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Title

Returning to emotional eating: The Emotional Eating Scale psychometric properties and associations with body image flexibility and binge eating

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Abstract

Purpose: This study tests the Emotional Eating Scale (EES) psychometric properties and correlates, and the moderator effect of body image flexibility on the association between emotional eating and binge eating.

Methods: The EES factorial structure was examined in female college students and women from the general population, through a Principal Component Analysis and a Confirmatory Factor Analysis. EES' psychometric properties and moderation analyses were further conducted.

Results: The EES presented a three-factor structure - Depression, Anxiety and Anger –, a good model fit, internal consistency, construct validity and temporal stability. EES was positively associated with general and eating psychopathology, binge eating, and negatively associated with mindfulness and body image flexibility. Body image flexibility moderated the association between emotional eating and binge eating.

Conclusions: Findings showed that EES is a valid measure of emotional eating, and clarified the association between emotional eating and binge eating moderated by body image flexibility.

Keywords: Emotional eating; Binge eating; Body image flexibility; Psychometrics; Moderation.

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4 **Introduction**
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6 There is growing research on how emotions impact individuals eating behaviour. Emotional eating refers to the tendency
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8 to overeat in response to a range of negative emotions such as anxiety, depression or anger [1,2]. Emotional eating was initially
9
10 described in Bruch’s psychosomatic theory [3], according to which it derives from the inability to distinguish hunger sensations
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12 from physiological cues linked to emotional states. Affect-regulation models also state that eating may be an attempt to escape,
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14 distract oneself from or avoid aversive affective states [4,5].
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16 Emotional eating is associated with mental health problems, and plays an important role in body image, weight and
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18 eating-related disorders [6-9]. In particular, studies suggest that negative mood states, combined with disturbing eating and body
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20 image-related thoughts, are precipitants of binge eating [10,11]. In fact, binge eating may serve to avoid such negative internal
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22 events [4,12], being however a futile strategy in the long term that creates greater distress, fueling a self-perpetuating cycle [13],
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24 with serious health and psychosocial consequences [14]. Thus, emotional eating has been highlighted as an important target of
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26 psychotherapeutic interventions for eating psychopathology, namely binge eating.
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28 There is growing research showing the efficacy of mindfulness and acceptance-based interventions in reducing emotional
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30 eating and binge eating. Such interventions target the willingness to adaptively cope with negative emotions and undesirable
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32 thoughts to promote adaptive living [15-18]. A particularly important process of change in the treatment of binge eating is body
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34 image flexibility, the capacity to fully and openly experience body image-related negative thoughts and feelings, while engaging
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36 in value-consistent behaviours, instead of in reactive attempts to avoid them, such as emotional eating [19-22].
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38 The development and refinement of assessment tools to address emotional eating and examine its interaction with
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40 processes relevant for body image and eating behaviors is therefore particularly relevant. Distinct self-report measures have been
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42 used to assess emotional eating [10,23]. The Emotional Eating Scale (EES) [1], first developed in obese women, includes 25 items
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44 comprising three subscales reflecting the desire to eat in response to Anger/Frustration, Anxiety, and Depression. The scale
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46 presented good psychometric properties, and scores were sensitive to changes in binge eating treatment. Waller and Osman [8]
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48 further examined EES in non-eating disordered female undergraduates and confirmed the scale’s internal reliability and that
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50 emotional eating was significantly associated with disordered eating behaviours, namely bulimic symptoms, and increased weight
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52 status. Nevertheless, this study used a small sample and did not confirmed whether the scale structure replicated the original EES.
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54 A recent study investigated the scale’s factor structure in a larger sample of treatment-seeking overweight and obese participants
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56 [24]. Although results confirmed the utility of the EES with this population, they did not replicate the original EES’ factor
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58 structure. The EES was also examined in specific samples (e.g., children and adolescents [25]) with results revealing a loading
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4 pattern distinct of what was originally found. Other adaptations of the scale added items comprising positive emotions [26,27], but
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6 the specificity of the samples used (undergraduate students) precluded conclusions regarding the measure's structure. Nonetheless,
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8 findings corroborated that negative affect was significantly associated with disordered eating behaviors (while positive affect
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10 failed to present significant associations).

