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Brief emotional eating scale: A multinational study of factor structure, validity, and invariance

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ABSTRACT

Emotional eating or the tendency to eat in response to emotional states can be assessed using self-report measures. The Emotional Eating Scale-II is a commonly used and reliable instrument that measures the desire to eat in response to a range of unpleasant and pleasant emotions. The current study aimed to corroborate the validity of the EES-II and expand its utility by investigating its dimensionality and testing its measurement invariance in samples from English-speaking and non-English-speaking countries. Convergent and predictive validity in respect of food craving, eating, and health indicators were also examined. This cross-national study included a total of 2485 adult participants recruited from Finland, North America, Philippines, United Kingdom, China, Italy, Spain, and South Korea, who completed the EES-II in six different languages. Factor analyses supported a four-factor structure including valence (pleasant, unpleasant) and activation (high, low) for a 12-item English version and slightly modified non-English adaptations. The model exhibited good fit in all samples, and convergent validity was demonstrated. Full invariance of factor loadings and partial invariance of factor loading, intercepts, and error variances was established across samples. Structural equation models revealed that high activation (pleasant and unpleasant) states predicted food cravings and reported eating. Overall findings across multiple samples and countries supported the factorial structure, reliability, invariance, and validity of the resulting Brief Emotional Eating Scale (BEES).

1. Introduction

The World Health Organisation reported that 39% of the entire world population of adults aged 18 years and over were overweight in 2016 (World Health Organization, 2021). Between 40 and 60% of individuals living with obesity display emotional eating behaviours (Dol et al., 2021). Emotional eating is the tendency to increase eating in response to pleasant and unpleasant emotions (Macht, 2008; Macht et al., 2004) and people can perceive it as a strategy to regulate emotions (Macht & Simons, 2000). Emotions are the most important non-homeostatic reason of food overconsumption, playing an important role in the initiation and modulation of eating. Thus, understanding emotional eating and its potential harmful effects is crucial.

Emotionally elicited eating is of interest to researchers and practitioners as it has been associated with cravings for, and intake of, foods high in fats and sugars (Penaforte et al., 2019, 2019v; van Strien et al., 2012), binge eating (Nicholls et al., 2016), weight gain, and as a consequence of these, obesity (Elfhag & Rössner, 2005; Koenders & van Strien, 2011). Empirically testing the relationship between emotions and eating behaviour requires valid and reliable measurement scales. In

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this regard, existing scales have shown inadequacies (Blair et al., 1990), such as the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985), which measures cognitive and behavioural components of eating. The TFEQ was developed based on restraint theory (Herman & Mack, 1975), with a focus on restraint eating. However, factor analysis resulted in items that did not load onto the cognitive restraint factor, forming the uncontrolled eating and emotional eating factors, the latter containing only three items. Moreover, the factor structure of the TFEQ could not be replicated in a subsequent study among participants living with obesity (Karlsson et al., 2000). A shortened 18-item version (TFEQ-R18; Karlsson et al., 2000) was developed, and later refined into the 21-item version (TFEQ-R21; Tholin et al., 2005). Administered to individuals living with obesity and normal weight participants, the TFEQ-R21 showed satisfactory factor structure and construct validity (Tholin et al., 2005). However, the TFEQ-based questionnaires include a very limited number of items to assess the perception of eating only in response to unpleasant emotions.

Another widely used scale is the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien et al., 1986), which is a 33-item scale assessing eating behaviours involved in the development and maintenance of obesity, including eating in response to external cues, restrained eating, and emotional eating. The DEBQ, which measures the frequency of eating in response to unpleasant emotions, has been criticised due to the narrow range of emotions measured, excluding relevant ones that may trigger eating (Arnow et al., 1995). As such, emotional eating is assessed by 13 items and forms a partial focus. This reason led Arnow and colleagues to develop the Emotional Eating Scale (EES; Arnow et al., 1995) that includes 25 unpleasant emotions to measure their relationship with overeating. The EES contains three subscales to gauge anger, depression, and anxiety, and has been validated with females living with obesity who had been accepted for treatment for binge eating and weight loss. Sound psychometric properties, including good construct, criterion, and discriminant validity, have been reported for the EES (e.g., Goldbacher, 2012).

The EES has been reported to be the most widely used validated scale to investigate emotional eating across clinical samples (Cassioli et al., 2022). All these scales are limited in that they only assess unpleasant emotions. However, pleasant emotions have repeatedly been linked to emotional eating, particularly in non-clinical populations (Barnhart et al., 2021; Macht et al., 2004; Reichenberger et al., 2020). In accounting for this, the Emotional Eating Scale-II (EES-II; Kenardy et al., 2003) measures the urge to eat in response to a wide range of emotions clustered into four distinct factors: anger, anxiety, depression, and positive mood.

Whilst the EES-II could be conceived as addressing limitations of earlier measures of emotional eating, it has not been subject to cross-cultural comparisons. It is well reported that where questionnaires have not been validated psychometrically across cultures, researchers may encounter problems in making cross-cultural comparisons between responses (Smith et al., 2001). For example, research has compared emotional eating across different countries, with measures (or subscales) of emotional eating simply translated and their psychometric properties taken for granted (Markey et al., 2022; Waller & Matoba, 1999). Cross-cultural validation aims to ensure that a translated version of a questionnaire functions as intended in a different sample, having the same properties as the original measure, and functioning in the same way.

