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# Relationships between observations and parental reports of 3-5 year old children's emotional eating using the Children's Eating Behaviour Questionnaire.

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RUNNING HEAD: EMOTIONAL EATING & CEBQ

**Abstract:**

**Background** The Children's Eating Behaviour Questionnaire [CEBQ] is a widely used, brief, psychometrically sound parent-report measure of children's eating behaviour traits. However, the relationship between parent report of children's emotional over-eating [EOE] and emotional under-eating [EUE] using the CEBQ and children's eating behaviour under conditions of negative emotion has not been examined. **Methods** Sixty-two mothers with children between 34-59 months of age (mean = 46.0 months, SD = 6.8; 33 boys, 29 girls) attended the laboratory and ate a meal to satiety. Children were randomly allocated to a negative mood induction or neutral condition. Children had access to snack foods for 4 minutes and their intake was measured. Mothers completed the CEBQ. All participants were weighed and measured from which BMI (mothers) and BMI SDS (child) scores were calculated. **Results.** Adjusting for covariates, children who were rated as higher in EUE on the CEBQ ate fewer kilocalories from crisps/potato chips and cookies when in a negative mood state, but not when in neutral mood. There were no significant relationships between maternal ratings of EOE on the CEBQ and children's snack food intake in either condition. **Conclusions** This study provides moderate support for the validity of the EUE scale of the CEBQ in 3-5-year-old children. Further work, including induction of different mood states, is required to explore whether the EOE scale truly captures young children's emotional over-eating.

**Keywords:** children's eating, emotional eating, parent report, observation

**Abbreviations:** Children's Eating Behaviour Questionnaire (CEBQ); Emotional Over-eating (EOE); Emotional Under-eating (EUE); Food responsiveness (FR); Satiety Responsiveness (SR); Food fussiness (FF); Enjoyment of food (EF); Standard Deviation (SD).

## 1. Introduction

The Children's Eating Behaviour Questionnaire [Wardle, Guthrie, Sanderson & Rappoport, 2001] was developed to provide a brief, parent-report measure of children's eating behaviour traits, encompassing both food approach (e.g. food responsiveness, enjoyment of food, desire to drink, emotional over-eating) and food avoidance (e.g. fussiness, slowness in eating, satiety responsiveness, emotional under-eating) behaviours. The CEBQ measure of these behaviours has been shown to be psychometrically sound in a number of samples [e.g. Domoff, Miller, Kaciroti & Lumeng, 2015; Sleddens, Kremers & Thijs, 2008; Svensson et al., 2011], and its subscales correlate predictably with child BMI [Domoff et al., 2015; Jansen et al., 2012; Sleddens, Kremers & Thijs, 2008; Viana, Sinde & Saxton, 2008; Webber, Hill, Saxton, Van Jaarsveld & Wardle, 2010]. The CEBQ also correlates well with other questionnaire measures of children's eating [Rogers, Ramsay & Blissett, 2018]. The validity of some of the subscales (food responsiveness, enjoyment of food, satiety responsiveness) has also been demonstrated in relation to measures of children's actual food intake, including eating in the absence of hunger, rate of eating and energy intake [Carnell & Wardle, 2007].

Despite the extensive validation of this measure and its wide use, there have not yet been any studies that have examined the relationship between parental report of emotional under and over-eating behaviours using the CEBQ, and observations of emotional eating within the laboratory. There is growing interest in emotional eating as a predictor of children's unhealthy food choices and obesity risk. Large studies have used the CEBQ to examine the development of emotional eating [e.g. Steinsbekk, Barker, Llewellyn, Fildes and Wichstrom, 2017; Herle, Fildes, Steinsbekk, Rijsdijk & Llewellyn, 2017a; Herle, Fildes, Steinsbekk, Rijsdijk & Llewellyn, 2017b]. These studies have suggested that parent report of emotional eating tends to be moderately stable across early and middle childhood [Steinsbekk et al., 2017; Herle et al, 2017b], that emotional over-eating (EOE) and

emotional under-eating (EUE) tend to be positively correlated, aetiologically distinct [Herle et al., 2017a], and largely explained by shared environment rather than genetics [Herle et al., 2017a; 2017b]. However, to date, it has not been clear the degree to which the CEBQ subscales of emotional eating are measuring distinct and observable emotional eating behaviour in children. A recent review demonstrated that experimental studies do not show consistent evidence to support the idea that adults who score highly on self-reported emotional eating also eat more in response to negative mood induction [Bongers & Jansen, 2016]. It is suggested that such ratings may actually be a better index of lack of control over eating or over-eating in general, rather than of eating in response to emotional states. Thus, it is important to examine whether similar effects are seen when parents report their children's emotional eating behaviour, and to examine the relationships with other subscales of the CEBQ, in addition to emotional eating.

