Recognising and responding to infant appetite cues – implications for developing a “baby translator”

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Abstract

Caregivers vary in how well they recognise and respond to infant hunger, appetite, and satiety cues, which affects responsive feeding (RF). This thesis explored whether RF is “teachable” with an impact on infant health outcomes, and whether individuals’ ability to recognise infant appetitive cues is related to how well they “tune in” to their own internal appetite cues and affect (i.e., alexithymia, difficulty identifying and describing feelings). Four studies were conducted: one systematic review and three online studies.

Study 1 systematically reviewed interventions designed to support RF. Across studies with both digital and face-to-face interventions, parental self-reported RF improved, but intervention effects on children’s weight outcomes and eating patterns were inconsistent. These mixed findings suggest self-reported changes to RF behaviours did not necessarily impact child obesity risk.

Study 2 assessed accuracy in recognising infant appetitive cues in adults (N = 198) online using ten videoclips of infants at the start and end of meals. Recognition scores were high, but alexithymia score was negatively correlated with infant appetite recognition.

Study 3 examined whether caregivers’ (N = 445) “tuning in” to their own internal appetite and affect cues associated with infant-cue recognition during feeding. Caregivers who were attuned to their own internal cues scored high in recognising infant appetite. Those with alexithymia showed lower recognition and fewer positive mealtime emotions compared to caregivers without alexithymia. Caregivers’ ability to “tune in” to their own satiation cues inversely mediated the relationship between alexithymia and infant appetite recognition.

Study 4 included one-to-one semi-structured, video-elicited interviews with 14 parents from Study 3 who had high alexithymia scores. Reflexive thematic analysis revealed mealtime challenges, stress experienced by caregivers, and the effect of context on feeding practices.

Overall, findings showed that individual differences in tuning in to interoceptive cues were associated with parental ability to recognise and respond to infant appetitive cues. Tailored support for caregivers, especially those with

alexithymia, may enhance parental sensitivity to their own and to their infants' appetite and affect cues, with the potential to improve RF and positive mealtime experiences.

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List of Abbreviations

AEBQ: Adult Eating Behaviour Questionnaire

ANEW: Affective Norms for English Words

ANOVA: Analysis of Variance

AQ-S: Autism-Spectrum Quotient Short Form

ASD: Autistic spectrum disorders

BABES: Baby Behaviours when Satiated coding scheme

BCT: Behavioural change technique

BEBECS: The Baby Eating Behaviour Coding System

BEBQ: Baby Eating Behaviour Questionnaire

BMI: Body Mass Index

BST: Behavioural Susceptibility Theory

CEBQ: Child Eating Behaviour Questionnaire

CEBQ-T: Child Eating Behaviour Questionnaire - Toddler version

CF: Complementary feeding

CFA: Confirmatory Factor Analysis

CFI: Comparison fit index

CI: Confidence interval

CR: Composite reliability

DFA: Decreased Food Appeal

DPE: Decreased Priority of Eating

EF: Enjoyment of Food

FACS: Facial Action Coding System

FF: Food Fussiness

FIBFECS: the Feeding Infants: Behaviour and Facial Expression Coding System

FR: Food Responsiveness

HV: Health visitors

IAPS: International Affective Picture System

IES-2: Intuitive Eating Scale-2

IFQ: Infant Feeding Questionnaire

MEM-P: Mealtime Emotions Measure for Parents

NHS: National Health Service

OR: Odds ratio

OSF: Open Science Framework

PA: Planned Amount

PS: Physical Satisfaction

RCFCS: Responsiveness to Child Feeding Cues Scale

RCT: Randomised controlled trial

RF: Responsive feeding

RISE-Q: Reasons Individuals Stop Eating Questionnaire

RISE-Q15: Reasons Individuals Stop Eating Questionnaire short form

RMSEA: Root mean square error of approximation

ROB: Risk of bias

RTA: Reflexive Thematic Analysis

SC: Self-Consciousness

SD: Standard deviation

SE: Slowness in Eating

SEM: Structural Equation Modelling, or Standard Error of the Mean depending on the context

SES: Socioeconomic status

SR: Satiety Responsiveness

SRMR: Standardised root mean square residual

STAI: The State-Trait Anxiety Inventory

ST-DEP: State-Trait Depression Questionnaire

TAS-20: 20-item Toronto Alexithymia Scale

TLI/TFI: Tucker-Lewis fit index

VIPP: Video-feedback Intervention to promote Positive Parenting

VIPP-SD: Video-feedback Intervention to promote Positive Parenting and Sensitive Discipline

WHO: World Health Organization

Chapter 1

Introduction

- **An overview of the association between parental ability in recognising and responding to infant appetitive cues, responsive feeding practices, and childhood obesity**

Chapter 1. Introduction

Following birth, babies communicate their need for nourishment to caregivers through agitation, orientation towards the breast, mouthing, hand movements to the mouth, progressing to high arousal until the hunger cry is heard (Hetherington, 2017). Beyond the milk feeding period, infants signal hunger, satiation, liking and wanting through facial expressions and overt behaviours including, eventually, through language (Hetherington, 2020). Responsive feeding (RF) makes the difference between the baby eating enough to meet their needs and providing either too much or too little (Eidhin et al., 2025). Rapid weight gain during infancy (gaining >0.67 standard deviations in weight between two weighing periods) may signify overconsumption and is known to be associated with later obesity (Ong, 2010). Findings from longitudinal studies also indicate that feeding practices and energy intake during early life are critical due to their ability to affect child body weight (e.g., body mass index, BMI) (Zheng et al., 2021), child growth, healthy food consumption and development over time (Sangalli et al., 2021).

The observed rise in childhood obesity is often attributed to the obesogenic environment involving high food availability, highly palatable, energy dense foods, and increased portion sizes, which consequently encourages excessive energy intake compared to energy expenditure (Llewellyn & Fildes, 2017). These factors explain how individuals may interact differently with the obesogenic environment, leading to individual variation in body weight. In addition, multiple factors such as genetics and eating traits may also contribute to the prevalence of obesity (Carnell & Wardle, 2008).