Bongers and Jansen (2016) are critical of existing emotional eating self-report scales suggesting that they do not measure increased food intake in response to emotions, and thus may lack predictive and discriminative validity. They suggest that emotional eating measures may in fact assess concerned eating, which is how individuals think about the relationship between emotion and eating rather than food intake. Specifically, this is proposed to include the extent of worry about eating, vigilance over eating, alongside reduced perceptions of control. Based on a review of experimental and naturalistic studies, Bongers and Jansen also call into question the predictive validity of self-report measures and suggest that emotional eaters could be better identified based on actual food intake. Their argument, however, is based on a review of 25 studies, most of which (80% of the studies) only included a limited number of unpleasant emotions assessed with the DEBQ.

Bongers et al. (2016) tested the contention that emotional eaters could be more accurately identified based on food consumption by inducing two states (i.e., sadness and happiness) in a sample of female undergraduate students. Participants who self-reported to be emotional eaters ate significantly more than low scorers in unpleasant and pleasant mood induction conditions, suggesting that emotional eating might be an indication of overeating in general, and not just in the presence of negative emotions.

Informed by research to date, we suggest that measures of emotional eating should not be abandoned, rather it is important to validate the robustness of any measure of emotional eating intended to be used for research or applied purposes. Otherwise, there is a risk of implementing an inaccurate measurement tool that could suggest unreliable individual or group differences in the variables being measured (Cheung & Rensvold, 2009). Furthermore, the process of exploring measurement invariance without the bias of psychometric fallacies can enable effective group contrasts and evaluations (Milfont & Fischer, 2010) to establish whether any disparities are the result of actual latent variations (Nair et al., 2009). In testing factor structure and measurement invariance, it is also worthwhile examining the predictive validity of the brief scale in accounting for variance in other key variables of interest. Indeed, Bongers and Jansen (2016) in their review of studies concluded that high scores on emotional eating scales are related to high scores on several other scales.

1.1. The present study

The purpose of this study was to assess the factorial structure of the EES-II in different languages, including English, Chinese, Finnish, Italian, Korean, and Spanish versions. As the EES-II comprises 34 items, we aimed to select the best factor indicators to form a shorter measure for quicker assessments. We also examined measurement invariance of the resulting brief scale across all national samples. A second purpose of this study was to evaluate convergent and predictive validity of the brief scale. Convergent validity was examined through correlations with a measure assessing emotions experienced at the time of highest food craving. We tested the predictive validity of the scale in accounting for variance in self-reported eating, health indicators, and reported emotions experienced at the time of the strongest food craving. We also tested whether perceptions of being an emotional eater mediate these relationships.

2. Materials and methods

2.1. Participants

An initial sample of 3064 participants took part in the study. After preliminary data screening (i.e., exclusion of 560 cases with >5% missing data and 19 cases identified as outliers), the final sample resulted in 2485 surveys. Participants resided in Finland (n = 415), North America (n = 366), Philippines (n = 348), United Kingdom (n = 330), China (n = 300), Italy (n = 264), Spain (n = 244), and South Korea (n = 218). Participants' age ranged from 18 to 76 years (M_{age} = 30.08, SD = 12.39) and 67.1% identified themselves as female (see also Table 1).

2.2. Measures and protocol

A multi-section questionnaire measured: (1) the extent to which selected emotions were associated with eating, (2) emotional states experienced with food cravings, (3) food cravings, (4) perceptions about

Table 1
Participants' gender and age information.

Full sample ($N = 2485$)	Gender					Age			
	Male	Female	Other gender	Did not specify	Total	Min	Max	*M*	*SD*
United Kingdom	66	251	0	13	330	18	76	36.10	12.35
North America	119	247	0	0	366	18	73	27.60	12.56
Philippines	94	248	6	0	348	18	67	25.67	8.40
Finland	127	285	2	1	415	18	75	30.94	11.40
Spain	49	193	2	0	244	18	72	32.64	13.93
Italy	100	157	2	5	264	18	75	28.25	11.96
South Korea	136	69	2	11	218	19	60	27.25	8.57
China	82	217	1	0	300	18	74	31.99	15.11

the influence of emotions on eating behaviours, and (5) perceptions about health, wellbeing, and changes in eating and wellbeing. This questionnaire was translated to Chinese, Finnish, Italian, Korean, and Spanish using standardised back-translation procedures (Brislin, 1986) and expert review (Sperber, 2004). A dual linguist translated the instruments from English to the native language of each target country. Two independent experts, competent in both languages, evaluated the translated version comparing it to the original. The experts discussed possible discrepancies between items to ensure that the translations maintained the intended meaning. The instruments were then back translated to English. Back translations were then compared to the original English version and extensively discussed by the researchers with efforts made to maintain the underlying meaning in the original items.

Emotional eating. Emotional eating was measured using the Emotional Eating Scale-II (EES-II; Kenardy et al., 2003). The EES-II was evolved from the emotional eating scale (EES; Arnow et al., 1995) through the inclusion of pleasant items drawn from the profile of mood states (POMS; McNair et al., 1981). Specifically, the 34-item EES-II measures the extent to which participants felt an urge to eat in response to 23 unpleasant states (e.g., bored, angry, jittery, sad) and 11 pleasant states (e.g., enthusiastic, satisfied, happy, pleased). Participants rated their desire to eat on a 5-point Likert scale (i.e., 0 = no desire, 1 = small desire, 2 = moderate desire, 3 = strong urge, 4 = overwhelming urge). In this study, the item "blue" was substituted by "down" to increase applicability across different languages. Acceptable internal consistency has been reported for the original EES (Cronbach α ranged from 0.72 to 0.78) which included anger/frustration, anxiety, and depression subscales (Arnow et al., 1995). Further research provided evidence for a four-factor solution including depression, anger, anxiety, and somatic arousal (Goldbacher, 2012). Adequate internal consistency, although no specific values were presented, has been reported for the EES-II on university students (Kenardy et al., 2003), however, no information regarding dimensionality of the EES-II could be found.