The aim of the study was to explore the relationship between parental report of child emotional eating behaviour using the CEBQ in 3-5 year old children, and food intake under conditions of negative and neutral mood in a laboratory setting. We hypothesised that parents' ratings of emotional over-eating would be related to greater consumption of snack foods in the absence of hunger when the children experienced negative mood, but not in a neutral mood condition. We hypothesised that parents' ratings of their children's EUE would be related to lower consumption of snack foods in the absence of hunger when the children experienced negative mood, but not in a neutral mood condition. We also examined the relationships between other key factors of the CEBQ which measure appetitive traits and fussy/picky eating (Food Responsiveness [FR], Satiety Responsiveness [SR], Enjoyment of Food [EF], Food Fussiness [FF]) and food intake under conditions of negative and neutral mood, to establish whether the EOE and EUE subscales of the CEBQ demonstrate specific relationships with eating under conditions of

negative mood which are not also seen when examining relationships with appetite and fussy eating.

## 2. Materials and Methods

To test these hypotheses we conducted a secondary analysis of existing data from a prior study of emotional eating in 3-5 year old children in our laboratory [Blissett, Haycraft & Farrow, 2010].

### 2.1 Participants

Sixty-three caregiver-child dyads from the East Midlands, UK, were recruited to the study. One family was excluded because a non-primary caregiver (a grandmother) attended the laboratory session. All other caregivers who attended were primary caregivers (mothers n=61; stepmother n=1). Therefore the final retained sample consisted of 62 mothers of children between 34-59 months of age (mean = 46.0 months, SD = 6.8; 33 boys, 29 girls). The families were predominantly White British (89%) and mothers were generally well educated (mean 4 years post-16 education; SD=3). Loughborough University ethics committee approved the study and it was registered at clinicaltrials.gov (NCT01122290). All procedures were conducted in accordance with the Declaration of Helsinki as revised in 1983.

### 2.2 Procedure

After informed consent, mothers and their children visited the laboratory, and after a period of familiarisation and play, received a standardised lunch to ensure the children were not

hungry. After lunch, mothers completed a series of questionnaires whilst their children engaged in either a negative emotion induction or neutral mood task; mothers could see their children from behind a screen but children could not see their mother. Full details of the procedure can be seen elsewhere [Blissett, Haycraft & Farrow, 2010] but, in brief, children were told by the researcher that they would receive a small toy if they completed a jigsaw successfully. In the experimental group (n=29), a piece of the jigsaw was missing, so the children were unsuccessful in their task. This resulted in a significant reduction in their mood ratings from baseline on a 5-point 'smiley face' scale (see Table 1; within subjects t=3.6, df=26, p=.001). In the control group (n=33) the jigsaw was completed successfully; mood was subsequently significantly different between experimental and control group (see Table 1). At this time, children were left alone with 6 small bowls of snack food; in the experimental group the children were told that the researcher would be looking for the missing jigsaw piece and the control group was told that the researcher would go and tidy up. All children were left for 4 minutes with access to snack foods amounting to approximately 330 kcal (6g salted crisps/potato chips; 2 chocolate chip cookies, 21 chocolate buttons, 9 green grapes, 2 carrot sticks, 3 mini breadsticks). After 4 minutes, the researcher returned and removed the snacks. In the experimental group, the researcher found the missing jigsaw piece, the child completed the task and received their toy. Post-task mood ratings showed a return to baseline mood for those who received negative mood induction (t=-1.1, df=27, p=.27). After this, children and their mothers were weighed and measured without shoes and in light indoor clothing.

## 2.3 Measures

*Demographics*

Mothers completed a brief questionnaire examining demographic factors including their age, years of education after the age of 16, and ethnicity.

