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Emotional eating following a laboratory mood induction: The interaction between parental feeding practices and child temperament

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ABSTRACT

Children who emotionally eat (EE) tend to consume palatable foods that are high in sugar and fat. How EE develops remains unclear, but children's temperament and parental feeding practices may interact to shape child EE. To date, no research has explored these interaction effects on EE experimentally. Furthermore, most research has explored EE in response to generic 'negative' mood rather than specific negative emotions, such as boredom, which has never been explored in this context. This study aimed to explore interactions between induced mood condition (sadness, boredom, control), parent-reported non-responsive feeding practices and parent-reported child temperament (negative affect, surgency, effortful control) in predicting kilocalories consumed by children aged 4–5-years in a laboratory setting. Using three-way ANOVA, the interactions between mood state, parental feeding practice and child temperament were assessed. Results indicated that children who experienced boredom consumed significantly more total kilocalories than children in the control condition. Additionally, children with high negative affect who also had parents who reported high use of food for emotion regulation consumed significantly more kilocalories from sweet food when experiencing boredom compared to control condition, and children with high negative affect who also had parents who reported low use of food as a reward consumed significantly more kilocalories from sweet food when experiencing boredom compared to control condition. These findings suggest that feelings of boredom differentially predict children's snack food intake, and that child negative affect and non-responsive feeding practices play an important role in the expression of this relationship.

1. Introduction

Emotional eating (EE) is defined as eating in response to emotions, particularly those that are negative (e.g. sadness, anger, boredom) (Macht, 2008) and in the absence of hunger (Arnow et al., 1995). The foods that are consumed are often palatable (Nguyen-Michel et al., 2007) and therefore provide hedonic pleasure to alleviate the experience of negative mood (van Strien et al., 2019). EE is evident in children as young as two years old (Haycraft & Blissett, 2012) and is therefore believed to develop during early life. The origins of EE are unclear, but heritability estimates of this eating behaviour are low (Herle et al., 2018), suggesting that EE can be considered as a predominantly learned behaviour.

Russell and Russell (2018) developed the Biopsychosocial Model, which posits that children's eating behaviours are shaped by child factors, parent factors, environmental factors, and interactions between these. In terms of child factors, previous research has focussed on the influence of child temperament which is often conceptualised according to three primary components: negative affect (the tendency to experience heightened negative emotions), surgency (the tendency to behave impulsively and to show low levels of shyness), and effortful control (the degree of self-regulation) (Rothbart & Bates, 2007). Each of these have been associated with children's EE and overeating; specifically, high surgency, high negative affect, and low effortful control have been linked with greater EE in children (e.g., Leung et al., 2014; Steinsbekk et al., 2020). In terms of parental feeding practices, more controlling practices that are not responsive to child hunger and satiety signals (e.g., using food as a reward, using food for emotion regulation, and restricting access to food) are often associated with greater child EE. Specifically, parental use of food for child emotion regulation (e.g., using food to soothe negative child emotions) may condition children to reach for food to deal with distress (Blissett et al., 2010), while parental

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use of food as a reward (e.g., offering sweets as a reward for good behaviour) may teach children to learn to anticipate, or seek out, high calorie foods as rewards in the absence of hunger (Farrow et al., 2015). Similarly, overt restriction of certain foods has been shown to heighten child preferences for those 'forbidden' foods. Through repeated exposure to these feeding practices children may learn to seek out typically high calorie, palatable foods, often in response to emotional stimuli, which can undermine their ability to regulate their hunger and satiety (Miller et al., 2020).

To date, much of the research about child EE has been based on questionnaire studies. These studies can lack the rigour of experimental or observational approaches and also tend to cluster different negative emotional responses together. For example, the Children's Eating Behaviour Questionnaire (Wardle et al., 2001) is commonly used to measure EE, but does not distinguish between eating due to sadness, anger, worry, or boredom. Studies that have used experimental methods with 3–5-year-old children have found that children ate more chocolate in response to negative emotions compared to a control group with no mood manipulation, but only when mothers reported using high food for emotion regulation (Blissett et al., 2010). In a different study, children consumed significantly more kilocalories from chocolate in a sad mood induction condition compared to children in a happy mood induction condition (Tan & Holub, 2018), which suggests that positive emotions can be associated with EE in children, but that positive emotions are not as strongly related to snack food consumption as negative emotion. Although these studies have explored negative/ sad mood manipulations experimentally, other distinct negative emotions, i.e., boredom, has not been studied in this way with children.

Boredom, defined by feelings of dissatisfaction and a lack of purposefulness at one's current situation (Mikulas & Vodanovich, 1993), is a common emotional response in children (Westgate & Steidle, 2020). Koball et al. (2012) found that EE in response to boredom in undergraduate students independently predicted EE outside of 'negative mood', suggesting that mechanistically, boredom-EE may operate differently to eating in response to negative mood. Several studies with adults have shown that feelings of boredom that are experimentally induced are associated with the consumption of more palatable foods (Havermans et al., 2015; Moynihan et al., 2017), however this research has not yet extended to children. The COVID-19 pandemic provided a natural experiment for many families where boredom was heightened as many children were prevented from socialising or attending schools or childcare facilities (Panda et al., 2021). One study suggested that increased boredom as a result of these lockdowns was significantly associated with parentally reported increased EE and frequency of snacking behaviour for 3–12-year-old children (Philippe et al., 2021). However, these results reflect a specific time period with multiple confounding factors and controlled experimental studies are needed. It would be interesting to explore whether boredom induced EE in children elicits different snacking behaviour in comparison to experiences of other negative emotions, such as sadness, as boredom might elicit more eating in the absence of hunger than feelings of sadness because of the suppressant effects of sadness on appetite in many young children (van Strien & Oosterveld, 2008). Indeed, boredom is an easily modifiable mood state and, should evidence suggest it is related to EE, it could prove to be a valuable intervention target.

Research is also needed to understand how parental feeding practices and children's temperament may shape eating behaviour in the context of boredom. Qualitative research suggest that parents use greater emotional feeding when their child is bored (Carnell et al., 2011), and children with more impulsive temperaments (a facet of surgency; Putnam & Rothbart, 2006) are also more prone to experiencing boredom (Golubchik et al., 2021). Therefore, it is possible that children with more surgent temperaments may be more predisposed to EE in response to boredom and that parental emotional feeding may heighten the likelihood of children using food in response to boredom. In a retrospective study with adults, Barnhart et al. (2021) found that greater exposure to restrictive feeding practices during childhood was more strongly related to greater boredom-EE in adulthood when emotion regulation was low during childhood. This work underscores the importance of child characteristics such as temperament in shaping responses to feeding practices that may predict boredom induced EE. However, these relationships have not yet been explored during childhood, and retrospective accounts from adulthood may lack accuracy.