Food cravings. Three items were specifically designed to assess three aspects of cravings (Nicholls & Hulbert-Williams, 2013). Participants were asked to assess the experience of cravings by responding to the question "How often have you experienced a food craving today", which ranged from 1 (never) to 5 (always). The frequency in giving in to cravings was measured with the question "How often did you give in to cravings and eat the food today?", ranging from 1 (never) to 5 (almost every time). Finally, the difficulty resisting the craving was assessed with the question "How difficult was it to resist temptation?", ranging from 1 (easy) to 5 (so difficult that I gave in).

Emotions accompanying food cravings. Participants were asked to identify the emotions they experienced with their food cravings. Specifically, the question asked "What emotions were you experiencing at the time of the strongest food cravings?" Participants could answer using a list of three pleasant states (i.e., energetic, happy, relaxed) and six unpleasant states (i.e., angry, anxious, miserable, tired, bored, and frustrated) drawn from existing instruments (e.g., POMS). Participants could report their own emotion if that was not included in the list of words presented. Each word was rated on a 6-point Likert scale (i.e., none at all, a little, moderately, quite a bit, a lot, and a great deal).

Perceived influence of emotions on their eating behaviours. A single item asked the participants to report the extent to which they considered themselves being an emotional eater, that is if their emotions influenced their eating. The item was rated on a 5-point Likert scale (i.e., never, rarely, sometimes, often, always).

Health perceptions and changes in health routines. Participants were asked to rate their physical and emotional health by responding to two items from the SF-8 Health Survey (Ware et al., 2001). Specifically, physical health was assessed with the item "Overall, how would you rate your health during the past week?", which was rated from 1 (very poor) to 6 (excellent). Emotional health was assessed on the item "How much did personal or emotional problems keep you from doing your usual work, school, or other daily activities?", which was rated from 1 (not at all) to 5 (could not do daily activities). Perceived changes in eating and wellbeing were assessed on an 11-point Likert scale ranging from −5 (significant decrease) to +5 (significant increase), with 0 indicating no change.

2.3. Procedure

The study was commenced following approval from the University of Wolverhampton (Unique code: 01/20/AF1/UOW). Data collection was conducted using Qualtrics software. Participants were provided with information regarding the nature and purpose of the study. That is, participants were informed that the study examined the effectiveness of two brief interventions intended to help them deal with food cravings and associated emotional experiences (see Devonport et al., 2022). Baseline data gathered from participants were used in the present study to test the validity of the EES-II, as well as convergent and predictive validity in respect of food craving, eating, and health indicators.

Participants were informed that participation was voluntary and they had the opportunity to withdraw from the study at any time. They were requested to provide their consent, which they granted electronically. Links to the surveys were distributed via social media (e.g., Twitter, LinkedIn, Facebook) with the request to re-share the study information and links. The survey took approximately 15 min to complete.

2.4. Data analysis

The factorial structure of the EES-II was examined with Mplus version 8.5 (Muthén & Muthén, 2017) using the robust full information maximum likelihood estimator to adjust for non-normality. The analytic strategy to examine dimensionality involved confirmatory factor analysis (CFA). Several competing models were tested, including a unidimensional model with all items loading into the same factor, a two-factor model based on valence (pleasure-displeasure), a two-factor model based on activation (high-low), and a four-factor model based on Russell's (1980) circumplex model of affect considering both valence and activation dimensions. Following Myers et al.'s (2016) recommendation, sample size for CFA was determined using the root mean square error of approximation (RMSEA). The minimum sample size for RMSEA was computed using the code developed by Preacher and Coffman

(2006). The calculation resulted in a sample size of 223 for α = 0.05, power = .80, null RMSE = 0.05, alternative RMSE = 0.04, and df = 527 for a unidimensional model for the whole sample. Thus, the sample size of 2485 participants was considered adequate.

Model fit was evaluated examining the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the standardised root mean square residual (SRMR) and the root mean square error of approximation (RMSEA). An acceptable model fit is inferred when cut-off values for RMSEA and SRMR are equal or smaller than 0.08, and CFI and TLI are higher than 0.90 (Schumacker & Lomax, 2016). An excellent fit is inferred for RMSEA value lower than 0.06, SRMR value lower than 0.08, and CFI and TLI values close to 0.95 (Hu & Bentler, 1999). We also examined Cronbach's alpha (α), McDonald's omega (ω), composite reliability (ρ) values, and average variance extracted. Reliability estimates between 0.60 and 0.70 were considered the lowest limits of acceptability. Average variance extracted values close to or larger than 0.50 suggest adequate convergence of items within the specific construct (Hair et al., 2019). The model that was most optimal in representing the data across English speaking samples (i.e., North America, Philippines, and United Kingdom) was identified based on these statistics. Most optimal models for each of the translated versions (i.e., Chinese, Finnish, Italian, Korean, and Spanish) were also examined. In examining the most optimal models representing data across all samples, an effort was made to retain the best items in each of the adapted versions of the scales. Although this may result in scales including different items, this process would ensure that the adapted versions function in each target language as intended, while maintaining the same properties and equivalence across all samples.

