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Validating the children's eating behaviour questionnaire in a UK sample: A suitable tool for mothers and fathers

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ABSTRACT

Children's eating behaviour is a complex construct linked to various health, social, and psychological outcomes. The Children's Eating Behaviour Questionnaire (CEBQ)assesses parents' perceptions of children's eating behaviours across eight subscales: food fussiness, enjoyment of food, food responsiveness, satiety responsiveness, desire to drink, slowness in eating, and emotional under- and overeating. Given that the initial validation of the CEBQ dates back to the early 2000s, this study aimed to (1) evaluate the psychometric properties of the CEBQ in a UK sample using current psychometric recommendations and (2) examine its measurement invariance based on parental sex. A total of 994 caregivers (196 fathers and 798 mothers) of children aged 3–5 years completed the questionnaire. The performance of the scale revealed that 23 items exhibited ceiling or floor effects or failed to meet recommended item-total correlation coefficients. Exploratory factor analysis supported an eight-factor, 34-item structure, which was confirmed via confirmatory factor analysis: $X^2 = 2129.845$ (df = 499; $p < 0.001$), TLI = 0.911, CFI = 0.921, RMSEA = 0.083 (90 % CI 0.079–0.087) and SRMR = 0.080. All factors demonstrated adequate internal consistency (omega 3 values over 0.7). Measurement invariance testing confirmed strict invariance by parental sex, indicating the instrument performs equivalently for mothers and fathers. These findings support the use of the revised 34-item CEBQ with its eight original factors for both maternal and paternal respondents. However, future research should consider revising certain CEBQ items included to strengthen its capacity to capture variations in children's eating behaviour, and to provide a more accurate evaluation of the construct.

1. Introduction

Accurate definition and measurement of children's eating behaviour is essential to underpin both the mechanistic understanding of the influence of children's eating behaviour on health outcomes and to inform potential interventions. Nonetheless, poor construct definition is common in this field (Russell et al., 2023), not least because of the variety of behaviours that are considered under the umbrella term of 'eating behaviour'. For this paper, we conceptualise children's eating behaviours broadly, as the specific actions that children perform and manifest in their eating context. In this context, it is essential to have instruments that accurately evaluate the construct. Such methodological improvements would enhance the robustness of results derived from studies using these instruments (Muñiz Fernández & Fonseca Pedrero, 2019; Rivera, 2025).

Children's eating behaviour is widely researched because of its relationship with a wide range of health, social and psychological outcomes (Herle et al., 2020; A. Kininmonth et al., 2021; Van Jaarsveld et al., 2011). For example, children's eating behaviours are related to children's BMI and their dietary intake (Kininmonth et al., 2021; Russell

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et al., 2023; Russell & Russell, 2018) as well as the development of eating disorders during adolescence (Derks et al., 2024; Herle et al., 2020). A widely applied conceptualisation of children's eating behaviour is that they can be separated into two overarching 'food approach' and 'food avoidance' categories (Llewellyn et al., 2023). Food approach eating behaviours such as food responsiveness or emotional overeating appear to increase the risk of developing obesity (Kininmonth et al., 2021; Van Jaarsveld et al., 2011), whereas food avoidant behaviours, including satiety responsiveness and slowness in eating, seem to decrease the likelihood of weight gain over time (Kininmonth et al., 2021).

Given the links with outcomes such as obesity, and poor dietary behaviours (e.g. low fruit and vegetable intake for children with fussy eating), much research has focused on understanding the development of eating behaviours, with the long-term aim of devising interventions to support the development of children's healthy eating. The Bio-psychosocial model proposed by Russell and Russell (2018) conceptualises the development of children's eating behaviours as a complex longitudinal interaction between biological, psychological and social factors. Importantly, the genetics of appetite have been widely studied (Llewellyn et al., 2010; Smith et al., 2017), establishing that there are strong links between more general approach/avoidance behavioural tendencies and eating behaviours, and that some eating behaviours (such as satiety responsiveness) have a stronger genetic component than others (such as emotional overeating and food fussiness) (Herle et al., 2018; Nas et al., 2024). Eating behaviours with weaker genetic components appear to be strongly shaped by a child's environment, with caregiver's feeding practices and styles (Farrow et al., 2015; Kininmonth et al., 2023; Qiu et al., 2023; Russell & Russell, 2018; Scaglioni et al., 2011) and wider societal influences such as accessibility and availability of foods or its marketing (DeCosta et al., 2017; Scaglioni et al., 2018) being related to these eating behaviours.

There are several different tools designed to measure children's eating behaviours. These include the Children's Dutch Eating Behaviour Questionnaire (DEBQ-C) (Van Strien & Oosterveld, 2008), the adapted version of the Three-Factor Eating Questionnaire for children and adolescents (CTFEQr17) (Bryant et al., 2018), the Child Self -Regulation in Eating Questionnaire (Tan & Holub, 2011), the Children's Eating Behaviour Questionnaire (CEBQ) (Wardle et al., 2001), and its version for younger children: the Baby Eating Behaviour Questionnaire (Llewellyn et al., 2011). The DEBQ-C and the CTFEQr17 are both self-reported questionnaires which assess eating behaviours in relation to three dimensions: restraint, emotional eating and uncontrolled eating (in CTFEQr17) or external eating (in DEBQ-C) in children around 10 years-old (Bryant et al., 2018; Van Strien & Oosterveld, 2008). The Child Self-Regulation in Eating Questionnaire assesses just one dimension: the child's capacity for energy regulation perceived by parents (Tan & Holub, 2011). However, the CEBQ, a parent-report instrument created for assessing children's eating behaviours aged between two and seven, is one of the most accepted and widely used instruments in research in this field (Russell et al., 2023).

