do not allow for comparisons with females due to their small sample size (Cavedini et al., 2004; Chan et al., 2014; Grant & Chamberlain, 2019; Kekic et al., 2016; Wu, Giel, et al., 2013). Only one study comparing a rather small sample of females and males with EDs, specifically with anorexia nervosa (AN), has shown that both groups display similar impairments in decision-making (Tchanturia et al., 2012). However, no previous study has explored gender differences related to these dimensions in binge-spectrum ED patients.

According to previous studies in binge-spectrum EDs, executive impairments are mostly noticeable in decision-making, inhibitory control and cognitive flexibility (Aloi et al., 2015; Guillaume et al., 2015; Lavagnino et al., 2016), relevant cognitive abilities addressed in the present study. Besides, these executive deficits have been linked to high impulsivity-related personality traits, such as high novelty seeking (Cassin & Von Ranson, 2005; Fassino et al., 2001) and low persistence (Fernández-Aranda et al., 2019), as well as a tendency towards high anxiety, cognitive rigidity and compulsivity, reflected by elevated levels of harm avoidance (Cassin & Von Ranson, 2005; Claes, Jimenez-Murcia, et al., 2012a; Fassino et al., 2001).

More precisely, despite some inconsistent findings (Brand et al., 2007; Svaldi et al., 2010), most evidence points to significant decision-making deficits in binge-spectrum ED patients, which would reflect a poor ability to learn from the reward/punishment contingencies of their choices (Aloi et al., 2015; Guillaume et al., 2015; Matsumoto et al., 2015; Weider et al., 2015); which can be consistent with the preference for immediate rewards, overeating behaviours and experiencing binge eating episodes regardless of future consequences (Davis et al., 2004).

Inhibitory control is described as the ability to inhibit automatic/impulsive responses (MacKillop et al., 2016). When examining binge-spectrum EDs, results differ depending on the condition, BED or BN. For instance, although inhibitory control is significantly impaired in obese compared to normal weight individuals, the presence of BED is not apparently a relevant factor (Lavagnino et al., 2016; Wu, Hartmann, et al., 2013). In

contrast, BN patients show small deficits in inhibition related to general stimuli, but larger difficulties when examining stimuli related to the disorder (e.g., food, body shape) (Kittel et al., 2015; Schag et al., 2013; Wu, Hartmann, et al., 2013). In this regard, these deficits could be acting as a maintenance factor (Eichen et al., 2017).

Finally, individuals with binge-spectrum EDs also display some cognitive flexibility impairments (Aloi et al., 2015; Guillaume et al., 2015), reflecting a difficulty to adapt their behaviour and thinking in response to the environment changes (Diamond, 2013; Rende, 2000). These impairments seem to be related to a decreased ability to handle negative affect, leading to a loss of control over eating (Dingemans et al., 2015).

The above-mentioned characteristics can have a direct impact on the treatment outcomes of individuals with binge-spectrum EDs. Evidence has pointed out that people with well-developed executive functions regulate their emotions in a healthier way and have more possibilities to benefit from treatment (Lantrip et al., 2016). In this regard, binge-spectrum EDs treatment includes activities (e.g., homework assignments, cognitive restructuring, monitor behaviour) that require good executive functioning abilities (Hybel et al., 2017; Mohlman & Gorman, 2005). Thus, it is expected that people with higher deficits in executive functioning are less likely to benefit from treatment (Hybel et al., 2017), which may negatively impact their therapy response (Lucas et al., 2021).

With this in mind, the first aim of this study was to assess gender differences in executive functions (decision-making, inhibitory control, and cognitive flexibility), personality traits and psychopathology, in patients seeking treatment for a binge-spectrum ED. Secondly, we aimed to separately explore the predictive value of gender and executive functions in treatment outcome, particularly in the risk of dropout or bad outcome (considered as dropout or non-remission).

2 | METHODS

2.1 | Participants

The present study included a total sample of 85 participants diagnosed with BN or BED according to the DSM-5 diagnostic criteria (American Psychiatric Association, 2013). Participants with AN binge-purging subtype were not included in our study since the main feature of this disorder is a consistent food restriction that leads to an extremely low body weight (vs. binge-spectrum EDs, mainly characterised by recurrent binge eating episodes). Participants were recruited and

diagnosed by experienced clinicians at the ED Unit within the Department of Psychiatry at a tertiary referral hospital in Barcelona. All participants were informed about the research procedures and gave their informed consent in writing. Procedures were approved by the Ethical Committee of the abovementioned institution. Exclusion criteria for being part of the study were: (1) history of chronic medical illness or neurological condition that might affect cognitive function; (2) history of head trauma with loss of consciousness for more than 2 min; (3) learning disability or intellectual disability; (4) age under 18 or over 60 (to discard neuropsychological deficits associated with the age).