Measurement invariance was examined across the national samples using multigroup CFAs following a sequential procedure imposing equality constraints of each indicator across groups and comparing the more constrained model against the less constrained model (Kline, 2016; Wang & Wang, 2020). Specifically, analyses of invariance involved progressively constraining parameter estimates of the model to be equal across groups to determine configural invariance (i.e., equality of number of factors and correspondence between factors and indicators across groups), weak measurement invariance (i.e., equality of factor loadings), strong measurement invariance (i.e., equality of factor loadings and intercepts). Satorra-Bentler chi-square difference ($\Delta\chi^2$) test adjusting for scaling correction factor for MLR, along with the RMSEA (Hu & Bentler, 1999) were used to compare nested models. Non-significant $\Delta\chi^2$ values indicate measurement invariance. In large samples, the $\Delta\chi^2$ test could be significant even when absolute differences are trivial (Cheung & Rensvold, 2009). Thus, in the case of a significant $\Delta\chi^2$, changes in RMSEA and SRMR were inspected with ΔRMSEA less than 0.015 and ΔSRMR less than 0.30 indicating invariance (Chen, 2007; Cheung & Rensvold, 2009).

Convergent validity of the emotional eating scale was assessed by examining factor correlations between the scale and the list of emotions accompanying strongest cravings, used as criterion-related measure. The effect size of the correlations was interpreted as follows: values smaller than 0.19 = no correlation, values between 0.20 and 0.39 = low correlation, values between 0.40 and 0.59 = moderate correlation, values between 0.60 and 0.79 = moderately high correlation, and values higher than 0.80 = high correlation (Zhu, 2012).

Predictive validity of the emotional eating scale was examined using structural equation modelling. Specifically, one model was estimated where constructs from the emotional eating scale were set as predictors of three aspects of cravings (i.e., experience, frequency in giving in to cravings, and difficulty resisting cravings). A second model was estimated with constructs from the emotional eating scale set as predictors of physical and emotional health, reported eating, and wellbeing. Adequacy of the models was established using the same criteria used to evaluate factorial models. Mediating effects of the perceptions of being an emotional eater were tested in both models using maximum likelihood estimator (ML) and bias-corrected bootstrap based on 5000 samples. Significant indirect effects are inferred when zero is not included within the upper and lower 95% confidence intervals.

3. Results

3.1. Factorial structure

There were significant differences in the national samples by age, $F(7, 2481) = 26.441$, $p < 0.01$, and gender, $\chi^2(7, N = 2485) = 159.26$, $p < 0.01$. Therefore, we controlled for such differences by entering these variables as covariates. Results from factor analyses are reported in Table 2. CFA results on the whole sample for models including one factor, two factors based on valence or hedonic tone (i.e., pleasant and unpleasant states), two factors based on states activation (i.e., high, low) and four factors based on the interaction between hedonic tone and activation (i.e., high activation pleasant states, low activation pleasant states, high activation unpleasant states, and low activation unpleasant states) including 34 items did not fit data well. After inspection of parameter estimates and modification indices, items were progressively discarded due to poor standardised factor loadings (<0.30), cross-loadings on unintended factors (>0.30), and moderated or large

Table 2
Fit indices for confirmatory factor analysis models of the emotional eating Scale-II.

Model	χ^2	df	CFI	TLI	RMSEA (90% CI)	SRMR
Whole sample (N = 2485) CFAs for 34-item scale						
one-factor model	25133.391	593	.460	.427	.130 (.129–.132)	.181
two-factor (pleasant/unpleasant states) model	8882.644	590	.817	.805	.076 (.075–.077)	.097
two-factor (high/low activation) model[1]						
four-factor (pleasant/unpleasant, high/low) model	7768.391	521	.843	.831	.075 (.073–.076)	.096
Whole sample (N = 2485) CFAs for 12-item scale						
four-factor model	299.202	64	.983	.976	.039 (.034–.043)	.023
Separate samples four-factor models, 12-item scale						
United Kingdom (n = 330)	118.619	48	.966	.953	.067 (.052–.082)	.042
North America (n = 366)	97.218	48	.978	.970	.053 (.038–.068)	.044
Philippines (n = 348)	83.163	48	.972	.962	.046 (.029–.062)	.040
Finland (n = 415)	108.639	48	.978	.970	.055 (.041–.069)	.049
Spain (n = 244)	111.938	48	.959	.943	.074 (.056–.092)	.053
Italy (n = 264)	109.003	48	.964	.950	.069 (.052–.087)	.048
South Korea (n = 218)	103.285	48	.944	.923	.073 (.053–.092)	.050
China (n = 300)	116.732	48	.933	.908	.069 (.053–.085)	.057

Note: χ^2 = Chi-square; df = Degrees of freedom; CFI = Comparative fit index; TLI = Tucker Lewis fit index; RMSEA = Root mean square error of approximation; SRMR = Standardised root mean square of residuals. [1] = no convergence.

modification indices (>15). Twenty-two items were excluded after several iterations. The resulting 12-item scale, we named the Brief Emotional Eating Scale (BEES), includes the following factors: high activation pleasant states (3 items), low activation pleasant states (3 items), low activation unpleasant states (3 items), and high activation unpleasant states (3 items).

Factor loadings and factor correlations for BEES for the national samples representing United Kingdom, North America, and Philippines are presented in Table 3. As the Table shows, all standardised factor loadings were above 0.45 (λ = 0.71-0.90 for United Kingdom, λ = 0.64-0.88 for North America, and λ = 0.45-0.87 for Philippines). Item residual variances were δ = 0.19-0.50 for United Kingdom, δ = 0.22-0.59 for North America, and δ = 0.24-0.80 for Philippines. Largest latent factor correlations were observed in UK data, ranging between 0.03 and 0.84. Reliability (i.e., alpha, omega, and composite reliability) scores and average variance extracted estimates are shown at the bottom of Table 3. Reliability scores were acceptable, with lowest α and ω values above 0.61 and 0.63, respectively, and composite reliability above 0.65, observed in the Filipino sample. All AVE estimates were above 0.70, and thus deemed acceptable.

