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Identifying an avid eating profile in childhood: Associations with temperament, feeding practices and food insecurity

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ABSTRACT

This study aimed to identify distinct eating behaviour profiles in young children and examine how other key predictors of children's eating behaviour, including child temperament, the experience of food insecurity, or parental feeding practices, may vary by identified profiles. An online survey was conducted with 995 parents/carers living in England and Wales (N = 995, *M*age = 35.4 years, 80% female, 88% White). Participants reported on their child's eating behaviour using the Child Eating Behaviour Questionnaire and completed measures of child temperament, household food security and parental feeding practices. Latent Profile Analysis (LPA) was carried out to identify distinct eating profiles amongst the children (36–72 months, *M*age = 48.8 months, 52% female). Four eating profiles emerged from the sample of children: (a) *avid eating*, (b) *avoidant eating*, (c) *happy eating*, and (d) *typical eating*. *Avid eating* (21.9% of children) was characterised by higher levels of food responsiveness, enjoyment of food, and emotional over-eating in combination with lower satiety responsiveness, slowness in eating and food fussiness. Children with an *avid eating* profile were reported to be more surgent and experienced greater food insecurity than all other eating profiles. Parents of children belonging to the *avid eating* profile showed significantly greater use of food for emotional regulation, varied and balanced food provision, restriction of food for health, and restriction of food for weight feeding practices than the three other eating profiles.

1. Introduction

In the United Kingdom, more than one in five children are living with overweight or obesity when they begin school, and this rises to one in three children by the time they leave primary school at 11 years old (NHS England, 2022, p. 2021). Causes of childhood obesity are multifactorial and include biological, physiological, behavioural, environmental, and psycho-social factors (e.g., Mazarello Paes et al., 2015). The increasingly obesogenic food environment in high-income countries consists of high accessibility and availability of palatable energy-dense foods: increased portion sizes, energy-dense foods that are cheaper and more accessible than healthier alternatives and marketed with the incentive to buy them in larger quantities (Swinburn et al., 2011; Zlatevska et al., 2014).

However, the obesogenic environment does not pose the same risk of overweight and obesity to all individuals. The Behavioural Susceptibility Theory (BST) of obesity, developed by Llewellyn and Wardle (2015), posits that inherited variation in appetitive traits influence individual differences in responsiveness to the 'obesogenic' environment – i.e., how much an individual eats in response to environmental opportunity. Appetitive traits are defined as a set of stable predispositions towards food, such as responsiveness to food or feelings of fullness (Carnell et al., 2013). Food approach traits in children are positively correlated with adiposity and obesity risk (e.g., Croker et al., 2011; Kininmonth et al., 2021; van Jaarsveld et al., 2011), and longitudinal work has established that higher levels of food approach traits contribute to weight gain, while higher levels of food avoidance traits protect against excessive weight gain, in infancy and childhood (Kininmonth et al., 2021).

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Despite knowing that specific appetitive traits are predictive of individual susceptibility to obesity, research is somewhat limited on how different eating behaviours cluster in childhood. When investigating individual eating behaviours in children, many studies have applied a variable-centred approach, such as using the well-established subscales of the Child Eating Behaviour Questionnaire (CEBQ; Wardle et al., 2001). However, the CEBQ scale generates eight different sub scores, which not only increases the risk of type 1 errors through multiple significance testing, but also does not allow us to examine outcomes based on patterns of individual eating behaviours which commonly co-occur. Therefore, several recent studies have favoured the person-centred approach of Latent Profile Analysis (LPA) for developing holistic eating profiles (Bauer & Shanahan, 2007).

A recent study investigated behavioural profiles of n = 1229 5-year-olds concerning eating behaviour, sleep and activity levels using LPA (Mattsson et al., 2021). Three distinct profiles were identified, with 20% of children belonging to the 'High Food Approach Class'. Children in this profile had high levels of food enjoyment, emotional over-eating, and food responsiveness (Mattsson et al., 2021). A study by Fisher et al. (2022) also applied LPA to five subscales of the Child Eating Behaviour Questionnaire (CEBQ) in n = 1004 3–5-year-old children. Their data identified three profiles reflective of 'high food avoidance' (n = 35.6%), 'high food approach' (n = 21.2%), and 'moderate eating behaviour' (n = 43.2%). Furthermore, an earlier study used the same five subscales of the CEBQ as Fisher and colleagues but found that a six-profile solution best fit the sample of 4914 four-year-old children living in the Netherlands (Tharner et al., 2014). These six profiles were defined as "moderate eater" (44.6% of children), "avoidant eater" (33.2%), "fussy eater" (5.6%), "responsive eater" (3.9%), "joyful eater" (5.6%) and "approaching eater" (7.1%). Together, these studies suggest that at least three eating behaviour profiles are typically found in childhood, ranging from food approach to avoidance, with the potential for solutions with more than three profiles to identify more nuanced aspects of children's food approach and avoidance.

The primary limitation of the previous LPAs of children's eating behaviours has been the frequent exclusion of measures of emotional eating. It is important to include emotional overeating in the characterisation of high food approach because this behaviour has repeatedly been implicated in the development of overweight or obesity in later life (Braet et al., 2008; Braet & Van Strien, 1997; Steinsbekk & Wichstrøm, 2015). It is also imperative to include measures of emotional eating when investigating how the environment shapes eating profiles because twin studies have indicated that emotional eating in childhood is predominantly shaped by the environment, with low genetic influence, indicating that this eating behaviour is amenable to environmental modification (Herle et al., 2018a). Data from a large twin cohort study demonstrated that the family environment is the most influential factor in the development of both emotional under and overeating (Herle et al., 2018b). Thus, this study used LPA on the full range of eating behaviours as measured by the CEBQ (Wardle et al., 2001), to provide a more holistic and nuanced view of children's food behaviour profiles. In particular, the aim of this work was to identify profiles of eating behaviour in 3–5-year-old children, with a particular focus on the identification of a profile that may be particularly at risk of overeating, including emotional over-eating.

An additional benefit of LPA is the ability to examine key predictive factors of profile assignment (Spurk et al., 2020). It is of critical importance not only to be able to identify and describe the different profiles of children's eating behaviour but also to understand differences between eating profiles in terms of factors that can inform prevention and intervention strategies. The determinants of eating behaviours are multiple, including factors related to the individual such as physiological factors and phenotypes (e.g., satiety, sensory sensitivity, and taste acuity), psychological factors (e.g., emotions and psychological traits), as well as characteristics of the food environments and food supply chains (Varela et al., 2023).