2.2 | Procedure, assessment and treatment

All participants underwent a clinical assessment as part of the standard protocol established at the ED Unit. This includes sociodemographic information, anthropometric data such as weight and Body Mass Index, as well as psychopathological and personality measures. Participants also completed a comprehensive neuropsychological assessment, including several neuropsychological tests to cover the main aspects of executive function. They were administered by a trained psychologist in a single session and in a specific order. Internal consistency in the sample of the study was between good to excellent for all the psychometrical scales (Cronbach's alpha values are shown in Table 1).

2.2.1 | Executive functions

Decision making

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. However, the rewards are interspersed with probabilistic punishments (monetary losses with different amounts). Therefore, participants are instructed to try to win as much money as possible and to avoid losing as much money as they can. Also, 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 disadvantageous, as the final loss is higher than the final gain; however, decks C and D are advantageous,

TABLE 1 Descriptive of the sample

| | Total (<i>n</i> = 85) | | Women (<i>n</i> = 64) | | Men (<i>n</i> = 21) | | <i>p</i> | <i>d</i> | |
|--------------------------------------|------------------------|--------|------------------------|--------|----------------------|-------|----------|-------------------|-------------------------|
| | <i>n</i> | % | <i>n</i> | % | <i>n</i> | % | | | |
| Marital status | | | | | | | | | |
| Single | 45 | 52.9% | 33 | 51.6% | 12 | 57.1% | 0.886 | 0.11 | |
| Married - partner | 30 | 35.3% | 23 | 35.9% | 7 | 33.3% | | 0.05 | |
| Divorced - separated | 10 | 11.8% | 8 | 12.5% | 2 | 9.5% | | 0.10 | |
| Education | | | | | | | | | |
| Primary | 39 | 45.9% | 33 | 51.6% | 6 | 28.6% | 0.166 | 0.48 | |
| Secondary | 35 | 41.2% | 23 | 35.9% | 12 | 57.1% | | 0.44 | |
| University | 11 | 12.9% | 8 | 12.5% | 3 | 14.3% | | 0.05 | |
| Employment | | | | | | | | | |
| Unemployed | 34 | 40.0% | 26 | 40.6% | 8 | 38.1% | 0.837 | 0.05 | |
| Employed/Student | 51 | 60.0% | 38 | 59.4% | 13 | 61.9% | | | |
| ED subtype | | | | | | | | | |
| Bulimia | 41 | 48.2% | 28 | 43.8% | 13 | 61.9% | 0.149 | 0.37 | |
| Binge eating disorder | 44 | 51.8% | 36 | 56.3% | 8 | 38.1% | | | |
| | <i>α</i> | Mean | SD | Mean | SD | Mean | SD | <i>p</i> | <i>d</i> |
| Chronological age (years-old) | | 36.99 | 11.45 | 37.22 | 10.82 | 36.29 | 13.46 | 0.748 | 0.08 |
| Onset of the ED (years-old) | | 25.82 | 11.15 | 24.84 | 10.62 | 28.81 | 12.41 | 0.158 | 0.34 |
| Duration of the ED (years) | | 11.69 | 10.39 | 12.32 | 9.83 | 9.76 | 11.98 | 0.330 | 0.23 |
| Body mass index (kg/m ²) | | 34.38 | 9.95 | 35.26 | 10.00 | 31.67 | 9.52 | 0.152 | 0.37 |
| EDI drive for thinness | 0.871 | 13.94 | 5.16 | 14.69 | 4.61 | 11.67 | 6.14 | 0.019* | 0.56^a |
| EDI Body dissatisfaction | 0.906 | 19.88 | 7.40 | 21.58 | 5.92 | 14.71 | 9.08 | <0.001* | 0.90^a |
| EDI interoceptive awareness | 0.871 | 11.85 | 6.64 | 11.98 | 6.27 | 11.43 | 7.81 | 0.741 | 0.08 |
| EDI Bulimia | 0.782 | 9.99 | 4.55 | 10.72 | 4.36 | 7.76 | 4.52 | 0.009* | 0.67^a |
| EDI interpersonal distrust | 0.910 | 5.89 | 5.50 | 5.72 | 5.48 | 6.43 | 5.65 | 0.611 | 0.13 |
| EDI ineffectiveness | 0.950 | 11.91 | 7.43 | 12.48 | 6.67 | 10.14 | 9.34 | 0.212 | 0.29 |
| EDI maturity fears | 0.874 | 8.22 | 5.72 | 7.94 | 5.71 | 9.10 | 5.81 | 0.424 | 0.20 |
| EDI perfectionism | 0.804 | 5.22 | 4.24 | 5.34 | 4.18 | 4.86 | 4.51 | 0.651 | 0.11 |
| EDI impulse regulation | 0.819 | 6.20 | 5.83 | 5.92 | 5.61 | 7.05 | 6.53 | 0.446 | 0.18 |
| EDI ascetic | 0.701 | 7.38 | 3.84 | 7.64 | 3.57 | 6.57 | 4.57 | 0.271 | 0.26 |
| EDI social insecurity | 0.882 | 7.87 | 5.24 | 8.03 | 4.98 | 7.38 | 6.08 | 0.625 | 0.12 |
| EDI total score | 0.973 | 108.35 | 43.59 | 112.05 | 39.06 | 97.10 | 54.74 | 0.174 | 0.31 |
| SCL-90R somatisation | 0.765 | 1.97 | 0.89 | 2.13 | 0.88 | 1.47 | 0.74 | 0.003* | 0.82^a |
| SCL-90R obsessive-compuls. | 0.911 | 2.01 | 0.94 | 2.06 | 0.91 | 1.85 | 1.01 | 0.365 | 0.22 |
| SCL-90R interpersonal sens. | 0.914 | 2.06 | 1.02 | 2.12 | 0.98 | 1.88 | 1.11 | 0.337 | 0.24 |
| SCL-90R depression | 0.933 | 2.29 | 0.96 | 2.36 | 0.90 | 2.07 | 1.11 | 0.236 | 0.28 |
| SCL-90R anxiety | 0.925 | 1.66 | 0.97 | 1.66 | 0.94 | 1.64 | 1.06 | 0.926 | 0.02 |
| SCL-90R hostility | 0.843 | 1.39 | 0.99 | 1.32 | 0.95 | 1.60 | 1.10 | 0.253 | 0.28 |
| SCL-90R phobic anxiety | 0.889 | 1.18 | 1.01 | 1.25 | 0.97 | 0.97 | 1.13 | 0.285 | 0.26 |
| SCL-90R paranoia | 0.825 | 1.40 | 0.80 | 1.39 | 0.75 | 1.43 | 0.96 | 0.832 | 0.05 |