*Children's Eating Behaviour Questionnaire* (*CEBQ)*

Mothers completed the Children's Eating Behaviour Questionnaire [Wardle et al., 2001]. The CEBQ is a 35-item parent report measure comprising eight subscales (Food Responsiveness; e.g. 'my child is always asking for food', Emotional Over-Eating; e.g. 'my child eats more when anxious', Enjoyment of Food; e.g. 'my child loves food', Desire to Drink; e.g. 'my child is always asking for a drink', Satiety Responsiveness; e.g. 'my child leaves food on her plate at the end of a meal', Slowness in Eating; e.g. 'my child eats slowly', Emotional Under-Eating; e.g. 'my child eats less when angry', and Food Fussiness; e.g. 'my child is difficult to please with meals'). Parents report children's eating behaviour on a 5-point Likert scale from never to always. Higher scores indicate greater frequency of eating behaviour in each subscale. In this study, we report data on 6 subscales: Emotional Over- and Under-Eating, Food Responsiveness, Enjoyment of Food, Satiety Responsiveness, and Food Fussiness.

*Body Mass Index (BMI) scores*

Children's weight and height scores were converted to BMI standard deviation scores (BMI SDS) adjusted for child gender and age [CGF, 1996]. Mothers' BMI was calculated (kg/m$^{2.}$).

*Snack food Consumption*

Consumption was measured by weighing bowls before and after serving; manufacturer's nutritional information was used to calculate total kilocalories (kcal) consumed.

## 2.4 Data analysis

*Identification of covariates*

Previous research has suggested that child gender, BMI and age, as well as maternal education, age and BMI (e.g. Berkowitz et al., 2010; Blissett & Farrow, 2007; Lumeng & Burke, 2006; Miller et al., 2019) may be correlated with feeding and eating outcomes, in particular food intake in the laboratory setting, and thus we examined the need to control for such effects within the data. Preliminary analysis demonstrated that boys were rated by their mothers as significantly lower in food responsiveness and emotional eating than girls (Supplementary Table A). Maternal BMI was not related to to any of the questionnaire or food intake variables. Child age, maternal age, maternal education and child BMI SDS were related to some intake and questionnaire measures (Supplementary Tables B & C) and child BMI SDS also differed between groups (Table 1). We did not find significant correlations between food intake variables, except that in both groups, kilocalories from cookies and chocolate were significantly, positively correlated with total energy consumed. Therefore, child gender, child BMI SDS, child age, maternal age, and maternal years of education were entered as covariates in the subsequent analysis.

*Hypothesis testing*

One tailed Partial correlation coefficients adjusted for covariates were calculated to examine the relationships between parental reports of CEBQ subscales and food intake under conditions of neutral and negative mood, with alpha set at $p \leq .05$. N size of each analysis varied according to missing data (see Tables 2 and 3). In order to evaluate the extent to which the correlation coefficients were statistically different for the experimental and control group, we then compared the difference in magnitude of each correlation coefficient between the groups using Fisher r-to-z transformations which account for differences in n size.

## 3. Results

### 3.1. Descriptive statistics

Table 1 demonstrates that the experimental and control group did not differ on any variables except that children in the control group had significantly lower BMI SDS score and EOE score, and consumed fewer kilocalories from breadsticks, than children in the experimental group. There was also a trend for children in the control group to be slightly younger than those in the experimental group.

201 Table 1: Descriptive statistics and parental report of emotional eating, other CEBQ subscales, and observed emotional eating at 3-5 years (N=62).