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12 To sum up, EES has been regarded as useful to evaluate emotional eating across distinct populations. This measure's
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14 factor structure reveals however some disparities, which suggests that the EES may be sensitive to the characteristics of the
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16 sample it is being applied to [24]. Also, negative emotions seem to co-occur within and across individuals and thus, the overlap
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18 between certain emotional states should be considered when analyzing negative affect scales [28].

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20 The current study aimed at conducting a more comprehensive evaluation of the EES dimensionality and psychometric
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22 properties in a wide nonclinical Portuguese sample of women. This study also intended to further examine the associations
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24 between emotional eating, psychopathology and body image and eating-related psychopathology, and treatment relevant
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26 constructs. In particular, it was examined whether body image flexibility significantly moderated the association between
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28 emotional eating and binge eating.

31 32 **Materials and Methods**

33 34 35 36 *Participants*

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38 A Principal Component Analysis (PCA) was conducted in 506 participants presenting a mean age of 24.71 ($SD = 9.13$)
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40 and 14.09 years of education ($SD = 1.80$). Most participants were students (81.5%). Body Mass Index (BMI) mean was 22.45 (SD
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42 = 3.41), 6.4% were underweight, 74.9% presented normal weight, 14.9% were overweight, and 3.8% obese.

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44 A Confirmatory Factor Analysis (CFA) and subsequent analyses were conducted in an additional sample ($n = 512$).
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46 Participants' mean age was 21.81 ($SD = 4.17$) and years of education' mean was 13.98 ($SD = 1.98$); most were students (81.3%).
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48 BMI mean was 21.72 ($SD = 3.00$); 10.4% were underweight, 75.5% had normal weight, 12.3% were overweight and 1.8% obese.
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50 Fifty-one participants were randomly selected to fill the retest of the EES after a one-month period.

51 52 53 54 *Measures*

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56 *BMI* was calculated by dividing current weight (in kg) by height squared (in m).
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4 *Eating Disorder Examination Questionnaire* (EDE-Q [29,30]) provides a comprehensive assessment of eating
5 psychopathology. It includes four subscales (Restraint, Eating Concern, Weight Concern and Shape Concern), and presents good
6 psychometric properties.
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10 *Binge Eating Scale* (BES [31,32]) assesses behavioural manifestations and emotional/cognitive factors linked to binge
11 eating. It comprises 16-items with each item including three/four statements representing a rating of severity ranging from 0
12 (difficulties with binge eating) to 3 (severe problems with binge eating). Participants are asked to choose the statement that best
13 describes their experience. The scale has good internal consistency [31,32].
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17 *Mindful Attention Awareness Scale* (MAAS [33,34]) is a self-report instrument assessing dispositional mindfulness.
18 MAAS includes 15 items related to everyday experiences, regarding which participants are asked to select an option using a 6-
19 point Likert scale (ranging from 1 “Almost always” to 6 “Almost never”). MAAS presents a high internal consistency [33,34].
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23 *Body Image Acceptance and Action Questionnaire* (BI-AAQ [21,19]) was designed to measure body image flexibility [21].
24 It includes 12 items, rated in a 7-point Likert scale (1 “Never true” to 7 “Always true”), regarding which participants are asked to
25 rate the subjective truth of each statement. BIAAQ presents good psychometric properties [19,21].
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29 *Depression Anxiety and Stress Scales – 21* (DASS21 [35,36]) assesses levels of Depression, Anxiety and Stress symptoms.
30 Participants are asked to indicate the frequency they experienced each symptom over the past week using a 4-point Likert scale (0
31 “Did not apply to me at all” to 3 “Applied to me very much or most of the time”). The scale reveals adequate internal consistency
32 [35].
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38 39 40 **Procedure**

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42 With the consent from the authors of the original EES, the scale was translated into Portuguese by a bilingual researcher
43 and analysed by a research group with a large experience with eating psychopathology. The comparability of content was verified
44 through stringent back-translation procedures.
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48 Participants were female college students recruited from various higher education courses, and women from the general
49 population collected within different public and private institutions. The boards of all involved institutions approved the study and
50 participants provided their informed consent.
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4 *Data analyses*
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6 The EES factor structure was examined through a PCA, following the analytical procedures of the original study of the
7 scale and previous research [1, 24]. The internal consistency of the scale was examined by McDonald's Omega coefficients (using
8 the statistical software R).
9