TABLE 1 (Continued)

| | α | Mean | SD | Mean | SD | Mean | SD | p | $ d $ |
|--------------------------|----------|--------|-------|--------|-------|--------|-------|---------------|-------------------------|
| SCL-90R psychotic | 0.868 | 1.33 | 0.79 | 1.35 | 0.78 | 1.28 | 0.84 | 0.731 | 0.09 |
| SCL-90R GSI | 0.976 | 1.81 | 0.80 | 1.86 | 0.76 | 1.65 | 0.89 | 0.299 | 0.25 |
| SCL-90R PST | 0.976 | 66.08 | 17.10 | 67.16 | 15.70 | 62.81 | 20.90 | 0.315 | 0.24 |
| SCL-90R PSDI | 0.976 | 2.36 | 0.60 | 2.40 | 0.57 | 2.23 | 0.69 | 0.269 | 0.27 |
| TCI-R novelty seeking | 0.825 | 102.27 | 16.62 | 101.89 | 17.15 | 103.43 | 15.21 | 0.715 | 0.09 |
| TCI-R harm avoidance | 0.942 | 123.29 | 20.37 | 125.13 | 18.25 | 117.71 | 25.51 | 0.149 | 0.33 |
| TCI-R reward dependence | 0.779 | 100.76 | 16.31 | 102.88 | 16.47 | 94.33 | 14.32 | 0.037* | 0.55^a |
| TCI-R persistence | 0.845 | 100.01 | 19.23 | 98.88 | 19.33 | 103.48 | 18.97 | 0.344 | 0.24 |
| TCI-R self-directedness | 0.905 | 111.52 | 19.31 | 112.00 | 17.29 | 110.05 | 24.91 | 0.690 | 0.09 |
| TCI-R cooperativeness | 0.922 | 133.73 | 18.30 | 136.70 | 16.44 | 124.67 | 20.98 | 0.008* | 0.64^a |
| TCI-R self-transcendence | 0.894 | 63.68 | 14.59 | 63.31 | 12.90 | 64.81 | 19.18 | 0.686 | 0.09 |

Abbreviations: SD, standard deviation; α , Cronbach's alpha in the sample.

^aBold: effect size into the moderate ($|d| > 0.50$) to high range ($|d| > 0.80$).

*Bold: significant comparison (.05 level).

since the punishments are smaller. Higher scores indicate better performance on the task while negative scores indicate persistently choosing disadvantageous decks.