The CEBQ was designed to assess children's eating behaviours more widely than other instruments as it contemplates the construct of eating behaviour from eight dimensions: satiety responsiveness, slowness in eating, fussiness, enjoyment of food, desire to drink, emotional undereating, and emotional overeating (Wardle et al., 2001). The CEBQ has been adapted and validated in different languages and contexts including China (Cao et al., 2012; Gao et al., 2020; Zhou & Sun, 2021), Singapore (Quah et al., 2017, 2019), Australia (Mallan et al., 2013; Somaraki et al., 2022), and Sweden (Somaraki et al., 2022; Svensson et al., 2011). Some studies have examined the validity of the CEBQ constructs using exploratory factor analysis (EFA) (Ayre et al., 2022; Cao et al., 2012; Malczyk et al., 2022; Svensson et al., 2011), but none of them performed confirmatory factor analysis (CFA) to confirm the structure found. Others carried out an initial CFA (Domoff et al., 2015; Gebru et al., 2021; Jimeno-Martínez et al., 2022; Leuba et al., 2023; Njardvik et al., 2018; Oyama et al., 2021; Purwaningrum et al., 2020; Quah et al., 2017, 2019; Sparks & Radnitz, 2012; Zhou & Sun, 2021), deciding to perform an EFA only if the fit indexes of the model were not adequate (Gebru et al., 2021; Leuba et al., 2023; Oyama et al., 2021; Quah et al., 2017, 2019; Sparks & Radnitz, 2012). Ideally, the use of EFA to explore the underlying factor structure should be paired with CFA on a separate dataset to confirm the adequacy of the model fit.

In comparison with the original version, previous validations have varied in their modifications and restructure of the CEBQ. For example, the number of factors detected vary from three (Oyama et al., 2021; Sparks & Radnitz, 2012) to eight factors (Domoff et al., 2015; Gebru et al., 2021; Jimeno-Martínez et al., 2022; Malczyk et al., 2022; Mallan et al., 2013; Njardvik et al., 2018; Purwaningrum et al., 2020; Somaraki et al., 2022; Zhou & Sun, 2021), while the number of items vary from 15 (Oyama et al., 2021; Sparks & Radnitz, 2012) to 35 (Domoff et al., 2015; Jimeno-Martínez et al., 2022; Malczyk et al., 2022; Njardvik et al., 2018; Quah et al., 2017, 2019) (Supplementary material 1). Moreover, although the CEBQ is framed as a parent-reported instrument, we could not find any version or validation examining sex invariance, the achievement of which indicates that the questionnaire works equivalently for both men and women. This is important given the rising involvement of fathers in child-care and feeding, and is an important aspect of establishing the validity of comparisons between mothers and fathers in their reports of children's eating behaviour (Mellenbergh, 1989; Meredith, 1993; Vandenberg & Lance, 2000).

In summary, there is yet to be a comprehensive validation of the CEBQ, which includes EFA and CFA, in a UK sample. Research is also yet to examine whether parent reports of children's eating behaviour using the CEBQ differ between mothers and fathers. Investigating this is important to ensure accurate measurement of children's eating behaviour. Therefore, this study aimed to (1) analyse the psychometric properties of the Children's Eating Behaviour Questionnaire (CEBQ) in a UK population according to current psychometric recommendations, and (2) to examine the measurement invariance of the CEBQ as a function of parental sex.

2. Methods

2.1. Design and sample

This online, cross-sectional study included 995 participants who were recruited as part of a larger study (The APPETItE study: https://osf.io/r6789/). Eligibility criteria required participants to live in England or Wales and to be responsible for feeding their child at least half of the time the child was in their care. Parents were excluded if the child had a medical condition or diagnosis that could affect children's dietary requirements and/or eating habits, such as Prader-Willi Syndrome, autism, or chronic illness. The participants were an ethnically representative sample of parents of 3–5 year old children living in the UK. Full sample characteristics are reported elsewhere (Pickard et al., 2023). For this study, the sample was randomly split using Statistical Package for the Social Sciences (SPSS) in two to obtain two samples to perform the exploratory and confirmatory factor analyses separately. The final sample for the EFA was 517 participants for the CFA it was 477 participants.

2.2. Variables

2.2.1. Sociodemographic variables

The parents' socio-demographic variables included in this study were sex (women, men, or other), age, ethnicity, educational level, and Index of Multiple Deprivation (IMD) decile scores. The IMD is a UK measure of area-level deprivation, based on factors that include income, health, education, crime, housing and local environment. Areas in England are split into 10 equal groups ranked from the most deprived areas (score = 1) to least deprived areas (score = 10). IMD decile scores from 1

to 10 were calculated using postcode data.

2.2.2. Children's eating behaviour questionnaire

The CEBQ is a tool that assesses parents' perceptions of children's eating behaviour (Wardle et al., 2001). The original questionnaire consists of 35 items across the following eight subscales: *food fussiness* (5 items, e.g. "My child enjoys tasting new foods"; Cronbach's α: 0.91) assessing pickiness regarding food accepted; *enjoyment of food* (4 items, e.g. "My child loves food"; Cronbach's α: 0.91) measuring the subjective pleasure that is experienced from eating; *food responsiveness* (5 items, e.g. "My child's always asking for food"; Cronbach's α: 0.82) measuring the child's drive to eat in response to external cues; *satiety responsiveness* (5 items, e.g. "My child gets full easily"; Cronbach's α: 0.83) measuring the capability of detecting internal cues of fullness; *desire to drink* (3 items, e.g. "My child is always asking for a drink"; Cronbach's α: 0.90) capturing the persistent desire to consume fluids; *slowness in eating* (4 items, e.g. "My child takes more than 30 min to finish a meal"; Cronbach's α: 0.80) measuring the speed of consuming food; *emotional overeating* (4 items, e.g. "My child eats more when anxious"; Cronbach's α: 0.72) and *emotional undereating* (4 items, e.g. "My child eats less when upset"; Cronbach's α: 0.75) assessing tendencies of eating in response to negative emotions. Supplementary Material 2 presents the list of items of the CEBQ, along with the distribution of items corresponding to each subscale. Responses are given on a 5-point Likert-type scale, ranging from "1 = never" to "5 = always". Higher scores on the "emotional overeating", "food responsiveness", and enjoyment of food" subscales indicate higher food approach. On the contrary, higher scores in the subscales of "satiety responsiveness", "slowness in eating", "food fussiness", and "emotional undereating" indicate lower food approach, also known as food avoidance. Separate to these is the subscale of "desire to drink".