| | Experimental group (n=29) | | | | Control group (n=33) | | | | t, p |
|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Mean | SD | Min | Max | Mean | SD | |
| Child age in months | 35.0 | 59.0 | 47.8 | 7.4 | 34.0 | 56.0 | 44.5 | 5.9 | 1.96, .06 |
| Mothers' age in years | 21.0 | 43.0 | 34.2 | 5.5 | 26.0 | 43.0 | 33.8 | 5.5 | .26, .79 |
| Mother's years of education post 16 | .0 | 8.0 | 4.0 | 2.7 | .0 | 14.00 | 4.6 | 3.3 | -.79, .43 |
| Child BMI SDS | -1.33 | 1.81 | .34 | .75 | -2.15 | 2.92 | -.13 | 1.01 | 2.05, .04 |
| Mother’s BMI | 19.3 | 34.1 | 24.0 | 3.6 | 17.8 | 40.5 | 25.1 | 5.9 | -.89, .37 |
| Food Responsiveness | 1.4 | 4.6 | 2.4 | .8 | 1.0 | 5.00 | 2.2 | .7 | .90, .37 |
| Emotional Over-eating | 1.0 | 3.0 | 1.7 | .6 | 1.0 | 2.3 | 1.4 | .4 | 2.24, .03 |
| Enjoyment of Food | 1.0 | 5.0 | 3.8 | .8 | 2.0 | 5.0 | 3.7 | .8 | .63, .53 |
| Satiety Responsiveness | 2.2 | 4.2 | 3.0 | .5 | 1.4 | 4.8 | 3.1 | .8 | -.18, .86 |
| Emotional Under-eating | 1.5 | 5.0 | 3.2 | .8 | 1.3 | 5.0 | 2.8 | 0.9 | 1.41, .17 |
| Food Fussiness | 1.0 | 5.0 | 3.1 | .9 | 1.0 | 4.3 | 2.7 | .9 | 1.45, .15 |
| Baseline Mood | 1.0 | 5.0 | 4.4 | 1.0 | 1.0 | 5.0 | 4.3 | 1.0 | .13, .90 |
| Mood after mood induction/control activity | 1.0 | 5.0 | 3.1 | 1.5 | 2.0 | 5.0 | 4.0 | .9 | -2.6, .01 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Kilocalories consumed from breadsticks | .0 | 34.3 | 6.0 | 9.2 | .0 | 12.0 | 2.0 | 3.9 | 2.28, .03 |
| Kilocalories consumed from carrot | .0 | 3.1 | .3 | .7 | .0 | 1.9 | .2 | .6 | .25, .80 |
| Kilocalories consumed from grapes | .0 | 27.0 | 3.4 | 6.1 | .0 | 41.1 | 4.4 | 8.9 | -.47, .64 |
| Kilocalories consumed from crisps/potato chips | .0 | 33.9 | 6.0 | 9.9 | .0 | 31.0 | 3.7 | 7.7 | .97, .34 |
| Kilocalories consumed from cookies | .0 | 57.2 | 8.7 | 19.2 | .0 | 128.0 | 14.8 | 30.8 | -.90, .37 |
| Kilocalories consumed from chocolate | .0 | 109.9 | 26.5 | 31.2 | .0 | 121.6 | 25.9 | 33.6 | .07, .95 |
| Total Kilocalories consumed | .0 | 144.5 | 51.1 | 42.2 | -.16 | 152.6 | 51.0 | 47.0 | .01, .99 |

3.2 Relationships between CEBQ subscales and snack food intake.

Table 2: One tailed partial correlations of CEBQ subscales with kilocalories consumed under conditions of negative mood, adjusted for child gender, child BMI SDS, child age, maternal age, and maternal years of education.

| **Kilocalories consumed** | **EOE** n=27 | **EUE** n=27 | **FR** n=29 | **EF** n=27 | **SR** n=29 | **FF** n=29 |
|---|---|---|---|---|---|---|
| Breadsticks | -.05 | .06 | .42* | .34 | .01 | .03 |
| Carrot | -.06 | -.10 | .07 | -.10 | -.26 | .17 |
| Grapes | .11 | .11 | .21 | .07 | -.19 | -.04 |
| Crisps/potato chips | -.35 | -.57** | .09 | .20 | -.06 | -.18 |
| Cookies | -.06 | -.36* | .08 | -.04 | .18 | .16 |
| Chocolate | -.02 | -.01 | .17 | .03 | .01 | -.01 |
| Total Kcal | -.07 | -.24 | .31 | .13 | .05 | .03 |

*$p \leq .05$ **$p \leq .01$ NB. EOE: Emotional Over-eating. EUE: Emotional Under-eating. FR: Food Responsiveness. EF: Enjoyment of Food. SR: Satiety Responsiveness. FF: Food Fussiness. Variation in n size for each analysis due to missing questionnaire data.

Table 2 demonstrates that, contrary to our hypothesis, parents' ratings of EOE were not significantly related to greater consumption of snack foods when the children experienced negative mood. Indeed, whilst not quite reaching significance, EOE was actually related to lower intake of crisps/potato chips in this condition. However, parents' ratings of their children's EUE were significantly correlated with lower consumption of both crisps/potato

chips and cookies when the children experienced negative mood. Children higher in food responsiveness consumed more kilocalories from breadsticks. However, EF, SR and FF were not correlated with any index of food intake in this condition.