The aim of the current study was to explore the interactions between parental non-responsive feeding practices (use of food for emotion regulation, use of food as a reward, restriction of food for health reasons), child temperament (negative affect, surgency, effortful control) and mood condition (sadness, boredom, control) on kilocalories consumed by children (overall total kilocalories, total sweet kilocalories, total savoury kilocalories) in a laboratory setting in the absence of hunger. It was hypothesised that 1) there would be a main effect of mood condition on kilocalories consumed where those children within the boredom and sadness mood conditions would consume more kilocalories than those in the control condition. It was also hypothesised that there would be main effects of non-responsive feeding practices and child temperament, 2) where children of parents who reported high use of non-responsive feeding practices would consume more kilocalories than parents who reported low use, and 3) children with high negative affect or surgency, or low effortful control would consume more kilocalories than children with low scores on these temperamental traits. It was also hypothesised that 4) there would be a three-way interaction between parental feeding practices, temperament, and mood condition. Specifically, it was hypothesised that children would consume significantly more kilocalories in the boredom or sadness condition compared to the control condition if their parent reported high use of non-responsive feeding practices and the child scored high in negative affect or surgency, or low effortful control.

2. Materials and methods

2.1. Participants

Ninety-three parent–child dyads were required for statistical power (using G*Power, large effect size (f = 0.40 (informed by previous research into parental feeding practices and temperament (Stone et al., 2022)), 80 % power, $\alpha = 0.05$). The current study utilised a sample of 119 parent–child dyads and so was sufficiently powered. Parents and their children were recruited using paid social media advertisements (Facebook) that were parametrised based on distance to the University's laboratory, and the study inclusion/exclusion criteria. The inclusion criteria were parents and their children aged between 4 and 5-years, not vegan and without food allergies, intolerances or medical conditions that would affect eating.

2.2. Design

The study was approved by Aston University's Health and Life Sciences Ethics Committee (#1646), and Aston University's Institute of Health and Neurodevelopment. All procedures were conducted in accordance with the Declaration of Helsinki as revised in 1983. All parents provided informed consent for their own and their child's participation. Children also provided verbal assent to take part.

This study used a between-subjects design where children were assigned using block randomisation to one of three mood conditions (sadness, boredom, control) to experience a mood induction paradigm. The control condition involved a task that induced no target emotion and so reflected a child's typical mood state. Following the mood induction, children had access to a buffet of snacks and their parents simultaneously completed a standardised battery of questionnaires regardless of the mood condition their child was randomised to. There were two independent variables consisting of three parental feeding practices (use of food for emotion regulation, use of food as a reward,

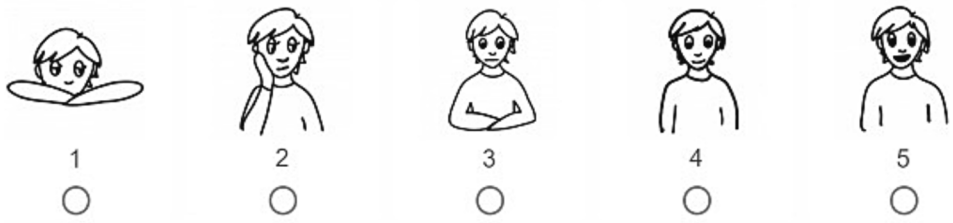

Fig. 1. Boredom mood Likert scale for boys as presented on Qualtrics.

restriction of food for health reasons) dichotomised using median splits into two levels of high and low, and three child temperaments (negative affect, surgency, effortful control) again dichotomised using median splits into two levels of high and low. There was also an independent variable of mood condition with three levels (sadness/boredom/control). Therefore, this study operated using a 2 × 2 × 3 design where the effects of each parental feeding practice and each child temperament were assessed with mood condition in turn. The dependent variables for this study were total kilocalories consumed from all snacks, total kilocalories consumed from sweet snack foods, and total kilocalories consumed from savoury snack foods. This enabled examination of whether any EE effects identified were specific to sweet or savoury foods because previous research suggests that when people emotionally eat, they consume highly palatable foods, which tend to be high in fat and sugar (Nguyen-Michel et al., 2007).

2.3. Procedure

Testing sessions took place at either lunchtime (11:00–14:00) or dinner time (16:00–18:00), and parents were instructed not to provide their child with this meal prior to the session. Testing sessions lasted approximately 60–90-minutes.

Upon entering the nutrition laboratory, the parent and child were taken into the "task room" and given 10-minutes of free playtime. After 10-minutes, the parent and child were invited to sit at the dining table for a standardised meal where the child was asked to "*eat as much as they could until their tummy was nice and full*". Mealtimes lasted around 30-minutes for most families.

After the meal, the child completed a task in the 'task room' with the researcher whilst their parent completed questionnaires in the "parent room". The child could not see their parent during this time, but parents could hear their child and view them using a one-way mirror. The child was aware that their parent was close by. A confederate researcher supervised the parent's completion of the questionnaires, whilst the main researcher remained with the child.

First, the child indicated their baseline mood rating using a Likert scale. Next, one of three mood induction tasks were completed (sadness, boredom, control). Following the mood induction task, the same Likert scale used before mood induction was shown to the child again to assess mood change. Immediately after reassessing mood, the child was presented with a tray of six snack food bowls and told that they could *"eat as much of the snacks as they wished, or they could go and play with any of the toys in the room*". Children were unaware they would have 4-minutes to consume the snacks before being cleared away. The whole task lasted approximately 20-minutes. When the parent had completed the questionnaires, the child was reunited with their parent. Both parent and child were then invited to be weighed and measured by a researcher. Parent-child dyads given a £30 Amazon voucher as compensation for their time and travel expenses.

2.4. Measures

2.4.1. Standardised meal

Following the protocol used by Blissett et al. (2010), parents and children were given the same pre-prepared lunch/dinner regardless of condition. The children's meal consisted of one white bread roll (cut in half) filled with one slice of chicken and one slice of cheese, alongside 4 cheese crackers, 5 carrot batons, 2 chocolate chip cookies, and 3 pieces of chopped red apple. Parents' lunches were the same as the child's but had double the size of the children's sandwich (2 bread rolls, 2 slices of chicken, and 2 slices of cheese). Those children or parents who were vegetarian were given an extra slice of cheese instead of the sliced chicken. Meals were weighed before and after the mealtime to determine the percentage intake of food. Children and parents could ask if they wanted more food, although none did.

2.4.2. Child measures

2.4.2.1. Sadness and control condition Likert scale. A smiley face Likert Scale was used to measure children's mood from happy to sad. This measure has been successfully used with children aged 3–5-years (Blissett et al., 2010) and 5–7-years (Farrow et al., 2015). This five-point Likert scale uses images of yellow emoticons ranging from "*Really sad*" (1), to "*Ok*" (3), to "*Really happy*" (5).

2.4.2.2. Boredom mood Likert scale. A novel scale was developed to capture children's experiences of boredom. Boredom is defined by differences in posture, eye gaze, and gestures (Bull, 1978; Wallbott, 1998). An artist was commissioned to sketch a five-point Likert scale ranging from 1 ("*really bored*") to 5 ("*really interested*"). Separate scales were developed for boys and girls. Children who were "really bored" were depicted sat down with their head on the table whilst children who were "really interested" were shown sat upright, their eyes wide and a wide grin (see Fig.1).