2.3. Procedure

The original dataset was part of the APPETItE project (Appetite in Preschoolers: Producing Evidence for Tailoring Interventions Effectively), which investigates feeding and eating behaviours in preschool-aged children to inform the development of more effective interventions (https://www.appetite-research.com). Participants were recruited via an online recruitment panel (www.prolific.com) in 2022. Primary caregivers with a child between 3 and 5 years who met eligibility criteria completed an online survey, through the online survey platform Qualtrics, which included a variety of measures assessing demographic and sociodemographic variables (Household Food Security Scale, IMD), parent feeding practices (Comprehensive Feeding Practices Questionnaire), children's eating behaviour (CEBQ), and child temperament (Children's Behavior Questionnaire). Full details of the measures can be found in Pickard et al., 2023, for full details of measures. Participants received financial compensation (£3.25) upon study completion. CAPTCHA and three attention checks were also included in the survey to improve data quality.

2.4. Data analysis

Statistical analyses were performed using R (2023.12.1 + 402) and SPSS (version 29.0). Descriptive analyses of the sociodemographic variables of the sample were carried out, including percentages, means and standard deviations.

To determine the performance of the scales, for each item, the mean, standard deviation, minimum, maximum, 25th percentile, 75th percentile, skewness, kurtosis, floor and ceiling effects and the item-total correlation coefficient were calculated. Skewness and kurtosis values between −1 and 1 were taken as an assumption of normality (Muthén, B. & Kaplan, D., 1985; Muthén, B. & Klapan, D., 1992). The item-total correlation coefficients exceeding 0.29 were considered adequate (Reynolds et al., 2021).

The psychometric properties, EFA, CFA, internal consistency, and sex invariance were evaluated. The EFA was performed using the minres and polycorics method, after verifying that the items have normal distributions. The degree of adequacy of the data in the EFA was established using the Barlett sphericity test with a $p < 0.05$ (Barlett, M.S., 1950), and with the Kaiser-Meyer-Olkin (KMO) static (Kaiser, H.F., 1970) for which satisfactory values were those exceeding 0.80. The factor loading was established at 0.40, those items that did not achieve this value were removed.

For the CFA, we used the Laavan package in R (Yves Roseel, 2012). For the categorical variables, we used the weighted least squares means and variance (WLSMV) as an adjusted estimation method (Rhemtulla et al., 2012). To analyse the model fitting data we used the robust Tucker-Lewis Index (TLI) and the robust comparative fit index (CFI), with values greater than 0.90 considered, in both indices, as adequate (Hu & Bentler, 1999), the robust root mean squared error of approximation (RMSEA) considering values from 0.05 to 0.08 as adequate (Browne, M.W. & Cudeck, R., 1992) and the standardised root mean residual (SRMR) with values < 0.08 indicating adequate fit. Internal consistency was analyzed with omega 3 (Viladrich et al., 2017), considering values above 0.70 as acceptable (Terwee et al., 2007).

The measures of sex invariance were evaluated using the method of Wu and Estabrook (2016). The invariance was assessed considering four levels: configurational which is evaluated using the factor loading or the number of factors; the metric that considers each item factor loading; the scalar which refers to the item thresholds for categorical responses values; and the strict that measures the uniqueness of the irem (equality of loadings, intercepts and unique factor variances). If a ΔCFI of 0.01 or less and a ΔRMSEA of 0.015 or less are found between these models, invariance can be assumed (Chen, 2007).

3. Results

3.1. Participants

Table 1 shows the sociodemographic characteristics of participants. Our initial sample was 994 caregivers, aged 35.38 ± 4.47. Because one of our aims was to analyse sex invariance, data from one participant was deleted for not self-defining as male or female. The majority of the sample were female (80.2 %), from the United Kingdom (82.5 %), and of degree level-education (54.3 %). The IMD mean was 5.63 ± 2.90.

3.2. CEBQ performance

Table 2 presents the performance of all CEBQ items. The list of items can be found in supplementary material 2. Scores on all items were normally distributed. For item 1, no participants selected the option "never". Concerning the ceiling and floor effects, we found a large floor effect for items 15, 13 and 2. The ceiling effect was found for items 5, 22 and 23 but they were close to the 15 % stabilized as maximum. 54.30 % of the items did not exceed the recommendation for the total-item coefficient correlation of 0.29. Items 1, 3, 4, 5, 10, 16, 20, 22, and 32 were far from the recommendation with values up to 0.06. Items that were closer to 0.29 were 8, 26, and 30, with values between 0.17 and 0.19. Very close to the established value were items 7, 11, 17, 18, 21, 24, and 33 exceeding 0.20, but not achieving 0.29.