Parental feeding practices have a reciprocal role in the development of children's eating behaviour. Parental feeding practices refer to feeding-specific behaviours that parents use in response to, or to influence their child's eating behaviours, such as restriction of food, pressure to eat, modelling of food intake, and teaching about nutrition (Holley et al., 2020; Loth et al., 2013). Recent evidence based on a large cohort study of British twins at 15 months and then at 5 years old showed that parental encouragement to eat healthily was bidirectionally related to children's enjoyment of food (Kininmonth et al., 2023a). Furthermore, using food to control the toddler's behaviour (instrumental feeding) was bidirectionally associated with children's emotional overeating tendencies and was prospectively associated with increased food responsiveness at 5 years old (Kininmonth et al., 2023a). However, despite substantial evidence linking feeding practices and child eating behaviour, there has been no examination of differences in feeding practice based on profiles of children's eating behaviour. Integrating these findings with evidence about how feeding practices differ according to children's eating behaviour profiles will provide useful information to inform targets for parent-based interventions to reduce children's unhealthy eating behaviour and resulting obesity risk.

Both children's eating behaviour and parental feeding practices are thought to be strongly linked to a child's temperament (Haycraft et al., 2011; Holley et al., 2020). Fisher et al. (2022) showed that children in the 'high food approach profile' had significantly lower inhibitory control than children in the 'food avoidance' profile and the 'moderate eating profile' as well as higher impulsivity than children in the 'food avoidance' profile. Furthermore, both negative affect and surgency are predictors of high food approach behaviours in young children (Steinsbekk et al., 2020). Whereas, unsociable, demanding, difficult, and shy temperaments are associated with food refusal (Farrow & Blissett, 2006; Pliner & Loewen, 1997). Child temperament is also interlinked with the use of specific feeding practices, moderating the bidirectional links between feeding practices and eating behaviour (Steinsbekk et al., 2017). For example, parents of children with higher emotionality are less likely to restrict their child's food intake (Farrow et al., 2018) and are more likely to use food to soothe their child (McMeekin et al., 2013). Longitudinal research has evidenced that negative affect in four-year-olds was linked to an increase in emotional feeding by parents at six and eight years old and a subsequent increase in emotional eating at ten years old (Steinsbekk et al., 2017). Furthermore, children's negative affect at four years was also linked to emotional eating at six and eight years and subsequent emotional feeding from parents at ten years old, demonstrating the reciprocity of these relationships.

As well as the interplay between children's temperament and parental feeding practices, socio-economic status, particularly household food security, plays an important role on a child's eating behaviour. Food insecurity – characterised as an individual or household lacking access to sufficient, safely accessible, and nutritious foods (Anderson, 1990) – may influence children's risk of overweight and obesity both directly by influencing eating behaviour and indirectly through shaping parental feeding practices which in turn affect child eating behaviours (Schuler et al., 2020). For example, parents may pressure children to eat available food to avoid food waste or may restrict food consumption to make food last longer (Crawford et al., 2007). Equally, food insecurity may directly influence eating behaviours in young children by prompting children to overeat when food is available, which reduces the ability to regulate food intake in response to hunger and fullness cues (Janssen et al., 2018). In the UK, household food insecurity has risen rapidly, with an increase in the demand for food parcels by 128 percent over the past five years (Trussel Trust, 2021). Further evidence as to how food insecurity influences pre-schoolers' eating behaviour is fundamental in appropriately designing interventions to encourage balanced eating in children.

2. Method

2.1. Participants

Parents and primary caregivers with a child between three and six years old were invited to participate in this study. Eligibility criteria were that the participant lived in England or Wales and was responsible for feeding their child at least half of the time the child was in their care. Participants were excluded from the research if their child had severe learning disabilities, Prader-Willi Syndrome, autism, or chronic illness (e.g., heart disease, cystic fibrosis, diabetes) that directly influences their dietary requirements and eating habits. A target sample size was preregistered as 2000 participants, based on the subsequent follow-up research intended for the identified profiles (see link for OSF preregistration). Data collection was paused at 1000 participants as the preliminary latent class analyses indicated that there was sufficient size across profiles and significant power for future studies. A total of 995 participants completed all sections of the questionnaire and reported on a child between the ages of 3 and 5 years old (mean ± SD = 48.8 ± 8.17 months), thus were retained for data analysis. A full overview of the sample demographics is provided in the results section (Table 3, column 1).

2.2. Procedure

Caregivers were recruited through an online panel hosting solution, Prolific (www.prolific.co), which holds demographic information about its participants. The study was conducted in 2022 and parents and primary caregivers with a child born between 2017 and 2019 were invited to complete the pre-screening survey, for which they were awarded 13 pence upon completion. Participants that satisfied the eligibility criteria were then invited to complete the online study for which they received £3.25 upon completion. If a parent indicated that they had more than one child between the ages of 3 and 5 years old, they were asked to report on the youngest child of that age range. In total, 1091 parents/caregivers were invited to take part in the full online study, of which 40 did not complete the study. To improve the quality of the data, a CAPTCHA was included at the beginning of the survey to screen-out automated respondents. Additionally, three attention checks were included throughout the survey asking participants to select a specific response and two survey items were included twice to check for consistent responding; 56 participants failed at least one of the five attention and consistency items and were excluded from analyses.

2.3. Measures

2.3.1. Child Eating Behaviour Questionnaire (CEBQ)

The CEBQ (Wardle et al., 2001) is a multi-dimensional, parent-report questionnaire, designed to capture individual differences in aspects of eating styles that have been hypothesised to contribute to both underweight and overweight. The CEBQ has seven eating behaviour subscales and one drinking subscale. Higher scores on three scales indicate higher food approach: *Emotional Overeating* (EOE; 4 items): the extent to which a child eats more in response to emotional stressors, *Food Responsiveness* (FR; 4 items): drive to eat in response to external food cues, and *Enjoyment of Food* (EF; 4 items): subjective pleasure from eating; Higher scores on four scales indicate lower food approach: *Satiety Responsiveness* (SR; 5 items): sensitivity to internal cues of 'fullness', *Slowness in Eating* (SE; 4 items): speed of meal consumption, *Food Fussiness* (FF; 7 items): selectivity of foods that are accepted, and *Emotional Undereating* (EUE; 4 items): extent to which a child eats less in response to emotional stressors. *Desire to Drink* (DD; 3 items): quantity and frequency with which children want to drink. Desire to drink is often conceptualised separately from food approach and avoidance but for the purposes of deriving holistic profiles of eating behaviours and appetite avidity it was included in this study. Participants rate the frequency of their child's behaviours and experiences on a 5-point scale: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always. The original development of the CEBQ showed good test-retest reliability for all subscales, except for the two emotional eating scales which had Pearson correlations of 0.64 and 0.52 (Wardle et al., 2001). All CEBQ subscales showed very good validity and reliability among this sample, with Cronbach's alphas for the eight scales ranging from 0.73 to 0.92 (see the OSF link for reliability analyses).