RF requires sensitive parenting, which in turn, involves caregivers providing a prompt, emotionally supportive, contingent, and developmentally appropriate response to their child’s hunger and satiety cues (Black & Aboud, 2011). Results from several large randomised controlled trials (RCT) suggest that interventions to improve responsive parenting and feeding may successfully promote children’s healthy eating patterns (Daniels et al., 2009; Paul et al., 2014; van der Veek et al., 2019) and reduce risk of childhood obesity (Daniels et al., 2009; Lakshman et al., 2015; Paul et al., 2014). However, caregivers may vary in their ability to recognise and respond to infant hunger, appetite, and satiation cues with potential consequences for RF.

This introduction presents the key constructs that are thought to be related to caregivers' RF practices, such as children's eating traits and caregivers' sensitivity to child appetitive cues during mealtimes. Additionally, the feeding environment in which mealtimes occur will be considered. The overview outlines the chapters within this thesis and how specific research questions in promoting caregivers' responsiveness to infant hunger and satiation cues are addressed in individual chapters.

1.1 Infant eating traits and appetitive cues

Rapid weight gain in the early years of life is a major risk factor for adult obesity (Ong, 2006). The National Child Measurement Programme of the UK National Health Service (NHS) reported that in 2024, approximately 1 in 10 children aged 4-5 years in England had developed obesity, and this number raised to 1 in 5 by age 10-11 years (*Obesity statistics - House of Commons Library*, 2025). Obesity is hard to reverse, with strong tracking into adolescence and adulthood. Research has suggested that rapid weight gain during infancy (defined as a change in weight z-score > 0.67 in the first 2 years of life) was associated with nearly four times increased risk of overweight or obesity in childhood or adulthood (Zheng et al., 2018), and children with obesity were nearly five times more likely to have obesity later in adulthood than those who did not have obesity early in life (Simmonds et al., 2016). Understanding the causes is important in order to prevent rapid weight gain. What makes some children more vulnerable to weight gain may be explained, in part, by theories of behavioural susceptibility.

1.1.1 Behavioural Susceptibility Theory: introducing the appetite manipulators

The Behavioural Susceptibility Theory (BST) was developed to understand the association between appetitive characteristics of the person and genetic risk of obesity. BST proposed that genes influence weight partly via biological mechanisms that control appetitive regulation and partly through behavioural attributes (Llewellyn & Wardle, 2015). Two key appetitive traits that contribute to overeating were identified: **responsiveness to food cues** which describes the tendency to eat in response to the sight, smell or taste of food; and **sensitivity to internal satiety signals** which describes the tendency to respond to feelings of fullness by inhibiting further intake. According to the BST model (see Figure 1.1), weight gain is associated with both genetic and environmental factors. In the obesogenic environment where food cues are pervasive, individuals who are genetically predisposed to be highly responsive to food cues or lower sensitivity to internal satiety cues are more likely to overeat and experience excessive weight gain (Llewellyn & Fildes, 2017). Therefore, obesity is considered a result of a combination of both genetic susceptibility to overeating and exposure to the obesogenic food environment.