3.3. Exploratory factor analysis (EFA)

The EFA of the CEBQ showed an eight-dimensional structure. The loadings of all items were positive except for item 3 ("*My child has a big appetite*"), which in the original validation was reversed. Looking at the threshold suggestions to improve the model, it was decided not to reverse score item 3. Carrying out the EFA with item 3 not reversed, the analysis revealed an eight-dimensional 34-item structure with a KMO = 0.90 and Bartlett's sphericity test = 10136.04 (df = 595, $p < 0.001$). The

Table 1
Parents' sociodemographic information: sex, ethnicity and education.

	n (%)
Sex	994
Fathers	196 (19.7)
Mothers	798 (80.2)
Ethnicity	994
Indian	21 (2.1)
Pakistani	9 (0.9)
Bangladeshi	6 (0.6)
Chinese	4 (0.4)
Any other Asian background	4 (0.4)
Caribbean	14 (1.4)
African	15 (1.5)
Any other Black, Black British, or Caribbean background	3 (0.3)
White and Black Caribbean	13 (1.3)
White and Black African	1 (0.1)
White and Asian	8 (0.8)
Any other Mixed or multiple ethnic background	7 (0.7)
English, Welsh, Scottish, Northern Irish or British	820 (82.5)
Irish	7 (0.7)
Roma	1 (0.1)
Any other White background	55 (5.5)
Arab	1 (0.1)
Any other ethnic group	5 (0.5)
Education	992
No degree	454 (45.8)
Degree	538 (54.3)
IMD decile	994
1	79 (10.0)
2	74 (9.4)
3	84 (10.6)
4	65 (8.2)
5	69 (8.7)
6	79 (10.0)
7	77 (9.7)
8	102 (12.9)
9	80 (10.1)
10	82 (10.4)

Note: Data about education level was not available for 2 parents. Because of one of our aims was to analyse sex invariance, data from one participant was deleted for not self-defining as male or female. IMD: Index Multiple Deprivation.

factor loading exceeded 0.40 in all items, accomplishing the methodological and substantive criteria, except for item 35 which obtained 0.36. Thus, item 35 was excluded. See Table 3 for values regarding the structural pattern matrix for each item. The 8 factors were named using the same names from the original version of the CEBQ: Food fussiness (factor 1, including items 10, 7, 33, 32, 16, 24), Enjoyment of food (factor 2, items 1, 5, 20, 22, 3), Food responsiveness (factor 3, items 34, 19, 12, 14, 27, 28), Satiety responsiveness (factor 4, items 21, 26, 17, 30), Desire to drink (factor 5, items 31, 29, 6), Slowness in eating (factor 6, items 8, 4, 18), Emotional overeating (factor 7, items 15, 2, 13), and Emotional undereating (factor 8, items 25, 9, 23, 11).

3.4. Confirmatory factor analysis (CFA)

The CFA analysis fit the eight-factor model obtained from the EFA: chi-square = 2129.845 (df = 499; $p < 0.001$), TLI = 0.911, CFI = 0.921, RMSEA = 0.083 (90 % CI 0.079–0.087) and SRMR = 0.080. The structural equation modelling diagram of the CFA can be found in supplementary material 3.

Internal consistency was good, with the following omega 3 values: factor 1 = 0.93; factor 2 = 0.91; factor 3 = 0.82; factor 4 = 0.75; factor 5 = 0.91; factor 6 = 0.80; factor 7 = 0.84; and factor 8 = 0.74.

3.5. Sex invariance

Table 4 presents the results regarding the sex invariance of the CEBQ in fathers and mothers. We found that the ΔCFI remained below 0.01 for all steps and the ΔRMSEA increased less than 0.015 in each step. These results confirm that the configurational, metric, scalar and strict invariance of the model was achieved. Therefore, the CEBQ works equally well with fathers and mothers.

4. Discussion

This study validates the Children's Eating Behaviour Questionnaire (CEBQ) (Wardle et al., 2001), a parent-report measure designed to assess children's eating behaviour, in a sample of parents with children aged three to five years old living in the United Kingdom. Our findings indicate that a reduced 34-item version of the original 35-item questionnaire demonstrated validity. In evaluating the performance of the scale, 23 items exhibited a ceiling or floor effect or failed to meet the recommended threshold for item-total coefficient correlation. Findings from both the EFA and CFA confirmed the validity of the original eight-factor structure, with all factors demonstrating adequate internal consistency. Furthermore, this study established strict invariance, supporting the robustness of the CEBQ in assessing parents' perceptions of children's eating behaviours consistently across both fathers and mothers.

Nonetheless, despite support for the construct validity of the CEBQ, certain psychometric properties of the measure warrant improvement. We found that more than half of the items did not achieve the adequate item-total correlation coefficient value or exhibited ceiling or floor effects. This suggests that 19 items in this sample, may not capture the underlying psychological trait that they are intended to measure, as small changes in respondent's behaviours may not be fully captured, and thus they should be improved or removed from the scale. Somaraki and colleagues (2022) also found in their validation that some items did not discriminate adequately. The discriminative capacity of a questionnaire item can be affected by several factors, such as the formulation of the items, some of which we identified in the CEBQ. One potential issue was the use of negatively worded items, such as item 30 "*My child cannot eat a meal if s/he has had a snack before*", which may introduce difficulties in comprehension and response accuracy. Ambiguity is another factor that can reduce item discrimination. For example, the item 18, "*My child takes more than 30 min to finish a meal*", may lead to inconsistent interpretation among parents, as the perception of whether 30 min is "slow" or "fast" could depend on portion size and individual eating habits. Additionally, for this specific item, using 30 min as a threshold may not effectively distinguish between typical and fast eaters. Similarly, the above item of "*My child cannot eat a meal if s/he has had a snack just before*" also lacks a clear definition of "snack", or how soon "just before" refers to, which could lead to variability in parental responses, as suggested by Somaraki et al. (2022). The same issue applies to the items 23 "*My child eats more when s/he is happy*" and item 11 "*My child eats less when s/he is tired*". What is meant by "more" and "less" is ambiguous, because it could refer to quantity of food or frequency, or both. These aspects should be clarified, either explicitly in the item or with examples, to facilitate parents' interpretation and avoid misunderstandings. Beyond the methodological and item-related factors, another possible explanation for variation in CEBQ item performance is that it was initially developed in 2001(Wardle et al., 2001). Since then societal attitudes, behaviours, and environmental influences related to eating and food (Imamura et al., 2015) may have shifted, affecting how eating behaviours manifest in children or how parents perceive and report them. As a result, some original items may now be outdated or less relevant. Therefore, the observed psychometric issues may reflect not only flaws in the scale's design but also broader shifts in the underlying construct that the CEBQ aims to assess.