Factor loadings, correlations, reliability scores, and average variance extracted estimates for samples representing Finland, Spain, Italy, South Korea, and China are presented in Table 4. All standardised factor loadings were also above 0.45 (λ = 0.45-0.91, Finland; λ = 0.54-0.93, Spain; λ = 0.62-0.88, Italy; λ = 0.55-0.84, South Korea; and λ = 0.47-0.79 China). Item residual variances were below 0.79. Similar patterns of factor intercorrelations were observed for English language and non-English language versions. As it can be seen at the bottom of Table 4, reliability scores and the AVE estimates were acceptable, with lowest scores observed in the Chinese sample.

3.2. Measurement invariance

Model fit for the CFA configural models was established across the eight national samples, indicating the same number of factors and correspondence between factors and indicators across all samples, χ^2 (512) = 922.209, CFI = 0.964, TLI = 0.949, RMSEA (90% CI) = 0.051 (0.046–0.057), SRMR = 0.046. Fit indices for metric or weak invariance representing invariance of factor loadings were: χ^2 (568) = 922.209, CFI = 0.964, TLI = 0.949, RMSEA (90% CI) = 0.051 (0.046–0.057), SRMR = 0.046. Full metric invariance was demonstrated across all samples, with changes in model fit indices meeting the adopted criteria, ΔS-B χ^2 (Δdf) = 243.09 (56), $p < 0.001$, ΔRMSEA = 0.008, ΔSRMR = 0.018. Fit indices for strong or scalar invariance indicating equality of intercepts were: χ^2 (652) = 2553.025, CFI = 0.833, TLI = 0.816, RMSEA (90% CI) = 0.098 (0.094–0.102), SRMR = 0.100. ΔRMSEA and ΔSRMR did not meet the adopted criteria. Partial scalar invariance could only be established after including specifications in the model comparisons. In particular, the intercepts of five items with highest modification indices (items 3, 4, 5, 7, and 11) were freely estimated (set to be non-invariant) across the samples. Fit indices for the partial invariant model were, χ^2 (610) = 1386.975, CFI = 0.932, TLI = 0.919, RMSEA (90% CI) = 0.075 (0.060–0.069), SRMR = 0.075, with ΔS-B χ^2 (Δdf) = 471.07 (98), $p < 0.001$, ΔRMSEA = 0.014, ΔSRMR = 0.029.

3.3. Convergent validity

Results for the two-factor structure of the emotions experienced at the time of highest cravings (pleasant, unpleasant) fitted data well for samples from Philippines, Finland, Spain, and Italy (see Table 1 in supplementary material). Model fit was improved after the specification of two correlated errors on the unpleasant emotions for samples from the United Kingdom, North America, South Korea, and three correlated errors in the case of China.

Table 3
Means, Standard Deviations, Reliability Coefficients, Average Variance Extracted, Standardised Factor loadings, Item Residual Variances, and Factor Correlations for the English versions of the Brief Emotional Eating Scale (BEES).

Factor/item	United Kingdom				North America				Philippines			
	(*n* = 330)				(*n* = 366)				(*n* = 348)			
	M	*SD*	*λ*	*δ*	*M*	*SD*	*λ*	*δ*	*M*	*SD*	*λ*	*δ*
f1												
1. Excited	2.15	1.03	.81	.34	2.55	1.13	.87	.24	3.00	1.10	.64	.59
2. Elated	2.28	1.02	.79	.38	2.30	1.07	.65	.58	2.85	1.02	.45	.80
3. Happy	2.63	0.94	.76	.42	2.81	1.03	.82	.33	3.53	0.92	.75	.45
f2												
4. Warm hearted	2.29	0.99	.83	.32	2.48	1.07	.88	.22	3.01	0.89	.80	.36
5. Kindly	2.21	0.95	.83	.32	2.30	1.03	.88	.23	2.80	0.85	.76	.42
6. Pleased	2.39	0.96	.81	.35	2.48	0.99	.81	.34	3.00	0.86	.72	.49
f3												
7. Uneasy	2.13	1.12	.78	.39	1.86	1.01	.74	.45	1.87	0.94	.73	.47
8. On edge	2.04	1.18	.81	.34	1.88	1.07	.71	.50	1.95	1.02	.63	.61
9. Nervous	2.03	1.15	.77	.41	1.81	1.04	.69	.52	1.79	0.99	.80	.35
f4												
10. Lonely	3.07	1.29	.71	.50	2.64	1.27	.64	.59	2.55	1.27	.66	.56
11. Down	3.12	1.34	.83	.32	2.42	1.30	.87	.25	2.44	1.36	.75	.44
12. Sad	2.75	1.36	.90	.19	2.29	1.29	.87	.24	2.42	1.32	.87	.24
φ	f1	f2	f3	f4	f1	f2	f3	f4	f1	f2	f3	f4
f1	–				–				–			
f2	.84	–			.83	–			.68	–		
f3	.20	.06	–		.09	.15	–		.15	.17	–	
f4	.03	−.06	.64	–	−.15	−.17	.67	–	.09	.09	.45	–
α	.83	.86	.83	.85	.82	.89	.76	.83	.61	.80	.76	.80
ω	.83	.86	.83	.86	.83	.89	.76	.84	.63	.80	.76	.81
ρ	.83	.90	.88	.86	.83	.89	.76	.84	.65	.80	.77	.81
AVE	.93	.96	.93	.94	.91	.97	.86	.92	.70	.91	.86	.90

Note. f1 = Pleasant high activation factor, f2 = Pleasant low activation factor, f3 = Unpleasant high activation factor, f4 = Unpleasant low activation factor, λ = Standardised factor loading, δ = Standardised residual variance, φ = Factor correlations, α = Cronbach's alpha values, ω = McDonald's omega values, ρ = Composite reliability coefficient; AVE = Average variance extracted.