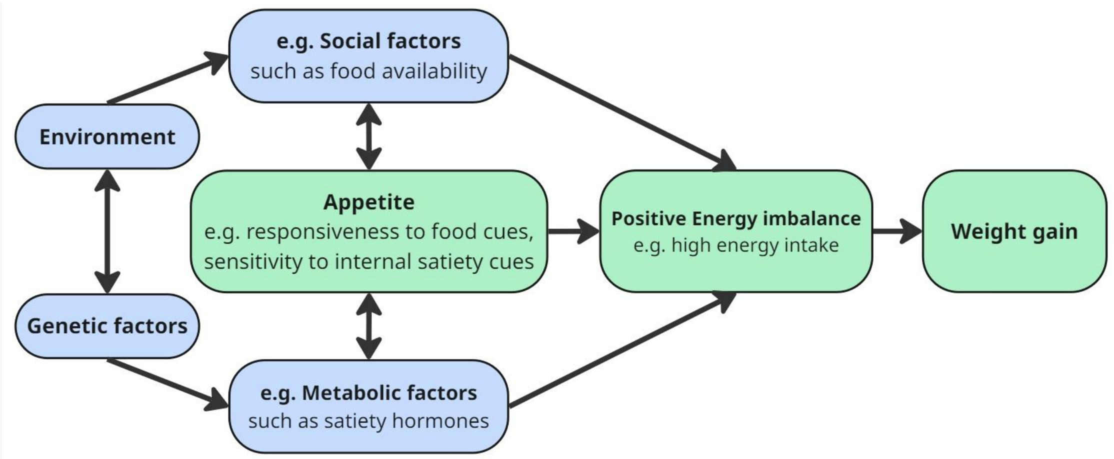


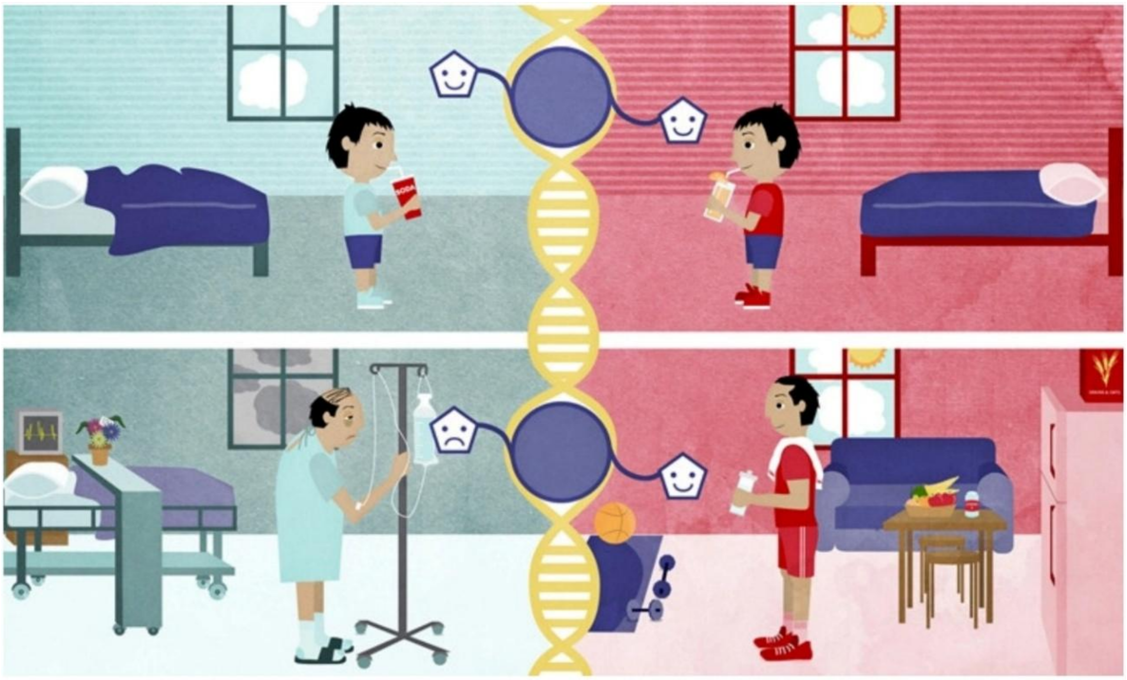
Figure 1.1. An illustration of how appetite mediates the interaction between genetic susceptibility to obesity and the environmental exposure in the BST. Adapted from Llewellyn and Fildes (2017).

Compared to adults, young children are less likely to be influenced by external pressures to diet or the long-term effects of chronic obesity (Jane Wardle et al., 2001). Therefore, the research by Wardle and her colleagues set out to characterise the appetitive traits of young children as reported by parents to produce a comprehensive psychometric measure of these traits, named the Child Eating Behaviour Questionnaire (CEBQ) (Jane Wardle et al., 2001). The CEBQ captures the enduring appetitive trait rather than the state of hunger or fullness at the time of evaluation, with parents responding to items that describe a range of eating behaviours using a five-point frequency scale (“never”, “rarely”, “1sometimes”, “often”, “always”). There are seven scales included in the CEBQ. “Food Responsiveness” (FR) measures children's responsiveness to external food cues and the tendency to eat (e.g., “even if my child is full up, s/he finds room for his/her favourite food”). “Enjoyment of Food” measures children's subjective reward during eating (e.g., “my child enjoys eating”). “Satiety Responsiveness” (SR) captures children's sensitivity to internal satiation cues (e.g., “my child gets full before his/her meal is finished”) and “Slowness in Eating” captures children's pace in finishing a meal (e.g., “my child takes more than 30 min to finish a meal”). Two scales measure children's tendency to experience under or overeating in response to negative emotions: “Emotional Overeating” (e.g., “my child eats more when worried”) and “Emotional Undereating” (e.g., “my child eats less when upset”). The last one “Food Fussiness” measures to what extend children are selective in eating (e.g., “my child refuses new foods at first”).

The CEBQ scales showed good internal and external reliability and have been adapted into a variety of versions to measure appetitive traits in different age groups, such as the Baby Eating Behaviour Questionnaire (BEBQ) (Llewellyn et al., 2011), the Child Eating Behaviour Questionnaire — Toddler version (CEBQ-T) (Herle et al., 2016), and the Adult Eating Behaviour Questionnaire (AEBQ) (Hunot et al., 2016).

The development of these psychometric appetitive measures largely facilitated studies investigating the association between appetite, eating behaviours, weight management, and obesity prevention outcomes across all age groups. For example, in a comprehensive systematic review and meta-analysis, A. Kininmonth et al. (2021) reported the strong genetic basis of appetitive traits and the associations between appetitive traits and adiposity in childhood. Results from cross-sectional studies included in the systematic review (N = 67) were consistent that high FR, as well as low SR linked to childhood obesity (A. Kininmonth et al., 2021). Furthermore, to explore the genetic and environmental influence on early growth via behavioural pathways from infancy, the Gemini cohort was established which was a large population-based prospective birth cohort containing 2402 British twin pairs (van Jaarsveld et al., 2010). Results from twin studies showed that while controlling for shared environmental confounders, twin pairs discordant for appetitive traits - such as FR and SR from first few weeks of life - had divergent weight gain trajectories from 3 to 15 months (van Jaarsveld et al., 2014; van Jaarsveld et al., 2010).

While obesity risk is associated with genes, BST hypothesised that it is the gene-environment interaction which determines whether genetic risk is expressed. A study examining the impact of gene-environment interaction on the heritability of child weight status (measured by child BMI) was conducted with twin pairs (N = 925) from the Gemini cohort (Schrempft et al., 2018). The family food environment was categorised as either “obesogenic” or “healthy” environment using the comprehensive Home Environment Interview (Schrempft et al., 2015). Schrempft et al. (2018) reported that the heritability of BMI of children living in the “obesogenic” home environment was more than two times higher compared to those living in the “healthy” home environment. Findings supported the hypothesis from BST that genes are more strongly expressed within a more permissive, obesogenic home environment. Therefore, investigating how and what a child is fed, under what environmental conditions provides an insight into the modifiable side of the gene-environment interaction (see Figure 1.2).



Identical twins start with identical genes (yellow). As they make different life choices including eating and exercising, and experience different environments, their genes stay the same, but their weight status can change.

Figure 1.2. An illustration of the gene-environment interaction based on the BST. Adapted from http://www.ohri.ca/epigenetics/

Overall, the BST provides a conceptual framework that childhood obesity is associated with a complex interaction between genetic susceptibility and exposure to an obesogenic environment, that appetite serves as a behavioural mediator of the gene-environment interaction from early life (Llewellyn & Wardle, 2015). Research on BST also demonstrated that appetitive traits including responsiveness to food cues and sensitivity to internal satiety cues are highly heritable and are predictive of prospective weight gain (Llewellyn et al., 2023). Although genes set the fundamental potential for obesity, the environment determines the outcome. For example, a healthy home food environment, responsiveness to infant needs and understanding infant appetite cues may serve to protect some vulnerable children from excessive weight gain. How do we then characterise and understand the ways in which infants express hunger, appetite and satiety, beyond parental reporting? An obvious method to do this is to observe infant behaviour, their response to food and to examine patterns of these responses associated with appetite.