Results from the EFA suggest three modifications to the original CEBQ structure: (1) not reverse scoring item 3 and changing it from the Satiety Responsiveness factor to the Enjoyment of Food factor, (2) reclassifying item 27 from the Emotional Overeating factor to the Food Responsiveness factor and (3) removing item 35 due to insufficient factor loading. We found that item 3 "*My child has a big appetite*", which was originally reverse-scored in the initial validation, worked better

Table 2
Performance of the CEBQ and related normative data in fathers and mothers (N = 994).

	min	max	*M* (*SD*)	p25	p75	Skewness	Kurtosis	Floor effect *n* (%)	Ceiling effect *n* (%)	Item-total Coefficient Correlation
Item 1	2	5	3.86 (0.80)	3	4	−0.19 (0.08)	−0.59 (0.16)	39 (3.9)	219 (22.0)	−0.03
Item 2	1	4	1.67 (0.68)	1	2	0.77 (0.08)	0.50 (0.16)	434 (23.7)	13 (1.3)	0.34
Item 3	1	5	3.18 (0.95)	3	4	0.06 (0.08)	−0.13 (0.16)	36 (3.6)	95 (9.6)	0.06
Item 4	1	5	3.43 (0.89)	3	4	−0.31 (0.08)	−0.04 (0.16)	21 (2.1)	98 (9.9)	−0.03
Item 5	1	5	3.68 (0.87)	3	4	−0.38 (0.08)	−0.07 (0.16)	10 (1.0)	163 (16.4)	−0.02
Item 6	1	5	3.19 (0.88)	3	4	0.18 (0.08)	−0.27 (0.16)	13 (1.3)	77 (7.7)	0.35
Item 7	1	5	3.35 (1.02)	3	4	−0.17 (0.08)	−0.55 (0.16)	32 (3.2)	133 (13.4)	0.21
Item 8	1	5	3.42 (0.87)	3	4	0.01 (0.08)	−0.26 (0.16)	10 (1.0)	110 (11.1)	0.18
Item 9	1	5	2.89 (1.14)	2	4	−0.01 (0.08)	−0.76 (0.16)	133 (13.4)	77 (7.7)	0.32
Item 10	1	5	3.15 (0.95)	3	4	−0.14 (0.08)	−0.27 (0.16)	44 (4.4)	66 (6.6)	0.05
Item 11	1	5	3.19 (0.90)	3	4	−0.48 (0.08)	0.13 (0.16)	23 (2.3)	118 (11.9)	0.24
Item 12	1	5	3.19 (0.94)	3	4	−0.00 (0.08)	−0.32 (0.16)	29 (2.9)	81 (8.1)	0.44
Item 13	1	5	1.80 (0.66)	1	2	0.53 (0.08)	0.78 (0.16)	321 (32.3)	2 (0.2)	0.37
Item 14	1	5	2.39 (1.09)	2	3	0.54 (0.08)	−0.36 (0.16)	226 (22.7)	43 (4.3)	0.33
Item 15	1	4	1.73 (0.68)	1	2	0.59 (0.08)	0.17 (0.16)	382 (38.4)	11 (1.1)	0.38
Item 16	1	5	2.65 (1.06)	2	3	0.23 (0.08)	−0.60 (0.16)	143 (14.4)	44 (4.4)	0.00
Item 17	1	5	3.53 (0.87)	3	4	−0.16 (0.08)	−0.34 (0.16)	7 (0.7)	124 (12.5)	0.22
Item 18	1	5	2.75 (1.01)	2	3	0.18 (0.08)	−0.45 (0.16)	102 (10.3)	46 (4.6)	0.25
Item 19	1	5	2.67 (1.07)	2	3	0.25 (0.08)	−0.61 (0.16)	137 (13.8)	49 (4.9)	0.38
Item 20	1	5	3.37 (0.93)	3	4	−0.33 (0.08)	−0.12 (0.16)	30 (3.0)	92 (9.3)	−0.03
Item 21	1	5	3.26 (0.76)	3	4	−0.14 (0.08)	0.39 (0.16)	15 (1.5)	39 (3.9)	0.23
Item 22	1	5	3.71 (0.84)	3	4	−0.39 (0.08)	0.17 (0.16)	10 (1.0)	158 (15.9)	0.02
Item 23	1	5	3.36 (0.98)	3	4	−0.47 (0.08)	0.11 (0.16)	54 (5.4)	158 (15.9)	0.40
Item 24	1	5	3.06 (1.08)	2	4	0.15 (0.08)	−0.69 (0.16)	57 (5.7)	114 (11.5)	0.23
Item 25	1	5	3.04 (1.05)	2	4	−0.13 (0.08)	−0.50 (0.16)	84 (8.4)	75 (7.5)	0.35
Item 26	1	5	2.96 (0.78)	2	3	0.15 (0.08)	0.15 (0.16)	19 (1.9)	25 (2.5)	0.17
Item 27	1	5	2.79 (1.07)	2	4	0.09 (0.08)	−0.74 (0.16)	117 (11.8)	48 (4.8)	0.47
Item 28	1	5	3.40 (1.15)	3	4	−0.31 (0.08)	−0.68 (0.16)	65 (6.5)	191 (19.2)	0.38
Item 29	1	5	2.75 (1.13)	2	3	0.41 (0.08)	−0.60 (0.16)	111 (11.2)	90 (9.1)	0.43
Item 30	1	5	2.91 (0.95)	2	4	0.08 (0.08)	−0.39 (0.16)	59 (5.9)	45 (4.5)	0.19
Item 31	1	5	2.79 (1.09)	2	4	0.41 (0.08)	−0.56 (0.16)	86 (8.7)	84 (8.5)	0.42
Item 32	1	5	3.19 (1.01)	3	4	−0.11 (0.08)	−0.42 (0.16)	49 (4.9)	96 (9.7)	0.00
Item 33	1	5	3.38 (1.04)	3	4	−0.20 (0.08)	−0.62 (0.16)	32 (3.2)	144 (14.5)	0.22
Item 34	1	5	2.25 (0.95)	2	3	0.65 (0.08)	0.15 (0.16)	208 (20.9)	20 (2.0)	0.44
Item 35	1	5	2.94 (0.94)	2	4	0.65 (0.08)	0.15 (0.16)	56 (5.6)	43 (4.3)	0.38
Factor 1	1	5	3.13 (0.86)	2.5	3.83	0.015 (0.08)	−0.554 (0.16)	6 (0.6)	14 (1.4)	–
Factor 2	1.2	5	3.56 (0.74)	3.0	4.00	−0.326 (0.08)	−0.076 (0.16)	3 (0.3)	30 (3.0)	–
Factor 3	1	5	2.78 (0.77)	2.17	3.33	0.216 (0.08)	−0.186 (0.16)	7 (0.7)	3 (0.3)	–
Factor 4	1	5	3.17 (0.63)	2.75	3.5	−0.009 (0.08)	0.096 (0.16)	2 (0.2)	28 (2.8)	–
Factor 5	1	5	2.01 (0.93)	2.33	3.67	0.432 (0.08)	−0.449 (0.16)	8 (0.8)	40 (4.0)	–
Factor 6	1	5	3.20 (0.79)	2.67	3.67	0.005 (0.08)	−0.376 (0.16)	4 (0.4)	13 (1.3)	–
Factor 7	1	4	1.73 (0.58)	1.33	2.00	0.534 (0.08)	0.246 (0.16)	246 (24.7)	2 (0.2)	–
Factor 8	1	5	3.20 (0.76)	2.75	3.75	−0.273 (0.08)	−0.103 (0.16)	6 (0.6)	6 (0.6)	–