Table 4
Means, Standard Deviations, Reliability Coefficients, Average Variance Extracted, Standardised Factor loadings, Item Residual Variances, and Factor Correlations for the Adapted Versions of the Brief Emotional Eating Scale (BEES).

Factor/item	Finland					Spain					Italy					South Korea					China				
	(n = 415)					(n = 244)					(n = 264)					(n = 218)					(n = 300)				
	M	*SD*	λ	δ		*M*	*SD*	λ	δ		*M*	*SD*	λ	δ		*M*	*SD*	λ	δ		*M*	*SD*	λ	δ	
f1																									
innostunut	2.00	0.94	.87	.24	feliz	2.51	0.96	.87	.24	entusiasta	2.42	1.03	.88	.23	즐거워하는	3.32	0.90	.84	.30	兴高采烈的	3.37	0.85	.79	.38	
riemuissan	2.10	0.96	.84	.30	contento	2.44	1.00	.87	.24	euforico	2.39	1.02	.78	.39	행복한	3.26	0.89	.83	.31	高兴的	3.38	0.86	.76	.42	
tohkeissaan	1.84	0.89	.80	.37	eufórico	2.13	1.02	.79	.38	contento	2.67	0.95	.76	.43	열정적인	3.04	0.92	.68	.54	热情的	3.11	0.79	.63	.60	
f2																									
hyvillään	2.10	0.93	.91	.18	amable	2.02	0.97	.89	.21	lieto	2.21	0.90	.83	.32	만족스러운	3.21	0.90	.73	.47	满意的	3.17	0.83	.77	.42	
tyytyväinen	2.30	0.96	.83	.32	afectuoso	1.93	0.92	.87	.24	affabile	2.03	0.90	.82	.33	친절한	2.83	0.89	.72	.49	热心的	2.94	0.76	.53	.78	
kiltti	1.94	0.94	.79	.38	satisfecho	2.27	1.03	.74	.45	cordiale	1.99	0.82	.81	.35	마음이 따뜻한	2.92	0.89	.71	.49	温和的	2.82	0.68	.47	.72	
f3																									
ärtynyt	1.93	1.02	.82	.33	enfadado	1.80	1.08	.94	.12	arrabbiato	1.91	1.10	.83	.32	화난	1.94	1.10	.70	.51	生气的	1.80	0.99	.70	.51	
raivostunut	1.60	0.92	.87	.24	furioso	1.80	1.07	.85	.29	nervoso	2.28	1.25	.79	.37	반항적인	1.94	1.09	.66	.56	受挫的	1.88	1.00	.65	.58	
vihainen	1.65	0.91	.80	.37	irritado	1.84	1.13	.65	.58	infastidito	1.91	0.93	.73	.47	초조한	1.70	0.87	.62	.62	紧张的	1.97	0.95	.59	.65	
f4																									
allapäin	2.77	1.23	.85	.27	desanimado	2.22	1.15	.76	.55	abbattuto	2.19	1.21	.89	.21	슬픈	1.60	0.88	.75	.44	情绪低落的	1.83	1.00	.77	.41	
lannistunut	2.33	1.16	.77	.40	abatido	1.97	1.15	.67	.74	triste	2.31	1.23	.78	.40	울적한	2.22	1.15	.66	.57	难过的	1.68	1.01	.77	.41	
tylsistynyt	2.96	0.92	.46	.79	aburrido	2.90	1.00	.51	.42	scoraggiato	2.16	1.11	.73	.46	어찌할 수 없는	1.83	0.95	.54	.71	孤独的	2.30	1.11	.53	.72	
φ	f1	f2	f3	f4		f1	f2	f3	f4		f1	f2	f3	f4		f1	f2	f3	f4		f1	f2	f3	f4	
f1	–					–					–					–					–				
f2	.90	–				.82	–				.84	–				.94	–				.85	–			
f3	.39	.34	–			.14	.19	–			.07	.13	–			.14	.35	–			−.05	.09	–		
f4	−.03	−.01	.40	–		.01	.01	.53	–		−.19	−.14	.66	–		.09	.23	.92	–		−.19	.02	.82	–	
α	.87	.88	.86	.73		.88	.87	.84	.68		.85	.86	.82	.84		.82	.77	.69	.66		.76	.62	.68	.72	
ω	.87	.88	.87	.78		.88	.87	.85	.70		.85	.86	.83	.85		.82	.77	.71	.67		.78	.63	.69	.73	
ρ	.87	.88	.87	.75		.88	.88	.86	.69		.85	.86	.83	.84		.83	.76	.70	.69		.77	.62	.68	.74	
AVE	.96	.96	.96	.81		.96	.96	.93	.76		.94	.95	.93	.94		.92	.87	.79	.77		.87	.66	.77	.82	

Note. f1 = Pleasant high activation factor, f2 = Pleasant low activation factor, f3 = Unpleasant high activation factor, f4 = Unpleasant low activation factor, λ = Standardised factor loading, δ = Standardised residual variance, φ = Factor correlations, α = Cronbach's alpha values, ω = McDonald's omega values, ρ = Composite reliability coefficient; AVE = Average variance extracted.