1.1.2 The development of infant facial expressions and affect

Before language skills develop in children, communication between infants and their caregivers includes a range of facial, gestural and affective cues. Charlesworth and Kreutzer (1973) noted the insight that Darwin shared in his work that “a satisfactory understanding of adult behaviours requires a solid knowledge of the ontogenesis of the behaviours in the infant and child” (P.93). Infant facial expressions are considered indicators of their perceptual and cognitive process, emotional responses and regulation, and their capacities for reciprocal social interaction (Oster, 2005). Almost 150 years ago, through close observation of infants and children including his own son, Darwin described at least seven common emotional states accompanied by distinctive facial expressions such as anger, fear, and affection (Darwin, 1877). Based on his research, measures of infant facial expression have been refined and systematised to avoid the reliance on self-report. For example, adapted from the adult Facial Action Coding System (FACS) (Ekman & Friesen, 1978), the Baby FACS was developed as a more objective, anatomically based coding system to assess dynamic aspects of facial expressions of infants and young children (Oster, 2006).

Meanwhile, to examine whether infant facial expressions differed by culture, cross-cultural studies were conducted with 11-month-old infants from the United States, Japan, and China in three emotion-eliciting situations (Camras et al., 2007; Camras et al., 1998). Infant facial expressions were recorded and coded with Baby FACS (Oster, 2006) during a 10-second baseline and the first 20 seconds of the stimulus episode. Results revealed that infants from three cultures produced subtle variations in smiles and cry faces and distinctive expressions, such as brow movements and pouts in response to different situations, but the overall infant facial expressions did not differ across cultures (Camras et al., 2007; Camras et al., 1998). Overall, findings suggested that facial expressions are unequivocally associated with emotional experiences from early life (Ekman & Friesen, 1971; Fridlund et al., 1985), which supported Darwin’s earlier research that there are universal facial expressions of emotion which are universally recognised (Ekman, 1977).

With facial expression as an indicator, some studies investigated infants' hedonic responses to taste stimuli during the first year of life. The sensation of taste, which contains five basic tastes including sweet, sour, salty, bitter, and umami, is considered a powerful stimulus for eliciting affective responses in infants (Forestell & Mennella, 2017). With limited language and cognitive abilities, infant hedonic facial expressions to basic tastes and more complex flavours provide evidence of different ways infants process the sensory characteristics of foods and their affective response to these foods (Forestell & Mennella, 2017). In the late 1970s, researchers began to analyse the microstructure of infants' facial expressions in response to food-related chemical stimuli (Weiffenbach, 1977). For example, Steiner (1977) explored how newborn infants responded to different taste stimuli (neutral, sweet, sour, and bitter) with distinct facial expressions (see Figure 1.3). The concentrations of the aqueous solutions contained 25% sucrose for sweet, 2.5% citric acid for sour, and 0.25% quinine sulphate for bitter. For each stimulus, 0.5ml of liquid was rinsed on the dorsal surface of each infant's tongue in a random sequence at room temperature. Findings showed that affective responses to taste were observable from birth, and infants' facial expressions served as reliable markers of sensory and emotional responses, long before infant language or learned behaviour develops (Steiner, 1977).

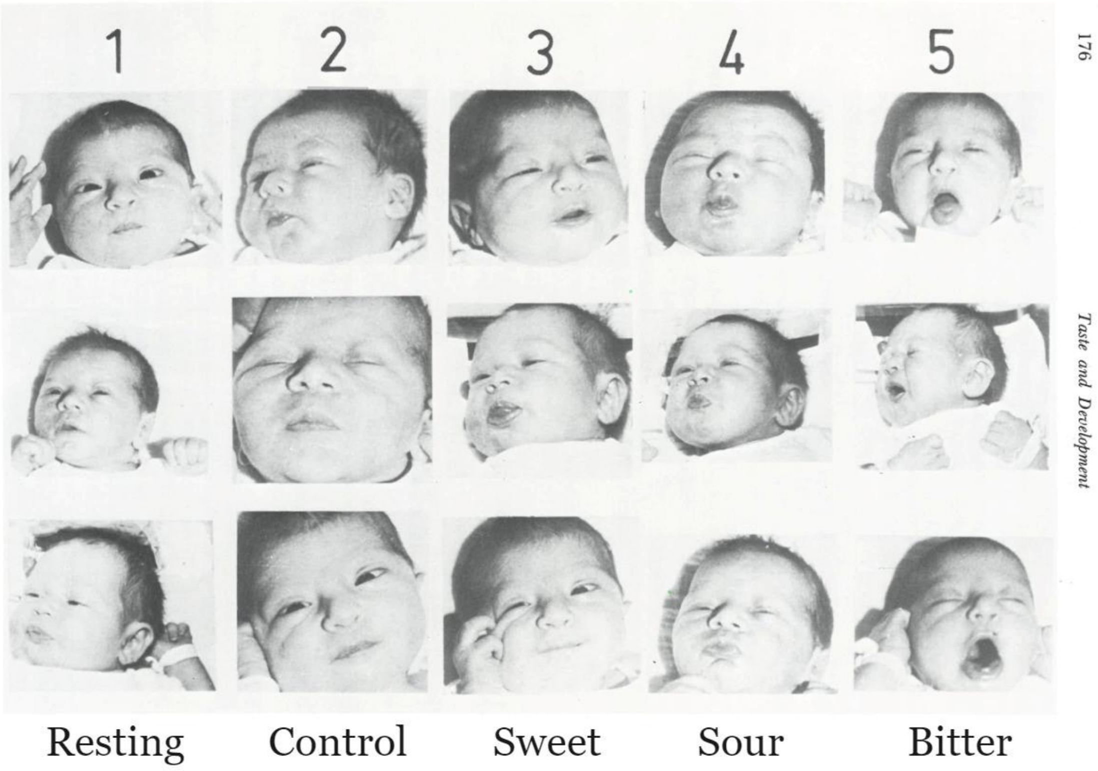


Figure 1.3. Typical features of gustofacial response summarised and presented by Steiner (1977), recorded in neonate infants between birth and the first feeding. 1: Resting face. 2: Reaction to distilled water (control). 3: Response to sweet (sucrose) stimulus. 4: Lip-pursing, response to sour (citric acid) stimulus. 5: Response to bitter (quinine sulphate) stimulus.