Note: CEBQ: Children Eating Behaviour Questionnaire; *M* = mean; *SD* = standard deviation; Min = Minimum; Max = maximum; p25 = 25th percentile; p75 = 75th percentile. The item list can be found in the Supplementary material 2. Factor 1: Food fussiness; Factor 2: Enjoyment of food; Factor 3: Food responsiveness; Factor 4: Satiety responsiveness; Factor 5: Desire to drink; Factor 6: Satiety responsiveness; Factor 7: Emotional overeating; Facot 8: Emotional undereating.

when it was not reverse-scored but considered as part of the Enjoyment of Food scale instead of the Satiety Responsiveness. This finding aligns with other validation studies (Domoff et al., 2015; Gebru et al., 2021; Jimeno-Martínez et al., 2022; Leuba et al., 2023; Oyama et al., 2021; Svensson et al., 2011). Additionally, our analyses suggest including item 27 "*My child eats more when she/he has nothing else to do*" in the Food Responsiveness factor instead of in the Emotional Overeating factor. This modification was also reported in previous research (Domoff et al., 2015; Gebru et al., 2021). Finally, our findings suggest that item 35 "*My child eats more and more slowly during the course of the meal*" should be removed from the measure, due to insufficient loading onto any of the given factors. Previous EFA research has similarly suggested the deletion of item 35 (Gebru et al., 2021; Oyama et al., 2021; Svensson et al., 2011). One possible explanation for the poor factor loading could be the complexity of the item wording which may inadvertently capture two different aspects (Moreno, 2004.). In fact, the "*eats more and more slowly*" could be interpreted in two different ways: firstly, as the child eats a greater quantity of food and, consequently, eats more slowly, or as being a gradual deceleration in eating speed. Given this ambiguity, revising the wording to better reflect to intended construct may improve its clarity. Moreover, the eating speed is adequately captured in other items such as item 4 "*My child finishes his/her meal quickly*" and item 8 "*My child eats slowly*". Furthermore, the Slowness in Eting subscale is sufficiently robust without this item. Therefore, our findings suggest that item 35 could be deleted from the scale.

Using this proposed 34-item questionnaire, we identified a final structure consistent with the eight-factor scale, as established in the initial validation and supported by subsequent validations (Domoff et al., 2015; Gebru et al., 2021; Jimeno-Martínez et al., 2022; Malczyk et al., 2022; Mallan et al., 2013; Njardvik et al., 2018; Purwaningrum et al., 2020; Wardle et al., 2001; Zhou & Sun, 2021). However, other exploratory factor analyses of the CEBQ have found a different number of factors (Ayre et al., 2022; Cao et al., 2012; Leuba et al., 2023; Oyama et al., 2021; Quah et al., 2017, 2019; Sparks & Radnitz, 2012; Svensson et al., 2011), ranging from three (Oyama et al., 2021; Sparks & Radnitz, 2012) to seven (Cao et al., 2012; Leuba et al., 2023; Quah et al., 2019; Svensson et al., 2011). Apart from the variety of structures, these validations also reported changes in the final number of items, ranging from 15 (Oyama et al., 2021; Sparks & Radnitz, 2012) to 35 (Quah et al., 2017, 2019). This disparity of structures and items integrated within the questionnaire could suggest that the CEBQ works differently in different cultures and/or socioeconomic backgrounds (Oyama et al., 2021; Sparks & Radnitz, 2012), or that during the validation process, some terminology has been inaccurately translated (Zhou & Sun, 2021). For this

Table 3
The structural pattern matrix for each item of the CEBQ obtained from an exploratory factor analysis.