2.3.2. Comprehensive Feeding Practices Questionnaire (CFPQ)

The Comprehensive Feeding Practices Questionnaire (CFPQ; Musher-Eizenman & Holub, 2007) was used to investigate parental feeding practices associated with the children's eating profiles. The CFPQ is composed of 49 items factored into twelve subscales; *Child Control* (5 items): allowing the child control of his/her eating behaviours and parent–child feeding interactions, *Emotion Regulation* (3 items): using food to regulate the child's emotional states, *Encouraging balance and variety* (4 items): promoting well-balanced food intake, including the consumption of varied foods and healthy food choices, *Environment* (4 items): making healthy foods available in the home, *Food as a reward* (3 items): using food as a reward for the child's behaviour, *Involvement* (3 items): encouraging the child's involvement in meal planning and preparation, *Modelling* (4 items): demonstrating healthy eating for the child, *Monitoring* (4 items): keeping track of child's intake of less healthy foods, *Pressure* (4 items): pressuring the child to consume more food at meals, *Restriction for health* (4 items): controlling the child's food intake with the purpose of limiting less healthy foods and sweets, *Restriction for weight control* (8 items): controlling the child's food intake with the purpose of decreasing or maintaining the child's weight, and *Teaching about nutrition* (3 items): using explicit didactic techniques to encourage the consumption of healthy foods. The CFPQ is constructed from items with two response formats. The first 13 questions had a 5-point response scale "never, rarely, sometimes, mostly, and always". The remaining questions had a 5-point scale, "disagree, slightly disagree, neutral, slightly agree, and agree". The CFPQ scales showed good validity and reliability among the sample, with Cronbach's alphas for the twelve scales ranging from 0.55 to 0.87 (see the OSF repository for the full reliability analyses).

2.3.3. The Children's Behavior Questionnaire (very short form)

The Children's Behaviour Questionnaire- Very Short Form (CBQ-VSF; Putnam & Rothbart, 2006) is a 36-item informant-report questionnaire with low participant burden assessing the temperament of children (aged 3–8 years). Informants are asked to rate how their child's reaction is likely to be in a variety of situations. The questionnaire is designed to capture the broad dimensions: surgency/extraversion, negative affectivity, and effortful control. *Surgency* (12 items) indicates high levels of activity, impulsivity, and intensity pleasure alongside low shyness. *Negative affectivity* (12 items) is characterised by high scores for discomfort, anger/frustration, fear, and sadness, but negative loadings for soothability. *Effortful control* (12 items), sometimes described as conscientiousness, is defined by high scores for low-intensity pleasure, perceptual sensitivity scales, attentional control, and inhibitory control. The CBQ subscales showed good validity and reliability among our sample, with Cronbach's alphas of .78, .73, and 0.73 for surgency, negative affect and effortful control, respectively.

2.3.4. Short form of the Household Food Security Scale

The Short Form of the Household Food Security Scale is a brief survey of subjective experiences of food security, with six items measuring financially based food insecurity and hunger (HFSS; Blumberg et al., 1999). All six responses are summed to create categories of food security (0–1 = high or marginal food security, 2–4: low food security, 5–6: very low food security). Thus, higher scores reflect less food security. The scale showed very good validity and reliability among our sample, with a Cronbach's alpha of .88.

2.3.5. Demographic information

Participants provided demographic information such as their age, sex, ethnicity, marital status, education, employment, and subjective quality of living on their current household income. Of the 995 respondents, 792 provided their postcode as a measure of Index of Multiple Deprivation (IMD). The IMD deciles are calculated by ranking the residential areas in England from most deprived to least deprived and dividing them into 10 equal groups. Areas in decile 1 fall within the most deprived 10% of areas nationally and areas in decile 10 fall within the least deprived 10% of areas nationally (Office for National Statistics, 2022). Participants also provided information on children's age, sex, birth weight, and childcare arrangements.

2.4. Statistical analyses

Descriptive statistics were conducted using IBM SPSS Statistics 25.0. After checking that all the relevant assumptions were met (see Spurk et al., 2020), Latent Profile Analysis (LPA) was conducted in Mplus 8.9 to identify children's eating behaviour profiles using continuous scores on the CEBQ subscales. For a clear interpretation of which indicator values are above or below the sample means the z-standardised scores for all the CEBQ scales were used.

LPA is an iterative process, by which separate models with an increasing number of profiles are fitted to the data. The best fitting model, with the most parsimonious number of profiles, is selected based on conceptual or theoretical considerations (for example, see Bauer & Shanahan, 2007) and common model-fit indices: Bayesian information criteria (BIC), sample size adjusted BIC (aBIC), Akaike information criteria (AIC), the maximisation of entropy (Celeux & Soromenho, 1996), size of profiles (Lubke & Neale, 2006) and Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT). LMR-LRT indicates whether a solution with $k + 1$ profiles fits the data better than a solution with k profiles. A low p-value indicates that the k-class model performs significantly better than the k-1-class model (Padgett & Tipton, 2020). To protect against local solutions, the default settings were increased in Mplus and the number of random starts set to 500 and the final stage optimisations to 50. The estimation revealed no error messages, and the output provided the information that the highest log-likelihood value was replicated. Thus, these results are highly unlikely to be due to local maxima.

Once the optimal number of profiles was identified, descriptive statistics were repeated for each profile (see the OSF repository for an overview). Once the best fitting solution is chosen, Mplus assigns each participant a posterior probability of profile membership (Muthén & Muthén, 2004), which indicates which profile they are most likely to be assigned to. After grouping participants according to most-likely class in a 1-step approach, bivariate analyses, including Chi-square and analysis of variance, were conducted to explore whether the child variables (i.e., temperament), the parental feeding practices (i.e., CFPQ subscales), and food insecurity, varied by assigned profile. To reduce family-wise error, a Tukey's HSD adjustment was applied to examine post hoc pairwise comparisons.

Finally, a multinomial logistic regression analysis was fitted to estimate odd ratios and determine which variables were the strongest predictors for eating profile assignment. Predictors were selected for inclusion based on the preregistered hypotheses and on previous evidence of predictive factors of eating behaviour, thus all CFPQ measures and CBQ-VSF scales were included as well as parental age, household index of multiple deprivation (IMD), and household food insecurity. The typical eating profile was entered as the reference group for all pairwise comparisons. The Bonferroni correction was applied to adjust for multiple testing.

3. Results

The study sample was fairly representative of the UK population (see link for ONS Census 2021 data). Respondents were predominantly born in the UK (89%), and the remaining 11% were born in 53 different countries. Of the sample, 4.4% were Asian, 3.2% were Black, Black British, Caribbean, or African, 2.9% were Mixed or multiple ethnic groups, 88.4% were White, and 0.6% self-defined as 'other ethnic group' (see supplemental material for detailed ethnographic information). The majority (84.7%) of children lived in a dual household e.g., two adults married or in a relationship looking after the child, whereas 9.9% of children came from single caregiver households. Approximately half of parents (45.8%) were working full-time and 54.1% of respondents had degree-level qualifications. The 995 participants were equally distributed concerning the level of deprivation, based on the UK Index of Multiple Deprivation measures (~10% of participants in each of the 10 IMD deciles).