Latent factor correlations between the items in the BEES and the emotions reported at the time of highest cravings showed a pattern of relationships in the expected direction across all samples (see Table 2 in Supplementary material). Specifically, low (r between 0.20 and 0.39) to moderate (r between 0.40 and 0.59) positive associations were observed between BEES pleasant emotions (high, low activation) and pleasant emotions associated with cravings, and low to moderately high (r between 0.60 and 0.79) associations were shown between BEES unpleasant emotions (high, low activation) and unpleasant emotions associated with cravings. In contrast, negative or no association was observed between BEES pleasant emotions and unpleasant emotions associated with food cravings or BEES unpleasant emotions and pleasant emotions reported at the time of highest cravings.

3.4. Predictive validity

We examined the validity of the BEES constructs (i.e., pleasant high activation, pleasant low activation, unpleasant low activation, and unpleasant high activation) as predictors of food cravings (i.e., craving experience, giving in to cravings, and resisting cravings). Direct and indirect paths via perceptions of being an emotional eater were tested. The model controlling for language, gender, and age across the national samples (i.e., Finland, North America, Philippines, United Kingdom, China, Italy, Spain, and South Korea) demonstrated a good fit to the data χ^2 (119) = 1034.583, CFI = 0.948, TLI = 0.926, RMSEA = 0.056, SRMR = 0.054. Direct and indirect effects are provided in the supplementary material (Table 2). Differential effects were found for unpleasant high and low activation states to the three aspects of cravings (craving experience, give into, and difficulty in resisting). Specifically, significant direct effects from unpleasant low activation states to the three craving aspects were found. Direct effects from unpleasant high activation states to the experience of cravings were also significant, but the paths were non-significant for the other two aspects, give into, and difficulty in resisting cravings. Indirect effects from unpleasant high and low activation states to the three craving aspects via perceptions of being an emotional eater were significant.

We also examined the validity of the BEES constructs as predictors of health outcomes (i.e., physical and mental health) and perceived changes in reported eating and wellbeing. Direct and indirect paths via perceptions of being an emotional eater were tested (see Table 3 in Supplementary material). The model fit the data well, χ^2(127) = 1056.453, CFI = 0.943, TLI = 0.916, RMSEA = 0.055, SRMR = 0.051. Significant direct effects were observed for paths from pleasant high and low activation states and unpleasant low activation states to perceived changes in reported eating. The direct path from unpleasant high activation states to reported eating was not significant. Indirect effects were observed for paths from the unpleasant high and low activation states to physical and emotional health, perceived changes in reported eating, and wellbeing, via perceptions of being an emotional eater.

4. Discussion

This study examined the psychometric properties and dimensionality of a brief measure of emotional eating and the measurement invariance of its structure. A second purpose of the study was to examine convergent validity as well as predictive validity of the scale in predicting food cravings, indicators of health and wellbeing, and self-reported eating. An English language version of the measure was administered to adults from the United Kingdom, North America, and Philippines, while translated versions were administered to adults from China, Finland, Italy, South Korea, and Spain. Overall, the study findings extend the current literature by contributing to the investigation of the psychometric properties of a brief measure of emotional eating that includes a range of pleasant and unpleasant states, which can be used for research or applied purposes.

In testing the dimensional structure of the scale, several competing models were examined: a unidimensional model, a two-factor model based on valence (pleasant, unpleasant), a two-factor model based on activation (high, low), and a four-factor model reflecting the interaction between valence (pleasure, displeasure) and activation (high, low) dimensions in line with the circumplex model (Russell, 1980). The last model estimated considers the somatic arousal as proposed by Goldbacher et al. (2012). Poor fit to the data was found for the 34-item scale models, especially for a two-factor model. Evaluation of fit indices, modification indices, and factor loadings suggested the deletion of several items. Further analysis on the 12-item Brief Emotional Eating Scale (BEES) revealed good fit to the data for a four-factor model across English speaking samples. Equivalent 12-item scales were developed for each of the non-English speaking countries.

Acceptable factor structure was found with loading estimates above recommended values of 0.40, and AVE values higher than 0.50 for all samples, demonstrating adequate convergent validity of the English and non-English versions of the BEES. Results demonstrated acceptable reliability (α, ω, and ρ) across English-speaking and non-English speaking samples, except for the Philippines with α and ω values above 0.61 and 0.63, respectively. Even though English is a widely used language in the Philippines, it may be that there are nuances due to cultural characteristics underlying the understanding of specific emotions in relation to eating. Alternatively, emotional eating may not manifest in comparable ways across cultures. For example, Hawks et al. (2006) suggested that emotional eating may not currently represent the same degree of eating pathology in the Filipino sample as in western cultures, whilst more recently Liday and Liwag (2021) found that Filipino elderly adults (aged 60+) showed high levels of emotional under eating and low levels of emotional eating during COVID-19. These results suggest that emotional eating may be less prevalent in Filipino culture. Future research should seek to replicate these findings and examine the dimensionality of the scale in Filipino participants, and to further explore emotional eating in this culture.

Results on the invariance testing of the BEES supported configural and metric invariance, demonstrating that the hypothesised four-factor structure was equivalent across all samples of adults. Taken together, metric invariance and factor loadings findings provide evidence that the BEES is a sound measure, which can be used with confidence to provide meaningful information about the relationship between eating and a range of pleasant and unpleasant states in samples of adult participants. Partial strong factorial invariance was achieved after specification of item intercepts, suggesting that some items may not function similarly across all countries. If researchers are interested in comparing latent means across groups, full or partial strong invariance is required, in addition to invariance of factor loadings, so that differences in item mean scores across groups reflect indeed differences in latent means, in which case mean item and scale scores are comparable across groups (Marsh et al., 2013). Based on the strong invariance results, caution should be taken in cross-cultural research, especially regarding meaningful comparisons of latent means across the different countries.