Inhibitory control

The Stroop Colour and Word Test (Golden, 1978, 2001) is an extensively used neuropsychological test to assess one's cognitive ability to override the dominant behavioural response to stimuli, namely inhibitory control (including response inhibition and interference control). It consists of three different lists: a word list containing names of colours (red, green or blue) printed in black ink (Stroop word-reading or SWR), a colour list that comprises the item 'XXXX' printed in colour red, green or blue ink (Stroop colour-naming or SCN), and a colour-word list (Stroop colour-word or SCW) comprised of names of colours (red, green or blue) in a colour ink (red, green or blue) that does not match the written name. Three final scores are obtained based on the number of items that the participant is able to read on each of the three lists in a time window of 45 s. In addition, there is also an interference score that is computed based on the three lists ($SCW - [(SWR \times SCN)/(SWR + SCN)]$) and it explores the individual's cognitive flexibility and the ability to inhibit cognitive interference.

Cognitive flexibility

The Wisconsin Card Sorting Test: Computer Version 4-Research edition (WCST:CV4) (Lezak et al., 2012) is a computerised set-shifting task for assessing cognitive flexibility. It includes 128 cards that vary according to three attributes: *number*, *colour* and *shape*. 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, *colour* 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, 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: *colour-shape-number-colour-shape-number*. Participants are not informed of the correct sorting principle and that it shifts during the test. The test is completed when all 128 cards are sorted or after the six full categories are completed. A number of categories relevant for cognitive flexibility are recorded: the number of completed categories, trials to complete the first category and the percentage of perseverative errors (i.e., failures to change sorting strategy after negative feedback).

2.2.2 | Psychopathological symptoms and personality traits

The *Symptom Checklist-90 Revised* (SCL-90-R) (Derogatis, 1994) is a 90-item questionnaire that evaluates psychopathological symptoms through nine subscales: somatisation, obsessive compulsion, interpersonal

sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. It also includes a global severity index, designed to measure overall psychological distress. This instrument has demonstrated satisfactory psychometric properties in the Spanish version (González de Rivera, J.L., et al., 2002). Cronbach's alpha values in the study are displayed in Table 1.

The *EDs Inventory-2* (eating symptoms levels (EDI-2)) (Garner, 1991) is a 91-item self-report questionnaire that assesses the following ED factors: drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. The instrument presented satisfactory psychometric properties in Spanish population (Garner, 1998). Cronbach alpha values in the study are displayed in Table 1.

The *Temperament and Character Inventory-Revised* (TCI-R) (Cloninger et al., 1994), is a reliable and valid 240-item questionnaire that measures seven personality dimensions: four temperament dimensions (novelty seeking, harm avoidance, reward dependence, and persistence) and three about character (self-directedness,

cooperativeness, and self-transcendence). Spanish validation (Gutiérrez-Zotes et al., 2004) was used in this study. Cronbach alpha values in the study are displayed in Table 2.

2.3 | Cognitive behavioural therapy intervention

All patients underwent cognitive behavioural therapy in a group setting. Groups were sorted based on the diagnosis (BN or BED); they consisted of 16 weekly sessions in which the following topics were addressed: psychoeducation of the disorder (BN or BED), eating monitoring, regular nutritional patterns, cognitive restructuring, emotion regulation, training in problem solving strategies, and improving self-esteem and body image. More detailed information about the treatments conducted in this EDs Unit can be found at Agüera et al. (2017).

According to the DSM-5 (American Psychiatric Association, 2013), patients were classified as good outcome (complete remission -no ED criteria have been met for a sustained period of time- or partial remission -some but

| | Women (n = 64) | | Men (n = 21) | | p | d |
|--------------------------------|-------------------|-------|--------------|-------|---------|-------------------|
| | Mean | SD | Mean | SD | | |
| Stroop words | 110.15 | 9.89 | 85.78 | 26.76 | <0.001* | 1.21 ^a |
| Stroop colours | 76.18 | 14.35 | 83.80 | 18.87 | 0.048* | 0.51 ^a |
| Stroop words/Colours | 46.06 | 6.46 | 44.76 | 8.98 | 0.457 | 0.17 |
| Stroop interference | 1.29 | 5.02 | 4.99 | 5.35 | 0.005* | 0.71 ^a |
| WCST total trials | 101.95 | 16.95 | 97.16 | 17.47 | 0.259 | 0.28 |
| WCST correct | 68.61 | 9.24 | 72.73 | 9.21 | 0.087 | 0.45 |
| WCST perseverative errors | 17.73 | 11.67 | 12.38 | 6.66 | 0.049* | 0.56 ^a |
| WCST non-perseverative errors | 15.61 | 10.20 | 12.05 | 7.40 | 0.139 | 0.40 |
| WCST conceptual | 59.52 | 13.22 | 66.33 | 10.29 | 0.038* | 0.58 ^a |
| WCST categories completed | 4.65 | 1.45 | 5.61 | 1.09 | 0.007* | 0.75 ^a |
| WCST trials complet 1st categ. | 27.33 | 21.67 | 15.13 | 8.94 | 0.016* | 0.74 ^a |
| IGT Raw1 | -2.12 | 4.75 | -1.54 | 4.84 | 0.630 | 0.12 |
| IGT Raw2 | -0.20 | 6.22 | 0.32 | 7.19 | 0.749 | 0.08 |
| IGT Raw3 | -0.70 | 5.74 | 2.32 | 9.08 | 0.083 | 0.40 |
| IGT Raw4 | 0.56 | 8.96 | 2.66 | 6.56 | 0.340 | 0.27 |
| IGT Raw5 | -0.42 | 8.41 | -0.34 | 6.68 | 0.967 | 0.01 |
| IGT total raw | -2.88 | 21.44 | 3.44 | 23.32 | 0.264 | 0.28 |