3.1. Research aim 1: identify a comprehensive eating behaviour profile reflecting high food approach (avid eating) in children between 3 and 5 years old

Model fit indices for latent profile analyses are listed in Table 1. On balance, a 4-profile solution fitted the data best. We investigated the fit statistics for solutions with one to six profiles (Table 1). We first considered the two-profile solution because it showed high entropy (0.78), indicating that the model accurately defines 78% of cases into the appropriate profile. However, the AIC, BIC and adjusted BIC continued to decrease with additional profiles indicating a better model fit to the data. Moreover, the two-profile solution showed profiles that only differed in the overall global score of all eight CEBQ indicators, thus providing only partial support for fit criteria and did not offer interpretations of theoretical interest. We then considered the four-profile solution, which showed a nonsignificant adjusted LMR-test when continuing to five profiles. Furthermore, no profiles of small sample sizes emerged in this solution. Finally, as detailed below the four-profile solution showed qualitatively different profiles of theoretical interest that are relatively different in context, partially supporting the primary hypothesis (see Table 2 for mean CEBQ subscale scores across four profiles).

Fig. 1 depicts the standardised means of CEBQ subscales for the selected four-profile solution and Table 2 details the mean scores across the four profiles for each of the eight CEBQ subscales and the differences between profiles. The four profiles were identified as Avid eating, Happy eating, Typical eating, and Avoidant eating:

1. "*Avid eating*" (n = 217, 22%) was characterised by high levels of food responsiveness and emotional overeating. This profile demonstrated equally high levels of enjoyment of food and low levels of satiety responsiveness as the *happy* eating profile. The *avid* and *avoidant* eating profiles both showed significantly greater desire to drink than the typical and happy eating profiles.
2. "*Happy eating*" (n = 170, 18%) was marked by similarly high levels of food enjoyment as the *avid eating* group, but low levels of slowness in eating, food fussiness, emotional overeating, and emotional undereating than the three other profiles.
3. "*Typical eating*" (n = 453, 44%) comprised children with 'average' levels across all eight eating behaviours. This profile had similar levels of food responsiveness as the *happy* eating profile, similar levels of emotional overeating as the *avoidant* eating profile and similar levels of emotional undereating as the *avid* eating profile.
4. "*Avoidant eating*" (n = 155, 16%) profile was characterised by significantly high levels of food fussiness, satiety responsiveness, slowness in eating, and emotional undereating concomitant with significantly low levels of food enjoyment in comparison to the three other profiles.

Table 1
Fit statistics for 1–6 profile solutions.

Number of profiles	LogL	Best H0 replicated	Parameters	AIC	BIC	aBIC	LMR-LRT (p)	Entropy
1	−11290.75	Y	16	22613.50	22691.94	22641.13	–	–
2	−10702.03	Y	25	21454.07	21576.63	21497.23	**1158.78 (p < .001)**	**0.781**
3	−10546.29	Y	34	21160.59	21327.28	21219.30	306.54 (p = .0304)	0.751
4	−10411.84	Y	43	20909.67	21120.49	20983.92	**264.66 (p = .0172)**	0.754
5	−10325.23	Y	52	20754.47	21009.41	20844.26	170.46 (p = .0657)	0.765
6	−10255.73	Y	61	20633.45	20932.52	20738.78	136.82 (p = .1649)	0.76

Note: AIC = Akaike Information Criterion; aBIC = adjusted BIC; BIC = Bayesian Information Criterion. Bold values indicate the "best" fit for each respective statistic.

Table 2
Mean scores across the four profiles for each of the eight CEBQ subscales.

	Avid eating	*Happy eating*	*Typical eating*	*Avoidant eating*	*F*	*P-Value*
	Profile 1	Profile 2	Profile 3	Profile 4		
	n = 217 (21.9%)	n = 170 (17.7%)	n = 453 (44.1%)	n = 155 (16.2%)		
Food responsiveness	1.1 (0.75)	−0.29 (0.78)†	−0.19 (0.77)†	−0.69 (0.92)	200	<.001
Emotional overeating	1.02 (0.81)	−0.62 (0.68)	−0.15 (0.86)†	−0.32 (0.89)†	154.1	<.001
Food enjoyment	0.88 (0.57)†	0.82 (0.55)†	−0.2 (0.57)	−1.55 (0.59)	690.8	<.001
Desire to drink	0.43 (0.98)†	−0.47 (0.78)	−0.13 (0.95)	0.28 (1.08)†	35.4	<.001
Satiety responsiveness	−0.74 (0.78)†	−0.85 (0.68)†	0.25 (0.67)	1.23 (0.71)	336.9	<.001
Slowness in eating	−0.47 (0.89)	−0.78 (0.75)	0.18 (0.80)	1 (0.88)	156.4	<.001
Emotional undereating	0.2 (0.82)	−0.85 (0.98)†	0.06 (0.94)†	0.48 (0.89)	67	<.001
Food fussiness	−0.49 (0.8)	−1.05 (0.67)	0.23 (0.72)	1.17 (0.67)	305.6	<.001

† Denotes groups do not differ significantly from one another.

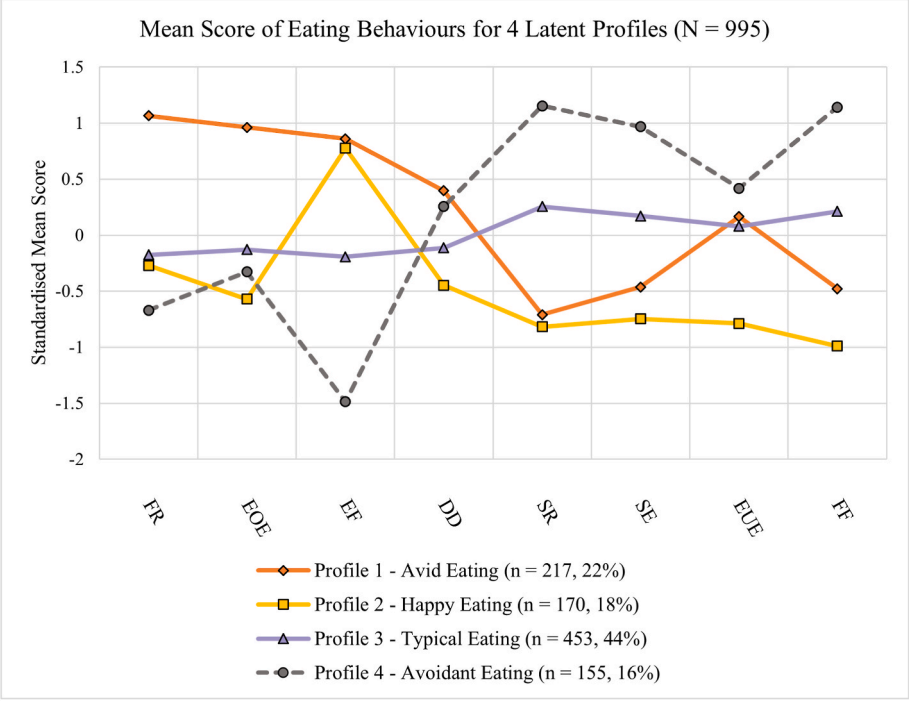

Fig. 1. Mean score of eating behaviours for 4 latent profiles (N = 995).
Note: FR = Food Responsiveness, EOE = Emotional Overeating, EF = Enjoyment of Food, DD = Desire to Drink, SR = Satiety Responsiveness, SE = Slowness of Eating, EUE = Emotional Undereating, FF = Food Fussiness.