10 The obtained structure was confirmed through a CFA, with Maximum Likelihood as the estimation method. The items
11 were specified to load on the respective latent-first order factor, and these were specified to load on a second-order factor of
12 emotional eating. The following indices were selected to examine model fit [37,38]: Chi-square (χ^2); Normed Chi-Square (χ^2/df),
13 with 2 to 5 indicating good fit; Goodness of Fit statistic (GFI) and Comparative Fit Index (CFI), with .90 suggesting good fit;
14 Parsimony Goodness of Fit Index (PGFI); and Root Mean Square Error of Approximation (RMSEA), with .05 to .08 indicating
15 reasonable error and acceptable fit [37, 38]. Construct validity was further established through the calculation of the Composite
16 Reliability (CR; indicator of construct reliability), the Average Variance Extracted (AVE; indicator of convergent validity), and
17 the discriminant validity. The association between the EES and the study variables were examined through Product-moment
18 Pearson correlations [39].
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20 The moderator effect of body image flexibility on the association between emotional eating (Independent variable) and
21 binge eating (Dependent variable) was examined through a hierarchical regression analysis. A standardized procedure was
22 adopted, centering the values of the two predictors. The interaction product of the predictors was obtained by multiplying the two
23 centered variables [40].
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25 Analyses were conducted using IBM SPSS Statistics 20 (Statistical Package for the Social Sciences, Chicago, IL, USA)
26 and the software AMOS (Analysis of Momentary Structure, software version 18, SPSS Inc. Chicago, IL).
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44 **Results**
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48 *EES factorial structure and initial psychometric properties*
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50 The suitability of the data for the analysis was confirmed through the Kaiser-Meyer-Olkin test (.93) and the Bartlett's
51 sphericity test ($\chi^2_{(351)} = 6031.64, p \leq .001$). All items presented high communalities (item 4 presented the lowest value; $h^2 = .35$).
52 The Kaiser-Guttman criteria suggested four factors. However, the Parallel Analysis indicated that three components had
53 eigenvalues exceeding the 95th percentile of the eigenvalues obtained in a random matrix.
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4 The analysis was then recalculated with a Direct Oblimin rotation with a three-factor solution, which explained 52.39% of
5 the variance. To achieve a parsimonious solution, a conservative approach was followed which indicated the progressive deletion
6 of items 1, 13, 20, 5, 11, 19 and 3, for presenting factorial loadings bellow .45. This resulted in an increase of the variance
7 explained to 58.88%, with the first factor explaining 38.68% of the variance, the second 12.78%, and the third 7.43%.
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10 Results indicated a good reliability for the first factor (coefficient omega = .89, 95% CI [.87, .91] and the third factor also
11 presented good reliability (coefficient omega = .88, 95% CI [.86, .90]). The second factor revealed a lower coefficient (coefficient
12 omega = .71, 95% CI [.66, .75]) and results indicated that the removal of item 4 would increase the internal consistency to .76
13 (95% CI [.70, .80]). The total scale internal consistency was .90 (95% CI [.89, .92]).
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20 A final PCA without item 4 was conducted and this structure explained 61.39% of the variance (Table 1). Factor 1
21 explained 40.64% and comprised items reflecting depression; factor 2 explained 13.51% and involved items regarding anxiety and
22 somatic activation; and factor 3 explained 7.24% and its items tapped into anger states.
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31 32 ***Confirmatory Factor analysis***