Table 3: Partial correlations of CEBQ subscales with kilocalories consumed under conditions of neutral mood, adjusted for child gender, child BMI SDS, child age, maternal age, and maternal years of education.

| **Kilocalories consumed** | **EOE** n=21 | **EUE** n=23 | **FR** n=29 | **EF** n=30 | **SR** n=30 | **FF** n=30 |
|---|---|---|---|---|---|---|
| Breadsticks | .06 | .31 | .10 | -.05 | .23 | .39* |
| Carrot | -.19 | .17 | -.05 | -.13 | .37* | .01 |
| Grapes | -.12 | .29 | -.05 | .21 | -.05 | .11 |
| Crisps/potato chips | -.36 | -.01 | -.02 | -.02 | .05 | -.20 |
| Cookies | .12 | -.32 | .02 | .13 | -.18 | .04 |
| Chocolate | .17 | .22 | -.02 | .36* | -.20 | .05 |
| Total Kcal | .10 | .06 | .00 | .34* | -.23 | -.08 |

*$p$<.05 NB. EOE: Emotional Over-eating. EUE: Emotional Under-eating. FR: Food Responsiveness. EF: Enjoyment of Food. SR: Satiety Responsiveness. FF: Food Fussiness. Variation in n size for each analysis due to missing questionnaire data.

The results presented in Table 3 demonstrate that parents' ratings of their children's emotional eating were not significantly related to children's consumption of snack foods in the absence of hunger in a neutral mood condition. Once again, whilst not reaching significance, EOE showed a trend of association with lower crisp intake. FR was not

correlated with food intake in this condition. Children higher in EF consumed more kilocalories from chocolate and kilocalories overall in the neutral mood condition. Children rated to be more satiety responsive ate more carrot, but did not consume more or less of any other snack food. Children rated high in FF consumed more kilocalories from breadsticks.

Comparison of the difference in magnitude of each correlation coefficient between the experimental and control groups is shown in Table 4.

Table 4: Fisher's r to z transformations to indicate magnitude of difference between correlation coefficients.

| | **EOE** | **EUE** | **FR** | **EF** | **SR** | **FF** |
|---|---|---|---|---|---|---|
| Breadsticks | -.35 | -.86 | 1.25 | 1.44 | -.82 | -1.39 |
| Carrot | .42 | -.90 | .07 | .11 | -2.38** | .59 |
| Grapes | .74 | -.62 | .95 | -.51 | -.52 | -.55 |
| Crisps/potato chips | .04 | -2.11* | .40 | .79 | -.4 | .08 |
| Cookies | -.58 | -.15 | .22 | -.61 | 1.32 | .44 |
| Chocolate | -.61 | -.77 | .69 | -1.24 | .77 | -.22 |
| Total Kcal | -.55 | -1.01 | 1.16 | .80 | 1.03 | .40 |

*p<.05, **p<.01

Z score analyses demonstrate that there were few significant differences between the groups in magnitude of correlations. There was a significant difference in magnitude of correlation between emotional under-eating scores and crisps/chip intake, and between satiety responsiveness and carrot intake.

Finally we examined the interrelationships between CEBQ subscales in our sample to aid interpretation of our findings. Supplementary Table D demonstrates that EOE and EUE were significantly and positively correlated. EOE did not show any other significant relationships with other parent reports of children's eating behaviour. EUE was signfiicantly positively correlated with SR and FF.

## 4. Discussion

This is the first study to examine whether the widely used EOE and EUE subscales of the CEBQ reflect preschool children's ingestive behaviour within a laboratory setting under conditions of negative or neutral mood. We did not find support for the hypothesis that mothers' ratings of EOE would be related to greater consumption of snack foods in the absence of hunger when the children experienced negative mood. EOE ratings did not reflect significantly greater intake of any snack food in either condition. We did find some support for the hypothesis that mothers' ratings of their children's EUE would be related to lower consumption of snack foods in the absence of hunger when the children experienced negative mood, but not in a neutral mood condition. Children rated as higher in EUE ate fewer kilocalories from crisps/potato chips and cookies, i.e. high calorie and palatable snack foods, when in a negative mood state but there were no significant relationships with intake when in neutral mood. One explanation for the fact that the relationships between EUE ratings and intake under negative mood conditions appeared to be specific to crisp/chip and cookie intake only is possibly that the palatability and relative consumption of the snack foods varied considerably. There were very few calories consumed from breadsticks, carrots or grapes, and this may have limited the chance of finding any significant relationships with EUE due to floor effects in the data. In contrast, most children, in both conditions, consumed chocolate and for many children this was the most substantial contributor to their caloric intake. It is possible that the palatability of chocolate