2.4.2.3. Mood induction. In all conditions, children were invited to complete an age-appropriate jigsaw puzzle (24 pieces) to receive a small toy of their choice as a reward for solving the puzzle. Prizes were up to the value of £5.

Sadness: The sadness condition replicated the procedure used by Blissett et al. (2010). Children rated their mood using the smiley face Likert scale and then attempted to complete a jigsaw but learned a piece was missing. The researcher told the child that they were not going to receive their prize because they did not complete the jigsaw. The child's mood was then re-rated. The researcher explained that the confederate in the parent room and the researcher would look for the missing piece, and in the meantime the child could eat any of the snack foods or play with the toys. The researcher then moved out of view from the child whilst keeping a view of the child. After 4-minutes the snacks were cleared and the confederate returned with the missing jigsaw piece. The child then completed the jigsaw, received their chosen prize, and re-rated their mood.

Boredom: The boredom procedure used a novel "sit and wait" paradigm. Children rated their mood using the boredom pictorial Likert scale and the researcher explained both researchers would complete the jigsaw with the child. The confederate researcher (waiting in the parent room) then entered the task room and said there was "*someone at the door of the laboratory*". The confederate left to speak with the pretend

person and the researcher reminded the child that they had to wait for the confederate to return before doing the jigsaw. The researcher asked the child to sit and wait at the table for the confederate whilst the researcher looked at some paperwork in the adjacent kitchen. This was to ensure the child was not distracted by the researcher or able to engage with them. The child did so for 4-minutes and then the researcher returned from the kitchen and the child re-rated their mood. Immediately after mood rating, the confederate returned and both researchers explained they were going to the adjacent kitchen to 'count all the puzzle pieces to ensure they could complete the jigsaw', and in the meantime, the child could eat any of the snack foods or play with any of the toys. This ensured the child could eat freely in private whilst not being distracted by the researcher. Both researchers could see the child, but the child could not see them. After 4-minutes the researchers returned, moved the snacks away, and the child completed the jigsaw. The child then received their prize and re-rated their mood.

Control: The control condition replicated the control procedure used by Blissett et al. (2010). Children first rated their mood using the smiley face Likert scale. Children then attempted the jigsaw without obstacle. Upon completion, the child received their chosen prize, and their mood was reassessed.

2.4.2.4. Snack foods. All children, regardless of mood condition, were provided with six bowls containing six different snacks (replicating Blissett et al., 2010). The snacks totalled 331 calories and comprised 6 g of salted crisps (32 kcal), 2 chocolate-chip cookies (115 kcal), 21 chocolate buttons (115 kcal), 9 green grapes (32 kcal), 2 carrot batons (6 kcal), and 3 mini breadsticks (31 kcal). The presentation of the snack foods was standardised and each snack food was weighed before presentation and after consumption. Manufacturers' nutritional information was used to calculate overall total kilocalories, total sweet kilocalories, and total savoury kilocalories consumed from snacks.

2.4.3. Parent measures

Parents completed the following measures:

2.4.3.1. A demographics questionnaire. Parents completed a demographics questionnaire to assess parent and child characteristics. Parents self-reported their age, sex, height, weight, education level, ethnicity, number of children, their child's age and sex, and their perceived socioeconomic status (SSS) using MacArthur's Scale of Subjective Social Status. This scale uses a ladder as a metaphor to reflect social status, where higher rungs are indicative of a greater perceived social class (Adler et al., 2000).

2.4.3.2. The Comprehensive Feeding Practices Questionnaire (CFPQ – Musher-Eizenman & Holub, 2007). Parents completed the CFPQ to assess parental feeding practices. Three subscales were used as these subscales have been implicated in the development of child EE (Steinsbekk et al., 2016). Subscales include: use of food as a reward, use of food for emotion regulation, and restriction of food for health reasons. All subscales showed good reliability in the current study (food for emotion regulation, $\alpha = 0.73$; food as a reward, $\alpha = 0.76$; restriction of food for health reasons, $\alpha = 0.79$).

2.4.3.3. The Children's Behaviour Questionnaire – Very Short Form (CBQ-VSF - Putnam & Rothbart, 2006). Parents completed the CBQ-VSF to assess their child's temperamental dispositions. This questionnaire assessed negative affect, surgency, and effortful control. In the current study, the CBQ-VSF had good reliability for negative affect ($\alpha = 0.73$), surgency ($\alpha = 0.75$), and effortful control ($\alpha = 0.70$).

2.4.3.4. The Children's Eating Behaviour Questionnaire (CEBQ - Wardle et al., 2001). Parents completed the emotional overeating (EOE) subscale of the CEBQ, which assessed children's EOE. The EOE subscale is one of eight subscales within the questionnaire and the EOE subscale is made up of four items of 35. The EOE subscale had good reliability in the current sample ($\alpha = 0.78$).

2.4.3.5. The Dutch Eating Behaviour Questionnaire (DEBQ - van Strien et al., 1986). Parents completed the EE subscale of the DEBQ, which assessed the extent to which parent's emotionally ate. The EE subscale is one of three within the questionnaire and comprises of 13 items of 33. The EE scale had excellent reliability in the current sample ($\alpha = 0.96$).

2.4.4. Height and weight

At the end of the session, children were weighed and measured with their shoes removed. Parents were also invited to be weighed and measured. If parents were weighed and measured, these metrics replaced any self-reported height and weight given during the demographic's questionnaire.

2.5. Data analysis

IBM SPSS Statistics 26 was used for all data analyses.

2.5.1. Normality and confounding variable analyses

The normality of the three dependent variables was assessed using Kolmogorov-Smirnov tests and these tests indicated that data were skewed (analysis not shown). Subsequent covariate analyses between demographic variables and dependent variables were conducted using non-parametric tests where possible.

2.5.2. Baseline differences and mood change analyses

One-way Analysis of Variance (ANOVA) was used to examine baseline differences in parent and child continuous demographics between conditions, and Chi-squared tests were used to examine baseline differences between categorical demographics. Wilcoxon Signed Ranks tests were used to examine changes in mood from pre-mood induction to post-mood induction for all mood conditions, and in the sadness and boredom condition from post-mood induction to after completing the jigsaw (returning to baseline). Mann-Whitney U tests were used to assess differences in children's baseline mood at pre-mood induction between sadness and control condition, and again to assess mood at post-mood induction between sadness and control condition. Comparisons between sadness and bored, and bored and control conditions were not assessed as they utilised different Likert scales.

2.5.3. Main analyses

ANOVA was used for the main data analyses as ANOVA is considered robust enough to account for a lack of normality and homogeneity (Field, 2013).

2.5.3.1. Main effects of independent variables. To assess the main effects of mood condition (boredom/sadness/control), each child temperament (negative affect, surgency, effortful control – median split high/low), and each parental feeding practice (use of food for emotion regulation, food as a reward, restriction of food for health reasons - median split high/low) on kilocalorie intake, a series of one-way ANOVAs were used. Evidence of a significant main effect ($p < .05$) was followed up using post-hoc analysis using a Bonferroni correction.