33 EES items showed acceptable values of Skewness and univariate and multivariate Kurtosis [37]. The first model had a
34 mediocre fit ($\chi^2 = 580.94$, $p = .000$; $\chi^2/df = 5.01$; GFI = .88; PGFI = .67; CFI = .87; RMSEA = .09, 90% CI = .08 to .10). The
35 analysis of the modification indices (MI) and standardized residuals (SR), suggested the correlation of the errors of items 8 and 10
36 (MI = 109.013, SR = 4.506). The content analysis of these items supported this decision given their similarity (with “blue” being a
37 more prosaic term for expressing sadness). This resulted in an improvement of the model adjustment ($\chi^2 = 459.61$, $p = .000$; χ^2/df
38 = 4.00; GFI = .90; PGFI = .68; CFI = .91; RMSEA = .08, 90% CI = .07 to .08).
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47 Results indicated that the three first-order factors – Depression, Anxiety and Anger – significantly loaded on the second-
48 order factor (.64, .59, and .96, respectively). All items revealed adequate Standardized Regression Weights [38], ranging from .57
49 (item 22) to .72 (item 24) in the first subscale, .65 (item 9) and .80 (item 7) in the second, and .66 (item 25) and .82 (item 17) in
50 the third subscale. Squared Multiple Correlations’ results confirmed the instrument reliability; items presented values ranging
51 from .32 (item 22) to .67 (item 17).
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4 **Validity Analyses**
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6 The first factor revealed a CR of .91, the second .85, and the third .92. Also, the total score showed a CR of .96.
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8 Regarding the AVE, results indicated a value of .53 for the first factor, .66 for the second, and .69 for the third factor. Given that
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10 the AVE of the three factors is higher than r^2 of the correlation between them ($r^2 = .14$, $r^2 = .32$, and $r^2 = .37$), the factors also
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12 showed adequate discriminant validity.
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16 **Retest Reliability**
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18 Results revealed significant positive correlations between the test and retest versions of the EES subscales ($r_{\text{Depression}} =$
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20 $.70$, $r_{\text{Anxiety}} = .40$, $r_{\text{Anger}} = .36$) and global score ($r = .57$). Also, there were no significant differences between the two assessment
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22 moments ($t_{\text{Depression}(50)} = .1.10$, $p = .278$; $t_{\text{Anxiety}(50)} = .91$; $p = .366$; $t_{\text{Anger}(50)} = .58$, $p = .563$; $t_{\text{Total}(50)} = 1.06$, $p = .293$).
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26 **EES correlations with other measures**
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28 The EES subscales presented moderate to large significant associations between them and are strongly associated with
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30 the total EES score (Table 2). Also the EES subscales Depression and Anger, and total score, were positively associated with
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32 EDE-Q. There were no significant associations between the EES subscale Anxiety and EDE-Q. Furthermore, the EES Depression
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34 and Anger subscales and total score were significantly and strongly associated with binge eating. The subscale Anxiety was
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36 moderately linked to binge eating. There were no significant associations between the three emotional eating subscales and
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38 participants' BMI.
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40 Positive lower correlations were found between the EES subscales and general psychopathology.

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42 Results indicated a significant and negative association between EES and mindfulness and psychological flexibility
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44 regarding body image, with the EES Depression subscale revealing the strongest negative association with these variables.
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51 **The predictive effect of emotional eating on binge eating behaviours having body image flexibility as a moderator**
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53 EES was entered as a predictor in the first step of the regression model. Body image flexibility was entered on step two.
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55 The predictors produced statistically significant models [Step 1: $R^2 = .36$, $F_{(1, 214)} = 121.59$, $p < .001$; Step 2: $R^2 = .54$, $F_{(1, 213)} =$
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57 82.53 , $p < .001$]. The third step produced a significant increase in R^2 to .60 [$F_{(1, 212)} = 32.88$; $p = .000$]. Results revealed a β of .27
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4 for EES ($t_{(212)} = 5.17; p < .001$), a β of $-.38$ for body image flexibility ($t_{(212)} = -7.24; p < .001$), and that the interaction between the
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6 two was significant [$\beta = -.30; t_{(212)} = -5.83; p < .001$].
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8 A graphic representation of the moderation analysis (Figure 1) considered three levels of body image flexibility: low (one
9 *SD* below the mean), medium (mean) and high (one *SD* above the mean [40]). The visual inspection of the graphic indicated that
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11 in women with the same tendency to eat in response to negative emotions, those with higher body image flexibility present lower
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13 levels of binge eating.
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20 Discussion