over-rode effects of EUE tendencies on intake, creating ceiling effects. Crisps and cookies however were frequently consumed, but not on the scale of chocolate, and are therefore perhaps more sensitive to variations in intake based on mood. In particular, the magnitude of difference of the correlation coefficients was significantly different between groups for the relationship between EUE and crisps/chip intake, but not cookie intake, suggesting that crisp/chip intake might be particularly sensitive to variations in intake based on mood. There was also some support for the hypothesis that EUE measures emotional eating rather than just smaller appetite per se, given that there was no significant relationship between ratings of EUE and intake when children were in the neutral mood condition. Similarly, enjoyment of food, satiety responsiveness and food fussiness were unrelated to intake in the negative mood condition, and food responsiveness only showed correlation with intake of kilocalories from breadsticks in this condition. This suggests that whilst EUE ratings overlap with other indices of reduced food intake, what is being measured by the EUE subscale is qualitatively distinct from satiety responsiveness and food fussiness.

This study did not find support for the validity of the EOE measure in relation to the intake of 3-5 year olds undergoing this particular negative mood induction in a laboratory setting. This mirrors the finding from the adult literature that emotional eating questionnaires are not always a good index of increased consumption in negative mood states [Bongers & Jansen, 2016], and whilst this study was an exploratory analysis of existing data, it is the first to suggest that the lack of correspondence between questionnaire and intake measures of emotional eating may also be the case in children. In our study, this may be related to the specific mood states that are listed within EOE items of the CEBQ, relative to the mood state induced in this study. Whilst we were able to demonstrate ‘more negative

mood' in children in the experimental group, we are unable to classify the specific type of mood state induced by the procedure, given that the age group of the participants precludes in-depth descriptions of specific emotions. However, we can imagine that this mood state might be one of frustration, anger, disappointment, or being generally 'upset'. Items of the CEBQ which indicate EUE ask about children's behaviour when angry, tired, happy or upset. This may mean that the mood induction chosen maps relatively well onto maternal reports of eating behaviour within these mood states. In contrast, CEBQ items relating to EOE ask about children's eating behaviour when worried, annoyed, anxious or 'nothing else to do' (boredom). With the exception of the CEBQ item asking about eating behaviour when 'annoyed', it is plausible that the negative mood state induced by our procedure did not sufficiently reflect the other mood states listed in these items. Further studies examining the relationships between other, specific induced mood states, such as boredom, and parent reports of emotional eating, are required.

Another important finding from this study was that parent ratings of EOE correlated positively with EUE; a finding which has been demonstrated in other, larger scale studies [Herle et al., 2017a]. One interpretation is that what is being measured here is perhaps linked to a child's emotionality rather than necessarily indicating a tendency to over-eat or under-eat in response to emotion. It is also possible that this correlation is explained by the fact that within an individual, different mood states might elicit different eating behaviours (for example, eating more whilst bored, but less when upset). Nonetheless, EOE was not

significantly correlated with other CEBQ subscales in this study, suggesting that it is not simply an index of maternal perception of the child's appetitive traits. Further work is needed to examine the degree to which parental perception of child emotionality and concerns about child eating behaviour or weight might interact to predict higher rates of reported child EOE.

A further factor which may explain why we did not see relationships between maternal report of EOE and eating behaviour in the laboratory may be that the sample were very young. A number of studies have demonstrated that emotional over-eating increases with age; parental reports of children's EOE increase and reports of EUE decrease between 4 and 10 years of age [Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2007]. In contrast, Van Strien and Oosterveld [2008] proposed that for most young children a reduction in appetite associated with loss of gut activity occurs under acute stress. Indeed, mean scores demonstrate that whilst EUE was rated as happening 'sometimes' on average, EOE was rated as happening 'rarely'. Therefore, laboratory studies with older children may be necessary to identify robust effects of negative mood induction on over- rather than under-eating, which may show better relationships with parental reports.