2.5.3.2. Three-way ANOVA. To test the hypothesis that there would be a three-way interaction between parental feeding practices, child temperament and mood condition on overall total kilocalories consumed, total sweet kilocalories consumed, and total savoury kilocalories consumed, a series of three-way ANOVAs were run. The independent fixed variables were mood condition, parental feeding practices (high/low) for each feeding practice, and temperament (high/low) for each temperament. A total of nine ANOVAs were run for each of the

Table 1
Participant characteristics of parent–child dyads (N = 119).

Measure	Mean ± *SD*	Min	Max
Parental age (years)	34.30 ± 5.16	21	48
Parental BMI[a]	29.45 ± 1.30	17.06	49.48
Child BMI z-score	0.21 ± 1.06	−2.16	3.16
Number of children	2.26 ± 1.05	1.00	7.00
Child age (years)	4.42 ± 0.60	3.00	6.00
Subjective social status[b]	5.37 ± 1.37	1.00	8.00
Measure		*n* (%)	
Parental ethnicity[d]:			
White:			
English/Welsh/Scottish/Northern Irish/British		81 (68.10)	
Irish		1 (0.80)	
Mixed or Multiple ethnic groups:			
White and Black Caribbean		4 (3.40)	
White and Asian		2 (1.70)	
Black, Black British, Caribbean, or African:			
African		1 (0.80)	
Caribbean		4 (3.40)	
Asian or Asian British:			
Indian		6 (5.00)	
Pakistani		10 (8.40)	
Other ethnic group:			
Arab		3 (2.50)	
Any other ethnic group		7 (5.80)	
Parental education:			
High School		17 (14.30)	
Sixth Form		23 (19.30)	
Undergraduate Degree		51 (42.90)	
Postgraduate Degree		28 (23.50)	
Sex of parent:			
Female		110 (92.40)	
Male		9 (7.60)	
Sex of child:			
Female		61 (51.30)	
Male		58 (48.70)	

[a] $n = 104$. [b] MacArthur's Scale of Subjective Social Status (SSS). [c] $n = 115$. [d] Parental ethnicity determined using the UK Government's list of ethnic groups.

Table 2
Means (±*SD*) of kilocalories consumed by children for each main effect of mood condition, child temperament, and parental feeding practices on each dependent variable (N = 119).

Main Effect	Overall Total Kcal	Total Sweet Kcal	Total Savoury Kcal
Mood Condition:			
Control[a]	52.87 (59.34)	47.19 (57.75)	5.69 (8.87)
Sadness[b]	69.29 (48.95)	58.59 (46.75)	10.69 (13.61)
Boredom[c]	94.41 (76.92)	83.16 (70.63)	11.25 (13.87)
Negative Affect:			
High[d]	75.66 (61.62)	65.83 (58.59)	9.83 (12.43)
Low[e]	68.02 (67.72)	59.53 (62.80)	8.49 (12.60)
Surgency:			
High[f]	72.93 (69.19)	62.52 (64.84)	10.41 (13.67)
Low[g]	71.06 (59.82)	63.11 (56.23)	7.95 (11.10)
Effortful Control:			
High[h]	78.58 (67.27)	69.25 (63.62)	9.32 (12.16)
Low[i]	63.82 (60.39)	54.79 (55.86)	9.03 (12.97)
Food for emotion regulation:			
High[j]	68.84 (63.01)	59.45 (60.34)	9.40 (12.19)
Low[k]	76.36 (66.79)	67.45 (60.95)	6.91 (12.97)
Food as a reward:			
High[l]	72.77 (67.59)	61.81 (62.09)	10.96 (13.51)
Low[m]	71.57 (63.06)	63.83 (59.94)	8.19 (11.82)
Restriction for health reasons:			
High[n]	72.55 (63.12)	64.30 (60.77)	8.25 (10.88)
Low[o]	71.27 (66.81)	60.83 (60.61)	10.44 (14.34)

[a] $n = 40$. [b] $n = 40$. [c] $n = 39$. [d] $n = 62$. [e] $n = 57$. [f] $n = 60$. [g] $n = 59$. [h] $n = 66$. [i] $n = 53$. [j] $n = 69$. [k] $n = 50$. [l] $n = 43$. [m] $n = 76$. [n] $n = 68$. [o] $n = 51$.

three dependent variables. The three-way interactions assessed the interactions of parental feeding practice and child temperament moderated by mood condition for each dependent variable in turn. Main effects and three-way interactions were reported first and then when a dependent variable presented a significant three-way interaction ($p < .05$) follow-up tests of simple effects were used to decompose the interaction, using Bonferroni corrections where possible.

3. Results

3.1. Sample characteristics

Participant characteristics are reported in Table 1. The sample consisted of 110 mothers and 9 fathers. Parents had a mean age of 34 years and a mean BMI of overweight, most described their ethnicity as White, and most were educated to degree level. Parents had an average of two children and described their SSS as middle-class on average. Children were on average 4-years-old, and 61 were female and 58 were male. The mean child BMI z-score was standardised for age and sex (Child Growth Foundation, 1996) and reflected a healthy weight. There were 88 children (73.95 %) with healthy weight, 17 children (14.29 %) with overweight, 11 children (9.24 %) with obesity, and 3 (2.52 %) with underweight.

3.2. Covariate analysis

As seen in Table A.1, none of the continuous parent or child demographics were significantly correlated with any dependent variable. Mann-Whitney U tests and Kruskal-Wallis H tests indicated that there were no significant differences in any dependent variables based on parent sex, child sex, parent education, or parental ethnicity (analysis not shown). Therefore, none of these variables were controlled for in subsequent analyses.

3.3. Baseline differences

One-way ANOVAs and Chi-squared tests indicated there were no significant differences between mood conditions for any continuous or categorical parent or child demographic variables (analysis not shown). As seen in Table A.2, one-way ANOVAs also indicated that there were no significant differences between mood conditions for all parent-reported CBQ-VSF, CEBQ, and DEBQ subscales, and parent-reported CFPQ subscales of use of food for emotion regulation and restriction of food for health reasons. However, there was a significant difference between the CFPQ subscale of use of food as a reward where children in the control condition had parents who reported using food as a reward more than those in the sadness condition ($p = .004$), and children in the boredom condition had parents who reported using food as a reward more than those in the sadness condition ($p = .002$). Nonetheless, there was no significant difference in parental use of food as a reward between children in the control condition and boredom condition ($p = .869$).

3.4. Mood change

As seen in Table A.3, mood ratings in the sadness and boredom conditions significantly changed from pre-mood induction to post-mood induction in the expected direction. There was no significant change in mood ratings in the control condition between pre-mood induction and post-mood induction, which was expected since no mood was induced.

At pre-test (before mood induction task), Mann-Whitney U tests suggested there were no significant difference between mood ratings in sadness and control condition ($U = 771$, $p = .663$). At post-test (after mood induction task), Mann-Whitney U tests indicated that those in the sadness condition were significantly less happy than those in the control condition ($U = 154$, $p < .001$). As seen in Table A.3, children in the sadness and boredom conditions significantly improved in mood after

Table 3
Main effects of parental feeding practices, child temperament, and mood condition on each dependent variable (one-way ANOVA) [ab].