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22 Emotional eating plays an important role in mental health problems, namely body image and eating-related difficulties
23 [6,11]. Also, research emphasizes that these difficulties should be considered from a dimensional perspective, supporting therefore
24 the relevance of assessing emotional eating both in clinical and nonclinical samples. The EES is one of the most cited measures in
25 the literature used to assess the tendency to eat when emotional [1]. Nevertheless, its psychometric properties have only been
26 partially examined in specific samples, with studies revealing mixed findings regarding its structure.
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32 Therefore, the current study aimed at conducting a more extensive study of the EES structure and psychometric
33 properties in a large and heterogeneous nonclinical sample. Furthermore, we intended to further investigate the association
34 between emotional eating and variables that are increasingly being pointed out as relevant for clinical interventions targeting
35 disordered eating behaviours (e.g., binge eating), such as mindfulness and psychological flexibility (e.g., [15,17]).
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41 Findings indicated a similar three-factor structure identified in the original scale [1]. Nevertheless, we opted to follow a
42 more stringent approach to the data. Rigorous criteria for item retention were adopted to reach a brief but reliable measure, and a
43 CFA was conducted to attest the adequacy of the obtained structure. A preliminary reliability assessment revealed that the scale
44 presented high internal consistency. The first subscale included items reflecting the original Depression subscale (e.g., eating
45 when feeling blue, lonely or bored), but it also included items that even though were originally included in the Anger/Frustration
46 subscale and in the Anxiety subscale, can be considered as being part of the pattern of affects co-occurring in a depressive state
47 (i.e., feelings of helplessness, discouragement, guilt, failure and rumination [28]). The second subscale included items referring to
48 the tendency to eat when feeling in a state of physiological activation and anxiety. The third subscale included items reflecting
49 anger states and an additional item (“upset”), originally belonging to the Anxiety subscale, but that may be conceptually
50 understood as integrating the constellation of affects co-occurring when one is angry. CFA results confirmed that this EES model
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4 was plausible and that all items significantly contributed to the assessment of the construct of emotional eating and its respective
5 dimensions. The scale and respective subscales also presented good construct reliability, convergent and discriminant validities.
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7 The test-retest analysis EES indicated an adequate temporal stability, but also suggested that the anger and anxiety subscales may
8
9 be particularly suitable to measure eating triggered by emotional states in laboratory studies.
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12 Furthermore, findings indicated that the EES' subscales are related but distinct constructs. As in prior research, emotional
13 eating, namely the subscales Depression and Anger, were significantly associated with eating psychopathology and in particular
14 with binge eating [1,27]. Furthermore the emotional eating subscales were associated with general psychopathology. These
15 findings are line with prior evidence and highlight that this variable merits attention in the context of mental well-being [27].
16
17 Additionally, results revealed significant associations between increased emotional eating, especially eating in response to
18 depressive affect, and a lower ability to being receptive to and aware of what is happening in the present moment [33] as well as
19 with lower body image flexibility [20,21].
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26 Lastly, the moderator effect of body image flexibility on the association between eating in response negative emotions
27 and binge eating was tested. The model explained a total of 60% of the variance of the severity of binge eating behaviours and
28 findings suggests that in women who may present the tendency to eat in response to negative emotions, those with higher
29 psychological flexibility regarding body image, tend to present lower engagement in binge eating. Even though the cross-sectional
30 design of the study does not allow to establish a causal ordering for the observed relationships between these variables, the current
31 findings show that their covariation is in accordance with theoretical suggestions and research demonstrating the association
32 between emotional eating, binge eating and self-regulatory processes. In fact, this model seems to extend the evidence on the
33 association between emotional eating and constructs that have been clinically explored as relevant to address emotional eating and
34 eating psychopathology in clinical populations, namely mindfulness and acceptance-based approaches, and further suggest the
35 importance of body image flexibility [19,20]).
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47 Other limitations should be considered when interpreting this study's findings. Even though the EES was examined in a
48 large population of women comprising both students and women from other occupational contexts, this sample is not
49 representative of the general population and future research should be conducted to confirm the plausibility of the scale's structure
50 in other samples (e.g., explore invariance across genders). Furthermore, even though weight and eating-related difficulties are
51 common in the community, the sample used in the current study also impairs the generalization of results to samples with varying
52 degrees of overweight, and clinical populations (e.g., patients with Binge Eating Disorder).
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Nonetheless, this study extend prior research on the assessment of emotional eating by offering evidence that this more stringent examination of the scale resulted in a plausible structure with adequate psychometric properties and seems to be a reliable and useful instrument to assess emotional eating and its correlates. Furthermore, this study’s findings offer preliminary evidence that suggests that emotional eating and the ability to tolerate and accept painful or disturbing emotional states without engaging in reactive attempts to avoid them, are relevant aspects to consider in binge eating prevention and treatment.