Convergent validity was demonstrated via correlations between the BEES latent factors and those of a list of pleasant and unpleasant emotions experienced at the time of food cravings on the day of the assessment. The patterns of correlations were in the expected direction and discriminated between high and low activation and valence features of the BEES latent factors. Regarding predictive validity, unpleasant low activation emotions of the BEES were significant direct predictors of the three aspects of food cravings assessed (i.e., craving experience, giving into craving, difficulty resisting craving) while unpleasant high activation emotions were only direct predictors of the experience of craving. Perceptions of being an emotional eater were mediators of the relationships between unpleasant high and low activation states and the three aspects of food cravings. These results are in line with previous literature on emotionally elicited eating, which has been typically focused on unpleasant emotions (Cardi et al., 2015; Evers et al., 2018, 2018v; van Strien et al., 2012).

Results from a second structural model revealed a direct significant positive path between pleasant high and low activation emotions and changes in reported eating. Differential results were also observed for relationships between unpleasant emotions. The path from unpleasant low activation emotions and changes in reported eating was also significant, whereas the path from unpleasant high activation emotions was not significant. Perceptions of being an emotional eater were mediators of the relationships among unpleasant high and low activation emotions with physical and emotional health, and wellbeing. Taken together, predictive validity findings provide support for the assessment of pleasant emotions, and the consideration of the activation dimension. In a meta-analysis of laboratory studies using unpleasant and pleasant mood induction on eating behaviour, preliminary evidence indicated that strategies to improve pleasant mood might be of benefit in clinical practice, although the effect size across a single meal was small (Cardi et al., 2015).

4.1. Implications

The findings from this study contribute to the literature in several important ways. First, our study extends the literature on emotional eating assessment by providing information about a measure that includes both pleasant and unpleasant emotional states. Most previous research has focused on the assessment of a limited number of unpleasant emotions. For example, commonly used instruments such as the DEBQ or TFEQ-based questionnaires assess the perception of eating in response to unpleasant emotions. To our knowledge, no other scale considers both valence and activation dimensions of emotions. While some scholars (e.g., Bongers & Jansen, 2016) have acknowledged the usefulness of scales measuring approach and avoidance tendencies to food, we argue that different emotions (e.g., anxiety or sadness) have specific tendencies for action. From a physiological, evolutionary perspective, high activation unpleasant emotions (such as anxiety) trigger a fight-or-flight response involving the sympathetic nervous system, resulting in increased cortisol and insulin levels (Jacques et al., 2019), and also increasing alertness and energy provision from bodily stores (Torres & Nowson, 2007). A growing body of research suggests that experiencing unpleasant emotions lead to increased intake of foods high in sugar, fat, or both. Could it be that high and low activation unpleasant emotions trigger physiological mechanisms honed through evolution to adjust energy intake and availability? Considering the activation dimension, as well as valence or hedonic tone of emotions, as is possible with the free-to-use BEES, allows such questions to be interrogated and may advance our knowledge of the relationship between emotional states and eating.

The number of studies that examined measurement invariance of self-report measures of emotional eating in several national samples is scarce. Moreover, most research on emotional eating has involved convenience samples, most often recruiting undergraduate students within the same cultural group. The findings from this study could be used to advance knowledge on cross-cultural factors underlying emotional eating, such as values, preferences, beliefs about food, and behaviours which may impact eating, that may emerge from eating socialisation or cultural practices (Markey, 2004). This knowledge could then be utilised to develop interventions or preventions programs targeting groups with different backgrounds.

4.2. Strengths and limitations

This study has a number of strengths. We involved participants from relatively large samples of adults which enabled us to test the structure of several competing models and the validity of the BEES. The inclusion of adults of a broad age range adds to the current literature stemmed from reliance on the use of university students or convenience samples. In examining the dimensionality of the emotional eating scale, we explored the intersection between valence and activation aspects of emotions. The use of several national samples allowed for the testing of the models and invariance across multiple groups.

The items comprised in the different versions of the BEES were derived from factor analysis of the 34-item EES-II. Good model fit was demonstrated for all non-English versions of the BEES indicating same factorial structure, however, the items were different across countries. While these scales may be used to examine emotional eating in participants from each country separately, researchers interested in cross-cultural comparisons are recommended to examine measurement invariance after making some adjustments to the items. Another limitation is the small number of male participants involved in our study compared to female counterparts, which is in line with previous studies on emotional eating. Although efforts were made to recruit participants from both genders, the number of male participants was too small, thus limiting comparisons across gender. Future research should examine the replicability of these results on samples with a similar number of participants by gender across non-clinical as well as clinical populations. The cross-sectional nature of the data is an additional limitation, with reliability of the BEES examined at one time point. Thus, future research should adopt a longitudinal design to examine test consistency over time and to better understand the interplay between emotions and food intake. Finally, similar to other subjective assessments, self-reported emotional eating relies on participant recall. Future research could compare results from the BEES with more ecologically valid measures. For example, the BEES could be used in combination with ecological momentary assessments where participants record daily changes in emotional experiences and their subsequent food intake is also measured.

Notwithstanding these limitations, the current study may offer an important contribution to emotional eating assessment research. The BEES may be suitable as a relatively brief measure which could be administered along a battery of tests. Furthermore, considering valence (pleasant, unpleasant) as well as activation (high, low) opens up new avenues for research and practice related to emotional eating.

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Declaration of competing interest

None.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2023.106538.

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