Strengths of this study include the objective observation of children's eating behaviour, measurement of the consumption of a range of snack foods, and the use of a controlled, experimental paradigm to explore a negative and a neutral mood state. The primary

limitation of this study is that it was not designed to test the validity of the measure, and we are therefore underpowered to detect small effects. Post hoc power calculations show that power to detect a correlation at r=.3 is 0.35 (control group) and 0.39 (experimental group). We were adequately powered to find large effects (r=.5 and above) only. Furthermore, n size for each analysis varied dependent on missing questionnaire data, so in some cases were further underpowered to detect relationships; in particular, this may have been important in examining relationships between EOE and food intake in the control group. Indeed, there are a number of relationships within the analysis that narrowly missed statistical significance and there were only two significant differences between groups in the magnitude of correlation coefficients; nevertheless, the basic pattern of relationships is such that we have confidence in the conclusions made here. However, of particular note was that EOE showed a trend towards a significant negative correlation with crisp/chip intake in both groups, perhaps suggesting that the measure of EOE might not be measuring emotional over-eating per se, but possibly a tendency towards emotional eating which might also include under-eating. Given the significant relationships between EOE and EUE in the sample, this possibility deserves further exploration in subsequent work. In addition, the experimental group had higher EOE scores than the control group (mean 1.7 vs. mean 1.4) and a larger range (1-3 vs. 1-2.3), which may have marginally affected ability to detect relationships between EOE and intake in each group. Further research should consider matching groups on such characteristics. A further limitation is that whilst we tried to reduce demand characteristics, such as children's expectation that they should

eat some of the snack food, and make the session as naturalistic as possible, laboratory studies of eating and emotion are of course different from those situations experienced outside of the laboratory. Parent report may better reflect children's tendencies towards emotional eating generally, rather than in response to the specific mood state induced and limited food choices presented in the laboratory setting.

In conclusion, this study shows some moderate support for the validity of the EUE scale of the CEBQ in 3-5-year-old children. Further work, including induction of different mood states, is required to explore whether the EOE scale captures young children's emotional over-eating, or whether it is better understood as an index of parental perceptions and concerns about their children's emotionality or other child eating behaviours.

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387 *Author Contributions:* JB, CF, & EH conceived and designed the study, contributed to the

388 analysis and interpretation of the data and the preparation of the manuscript. All authors

389 have read and approved the final version for publication.

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391 *Conflicts of Interest:* The authors declare no conflict of interest.

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***Key points:***

- Investigation of early origins of children's emotional eating is important for understanding the development of eating disorders and obesity.
- Many studies utilise the parent-report of emotional over-eating [EOE] and emotional under-eating [EUE] subscales of the Children's Eating Behaviour Questionnaire [CEBQ].
- The relationship between EOE and EUE using the CEBQ and children's eating behaviour under conditions of negative emotion has not been examined.
- After negative mood induction, children who were rated as higher in EUE ate fewer kilocalories from crisps/potato chips and cookies, supporting the validity of the EUE scale of the CEBQ.
- There were no significant relationships between EOE and children's snack food intake; caution is required when inferring that EOE reflects young children's emotional over-eating behaviour.

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Supplementary Table A: Gender differences in key study variables:

| | Child gender | N | Mean | Std. Deviation | t |
|---|---|---|---|---|---|
| Child BMI SDS | Male | 33 | .18 | .98 | .84 |
| | Female | 29 | -.02 | .85 | |
| Enjoyment of Food | Male | 30 | 3.73 | .60 | -.21 |
| | Female | 29 | 3.78 | .93 | |
| Satiety | Male | 30 | 3.03 | .56 | -.28 |
| Responsiveness | Female | 29 | 3.08 | .79 | |
| Slowness of Eating | Male | 30 | 3.06 | .65 | -.98 |
| | Female | 29 | 3.23 | .72 | |
| Food Fussiness | Male | 30 | 2.99 | .73 | .85 |
| | Female | 29 | 2.79 | 1.07 | |
| Emotional Over-eating | Male | 28 | 1.43 | .49 | -.21* |
| | Female | 23 | 1.73 | .52 | |
| Emotional Under-eating | Male | 30 | 3.03 | .79 | .10 |
| | Female | 23 | 3.00 | .96 | |
| Food | Male | 33 | 2.05 | .41 | -3.38** |
| Responsiveness | Female | 28 | 2.64 | .90 | |
| Kilocalories | Male | 30 | 4.21 | 7.13 | .12 |
| consumed from | Female | 29 | 3.98 | 7.49 | |
| breadsticks | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Kilocalories consumed from carrot | Male | 30 | .23 | .71 | -.20 |
| | Female | 29 | .26 | .60 | |
| Kilocalories consumed from grapes | Male | 30 | 3.04 | 4.83 | -.89 |
| | Female | 29 | 4.81 | 9.74 | |
| Kilocalories consumed from crisps | Male | 30 | 5.77 | 9.46 | .83 |
| | Female | 29 | 3.86 | 8.21 | |
| Kilocalories consumed from cookies | Male | 30 | 14.60 | 30.34 | .85 |
| | Female | 29 | 8.90 | 19.98 | |
| Kilocalories consumed from chocolate | Male | 30 | 32.15 | 38.54 | 1.46 |
| | Female | 29 | 20.06 | 22.97 | |
| Total Kilocalories consumed | Male | 30 | 59.99 | 49.05 | 1.59 |
| | Female | 29 | 41.89 | 37.47 | |