Like adults, newborn infants and young children can convey a wide range of hedonic responses to taste and flavours (Ekman & Oster, 1979). These early sensory experiences and expressions set the foundation for infants to communicate more complex appetitive cues such as hunger, appetite, and satiation with their caregivers during feeding as they develop.

1.1.3 Understanding infant appetitive cues and eating behaviours during feeding

Feeding is a reciprocal activity which involves children expressing appetitive cues and caregivers responding to these cues (Costa & Oliveira, 2023). Newborn infants exhibit distinctive responses to basic tastes through facial expressions. While infants grow, they expand their capacity to communicate their appetite through interest and disinterest in food using a variety of facial expressions, overt behaviours, vocalisations, and eventually language (Shloim et al., 2018). Through synthesising quantitative and qualitative data across longitudinal, cross-sectional, experimental, and cohort designs, McNally et al. (2016) systematically reviewed how infants communicate hunger and satiation in the first two years of life, and how these cues were perceived by parents. Findings showed that infants displayed diverse and variable feeding cues to indicate hunger and satiation such as crying, hand-to-mouth movements, orientation towards or away from the food, gesture, mouthing, agitation, and outward displays of stress (McNally et al., 2016). This synthesis was further supported by results from an observational study of mother-infant feeding interactions during early infancy (Shloim et al., 2017). The review also indicated that both infant and parental factors were associated with child expression of hunger and satiation cues. For example, the expression was related to child temperament and developmental stage; whereas maternal high BMI or low education were related to low sensitivity to infant satiation cues (McNally et al., 2016). Using the Infant Gaze at Mealtime coding scheme on observations of mealtimes at home, McNally et al. (2019) further suggested that as the meal progressed, infants' gaze shifted from food-focused to other stimuli (e.g., exploratory gaze and gaze aversion) as they became satiated. This gaze shift may serve as a practical, easy-to-observe cue for parents to support their RF practices.

However, in a different, lab-based setting, variability in the clarity of infant appetitive cues during early feeding interactions was reported. For instance, Ventura et al. (2019) suggested that infants vary in how well, and how clearly they communicate hunger and satiation, but the clarity was not associated with infant gender, age, temperament, eating behaviours, or whether they were breastfed or formula-fed. Instead, greater clarity of infant appetitive cues was significantly associated with higher maternal sensitivity to infant hunger and satiation cues as well as maternal self-reported RF practices (Ventura et al., 2019). Furthermore, based on recorded mealtime interactions at home, observations on maternal responsiveness to infant appetitive cues at 8 and 12 months of age revealed that mothers were more attuned to infant hunger than satiation cues at both ages, and their responsiveness to hunger cues improved as their child grew (Di Prete et al., 2023).

Overall, infant hunger cues tend to be more salient for parents, across studies, compared to satiation cues which may indicate the primacy of hunger as a survival need, and these feeding cues become easier to interpret with child maturity (Di Prete et al., 2023; McNally et al., 2016). Meanwhile, the clarity of infant appetitive cues plays a critical role since clear signalling may facilitate parental RF practices. In contrast, poor clarity of appetitive cues may lead to overfeeding and increased risk of rapid weight gain, particularly in formula-fed infants (Ventura et al., 2019).

Observational studies of infant mealtimes present rich and meaningful data on the ways that hunger, appetite, and satiation are expressed in early life. Therefore, to systematically assess and characterise parental responsiveness to child feeding cues, and to evaluate parental feeding practices and its link to childhood obesity, the Responsiveness to Child Feeding Cues Scale (RCFCS) was developed which identified 20 types of hunger cue and 28 types of satiation cue (Hodges et al., 2013). These cues were further categorised into early (e.g., increased alertness), active (e.g., excitatory bodily movements) and late (e.g., crying) to reflect changes of cue intensity (Hodges et al., 2013). In another study regarding the development of feeding cues during infancy and toddlerhood, Hodges et al. (2016) observed mother-infant dyads at infant age 3, 6-, 9-, 12- and 18 months during mealtimes at home. The RCFCS was used at each time point and comparisons over time showed that while infants' intention to signal appetitive cues increased over time in the first 18 months of life, satiation cues became more diverse and assertive after 6 months, such as pushing food away, verbal or non-verbal indicators of “no” from infants. The RCFCS was also used to compare how different complementary feeding approaches (i.e., parent-led weaning, baby-led weaning, and mixed methods) related to maternal responsiveness to infant appetitive cues at infant aged 8 and 12 months (Di Prete et al., 2023). Results showed that infant self-feeding behaviours coded by RCFCS, rather than maternal self-reported feeding approaches, were associated with great maternal responsiveness to infant satiation cues (Di Prete et al., 2023), indicating that observed behaviour (i.e., infant actual self-feeding) may be more informative than reliance on parental reported feeding practices.

To enhance the understanding of infant food preferences (for example novel vegetables) and the ways infants express liking and wanting, the Feeding Infants: Behaviour and Facial Expression Coding System (FIBFECS) was adapted from the Baby FACS in a study with infants during the complementary feeding stage (Hetherington et al., 2016). Overall, this coding scheme captured infant behaviour/mouth movements and facial expressions indicating hunger, satiation, liking and disliking during feeding, and is divided into two sections with 6 acceptance/rejection behaviours (e.g., turns head away, arches back, crying/fussy, pushes spoon away, leans forward and rate of acceptance) and 7 facial expression items (e.g., brow lowered, inner brow raised, squinting, nose wrinkling, lip corners down, upper lip raised and gaping). Notably, this coding scheme is specific to the spoon-feeding and to the introduction of solid foods.