3.2. Research aim 2: how child temperament, food insecurity, and parental feeding practices vary by child's eating profile

Table 3 presents demographic characteristics by eating behaviour profile. Parental age differed across eating behaviour profiles: parents of children in the *avid* eating profile had a lower mean age than parents of children in the *typical* and *happy* eating profiles ($F = 8.26$, $p < .001$). No differences were observed for child sex, birth weight, parent sex, parent education, level of deprivation or ethnicity.

3.2.1. Household food security

A Chi-square test of independence showed that there was a significant association between food security and eating behaviour profile, X^2 (6, $N = 995$) = 24.96, $p < .001$, $w = 0.16$. The proportion of avid eaters with food security is significantly lower than the proportion of happy eaters with food security. The proportion of avid eaters experiencing

Table 3
Latent Profile Comparisons for demographic variables.

	Total Sample	*Avid eating*	*Happy eating*	*Typical eating*	*Avoidant eating*	*P*
		Profile 1	Profile 2	Profile 3	Profile 4	
	N = 995	n = 217 (21.9%)	n = 170 (17.7%)	n = 453 (44.1%)	n = 155 (16.2%)	
Child Age, months, M (SD)	53.29 (8.16)	53.2 (8.5)	54.09 (8.37)	53.26 (7.91)	52.64 (8.24)	.45
Child sex, n (%)						.107
Male	477 (47.9)	113 (52.1)	91 (53.5)	206 (45.5)	67 (43.2)	
Female	518 (52.1)	104 (47.9)	79 (46.5)	247 (54.5)	88 (56.8)	
Birth weight, kg (SD)	3.45 (1.2)	3.41 (0.58)	3.42 (0.59)	3.34 (0.56)	3.36 (0.56)	.335
Parent Age (years)	35.39 (5.47)	**34.03 (5.66)**	36.33 (5.06)	35.9 (5.51)	34.76 (5.09)	**<.001**
Parent sex, n, (%)						.375
Male	196 (19.7)	35 (16.1)	40 (23.5)	96 (21.2)	25 (16.1)	
Female	798 (80.2)	182 (83.9)	130 (76.5)	356 (78.6)	130 (83.9)	
Parent Education, n (%)						.283
Degree	538	107 (19.9)	98 (18.2)	253 (47)	80 (14.9)	
No degree	457	110 (24.1)	72 (15.8)	200 (43.8)	75 (16.4)	
Index of Multiple Deprivation, M (SD)	5.63 (2.9)	5.46 (2.98)	5.74 (2.9)	5.64 (2.88)	5.73 (2.87)	.820
Food Security, n (%)						<.001
Food Security	781 (78.5)	156 (71.9)	151 (88.8)	363 (80.1)	111 (71.6)	
Food Insecurity	121 (12.2)	29 (13.4)	12 (7.1)	53 (11.7)	27 (17.4)	
Extreme Food Insecurity	93 (9.3)	32 (14.7)	7 (4.1)	37 (8.2)	17 (11)	
Parent ethnicity						.225
Asian or Asian British	44 (4.4)	5 (2.3)	9 (5.3)	19 (4.2)	11 (7.1)	
Black, Black British, Caribbean, or African	32 (3.2)	11 (5.1)	4 (2.4)	15 (3.3)	2 (1.3)	
Mixed or multiple ethnic groups	29 (2.9)	8 (3.7)	2 (1.2)	13 (2.9)	6 (3.9)	
White	884 (88.8)	191 (88)	155 (91.2)	402 (88.7)	136 (87.7)	
Other ethnic groups	6 (0.6)	2 (0.9)	0	4 (0.9)	0	

Bold values denote significant differences from all other groups.

extreme food insecurity (15%) is significantly greater than happy eaters experiencing extreme food insecurity (4%).

3.2.2. Child temperament

A one-way ANOVA was performed to compare all parental feeding practices and temperamental traits across eating profiles. Significant differences were observed for all measured variables between at least two eating profiles (Table 4). For brevity, only the significant results relevant to the avid eating profile are described and visualised in Figs. 2 and 3 (see the OSF link for the full post-hoc comparisons).

Table 4
- One-way ANOVA across eating profiles.

Total Sample	*Avid eating* (†)	*Happy eating* (⁋)	*Typical eating*	*Avoidant eating* (§)	*F value*	*Eta-squared*	*P-value*
N = 995	n = 217 (21.9%)	n = 170 (17.7%)	n = 453 (44.1%)	n = 155 (16.2%)			
Temperament							
Surgency	4.84 (.79)	4.69 (0.88)	4.51 (0.84)†	4.49 (1.09)†	8.16	0.024	<.001
Negative affect	4.17 (0.83)	**3.47 (0.84)**	4.04 (0.81)§	4.38 (0.92)	36.97	0.101	<.001
Effortful control	5.17 (.77)	**5.38 (.68)**	5.16 (.74)	**4.95 (.81)**	9.05	0.027	<.001
Parental Feeding Practices							
Child control	2.64 (.64)	**2.35 (.57)**	2.64 (.63)	2.77 (.68)	13.64	0.04	<.001
Emotional regulation	**2.28 (.69)**	**1.8 (.58)**	2.11 (.67)	2.1 (.71)	16.78	0.048	<.001
Balance and variety	4.49 (0.46)§	4.57 (.45)§	4.36 (.51)†⁋	4.31 (.55)	11.59	0.034	<.001
Environment	3.46 (.74)	**3.84 (.73)**	3.48 (.72)	**3.22 (.73)**	20.03	0.057	<.001
Food reward	3.01 (1.1)	**2.47 (1.13)**	2.87 (1.09)†	3.05 (1.16)†	9.90	0.029	<.001
Involvement	3.7 (.86)	3.88 (.87)	3.64 (.92)⁋	**3.36 (1.07)**	8.82	0.026	<.001
Modelling	4.12 (.78)	4.3 (.68)§	4.14 (.76)§	3.93 (.87)	6.27	0.019	<.001
Monitoring	3.9 (.82)	4.02 (.81)	3.85 (.81)	**3.57 (.98)**	8.28	0.024	<.001
Pressure to eat	3 (.91)	**2.73 (.96)**	3.03 (.89)	3.21 (.83)	8.22	0.024	<.001
Restriction for health	3.7 (.83)	**3.03 (.98)**	3.42 (.90)†	3.55 (.96)	18.37	0.053	<.001
Restriction for weight	**2.09 (.76)**	1.9 (.69)	1.9 (0.69)	1.76 (.64)	6.96	0.021	<.001
Teaching about nutrition	3.92 (.83)	**4.27 (.70)**	4.03 (.76)	3.89 (.80)	8.88	0.026	<.001

Mean scores across the four profiles and levels of significance for differences across the four profiles.
§ Denotes significantly different to avoidant eating profile.
† Denotes significantly different to avid eating profile.
⁋ Denotes significantly different to happy eating profile.
Bold indicates significantly different from all other profiles.