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
i10 R	**0.935**	0.065	−0.089	−0.043	−0.016	0.029	0.050	−0.020
i7	**0.901**	0.144	0.002	0.048	0.008	0.035	0.019	0.035
i33	**0.820**	0.087	0.073	0.060	0.022	0.070	0.016	0.012
i32 R	**0.790**	−0.013	−0.049	−0.063	0.026	−0.076	0.029	−0.011
i16 R	**0.659**	−0.275	0.018	−0.041	−0.007	−0.028	−0.029	−0.031
i24	**0.515**	−0.293	0.194	0.190	0.013	0.033	−0.027	−0.003
i1	−0.014	**0.858**	−0.041	0.002	0.005	0.063	0.074	−0.047
i5	−0.082	**0.836**	0.046	0.099	−0.031	−0.008	−0.057	0.021
i20	−0.099	**0.708**	0.071	−0.053	−0.033	0.063	0.022	0.016
i22	−0.146	**0.704**	0.140	0.095	0.012	−0.010	−0.106	0.013
i3	−0.047	**0.470**	0.258	−0.195	−0.006	−0.061	0.034	0.025
i34	−0.084	0.022	**0.741**	−0.080	0.054	0.068	−0.003	−0.034
i19	−0.127	0.124	**0.705**	−0.030	0.056	0.067	−0.013	−0.097
i12	−0.026	0.163	**0.676**	0.081	0.050	−0.026	−0.051	−0.054
i14	0.061	0.058	**0.604**	−0.041	−0.010	−0.106	0.116	−0.094
i27	−0.043	−0.181	**0.569**	0.077	−0.055	−0.096	0.144	0.111
i28	0.152	−0.041	**0.555**	−0.075	−0.066	0.012	−0.113	0.065
i21	0.042	0.208	−0.095	**0.877**	−0.019	−0.062	0.032	−0.035
i26	−0.055	−0.011	−0.111	**0.757**	−0.024	−0.059	0.074	−0.007
i17	0.092	−0.135	0.087	**0.656**	−0.003	0.024	−0.058	−0.079
i30	0.002	−0.064	0.035	**0.456**	0.013	0.059	−0.035	−0.012
i31	0.046	−0.042	−0.006	−0.030	**0.929**	0.023	0.024	−0.009
i29	0.001	−0.111	0.084	−0.033	**0.857**	0.009	−0.034	0.014
i6	0.007	0.069	−0.059	0.018	**0.741**	−0.044	0.022	−0.003
i8	0.066	0.209	−0.084	0.059	−0.036	**0.862**	0.002	0.003
i4R	0.027	−0.073	−0.106	−0.064	−0.064	**0.817**	−0.036	−0.052
i18	−0.022	−0.098	0.036	−0.056	0.058	**0.683**	0.001	0.039
i35	−0.085	−0.019	0.163	0.299	0.013	0.357	0.088	0.034
i15	0.033	0.017	−0.030	0.031	0.003	0.043	**0.935**	−0.029
i2	0.004	−0.033	−0.044	−0.037	0.022	−0.016	**0.780**	0.046
i13	0.045	0.009	0.043	0.066	−0.009	−0.009	**0.711**	0.025
i25	0.028	−0.056	−0.053	−0.082	−0.012	0.004	−0.012	**0.871**
i9	−0.032	−0.132	−0.029	−0.058	−0.032	0.021	0.071	**0.699**
i23	−0.015	0.201	0.056	−0.031	0.026	−0.006	0.061	**0.565**
i11	0.018	0.010	−0.052	0.236	0.042	−0.009	−0.144	**0.410**

Note: CEBQ: Children Eating Behaviour Questionnaire; i: item; R: item reverse. Factor 1: Food fussiness; Factor 2: Enjoyment of food; Factor 3: Food responsiveness; Factor 4: Satiety responsiveness; Factor 5: Desire to drink; Factor 6: Satiety responsiveness; Factor 7: Emotional overeating; Facot 8: Emotional undereating.

Table 4
The CEBQ sex invariances among fathers and mothers from UK.

Invariance	Chi square	Df	RMSEA	TLI	CFI
Configurational	4150.678	998	0.07980566	0.9769814	0.9795253
Metric	4262.562	1024	0.07985191	0.9769547	0.9789676
Scalar	4327.009	1115	0.07620967	0.9790091	0.9791400
Strict	4327.009	1115	0.07620967	0.9790091	0.9791400

Note: CEBQ: Children Eating Behaviour Questionnaire; UK: United Kingdom; df: degree of freedom; RMSEA: Root Mean Squared Error of Approximation; TLI: Tucker-Lewis Index; CFI: Comparative Fit Index.

reason, to obtain rigorous results and to reduce misinterpretations, instruments should be adequately validated within the intended language and context before use.

The CFA confirmed the 34-item eight-factor structure of the questionnaire obtained from the EFA. Other previous validations obtaining an eight-factor structure, directly performed the CFA, without contemplating an EFA first to explore another possible structure compatible with their context (Domoff et al., 2015; Gebru et al., 2021; Jimeno--Martínez et al., 2022; Mallan et al., 2013; Njardvik et al., 2018; Purwaningrum et al., 2020; Zhou & Sun, 2021). Therefore, our paper improves on these validations by conducting both EFA and CFA. Moreover, our results showed an acceptable internal consistency for all factors (Omega 3 over 0.7), in line with previous validations. Hence, in our validation, we observed that the CEBQ presented adequate construct validity and internal consistency.