Additionally, the Baby Eating Behaviour Coding System (BEBECS) has been developed to code behaviour of infants following a baby-led weaning method (Urkia-Susin et al., 2024). Variables regarding time (e.g., food in month, meal duration), child behaviours (e.g., mouth approach), caregiver-led actions, and other meal-related variables (e.g., child approach difficulties) are measured along with intake and maternal ratings of liking and calmness in this coding scheme (Urkia-Susin et al., 2024). Authors also suggested that BEBECS could be used together with FIBFECS facial expressions coding scheme to better decode infant appetitive cues, their liking and wanting towards foods regardless of the complementary feeding method that caregivers adopt (Urkia-Susin et al., 2024).

More recently, Ventura et al. (2024) developed a coding scheme named Baby Behaviours when Satiated (BABES) based on videos of mother-infant bottle-feeding interactions from a longitudinal study to assess infant disengagement/satiation cues and maternal responses during feeding. Building on the existing evidence, findings indicated developmental trends in behaviours across the first year, for example, infants showed clearer and more active disengagement/satiation cues as they got older. Varied maternal responsiveness was observed suggesting that mothers were more sensitive to hunger/receptiveness cues than to satiation cues. Ventura et al. (2024) also suggested that RF is more challenging when infant cues are unclear, but parents may benefit from tailored support to understand and respond to infant feeding cues, particularly related to satiation. However, the BABES coding scheme was only conducted with bottle-fed infants up to 12 months old, which limited its generalisation since infant appetitive cues and maternal response might differ in older children, or in the breastfeeding and complementary feeding context. The additional longitudinal follow-up on child growth, weight gain and obesity risk may also contribute to the translation between observed behaviours into developmental or health trajectories. Moreover, while Ventura et al. (2024) reported moderate to strong reliability, some subtle or context-specific behaviours might not be captured by the scale, such as infant gaze, parental involvement, and cultural feeding norms that may influence parental feeding behaviours (e.g., what constitutes a “healthy” child (Ventura, 2022)).

Overall, infants exhibit a variety of appetitive cues in terms of gaze, facial expressions, and overt behaviours associated with eating to communicate hunger and satiation during feeding. While infants’ ability to signal appetitive cues improves as they grow, mothers also improve their skills in recognising, interpreting and responding to infant appetitive cues in the dynamic mother-infant communications (McNally et al., 2016). It is worth noting that observational studies and the use of coding schemes such as RCFCS and FIBFECS applied to mealtime video recordings have yielded more sensitive evidence than self-reported data (Pesch & Lumeng, 2017). More details of what happens in the moment (e.g., actions, behaviours, vocalisations, environmental components, etc.) are obtained which cannot be captured by self-report questionnaires (Pesch & Lumeng, 2017). How infants communicate their needs during feeding and the ways in which caregivers respond are essential in healthy growth and wellbeing (Hetherington, 2020). Understanding infant hunger, appetite and satiation cues during infancy and early childhood may contribute to positive feeding practices and healthy mealtime patterns, avoiding overfeeding, thereby protecting infants from early childhood obesity. However, there is also evidence that environmental influence on risk for obesity is apparent *before* birth.

1.2 The first 1000 days of development

The ante-natal period and first two years postpartum, which is also referred to as “the first 1000 days”, has been identified as the most important and active time for neurodevelopment and a time of great vulnerability (Georgieff et al., 2015). Rapid brain development of important primary structures and processes that support fundamental behaviours occurs, including the sensory systems and the monoamine neurotransmitter systems for affect and reward (Schwarzenberg et al., 2018). By age two, the brain undergoes extensive restructuring with critical developmental changes that cannot be replicated later in life, whereas toxic stress, emotional deprivation, and deficient diets are associated with less optimal brain development during early childhood (Schwarzenberg et al., 2018). The Developmental Origins of Health and Disease theory (i.e., Barker Hypothesis) also proposed that early life environments such as poor nutrition, maternal physiology, or other adverse conditions during foetal development may lead to permanent physiological and metabolic changes that increase the risk of chronic diseases in adulthood, including obesity, diabetes, cardiovascular disease and mental health (Wadhwa et al., 2009).

In the infant feeding and nutrition domain, findings from a review reported a variety of risk factors in each critical time frame (prenatal period, breast/formula feeding period, and complementary feeding period) as possible determinants of obesity in later life (see Figure 1.4) (Mameli et al., 2016). Through prospective birth cohort studies in the UK, results also showed that rapid infant weight gain served as a compensatory mechanism for intrauterine growth restraint, and children who experienced rapid weight gain from birth to two years were more vulnerable to childhood obesity and showed more central fat distribution at five years than those who didn’t have rapid weight gain (Ong et al., 2000). Furthermore, Ong et al. (2006) reported that formula-fed infants consuming more energy at 4 months were at higher risk of postnatal rapid weight gain and childhood obesity, whereas breastfeeding during this same period generated a protective effect. To summarise, early life nutritional and environmental factors are significant determinants of optimal brain development (Schwarzenberg et al., 2018) as well as childhood obesity (Mameli et al., 2016).

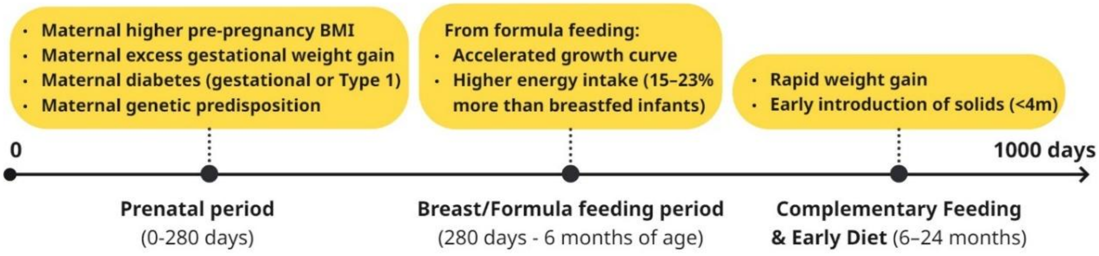


Figure 1.4. Several main risk factors identified in the first 1000 days for the development of childhood obesity. Adapted from Mameli et al. (2016).