	Overall Total Kcal			Total Sweet Kcal			Total Savoury Kcal		
Main Effects	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Mood condition	4.40	.014	.070	3.81	.025	.062	2.47	.089	.041
Child negative affect	0.42	.520	.004	0.32	.572	.003	0.34	.559	.003
Child surgency	0.03	.875	.000	0.00	.958	.000	1.16	.285	.010
Child effortful control	1.55	.216	.013	1.69	.196	.014	0.12	.898	.000
Food for emotion regulation	0.39	.532	.003	0.51	.478	.004	0.04	.833	.000
Food as a reward	0.01	.923	.000	0.02	.893	.000	1.36	.247	.011
Restriction for health reasons	0.01	.915	.000	0.10	.758	.001	0.89	.346	.008

[a] Mood condition degree of freedom (df) = 2, error df = 116. [b] Parental feeding practices and child temperaments df = 1, error df = 117.

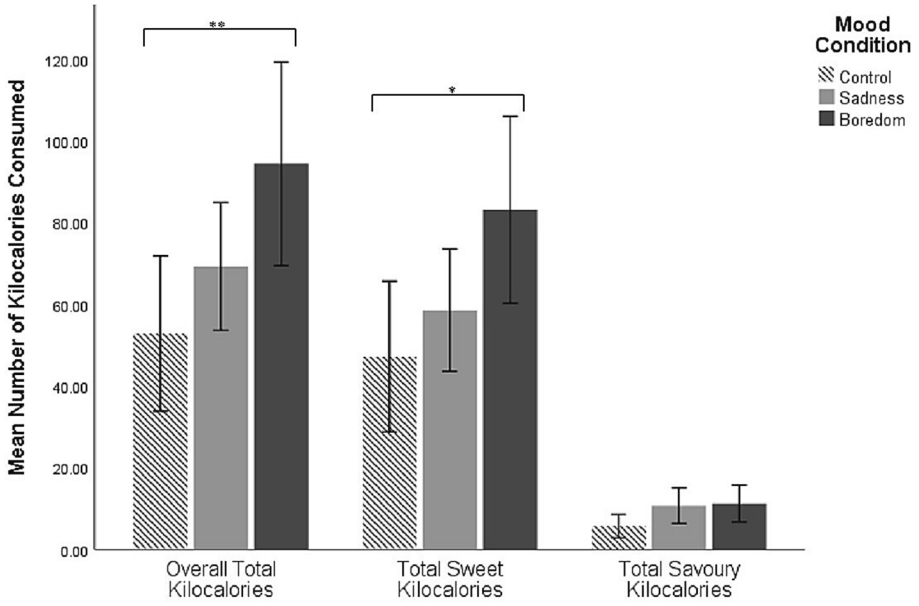

Fig. 2. Clustered bar chart illustrating post-hoc analyses to compare the mean number of kilocalories consumed per mood condition. ** p =.012, * p =.024 (adj Bonferroni). Error bars show 95 % confidence interval.

successfully completing the jigsaw.

3.5. Analysis of Variance (ANOVA)

3.5.1. Main effects (Hypotheses 1, 2 and 3)

Table 2 depicts the means and standard deviations of the main effects for each dependent variable. As shown in Table 3, a series of one-way ANOVAs suggested that there was one significant main effect of mood condition on overall total kilocalories and total sweet kilocalories consumed (Hypothesis 1). Post-hoc analyses using Bonferroni correction indicated that more overall total kilocalories were consumed when children were in the boredom condition compared to the control condition, but there was no significant difference in consumption between the boredom and sadness condition (p =.232), or sadness and control conditions (p =.731). Post-hoc analyses also revealed that more total sweet kilocalories were consumed when children were in the boredom condition compared to the control condition, but there was no significant difference in consumption between boredom and sadness (p =.201), or sadness and control conditions (p =.100) (see Fig. 2). There were no significant main effects of any parental feeding practices (Hypothesis 2) or temperament (Hypothesis 3) on kilocalories consumed.

3.5.2. Three-way interaction (Hypothesis 4)

Three-way ANOVAs suggested that there were two significant three-way interactions (Hypothesis 4). These were the interactive effect of use of food for emotion regulation, negative affect, and mood condition on total sweet kilocalories consumed (F(2,107) = 3.24, p =.043, ηp^2 = 0.058), and the interactive effect of the use of food as a reward, negative affect, and mood condition on total sweet kilocalories consumed (F (2,107) = 3.33, p =.040, ηp^2 = 0.095). There were no other significant three-way interactions for any of the outcome variables (see Table A.4).

3.6. Three-way interaction between parental use of food for emotion regulation, child negative affect, and mood condition on the total number of sweet kilocalories consumed from food

Simple simple main effect analysis suggested that there was a statistically significant simple simple main effect of mood condition for children with high negative affect who have parents who use high use of food for emotion regulation, F(2,107) = 5.62, p =.005, ηp^2 = 0.095, but not for children with high negative affect with parents who use low use of food for emotion regulation F(2,107) = 0.506, p =.605, ηp^2 = 0.009. There was no statistically significant simple simple main effect of mood condition for children with low negative affect who have parents who use high use of food for emotion regulation, F(2,107) = 0.311, p =.733, ηp^2 = 0.006 or for children with low negative affect with parents who use low use of food for emotion regulation F(2,107) = 2.15, p =.121, ηp^2 = 0.039. Therefore, there is an overall effect of mood condition on the number of total sweet kilocalories consumed for children with high negative affect with parents who used high use of food for emotion regulation.

Simple simple pairwise comparisons were run for children with high

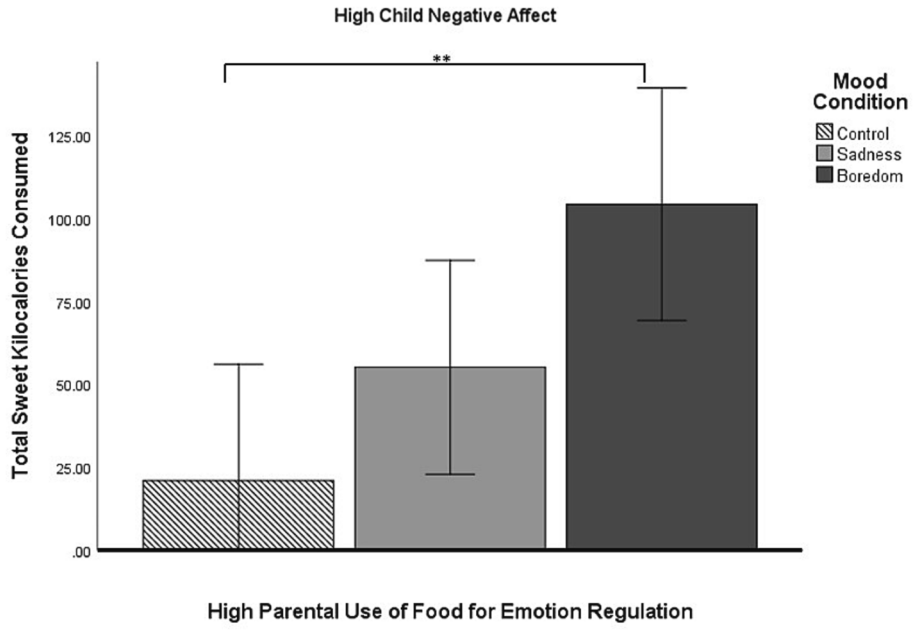

Fig. 3. Simple simple pairwise comparisons (adj Bonferroni) for children with high negative affect with parents who use high use of food for emotion regulation comparing the number of total sweet kilocalories consumed between mood condition. ** p =.004, error bars show 95 % confidence intervals.