Finally, we also analyzed the parent's sex invariance of the CEBQ. Our results showed that the four invariances (configurational, metric, scalar and strict invariance) were achieved. Meeting the strict invariance, which is the most restrictive because it shows the uniqueness of the item by referring to the equality of loadings, intercepts and factor variances (Tse et al., 2023; Vandenberg & Lance, 2000; Wu & Estabrook, 2016), means that the CEBQ works equally among men and women. Our findings have important relevance to children's eating behaviour research because, as previous authors have suggested, meeting the strict invariance should be considered a prerequisite before doing any comparison between different groups (e.g. fathers vs mothers) to ensure that the results are not being misinterpreted (Tse et al., 2023; Vandenberg & Lance, 2000).

Incorporating these findings, this validation of the CEBQ among parents from the UK identified the same 8-factor structure as was established in the original version (Wardle et al., 2001), with three main modifications: the removal of item 35, the discontinuation of reverse scoring item 3, and the reclassification of item 3 and 27 in different subscales. Moreover, the revised version demonstrated adequate internal consistency. However, due to the scale performance, future work should consider a re-evaluation and revision of its items to enhance the validity of the measure. In future work, it will be necessary to carefully analyse why these items are not showing the expected differential

functioning and to improve them in accordance with the existing principles regarding item construction: representativeness, relevance, diversity, clarity, simplicity, and comprehensibility (Muñiz et al., 2005). An adaptation of the CEBQ could also incorporate the assessment of additional constructs to better reflect current societal norms around children's eating behaviours. For example, it may be beneficial to include items that differentiate between eating behaviours during meals and snack times, as these contexts may elicit different behaviours (Edwards et al., 2024). The first step in this process should be to integrate the suggestions and feedback from experts in children's eating behaviours regarding new items and constructs which may not be represented well in the current version, including important changes in the sociocultural context of eating that impact children's eating behaviour but are not currently well captured.

Nevertheless, the findings of this study are highly valuable. Validating the CEBQ specifically with fathers, while demonstrating measurement invariance across parents' sex, represents a significant methodological advancements with important social implications. This means that health professionals working with families now have a reliable tool that can be used not only with mothers but also with fathers to assess their children's eating behaviour. Including fathers in both research and instrument validation acknowledges their increasing involvement in child-rearing, particularly in the feeding context (Moura & Philippe, 2023). From a research perspective, our findings show that the CEBQ can be used with both parents. Ensuring the use of valid and reliable instruments is essential for advancing research and improving practice, as validated tools minimise measurement bias, prevent misinterpretation of results, and help to provide a robust foundation for designing interventions that are better tailored to the real context and needs of families (Muñiz Fernández & Fonseca Pedrero, 2019; Rivera, 2025). Therefore, this validation of the CEBQ, following the current psychometric recommendations, has the potential to strengthen the translation of research into practice, leading to more effective and evidence-based applications.

There are several limitations to this study. First, the sample in this study is specific to UK-based families. This limitation affects the generalizability of these findings, as the eating behaviours and parental perceptions captured by the CEBQ are likely to differ across diverse contexts. Therefore, we would recommend that the models and structures found in this study be validated in other populations from different contexts to ensure the structural stability of the CEBQ. Another consideration is the reliance on self-reported data from parents, which is inherently subject to bias. Parents may have provided socially desirable responses, or may not have accurately recalled or observed their children's eating behaviours. This could lead to an over- or underestimation of certain behaviours. While this study focused on the psychometric properties of the CEBQ, it did not extensively explore the cultural relevance of the items. As eating behaviours are influenced by cultural norms, it may be necessary to consider cross-cultural adaptations of the scale in future research to ensure its applicability in diverse contexts. The UK is multi-cultural, thus a range of ethnicities was represented in the sample and the CEBQ performed adequately in this context, but we were not able to examine its sensitivity to cultural differences in eating behaviour. Hence, in future research with larger samples, it would be valuable to undertake an analysis incorporating family ethnicity.

5. Conclusions

To conclude, our version of the CEBQ is a valid and reliable tool for assessing children's eating behaviours reported by parents and caregivers. Our findings suggested several revisions to the original CEBQ, resulting in a 34-item questionnaire that retains the original eight-factor structure. Our results provide evidence for its factorial equivalence between fathers and mothers, suggesting that it can be reliably used among mothers and fathers independently. However, further evidence is needed with other methods or simples. Finally, although the tool demonstrates adequate psychometric properties, some items should undergo a revision to further improve the CEBQ's capacity to accurately measure children's eating behaviour. Future research should focus on revising and validating these items to ensure the scale remains an effective tool for capturing variation in eating behaviours across diverse populations and sociocultural contexts.

CRediT authorship contribution statement

Mar Lozano-Casanova: Writing – original draft, Formal analysis, Conceptualization. **Silvia Escribano:** Writing – review & editing, Formal analysis, Conceptualization. **Abigail Pickard:** Writing – review & editing, Project administration, Methodology, Investigation, Conceptualization. **Katie L. Edwards:** Writing – review & editing, Project administration, Methodology, Investigation, Conceptualization. **Alice R. Kininmonth:** Writing – review & editing. **Miguel Richart-Martinez:** Writing – review & editing. **Isabel Sospedra:** Writing – review & editing. **Claire Farrow:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Jacqueline Blissett:** Writing – review & editing, Supervision, Resources, Methodology, Funding acquisition, Conceptualization.

Ethical statement

Aston University Health and Life Science Research Ethics Committee provided ethical approval (#HLS21053). Participants provided informed consent for their participation.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108322.

Data availability

Data will be made available at https://osf.io/r6789.

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