Abbreviation: SD: standard deviation.

^aBold: effect size into the moderate ($|d| > 0.50$) to high range ($|d| > 0.80$).

*Bold: significant comparison (0.05 level).

TABLE 2 Comparison of the neuropsychological measures: ANCOVA adjusted by age and education

not all criteria have been met for a sustained period of time-) or poor outcome (non-remission or dropout).

2.4 | Statistical analyses

Data analysis was carried out with Stata16 for Windows (StataCorp, 2019). Comparison between men and women was based on chi-square test (χ^2) for the categorical sociodemographic data. T-TEST compared mean values obtained for men and women in quantitative measures for sociodemographic data, EDI-2, psychopathological state (SCL-90-R) and personality profile (TCI-R). Analysis of covariance (ANCOVA, adjusted by age and education levels) compared psychoneurological measures between the groups defined by the participants' gender. The effect size of these comparisons was estimated with the standardized Cohen-*d* coefficient, considering null effect for $|d| < 0.20$, low-poor for $|d| > 0.20$, moderate-medium for $|d| > 0.50$ and large-high for $|d| > 0.80$ (Kelley & Preacher, 2012). Finner-method was used to control Type-I error due to the multiple statistical comparisons (this procedure is included into the Familywise error rate stepwise procedures, offering a more powerful test than the classical Bonferroni correction) (Finner, 1993).

3 | RESULTS

3.1 | Characteristics of the sample

Table 1 includes the descriptive indices of the variables in the study, both for the total sample and stratified and compared by sex. Differences between genders were found in the EDI-2 drive for thinness, body dissatisfaction, and bulimia scales (higher mean scores in women), and SCL-90R somatisation (higher mean scores in women). Higher mean scores were reported by women in the reward dependence and cooperativeness dimensions of the TCI-R personality questionnaire.

3.2 | Comparison of the neuropsychological measures

Table 2 includes the gender comparisons of the neuropsychological profiles obtained in the ANCOVA analysis (adjusted by the participants' age and education). Women obtained statistically higher means in the Stroop words ($M = 110.2$ vs. $M = 85.8$, $p < 0.001$, $|d| = 1.21$), and lower means in the Stroop colours ($M = 76.2$ vs. $M = 83.8$, $p = 0.048$, $|d| = 0.51$) and the Stroop interference scales

($M = 1.3$ vs. $M = 5.0$, $p = 0.005$, $|d| = 0.71$). Women also registered worse performance in the following WCST subscales: perseverative errors ($M = 17.7$ vs. $M = 12.4$, $p = 0.049$, $|d| = 0.56$), conceptual ($M = 59.5$ vs. $M = 66.3$, $p = 0.038$, $|d| = 0.58$), categories completed ($M = 4.7$ vs. $M = 5.6$, $p = 0.007$, $|d| = 0.75$), and trials to complete the first category ($M = 27.3$ vs. $M = 15.1$, $p = 0.016$, $|d| = 0.74$). Figure 1 shows the line-plots for the overall performance profiles on the IGT, stratified by gender. The examination of the pattern showed a better performance for men compared to women. Figure 2 includes the radar-chart with the standardized mean scores in the psychoneurological measures of the study, which provides a summary of the results.

3.3 | Predictive capacity of the neurological profile on the therapy outcome

Figure 3 includes the stacked-bar-chart with the distribution of the treatment outcomes stratified by sex. No statistical differences were found comparing sexes in the distribution of the outcomes ($\chi^2 = 4.17$, $df = 3$, $p = 0.244$).

Table 3 contains the results of the logistic regression measuring the contribution of gender and psychoneurological profile on the risk of dropout (first model) and the risk of a bad treatment outcome (dropout or non-remission, second model), adjusting by the covariates age and education levels. The likelihood of dropout or bad outcome (dropout or non-remission) was increased for patients with lower scores in the WCST conceptual and WCST trials to complete the first category.