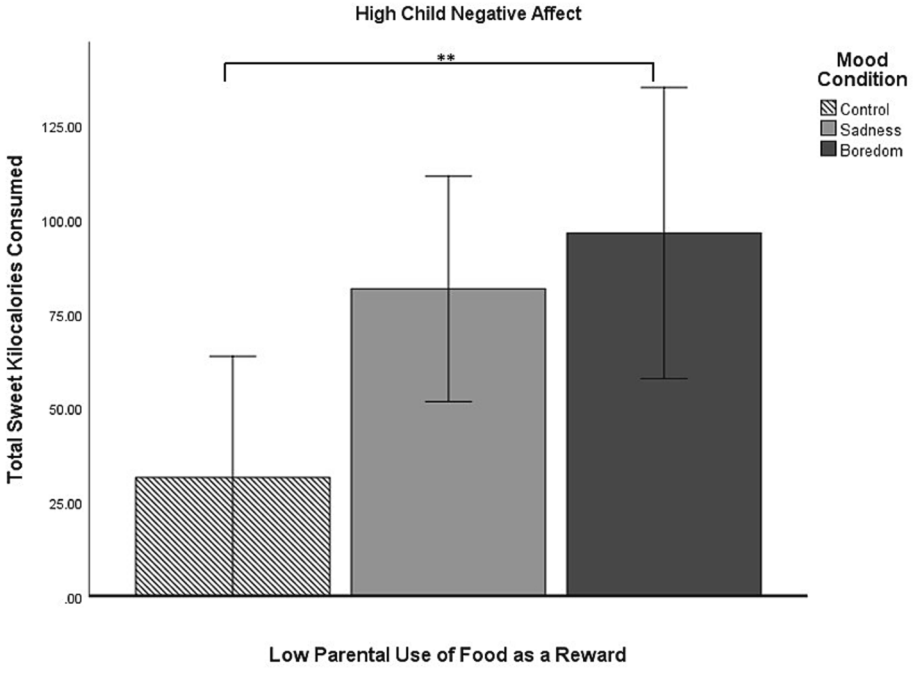

Fig. 4. Simple simple pairwise comparisons (adj Bonferroni) for children with high negative affect with parents who use low use of food as a reward comparing the number of total sweet kilocalories consumed between mood condition. ** p =.036, error bars show 95 % confidence intervals.

negative affect with parents who use high food for emotion regulation with a Bonferroni adjustment applied. Mean number of total sweet kilocalories consumed in the boredom condition was 104.36 kcal (SE = 17.69), 55.17 kcal (SE = 16.27) in the sadness condition, and 21.02 kcal (SE = 17.69) in the control condition. There was a statistically significant mean difference between the number of total sweet kilocalories consumed in the boredom condition and control condition of 83.34 kcal, 95 % CI[22.50, 144.19], p =.004, with those in the boredom condition consuming more than the control condition. However, the difference between the boredom and sadness condition was not statistically significant (95 % CI[-9.26, 107.66], p =.129), nor was the difference between the sadness and control condition (95 % CI[24.31, 92.61], p =.475). Therefore, when a child scored high in negative affect *and* their parent used high use of food for emotion regulation, these children consumed more total sweet kilocalories when they experienced boredom (n = 11) compared to when they experienced a control condition (n = 11) (see Fig. 3).

Table A.1
Spearman's Rho correlations between overall total kilocalories, total sweet kilocalories, and total savoury kilocalories consumed with parent and child demographics (N = 119, two-tailed).

Measure	Overall total kcal consumed	Total sweet kcal consumed	Total savoury kcal consumed
Parent age (years)	.098	.082	.115
Child age (years)	.099	.096	.078
SSS[a]	.088	.069	.136
Parent BMI[b]	.022	.022	.024
Child BMI z-score	.039	.033	.049
Number of children	-.113	-.124	.027

[a] MacArthur's Scale of Subjective Social Status (SSS). [b] $n = 103$.

Table A.2
Means (±*SD*) of parent-reported parent and child individual differences between mood condition (one-way ANOVA).

Measure	Sadness ($n = 40$)	Control ($n = 40$)	Boredom ($n = 39$)	*F*	*p*
Child Surgency[a]	4.67 (0.93)	4.81 (0.90)	4.76 (0.77)	.290	.749
Child Negative Affect[a]	4.25 (0.89)	4.04 (1.06)	4.17 (0.72)	.573	.565
Child Effortful Control[a]	5.21 (0.74)	5.21 (0.57)	5.28 (0.86)	.129	.879
Food for Emotion Regulation[b]	2.18 (0.78)	2.32 (0.69)	2.22 (0.66)	.408	.666
Food as a Reward[b]	2.83 (1.09)	3.51 (0.91)	3.55 (1.11)	6.09	.003
Restriction for Health Reasons[b]	3.59 (0.99)	3.59 (0.91)	3.46 (1.09)	.209	.812
Child EOE[c]	2.11 (0.82)	2.07 (0.70)	2.14 (0.76)	.089	.915
Parent EE[d]	2.57 (1.17)	2.65 (1.19)	2.73 (1.10)	.185	.831

[a] Comprehensive Feeding Practices Questionnaire (CFPQ). [b] Children's Behaviour Questionnaire – Very Short Form (CBQ-VSF). [c] Children's Eating Behaviour Questionnaire (CEBQ). [d] Dutch Eating Behaviour Questionnaire (DEBQ).

3.7. Three-way interaction between parental use of food as a reward, child negative affect, and mood condition on the total number of sweet kilocalories consumed from food

Simple simple main effect analysis suggested that there was a statistically significant simple simple main effect of mood condition for children with high negative affect who have parents who use low use of food as a reward, $F(2,107) = 4.00$, $p = .021$, $\eta p^2 = 0.069$, but not for children with high negative affect with parents who use high use of food as a reward $F(2,107) = 2.18$, $p = .118$, $\eta p^2 = 0.039$. There was also no statistically significant simple simple main effect of mood condition for children with low negative affect who have parents who use high use of food as a reward, $F(2,107) = 2.15$, $p = .121$, $\eta p^2 = 0.039$ or for children with low negative affect with parents who use low use of food as a reward $F(2,107) = 0.919$, $p = .402$, $\eta p^2 = 0.017$. Therefore, there is an overall effect of mood condition on the number of total sweet kilocalories consumed for children with high negative affect with parents who use low use of food as a reward.