Children belonging to the *avid eating* profile displayed greater surgency than the children in *avoidant* and *typical* eating profiles. Negative affect was significantly greater among the *avid eating* profile than the *happy eating* profile. In the *avid eating* profile, effortful control was significantly greater than in the *avoidant eating* profile, but significantly lower than in the *happy eating* profile (see Fig. 2).

3.2.3. Parental feeding practices

Children belonging to the *avid eating* profile experienced significantly greater levels of parental use of food for emotional regulation and restriction of food for health purposes than children belonging to the other three profiles (see Fig. 3). Parents of children in the *avid eating* profile reported significantly greater levels than parents of children in the *happy eating* profile for child control, food reward, and pressure to eat. Parents of children in the *avid eating* profile also reported significantly greater use of restriction for health than parents of children in the *happy eating* and *typical eating* profiles. Parents of children in the *avid eating* profile reported greater levels than parents of children in the *avoidant eating* profile for involvement, monitoring and food environment. However, parents of children in the *avid eating* profile reported significantly lower use of feeding practices involving the environment and teaching than parents of children in the *happy eating* profile. Finally, parents of children in the *avid eating* profile had higher scores for balance and variety than parents of children in both the *avoidant eating* profile and the *typical eating* profile.

3.3. Variables predictive of eating profile assignment

Multinomial logistic regression was used to examine which variables were strongly associated with profile assignment (see Table 5). Higher levels of surgency were associated with greater assignment to the *avid eating* profile. Higher negative affect but lower effortful control was associated with assignment to the *avoidant eating* profile. Higher effortful control and lower negative affect was associated with assignment to the *happy eating* profile. Higher levels of parents' use of food for emotional regulation, encouragement of balance and variety, restriction for health, and restriction for weight feeding practices were associated with *avid eating* profile assignment. Lower levels of modelling, pressure to eat, and teaching about nutrition feeding practices were also associated with assignment to the *avid eating* profile. There was a significant negative association between the *avid eating* profile and the parent/carer's age.

4. Discussion

The main aim of this study was to identify a comprehensive eating behaviour profile reflecting high food approach including emotional eating in children between 3 and 5 years old. Four eating profiles emerged: (a) *avid eating* (21.9% of children), (b) *avoidant eating* (16.2% of children), (c) *happy eating* (17.7% of children) and (d) *typical eating* (44.1% of children). The *avid eating* profile was characterised by higher levels of food responsiveness, enjoyment of food, and emotional overeating in combination with lower levels of satiety responsiveness, slowness in eating, and food fussiness. Thus, children belonging to the *avid eating* profile may be particularly responsive to obesogenic environments and consume food to regulate their emotions.

This latent profile solution demonstrated that at least four distinct eating profiles exist in young children, which is partially aligned with previous work identifying at least three distinct eating profiles, (namely high food approach, typical eating, and high food avoidance; Mattsson et al., 2021). However, previous latent profiling of children's eating habits has neglected the emotional drivers of eating (both emotional over-eating and emotional under-eating). As evidenced by these results, the emotionality of eating is a primary factor which distinguishes children of high food approach into *happy eating* and *avid eating*. Both emotional overeating and emotional undereating were significantly greater in the avid eating profile compared to the happy eating profile. The second differentiator of these groups was food responsiveness: children in the avid eating profile were more likely than all other groups to notice and respond to food cues in their environment, also known as 'external eating' and which is a significant predictor of children's adiposity (Kan et al., 2020). Key to the application of these findings is that it is the *combination* of eating behaviour traits into profiles that yields the greatest insight into behavioural risk. The combined phenotype of external and emotion driven eating may synergistically make children more susceptible to health risks and adiposity in an obesogenic environment (Braet et al., 2008). In contrast, children in the *happy eating* profile, who have similarly high enjoyment of food and similarly low satiety responsiveness as those in the *avid eating* profile, do not show high levels of other problematic eating behaviours such as emotional overeating and food responsiveness. The differentiation of these two 'food approach' profiles emphasise the importance of examining children's eating behaviours as profiles rather than individual behaviours. Following the identification of an additional *avid eating* profile, it is important for future work to examine the longitudinal stability of such a

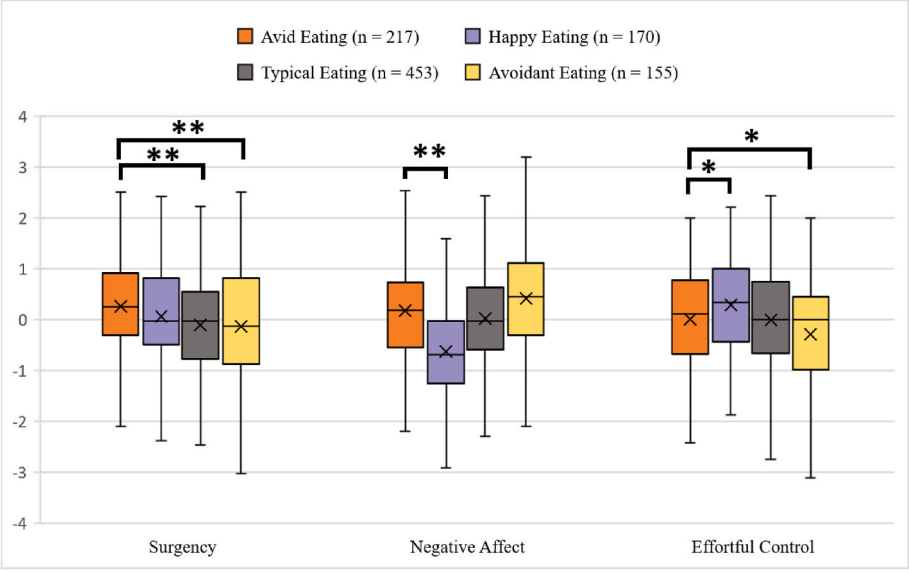

Fig. 2. Boxplot of standardised temperament subscale scores across 4 eating profiles (** denotes significant difference between profiles at $p < .001$, *$p < .05$).