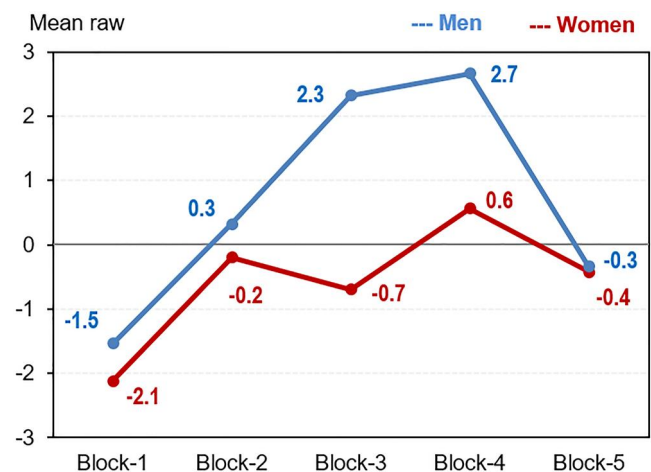


FIGURE 1 Line-plot for the overall performance on the Iowa gambling task (IGT) profiles. [Colour figure can be viewed at wileyonlinelibrary.com]

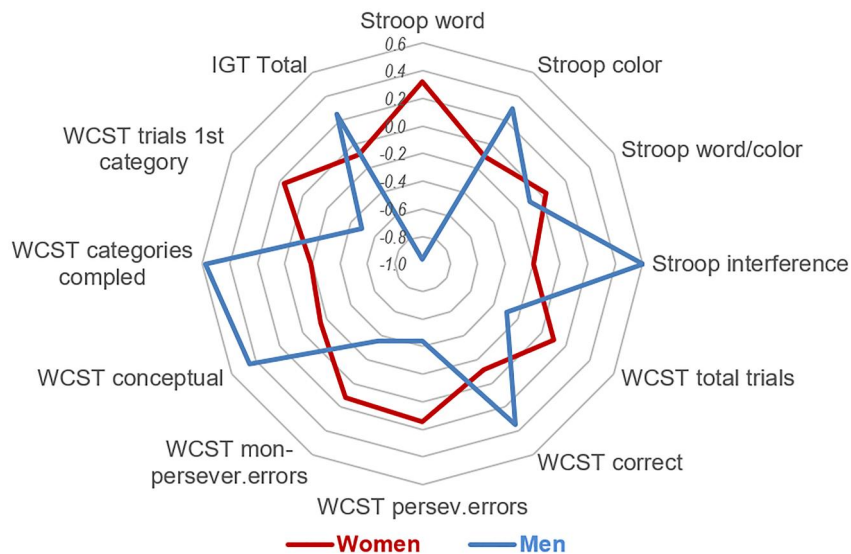


FIGURE 2 Radar-chart with the standardized mean scores in the psychoneurological measures. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

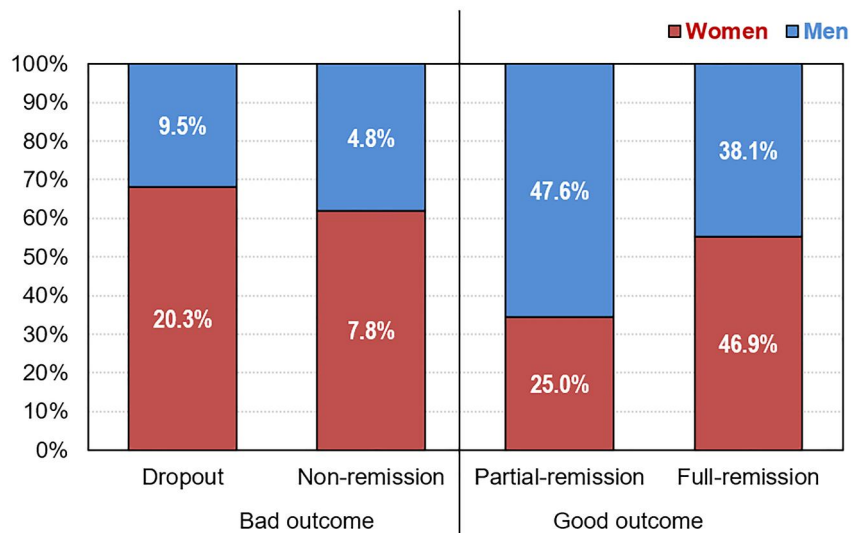


FIGURE 3 Stacked-bar-chart with the distribution of the treatment outcomes stratified by sex. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

4 | DISCUSSION

This study aimed to assess gender differences in executive functioning (i.e.: decision-making, inhibitory control, and cognitive flexibility), personality traits, and psychopathology in patients seeking treatment for binge-spectrum EDs. It also aimed to examine if gender and executive functions would be potential predictors of treatment outcome. In this respect, the results showed several gender-related differences regarding executive functioning, specifically, women displayed lower inhibitory control and lower cognitive flexibility than men. As for personality and psychopathology measures, women with binge-spectrum EDs presented higher reward dependence and cooperativeness, as well as more drive for thinness, body dissatisfaction, bulimia and somatisation symptoms than men. Finally, having lower ability in concept formation seems to predict dropout and bad

outcome (dropout or non-remission) in binge-spectrum ED patients.