Simple simple pairwise comparisons were run for children with high negative affect with parents who use low food as a reward with a Bonferroni adjustment applied. Mean number of total sweet kilocalories consumed in the boredom condition was 96.53 kcal ($SE = 19.51$), 81.72 kcal ($SE = 15.14$) in the sadness condition, and 31.60 kcal ($SE = 16.24$) in the control condition. There was a statistically significant mean difference between the number of total sweet kilocalories consumed in the boredom condition and control condition of 64.94 kcal, 95 % CI[3.20, 126.67], $p = .036$ with those in the boredom condition consuming more than control condition. However, the difference between the boredom and sadness condition was not statistically significant (95 % CI[-3.82, 104.08], $p = .078$), nor between the sadness and control condition (95 % CI[-74.84, 45.22], $p = .999$). Therefore, when a child scored high in negative affect and their parent used low use of food as a reward, these children consumed more total sweet kilocalories when they experienced boredom ($n = 9$) compared to when they experienced a control condition ($n = 13$) (see Fig. 4).

4. Discussion

This study implemented a laboratory experimental design to explore the interactions between children's mood state, parental feeding practices, and child temperament in predicting the number of kilocalories eaten in the absence of hunger by 4–5-year-old children from snack foods. The findings indicate that there were differences in the number of overall kilocalories and total sweet kilocalories consumed between mood conditions (Hypothesis 1), and evidence of two significant three-way interactions between specific non-responsive feeding practices, child temperament and child mood on the number of total sweet kilocalories consumed (Hypothesis 4).

Supporting Hypothesis 1, children who took part in the boredom condition consumed significantly more kilocalories, specifically from sweet foods, compared to children in the control condition. In fact, children consumed 79 % more overall total kilocalories, and 76 % more total sweet kilocalories in the boredom condition compared to control. This finding mirrors previous literature from adult samples where adults who watched a boring film segment consumed twice the number of kilocalories from M&M chocolate compared to those who watched a neutral film segment (Havermans et al., 2015). Despite popular opinion that children eat more when they are bored (Klass, 2020), this study is the first to empirically study this phenomenon. We provide experimental evidence that children as young as 4-years-old eat more kilocalories from snacks when feeling bored in comparison to neutral mood, even when they have very recently eaten to satiety. Additionally, the effect size was medium; children in the boredom condition ate 42 more kilocalories overall during a 4-minute period (of which 36 kcal were from sweet snacks) compared to children in the control condition. If children are eating this many more kilocalories during one instance of boredom, given that boredom is believed to be a common emotion in children (Westgate & Steidle, 2020), the potential for excess kilocalorie intake in response to being bored across one day, one week, or one year, is potentially very significant in a food abundant environment. The fact

Table A.3
Means (±*SD*) of children's pre-mood and post-mood induction ratings within each mood condition, and return to baseline mood in sadness and boredom condition (Wilcoxon Signed Rank test).

Mood Condition	Pre-test Mood	Post-test Mood	*Z*	*p*	Return to Baseline Mood	*Z*	*p*
Control ($n = 40$)[a]	4.85 (0.36)	4.95 (0.22)	−1.41	.157	–	–	–
Sadness ($n = 40$)[a]	4.75 (0.59)	2.80 (1.47)	−4.72	<.001	5.00 (1.47)	−5.05	<.001
Boredom ($n = 39$)[b]	4.46 (0.79)	3.82 (1.30)	−2.54	.011	4.56 (0.64)	−3.45	<.001

[a] Sadness and Control condition assessed using the same 5-point smiley face Likert scale. [b] Boredom condition was assessed using a different 5-point pictorial Likert scale.

Table A.4
Non-significant three-way ANOVA interactions between each parental feeding practice (high/low), child temperament (high/low), and mood condition (sadness/control/boredom) on outcome variables.[a]

	Overall Total Kcal			Total Sweet Kcal			Total Savoury Kcal		
Three-way ANOVA	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
RfHR[b] × NA[c] × Mood	1.29	.278	.024	.728	.485	.013	2.17	.112	.042
RfHR × S[d] × Mood	.648	.525	.012	1.11	.334	.020	1.90	.155	.034
RfHR × EC[e] × Mood	.531	.590	.010	.240	.787	.004	2.23	.113	.040
FaR[f] × NA × Mood	2.99	.055	.053	–	–	–	2.16	.120	.039
FaR × S × Mood	.125	.882	.002	.173	.841	.003	.488	.615	.009
FaR × EC × Mood	.354	.702	.007	.277	.759	.005	.511	.602	.009
FER[g] × NA × Mood	2.83	.063	.050	–	–	–	.086	.918	.002
FER × S × Mood	1.98	.143	.036	2.22	.114	.040	1.93	.150	.035
FER × EC × Mood	1.35	.264	.025	1.46	.237	.027	.578	.563	.011

[a] For all analyses, degrees of freedom (df) = 2 and error df = 107. [b] RFHR = restriction for health reasons. [c] NA = negative affect. [d] S = surgency. [e] EC = effortful control. [f] FaR = use of food as a reward. [g] FER = use of food for emotion regulation.

that the main effect of boredom-EE occurred irrespective of child temperament or parental feeding practices highlights the importance of this emotion as a driver for eating in young children, which should be considered by families who are concerned about children eating in the absence of hunger. According to parental report, EE in children appears to be a stable trait across childhood (Ashcroft et al., 2008), so children who eat more in response to boredom may be predisposed to continue to eat when bored in later life. Despite providing evidence for a main effect of mood condition, this study provided no support for the hypotheses that there would be main effects of non-responsive feeding practices or child temperament on children's EE. This reinforces the narrative that it is the interaction of these variables rather than their independent effects that contribute to children's eating behaviour.

Hypothesis 4 indicated that there would be a three-way interaction between non-responsive feeding practices, child temperament, and mood condition. Specifically, that children would consume the most kilocalories in the boredom or sadness condition compared to the control condition if their parent reported using high levels of non-responsive feeding practices and the child scored high in negative affect or surgency. Findings from this study partially supported Hypothesis 4 since children consumed five times more total sweet kilocalories under feelings of boredom compared to the control condition if their parent reported *high* use of food for emotion regulation and the child scored *high* in negative affect (boredom: $M = 104.36$, $SE = 17.69$ vs. control: $M = 21.02$, $SE = 17.69$). It may be that children who were bored ate significantly more kilocalories from sweet foods if they were high in negative affect and exposed to higher use of food for emotion regulation because parental use of food for emotion regulation tends to be associated with the use of sweet, high calorie foods in the context of regulating the child's emotional arousal. Parents who use this feeding practice more frequently may have found that these foods are particularly effective at comforting their child in response to emotional arousal (van Strien et al., 2019) and/or through repeated exposure, children may learn to find comfort in those sweet foods.