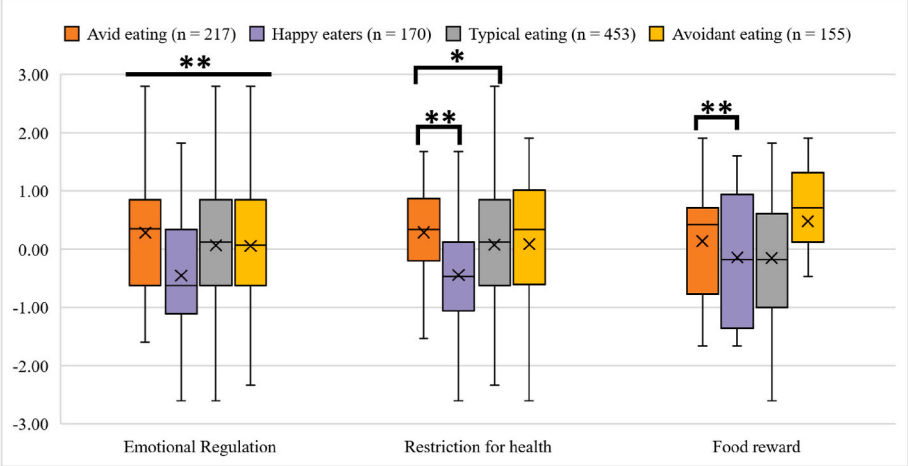

Fig. 3. Boxplot of standardised parental feeding practice scores across 4 eating profiles (** denotes significant difference between profiles at $p < .001$, *$p < .05$).

Table 5
Multinomial regression analysis for the avid, avoidant, and *happy eating* (reference category: *typical eating* in the CBQ, CFPQ and demographic variables.

	Eating Profiles			
	Avid Eating	*Avoidant Eating*	*Happy Eating*	*Typical Eating*
	OR	OR	OR	
Surgency	**1.493**	0.970	1.159	Ref
Negative Affect	1.09	**1.640**	**0.496**	Ref
Effortful Control	0.935	**0.756**	**1.352**	Ref
Child Control	**0.667**	1.186	**0.426**	Ref
Emotional Regulation	**1.529**	0.744	0.826	Ref
Balance & Variety	**1.977**	1.171	**2.424**	Ref
Environment	0.969	0.900	1.117	Ref
Food Reward	0.853	0.956	0.939	Ref
Involvement	1.139	0.847	1.043	Ref
Modelling	**0.741**	0.846	**0.711**	Ref
Monitoring	0.921	0.846	0.912	Ref
Pressure	**0.688**	1.236	**0.763**	Ref
Restriction for Health	**1.46**	**1.319**	**0.666**	Ref
Restriction for Weight	**1.378**	**0.669**	1.369	Ref
Teaching about nutrition	**0.662**	1.007	1.154	Ref
Parent's age	**0.915**	0.972	1.012	Ref
Food insecurity	1.076	1.088	0.869	Ref
IMD	0.999	1.035	0.985	Ref

Odds Ratios are represented as Exp(B)s. $p < .05$ considered significant and represented in bold.

profile and how early avid eating behaviour may be associated with current and future health and weight outcomes. This is particularly important given previous studies which demonstrate that children with increasing overeating trajectories across childhood have significantly greater risk of adolescent binge eating (Herle et al., 2020).

In identifying such eating profiles, it is also important to examine the factors that are associated with an avid eating profile to develop more effectively tailored support and interventions. The second aim of this study was to determine which key factors were most strongly associated with eating profile assignment. Parents of children with *avid eating* behaviour reported greater use of restriction for weight and health, than those with children with *typical eating* behaviour. Parental practices such as restriction for health and weight may work effectively in the short term but appear counterproductive over time because they result in a heightened preference for forbidden foods and lowered preference for substitute foods (Brown et al., 2008). Additionally, restrictive feeding practices have been proposed to deregulate the formation of healthy eating behaviours by failing to foster self-regulation in children's eating (Rollins et al., 2016). However, it is also well established that parent feeding practices are reciprocally related to children's eating behaviour traits and that children with a more avid appetite in toddlerhood are differentially affected by parental feeding practices (e.g., Kininmonth et al., 2023a, 2023b). Thus, the challenge is to create tailored interventions which empower parents of children with avid eating behaviour profiles to construct food environments and use feeding practices that maximise healthy outcomes *and* minimise exacerbation of behavioural risks.

Parents of children with *avid eating* tendencies also reported greater use of food to regulate the child's emotional state. Such practices have been linked to early emotional eating (Blissett et al., 2010; Stone et al., 2022); emotional feeding predicts greater increases in children's emotional eating across the preschool years (Kininmonth et al., 2023a). These practices also predict later eating in the absence of hunger and a reduced ability to self-regulate appetite and dietary intake, which in turn impacts adiposity (Scaglioni et al., 2008). Reducing the use of food to regulate children's emotions is therefore a potentially promising intervention target.

Parents of children in the *avid eating* profile also used fewer positive 'structure' practices, in particular, lower modelling and teaching about food. However, these parents also demonstrated some facilitative feeding practices (greater encouragement of balance and variety and less pressure to eat) in comparison to parents of children in the typical eating profile. Identifying the key feeding practice differentiators from typical groups highlights healthy practices that parents are already using with their children with *avid eating* behaviour as well as potential intervention targets. These targets need to be investigated in future research which examines causal development of eating behaviours in children who are at greater risk based on their temperamental traits or early eating behaviours.

In examining the parental feeding practices linked to *avid eating* behaviour, it is also important to compare such relations with children showing a healthier approach to food (i.e., the *happy eating* profile). Children displaying the *happy eating* profile constitute approximately 17 percent of this sample and display high levels of food enjoyment while low levels for most other eating behaviours. In other words, children in the *happy eating* profile demonstrate better appetite regulation in that they enjoy food but are not externally driven by the availability of food in the immediate environment. These analyses also found that children with a healthier approach to food (*happy eating* profile) were recipients of more explicit didactic techniques to encourage the consumption of healthy foods (teaching about nutrition) and greater availability of healthy food in the home (environment). These more 'structural' feeding practices have been associated with healthier weight outcomes (Haycraft et al., 2017). Equally, across all four eating profiles, parents of

children in the *happy eating* profile reported the lowest levels of use of pressure to eat more food, use of food as a reward for child behaviour, and use of food to regulate emotional state, which have previously been associated with poorer eating outcomes (Haycraft et al., 2017).