Overall, children's eating behaviours develop through a complex interplay between hormone regulation, brain-based activity, early motor, sensory and socio-emotional capacity, in addition to cultural and social interactions (Gahagan, 2012). Although variation in appetite is partially determined by genes and present from birth (Llewellyn et al., 2010), environmental factors remain critical (even before birth) since the interaction of genetic factors and environmental factors significantly modify growth trajectories, an individual's appetite traits and their eating behaviours (Llewellyn & Fildes, 2017). Understanding both genetic and environmental factors that influence child eating behaviours has contributed to our understanding of child weight change, growth and risks for childhood obesity. This raises the question of *how* parents influence eating behaviours through specific aspects of parenting styles, feeding styles and feeding practices in early life.

1.2.1 A typological approach to parenting and feeding styles

As eating patterns established early track into later life, childhood serves a critical period in the prevention of obesity. During this time, parents play an essential role in determining their children's intake patterns and food preferences through both direct and indirect influences, from monitoring their children's food intake (Yee et al., 2017) to passively modelling a healthy or unhealthy diet during mealtimes (Scaglioni et al., 2018; Yee et al., 2017). Thus, parental approaches to how they provide food to their children via their general parenting style, feeding styles, and feeding practices have a profound impact on which foods are offered, how these are eaten and how much is eaten, which in turn affects child growth and development (Mahmood et al., 2021).

Parenting style is a general behavioural construct which refers to the emotional context for parent-child interactions, and a stable parental attitude towards their children through time (Darling & Steinberg, 2017). Patterns of parental behaviours have been conceptualised with two underlying dimensions named “Demandingness” which reflects the extent to which parents expect their child to regulate impulses, show responsibility and independence, and achieve tasks suited to their developmental stage; and “Responsiveness” which indicates the extent to which parents show affective warmth, acceptance, as well as involvement (Maccoby & Martin, 1983). Based on these two dimensions, a four-fold classification of parenting style was developed: (1) “Authoritative” style, which is characterised by a relatively high demandingness and responsiveness including parental involvement, nurturance, reasoning, and structure; (2) “Authoritarian” style pairs a high level of demandingness with a relatively low level of responsiveness characterised by parents asserting their power through restriction and punitive measures, with less influence from the child’s expressed needs; (3) “Indulgent” style, involves a relatively low demandingness with high responsiveness characterised by warmth and acceptance in conjunction with high engagement with the child’s needs but without structure or expectations from the child; (4) “Uninvolved” style, is observed where there is both low demandingness and responsiveness characterised by little parental control and involvement with their children. The Authoritative style is generally associated with the most positive child outcomes including higher school performance in cross-sectional studies with large samples in the US (Darling & Steinberg, 2017), and a healthier home food environment also from a cross-sectional study (Johnson et al., 2012).

Aligned with the typology of general parenting that Maccoby and Martin (1983) proposed, Hughes et al. (2005) developed a parenting model using the same two dimensions named “Demandingness” and “Responsiveness”, to identify the feeding typology. This model aimed to conceptualise parenting strategies in the feeding context. For example, in the feeding domain, “Demandingness” indicates **the extent to which** parents encourage their child to eat, whereas

“Responsiveness” indicates **in what ways** parents encourage eating in line with their child's needs in a responsive or nonresponsive way (see Figure 1.5)

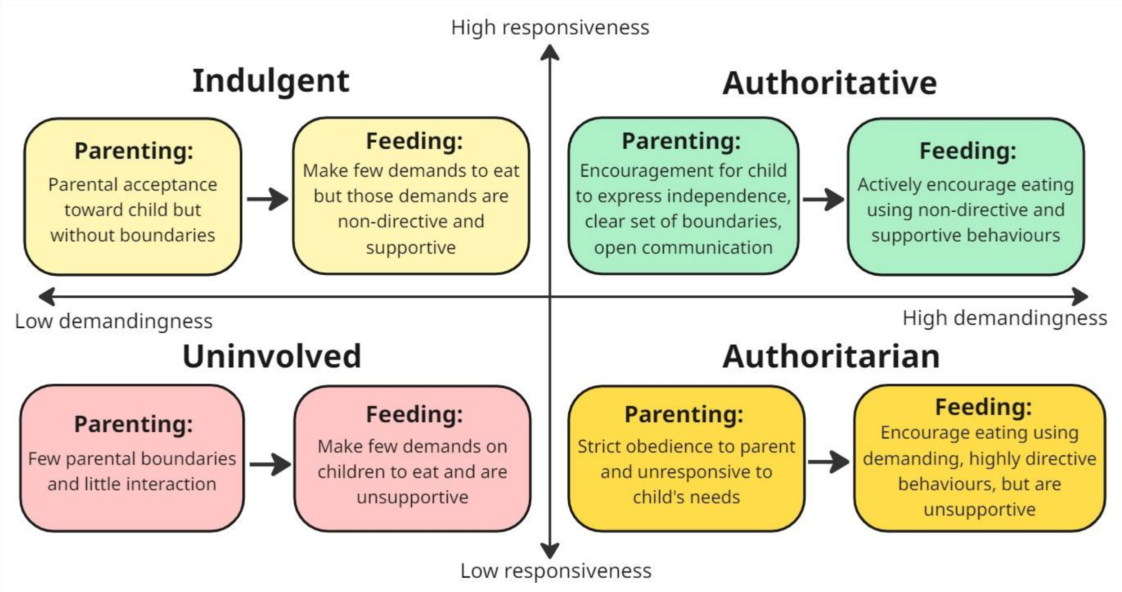


Figure 1.5. An illustration of the model development from parenting styles to feeding styles. Adapted based on the typological approach to parenting and typological approach to feeding from Hughes et al. (2008).