Children with high negative affect often perceive heightened experiences of negative emotions (Rothbart & Bates, 2007) and struggle with regulating such emotions (Rothbart & Sheese, 2007). Therefore, children with high negative affect may be more likely to experience more incidences of parental use of food for emotion regulation to regulate their more negative mood. In situations of boredom, children with high negative affect may be unable to self-soothe as easily as their peers with low negative affect, and, if they have been exposed to greater parental use of food for emotion regulation, they may learn to associate food with a reduction in distress and be more likely to consume sweet foods to relieve feelings of boredom. As the control condition did not evoke an emotion per se, there is less of a need for the child to regulate this experience using sweet foods, even if they were rated high negative affect or if their parents often used food to regulate their emotions. Indeed, mood ratings indicated children were relatively content in the control condition (Table A.3). Importantly, the effect size for this significant three-way interaction was medium. This demonstrates the importance of considering children's temperament and parental feeding practices in children's boredom-EE, and that over time, these factors could make a difference to children's caloric intake which may predispose obesity.

The current study found no evidence of restrictive feeding, surgency, or effortful control effects; either as a significant main effect (Hypotheses 2 and 3) or involved in a significant three-way interaction. This suggests that restriction for health reasons, surgency, and effortful control, may not be related to children's EE. As restriction does not attenuate the emotional meaning of food, this may explain why no restriction effects were found (unlike via reward, or in the context of emotion regulation). As the trait of surgency includes different dimensions such as high impulsivity and high intensity pleasure (Rothbart & Bates, 2007), it is possible that the collective of these behavioural traits - defined as surgency - is not associated with EE, but instead individual traits of a surgent temperament may best predict EE, especially in times of boredom where stimulus engagement is low, and children may be more inclined to seek out alternative stimulation. Additionally, as the children in the current study were 4–5-years old, effortful control effects may have not been found because effortful control has yet to have developed (Leung et al., 2014). Indeed, as children age, they become more autonomous over their food intake (Ogden & Roy-Stanley, 2020) and so deficits in effortful control may only become clear when children are more responsible for their food choices.

It was surprising that there was no evidence of a significant difference in children's kilocalorie consumption when experiencing sadness compared to the control condition for children with high negative affect who had parents reporting high use food for emotion regulation (Hypothesis 4). Previous research has demonstrated that children eat significantly more kilocalories from chocolate when experiencing negative mood compared to a control condition if their mothers reported using more food for emotion regulation (Blissett et al., 2010). However, the mean intake of total sweet kilocalories in the sadness condition for children with high negative affect whose parents reported high use of food for emotion regulation was 55.17 kcal ($SE = 16.27$) compared to the control condition mean of 21.02 kcal ($SE = 17.69$). Therefore, the trend in these means suggest that children with high negative affect who had parents who reported using high use of food for emotion regulation did eat more kilocalories from food, but not enough to represent a statistically significant difference in this sample.

The second significant three-way interaction also partially supported Hypothesis 4, where children would consume more kilocalories when experiencing boredom compared to a control condition if parents rated their child high in negative affect or surgency and reported high use of non-responsive feeding practices. This is because children consumed three times more total sweet kilocalories when experiencing feelings of boredom compared to control condition if the child was rated *high* in

negative affect, but this was in the context of a parent who reported *low* use of food as a reward (boredom: $M = 96.53$, $SE = 19.51$ vs. control: $M = 31.60$, $SE = 16.24$). This finding is contrary to previous literature where high use of food as a reward is related to greater child EE (e.g., Miller et al., 2020). Indeed, this finding was surprising and difficult to interpret, but one speculation is that it is an issue of opportunity to consume these foods for children that may normally experience a more healthy food environment.

5. Strengths, limitations, and future directions

The current study has many strengths, including its use of a rigorous experimental laboratory design to induce mood and assess food intake. This study effectively replicated Blissett et al.'s (2010) mood induction paradigm, and is the first to have successfully developed and implemented a mood induction paradigm to induce boredom in children. However, despite using an experimental laboratory design, child temperament and parental feeding practices were measured using parent self-report, which are susceptible to response bias and inaccuracies (e.g., Bergmeier et al., 2015; Blissett et al., 2019). Therefore, future research could supplement questionnaire measures of parental feeding practices and child temperament with observations during mealtime interactions and more objective measures of temperament such as the Laboratory Temperament Assessment Battery (Lab-TAB). It is also important to note that children only had access to the snack foods for 4-minutes, and it remains to be seen whether giving children free access to snack foods for a longer period would alter the study findings. This is of particular interest when considering boredom-EE as real-life experiences of boredom (in contrast to the laboratory induced boredom of the current study), and/or access to palatable foods, may not be limited to 4-minutes in duration. However, it is also unclear how durable the emotions induced by the mood induction paradigms were and whether increasing the free access period would lose the essence of the emotion induced or conversely result in even greater consumption. Considering this, it is important to acknowledge that the current research was conducted in a laboratory, which could limit the generalisability of the findings. Additionally, participation from fathers was low despite advertisements inviting 'parents' to participate, which reflects a common issue in research within this area (e.g., Leach et al., 2019). There are notable differences between mothers' and fathers' use of feeding practices, where for example, fathers are less likely to monitor their child's food intake and to restrict access to food compared with mothers (Khandpur et al., 2014). Additionally, previous research has suggested that the relationships between children's EE and feeding practices such as use of food for emotion regulation and use of food as a reward may be different for fathers and mothers (Trevino et al., 2021), so further work examining parent gender effects on pathways between feeding practice and boredom-EE in children is warranted. This study is the first to explore children's EE in response to feelings of boredom compared to feelings of sadness and a neutral mood. Next steps for this research domain include further exploration of the effects of other negative mood states on EE (e.g. anger, frustration, or anxiety), and examination of the mechanisms of action by which different mood states exert their effects on children's eating behaviour.

5.1. Theoretical and practical implications

Previous research has tended to report the individual associations between child and parent factors, but the current study highlights the importance of considering how the parent and child interact to shape child EE and thus aligns with Biopsychosocial Model (Russell & Russell, 2019). What this research has highlighted, which the Biopsychosocial Model does not account for, is the role of different emotional states in the expression of appetitive traits. Findings underscore how differences in children's mood state can evoke greater EE when in combination with temperament and feeding practices. This suggests that the relationship between parental feeding practices and child temperament in predicting child EE is more complex than a simple direct relationship and may vary depending on differences in mood states, but may be particularly apparent during feelings of boredom. As the experience of boredom is important in the development of children's sense of self and creativity (Eastwood & Gorelik, 2022), it is not recommended that children could or should avoid being bored, but instead that they learn to experience boredom without turning to food. Therefore, it would be useful to explore whether it is possible to teach parents to divert their child's attention away from food when feeling bored (in the absence of hunger), or to restructure the home food environment to become more challenging to access food during the experience of boredom.

6. Conclusion

In conclusion, this study is the first to find empirical evidence that children eat more kilocalories when feeling bored. Additionally, this study is the first of its kind to suggest that child temperament and parental feeding practice interact to predict boredom-EE in a laboratory setting. Results suggest that feelings of boredom differentially predict children's snack food intake, and that child negative affect and parental emotional feeding play an important role in the expression of this relationship.

CRediT authorship contribution statement

Rebecca A. Stone: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Project administration. **Jacqueline Blissett:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Emma Haycraft:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Claire Farrow:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition.

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.

Data availability

Data will be made available on request.

Appendices

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