The associations between parental feeding practices and children's eating behaviour are further associated with the child's temperament. Children assigned to the *avid eating* profile display greater surgency than *avoidant* and *typical* eating profiles. Surgency is characterised by high levels of impulsivity, pleasure intensity, and activity, but low levels of shyness. Higher surgency may in part be responsible for the *avid eating* observed in this group of children, in particular with regard to their high levels of food responsiveness. Zhou et al. (2019) suggest that poor self-regulation and high impulsivity, dispositions both associated with surgency, increase individual susceptibility to obesogenic environments. Such susceptibility is believed to stem from increased difficulty with impulse control and response inhibition making children more reactive to rewards from food in the environment (Nederkoorn et al., 2006). Children with greater levels of surgency have, by definition, reduced self-regulation and inhibitory control which, in combination with restrictive feeding practices reported by parents of this group, may exacerbate poor dietary self-control. Children in the *avid eating* profile also displayed greater negative affect than children in the *happy eating* profile, characterised by higher levels of sadness, fear, anger, frustration, and discomfort, and a lower ability to be easily soothed. This finding is somewhat surprising as negative affect and surgency tend to be inversely correlated in the general population, which we indeed found in this global sample of children. However, when accounting for eating profile, negative affect and surgency were no longer negatively correlated in the profile of children with *avid eating* behaviours. However, results from the regression illustrate that surgency alone was a key predictive temperament of assignment to the *avid eating* profile.

The biopsychosocial model of pathways to obesity and overweight in children proposes that temperament shapes dietary and weight outcomes via direct influences on children's eating behaviour as well as indirect influences through parental styles and behaviour. For example, children with greater negative affect may elicit greater use of food to manage negative feelings, which subsequently results in emotion-based eating. Tate et al. (2016) demonstrated that the overweight risk associated with emotional overeating was greater among children with a more difficult temperament (i.e., higher levels of negative affect and surgency). Their research supports the notion that certain contexts affect emotional eating more strongly in children higher in surgency and negative affect than children with 'easy' temperament. That is to say, the risk of obesity and overweight resulting from environmental triggers (e.g., food availability) differentially affects children with easy versus difficult temperaments (Tate et al., 2016). Children with high levels of surgency may be less self-regulated in the presence of food, subsequently increasing the susceptibility to overweight and obesity in later childhood.

Socio-economic variables were also examined in this study because food security and economic environment are important determinants of dietary behaviour (Varela et al., 2023). Although we didn't see any differences in our other measures of socio-economic variables (IMD, subjective quality of living, level of education) food security was significantly different across groups, but additionally food security was collinear in the expected direction to all socio-economic variables. Children facing greater economic hardship and food insecurity may exhibit greater food motivation (Janssen et al., 2018) which in turn may lead to behaviours witnessed in the *avid eating* profile. However, the association of food security with eating behaviour profile was not significant in our regression analysis, when controlling for child temperament, parent feeding practices, and parent age. Younger parents had an increased likelihood of their child being assigned to the *avid eating* profile. This could explain our findings since younger parents are more likely to experience financial hardship and food insecurity (Bocquier et al., 2015). However, further replication and investigation is needed to better understand the relationship between age, SES, and food security in parents of young children.

Strengths & Limitations.

This study benefits from the relatively large sample size of children across England and Wales from racially, ethnically, and socio-economically diverse backgrounds. However, a limitation of the study is the utilisation of an online portal for participant recruitment, potentially capturing a population not completely representative of the general population of interest. Although this sample had a similar demographic representation to the 2021 UK Census figures (see ONS data), there was a lack of individuals with no formal education in this sample which may potentially be due to the study's need for participants with good technological literacy. Moreover, the absolute values of food security among this sample align with the national statistics in the UK; 92% of households regarded themselves as being food secure in the financial year 2019–2020 (Department for Environment, Food & Rural Affairs, 2021). However, given that data was collected post COVID-19 pandemic it's important for future research to look at changes in household demographics and food security over the past three years.

Another strength of this work is the use of established measures in child eating behaviour, parental feeding practices, and child temperament to drive the person-centred approach to eating behaviour. At the same time, a limitation of this methodology is the reliance on parent report measures which may differ from objectively observed practices. Additionally, parents reported on all the measures included in this analysis, so correlations or associations could be due shared method variance. Future observational work is needed to examine the consistency between latent profile belonging based on parent report measures versus observed eating behaviour measures. An additional limitation to the methodology is that the sample used to generate the profiles is same sample used to test for subgroup differences. The nature of LPA limits generalizability and replication is important to validate the results of this study among new samples.

Although this research is the first to outline the importance of emotional eating behaviour in young children and how such behaviour aggregates onto other eating behaviour, the cross-sectional nature of the work raises several limitations. Eating behaviour is a complex phenomenon with many different influencing factors. Longitudinal evidence has further demonstrated that the relation between children's eating behaviour and parental feeding practices is bidirectional. While this study reports associations between environmental variables and eating profiles, it is not possible to determine the cause of eating profiles or the impact of profiles on feeding practices. However, recent work does offer theoretical support of the causality and directionality of our included individual variables (see Kininmonth et al., 2023b, 2023c). Bidirectional relations were established between preschool children's food approach traits (namely emotional overeating) and nonresponsive feeding practices (i.e., instrumental feeding) (Kininmonth et al., 2023c).

Finally, future research should aim to replicate these eating profiles in the same sample but also collect accurate anthropometric measures of children's current weight status. Based on evidence from previous research we hypothesise that there would be distinct differences in standardised BMI scores across the four profiles; for example, a previous study demonstrated that obesity was more common in children belonging to a high food approach profile than in other food-avoidant and moderate eating profiles (Fisher et al., 2022). Therefore, future research should test this theory by replicating these latent profiles in a wider sample and examining anthropometric outcomes.

5. Conclusion

These findings build upon previous research by providing novel evidence that *avid eating* is a distinct, multi-dimensional and emotionally charged eating behaviour observable in children as young as three years old. *Avid eating* is systematically related to more surgent temperament and more non-responsive parental feeding practices such as restriction

and the use of food for emotion regulation. These findings suggest that environmental factors and children's temperament contribute synergistically to a child's display of *avid eating* behaviour. In this sense, a two-pronged approach appears promising in targeted intervention strategies to reduce early childhood overeating. The first potential strategy is to tailor preventative and intervention methods to promote healthier eating habits to both the child's environment and temperament. The second strategy focuses on the key modifiable component of parental feeding practices to promote a healthier food experience for the child. In the context of developing interventions to support the development of healthy eating behaviours in children, further research should build on this study by investigating how feeding practices may be modified in response to children's temperament, eating behaviour, and socio-economic background.

Ethical statement

To foster transparency and replicability in science, all our hypotheses and study designs were preregistered and received ethical approval prior to data collection. The data sets, materials, and analyses are openly available through the Open Science Framework platform, a link to this supplementary material is given in the manuscript body.

Ethical approval was granted by the Aston University School of Health and Life Sciences Ethical board (Project ID Number: HLS21003). Written informed consent was provided by participants. All aspects of data collection and storage followed the standards specified by this ethical board.

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Author Contributions

Each named author has substantially contributed to conducting the underlying research and drafting this manuscript. AP has led the data collection, analyses, and write-up of the manuscript, JB, CF, HC, MH, EH, CL have contributed to the conception and design of the study, AK and KE have contributed to the editing and proofing of the manuscript. The named authors have no conflict of interest, financial or otherwise.

Declaration of competing interest

No conflict of interest

Data availability

I have shared a link to the data in the manuscript body

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