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Table 1.

Principal Component Analysis factor loadings (λ) communalities (h^2), mean (M), standard deviation (SD ; $n = 506$); Standardized regression weights (SRW) and Squared Multiple Correlations (SMC) in the Confirmatory Factor Analysis ($n = 512$)

Items	Factors			h^2	M	SD	SRW	SMC
	λ Depression	λ Anxiety	λ Anger					
<i>Factor 1 - Depression</i>				19.03	7.79			
8 – blue	.87	.10	.11	.67	2.45	1.31	.63	.39
10 – sad	.83	.15	.03	.65	2.29	1.31	.61	.37
16 – lonely	.72	.24	.11	.55	2.60	1.26	.64	.41
24 – helpless	.71	.03	.14	.61	1.94	1.14	.72	.52
23 – bored	.69	.20	.06	.51	2.23	1.18	.61	.38
2 – discouraged	.65	.11	.05	.50	1.91	1.10	.64	.40
15 – frustrated	.59	-.11	.30	.57	2.06	1.21	.70	.49
14 – worried	.57	-.09	.20	.45	1.90	1.14	.61	.37
22 – guilty	.56	.02	.22	.49	1.67	1.07	.57	.32
<i>Factor 2 - Anxiety</i>				5.91	2.67			
6 – excited	.01	.82	.00	.67	2.06	1.12	.73	.53
7 – rebellious	.08	.80	.15	.73	1.83	1.02	.80	.64
9 – jittery	.13	.72	.07	.61	2.03	1.12	.65	.43
<i>Factor 3 - Anger</i>				9.05	4.62			
17 – furious	.15	.10	.91	.78	1.72	1.10	.82	.67
21 – angry	.05	.07	.79	.71	1.74	1.11	.80	.64
18 – on edge	.03	.04	.78	.66	1.76	1.15	.67	.45
12 – irritated	.09	.02	.77	.68	1.92	1.15	.77	.60
25 – upset	.30	.02	.59	.61	1.90	1.09	.66	.44

Table 2.

EES's subscales correlations and correlations with other measures ($n = 512$)

		EES			
		Depression	Anxiety	Anger	Total
EES	Depression	1	.30***	.54***	.89***
	Anxiety	.30***	1	.48***	.61***
	Anger	.54***	.48***	1	.83***
	Total	.89***	.61***	.83***	1
	Restriction	.19***	-.03	.10*	.15***
EDEQ	Eating Concern	.34***	.08	.22***	.31***
	Shape Concern	.27***	.02	.13**	.22***
	Weight Concern	.25***	.03	.15**	.22***
	Total	.29***	.03	.16***	.25***
	BES	.53***	.20**	.49***	.56***
DASS21	Depression	.23***	.12**	.20***	.24***
	Anxiety	.17***	.21***	.15**	.21***
	Stress	.28***	.25***	.22**	.31***
	MAAS	-.29***	-.19***	-.19***	-.30***
	BIAAQ	-.31***	-.11*	-.19***	-.29***
	BMI	.07	-.07	.04	.04

Notes: EES = Emotional Eating Scale; EDEQ = Eating Disorders Examination-Questionnaire; DASS21 = Depression Anxiety and Stress Scales-21; MAAS = Mindful Attention Awareness Scale; BIAAQ = Body Image Acceptance and Action Questionnaire; BMI = Body Mass Index.

*** $p < .001$; ** $p < .01$; * $p < .05$

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Figure 1. Moderator effect of body image flexibility (BIAAQ) on the association between emotional eating (EES) and binge eating (BES).

Figure
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