Research in general population points to decision making not being consistently different between genders. Nevertheless, women apparently display a greater sensitivity to both rewarding and punishing outcomes, indicating that information used to influence decisions seems to be processed differently by women and men (Grisson & Reyes, 2019). To our knowledge, no previous studies have explored gender-related executive functioning differences in binge-spectrum EDs. However, no gender differences in decision-making patterns were reported in one study conducted with individuals suffering from AN (Tchanturia et al., 2012). In line with this previous study, our results add some extra evidence on the field of EDs, by showing similar overall decision-making patterns in women and men with binge-spectrum EDs. Still, our results show a slightly more maladaptive

TABLE 3 Contribution of sex and neuropsychological profile on treatment outcomes: Stepwise logistic regression adjusted by age and education

| | <i>B</i> | <i>SE</i> | <i>p</i> | <i>OR</i> | <i>95%CI OR</i> | <i>H-L</i> | <i>NR²</i> |
|-------------------------------------|----------|-----------|----------|-----------|-----------------|------------|-----------------------|
| Criterion: dropout | | | | | | | |
| <i>Age (years-old)</i> | -0.066 | 0.032 | 0.039 | 0.937 | 0.880 0.997 | 0.761 | 0.279 |
| <i>Education level</i> | -0.369 | 0.240 | 0.124 | 0.691 | 0.432 1.106 | | |
| Sex (0 = women; 1 = men) | -1.370 | 0.928 | 0.140 | 0.254 | 0.041 1.567 | | |
| WCST conceptual | -0.060 | 0.034 | 0.047 | 0.942 | 0.882 0.998 | | |
| WCST trials complete first cat. | -0.066 | 0.034 | 0.049 | 0.936 | 0.876 0.999 | | |
| Criterion: bad outcome ^a | | | | | | | |
| <i>Age (years-old)</i> | -0.043 | 0.027 | 0.106 | 0.958 | 0.909 1.009 | 0.175 | 0.259 |
| <i>Education level</i> | -0.344 | 0.209 | 0.100 | 0.709 | 0.470 1.068 | | |
| Sex (0 = women; 1 = men) | -1.299 | 0.795 | 0.102 | 0.273 | 0.057 1.295 | | |
| WCST conceptual | -0.059 | 0.031 | 0.048 | 0.943 | 0.887 0.995 | | |
| WCST trials complete first cat. | -0.068 | 0.030 | 0.024 | 0.934 | 0.881 0.991 | | |

Note: Results obtained in the second step of the logistic regression. Italic font: covariates. List of predictors: Stroop Interference, WCST Perseverative errors, WCST Conceptual, WCST Categories completed, WCST Trials to Complete First Category.

Abbreviations: SE, standard error; OR, odds ratio; H-L, Hosmer-Lemeshow test (*p-value*); NR², Nagelkerke's pseudo-R².

^aBad outcome: dropout or non-remission.

learning-through-the-task pattern in women, which could be an indicator of increased risk of experiencing binge eating episodes in comparison to men (Davis et al., 2004).

Additionally, evidence in general population suggests weak gender differences in inhibitory control, revealing a small female advantage, probably better explained through superior verbal rather than inhibition abilities (Grissom & Reyes, 2019; Mansouri et al., 2016). In contrast, gender differences in cognitive flexibility are not consistent across studies in healthy population, although recent studies failed to report gender differences in this ability (Faustino et al., 2022; Miranda et al., 2020). Focussing on the EDs field, inhibitory control and cognitive flexibility impairments have previously been associated with EDs, especially with binge-spectrum EDs (Wu, Hartmann, et al., 2013). Yet, the present results are the first to report some gender-related differences in these domains, with women showing higher impairments than men. Analogous results have been found when exploring other similar conditions characterised by difficulties in impulse control mechanisms (Mallorquí-Bagué et al., 2021), indicating that females might be at a higher risk of developing specific pathologies due to their enhanced neuropsychological impairments.