456 *p<.05 **p<.01
457

458 Supplementary Table B: Two-tailed Pearson's correlations between demographics and
459 child characteristics with key study variables: Experimental group (n=29).
460

| | Child age in months | Mothers' age in years | Mother's years of education post 16 | Child BMI SDS | Mother's BMI |
|---|---|---|---|---|---|
| Emotional Over-Eating | .16 | -.26 | .07 | -.11 | -.14 |
| Emotional under-eating | -.47* | .02 | .49** | -.44* | -.22 |
| Enjoyment of Food | .06 | .03 | -.11 | .27 | -.16 |
| Satiety Responsiveness | -.14 | -.20 | .22 | -.43* | .18 |
| Slowness of Eating | -.13 | -.27 | .02 | -.31 | .02 |
| Food Fussiness | .10 | .14 | .21 | -.27 | -.01 |
| Kilocalories consumed from Breadsticks | .08 | .18 | -.03 | .02 | -.06 |
| Kilocalories consumed from carrot | -.08 | -.49** | .18 | -.34 | -.29 |
| Kilocalories consumed from grapes | -.08 | .02 | -.14 | .34 | -.05 |
| Kilocalories consumed from crisps | -.01 | .19 | -.08 | -.08 | .13 |
| Kilocalories consumed from cookies | .10 | -.21 | -.15 | -.11 | -.02 |
| Kilocalories consumed from chocolate | -.19 | .22 | .20 | -.19 | .08 |
| Total Kilocalories consumed | -.09 | .141 | .04 | -.16 | .05 |

461 *p<.05 **p<.01
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Supplementary Table C: Two-tailed Pearson's correlations between demographics and child characteristics with key study variables: Control group (n=33).

| | Child age in months | Mothers' age in years | Mother's years of education post 16 | Child BMI SDS | Mother's BMI |
|---|---|---|---|---|---|
| Emotional Over-Eating | -.14 | .05 | -.01 | .30 | .27 |
| Emotional under-eating | -.38 | -.40* | -.22 | .23 | .29 |
| Enjoyment of Food | .01 | .20 | .26 | -.12 | .19 |
| Satiety Responsiveness | .03 | -.31 | -.17 | -.12 | -.10 |
| Slowness of Eating | .04 | -.15 | -.09 | .02 | -.19 |
| Food Fussiness | -.07 | -.13 | -.13 | .04 | -.09 |
| Kilocalories consumed from Breadsticks | -.05 | .23 | .01 | .11 | -.03 |
| Kilocalories consumed from carrot | .08 | -.02 | .03 | -.07 | -.08 |
| Kilocalories consumed from grapes | -.28 | -.21 | -.26 | -.15 | .21 |
| Kilocalories consumed from crisps | .27 | -.04 | .10 | .05 | -.12 |
| Kilocalories consumed from cookies | -.03 | .08 | .11 | -.11 | -.22 |
| Kilocalories consumed from chocolate | .49** | .01 | .30 | .12 | -.08 |
| Total Kilocalories consumed | .32 | .03 | .25 | .00 | -.19 |

470 *p<.05 **p<.01

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Supplementary Table D: Pearson's 2 tailed correlation coefficients between subscales of the CEBQ (n=62)

| | Emotional Under-Eating | Food Responsive-ness | Enjoyment of Food | Satiety responsiveness | Food Fussiness |
|---|---|---|---|---|---|
| Emotional Overeating | .30* | .16 | -.11 | .09 | .10 |
| Emotional Under-Eating | - | -.20 | -.27 | .49** | .31* |
| Food Responsiveness | - | - | .49** | -.29* | -.17 |
| Enjoyment of Food | - | - | - | -.51** | -.58** |
| Satiety responsiveness | - | - | - | - | .39** |

*p<.05 **p<.01