When comparing women and men according to personality traits and psychopathology, some significant results were observed. First of all, males suffering from a binge-spectrum ED presented lower cooperativeness

and reward dependence than women. Likewise, a previous study conducted with all EDs sub-types reported lower harm avoidance, reward dependence, and cooperativeness in men than women (Núñez-Navarro et al., 2012). Similar related personality differences exist in the general population with no EDs, which have been postulated to evolve partially from psychological adaptations (Schmitt et al., 2017). Yet, these differences could have an impact on the course of treatment of EDs, given that lower scores in reward dependence can predict higher dropout (Agüera et al., 2017). Secondly, women score higher on drive for thinness, body dissatisfaction and somatisation symptoms, factors which seem to be linked to higher ED severity and worse psychotherapy response (Claes, Jiménez-Murcia, et al., 2012b; Hintsanen et al., 2012; Rodríguez-Cano et al., 2014).

On the other hand, some neuropsychological variables were pointed out as predictors of treatment outcome in binge-spectrum EDs yet gender was not. Thus, women and men showed a similar likelihood of abandoning treatment or having a bad outcome (including dropout or non-remission). It has previously been suggested that gender differences could make an impact on the efficacy of current available treatments for patients with EDs (Strother et al., 2012). In fact, a previous study highlighted that the risk of dropout was higher in men with BN; however, they were also more likely to obtain full remission in comparison with females

(Agüera et al., 2017). Our results would not support this previous study; hence, it seems that the role of gender differences in treatment outcome should be further explored in order to elucidate this issue.

Regarding executive functioning, our study revealed that some WCST subscales (i.e.: conceptual level responses and trials to complete the first category) predict worse treatment outcome in patients with binge-spectrum EDs. Both subscales are a measure of what it is known as concept formation; that is the ability of forming and maintaining new concepts and rules, and trying new hypotheses when receiving negative feedback (Perrine, 1993). Low scores in concept formation are a reflection of reduced cognitive flexibility, which in AN patients has been linked to enhanced rigid cognitive and behavioural patterns that can negatively affect daily functioning, clinical symptoms and treatment (Duriez et al., 2021). However, there is a lack of research in binge-spectrum EDs, only a recent study suggested that deficits in executive functioning are weakly related or even not related to becoming abstinent of binge eating symptomatology (Dingemans et al., 2020). According to these findings, it would be convenient to develop future investigations to clarify the involvement of cognitive flexibility in treatment outcome of the heterogeneous EDs spectrum.

The results of this study should be considered within the context of some limitations. Firstly, only patients seeking treatment for ED were assessed and they might not be representative of all patients with EDs. Future studies should also test ED samples of other clinical and non-clinical settings. Secondly, some of the measures used are self-reported and despite being validated and highly used in the studied population they are susceptible to recall biases. Finally, the prevalence of men suffering from and seeking treatment for an EDs is still low compared to women, and this makes it difficult to collect large samples. Thus, although in this study the size of males group is adequate for the statistical analysis performed, future studies should further test these variables with larger samples.

5 | CONCLUSIONS

To our knowledge, this is the first study to assess the role of gender and executive functions in binge-spectrum EDs treatment outcome. It is also the first study to focus on gender-related differences according to three different facets in this clinical population: psychopathological symptoms, personality traits and executive functioning. Primarily, the present results show that women with binge-spectrum EDs present more accentuated

neuropsychological deficits and psychopathological symptoms than men with binge-spectrum EDs. Moreover, patients with higher deficits in executive functioning, appear to be less likely to benefit from treatment, since poorer therapy response is particularly displayed by these patients. This study appears to have some clinical implications, since its results point out the necessity to adapt intervention protocols to the specific profile of binge-spectrum ED patients. It seems that patients with impairments in executive functions may benefit from adding some adjunctive therapy that particularly targets these deficits-For instance, Cognitive Remediation Therapy (Hagan et al., 2020) or Inhibitory Control Training (Turton et al., 2018), among others.

AUTHOR CONTRIBUTIONS

Núria Mallorquí-Bagué, María Lozano-Madrid, Susana Jiménez-Murcia and Fernando Fernández-Aranda contributed to the development of the study concept and design. Roser Granero performed the statistical analysis. María Lozano-Madrid, Gemma Mestre-Bach, Cristina Vintró-Alcaraz and Isabel Sánchez aided with data collection. Núria Mallorquí-Bagué, María Lozano-Madrid, Roser Granero, Susana Jiménez-Murcia and Fernando Fernández-Aranda aided with interpretation of data and the writing of the manuscript.

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CONFLICT OF INTEREST

Fernando Fernández-Aranda received consultancy honoraria from Novo Nordisk and editorial honoraria as EIC from Wiley. The rest of the authors declare no conflict of interest. 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.

DATA AVAILABILITY STATEMENT

The datasets generated 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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