Due to the context-specific impact of parental feeding practices on children's eating behaviours, measuring feeding styles rather than the overall parenting style may be more effective in predicting children's weight status (Hughes et al., 2008), or understanding children’s food consumption patterns (Patrick et al., 2005). For example, parents who perceive their children to be fussy or have weight-related problems, may use different feeding strategies than those applied to other children in the family. In addition, Birch et al. (1987) reported that parental control of preschoolers’ food intake through Authoritarian practices reduced children’s responsiveness to energy density and portion size. Moreover, children who were instructed to “clean the plate” were less responsive to energy-density cues than those who were taught to focus on their own internal hunger and satiation cues (Birch et al., 1987). Therefore, identifying feeding styles may prove helpful in understanding how parents shape their children’s eating, as well as what drives some feeding strategies (such as pressure to eat or indulgent feeding behaviours). Clearly, the relationship between caregivers and their child during mealtimes is reciprocal. It is this bidirectionality which is explored next.

1.2.2 Reciprocity as fundamental to responsive parenting and feeding

Starting from birth and during infancy, caregivers and their infants learn to recognise and interpret gestural, vocal and non-verbal communication cues from each other. This reciprocal process forms a fundamental basis for attachment between the caregiver-infant dyad that is critical to healthy social-emotional functioning (Ainsworth et al., 2015). Research on responsive parenting has most often been conducted in the context of observations of play (Bornstein & Tamis-Lemonda, 1997; Landry et al., 2001). Responsive parenting has been conceptualised as prompt, emotionally supportive, contingent, and developmentally appropriate behaviours which includes a 4-step dynamic process between the caregiver and the child (see Figure 1.6) (Black & Aboud, 2011). To achieve responsive parenting, caregivers proactively set the stage for responsive interactions, consequently, their behaviours may facilitate subsequent interactions particularly with contingent responses. On the other hand, studies showed that infants were more attentive to caregivers whose response aligned with their cues (Rochat & Striano, 2002), such as a match on subtle facial expressions (e.g., caregivers smile which their child then also do; parents are surprised when their children seem surprised) (Nicely et al., 1999; Rochat & Striano, 2002).

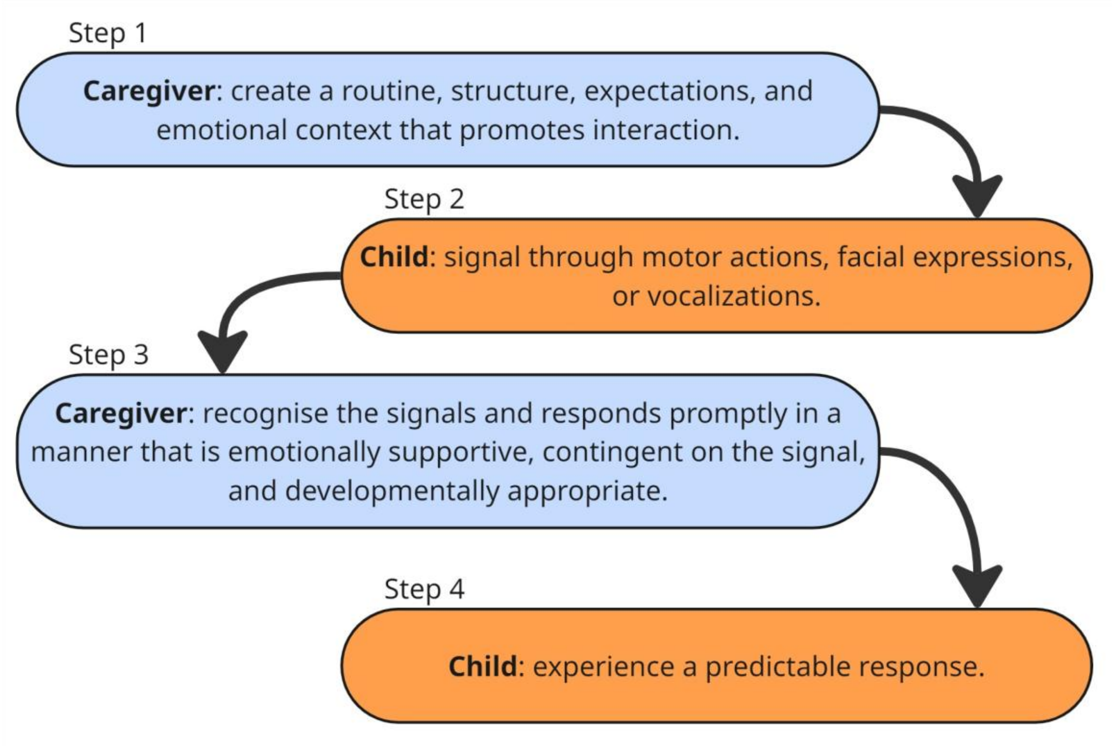


Figure 1.6. The flow diagram that captures the 4-step process in responsive parenting. Adapted from Black and Aboud (2011).

In the child development domain, understanding parental responsivity has originated from attachment theory (Ainsworth et al., 2015), socialisation theories (Bugenthal & Goodnow, 1998), and ecological and transactional theories of child development (Bronfenbrenner & Ceci, 1994; Sameroff, 2009). In their meta-analysis of early childhood sensitivity and attachment interventions, Bakermans-Kranenburg et al. (2003) synthesised evidence from observational studies demonstrating consistent associations between sensitive, warm caregiving and secure infant attachment. In addition, they reviewed randomised and quasi-experimental intervention studies, particularly those employing short, focused, behavioural coaching with video feedback which yielded significant improvements in parental sensitivity and infant attachment security (Bakermans-Kranenburg et al., 2003). Moreover, infants benefit from parents who are more attentive to them, especially when more distinct and meaningful signals are given. For example, findings from a narrative review revealed that responsive play and social interactions in early life were related to children's more advanced cognitive and language development in the second year of infancy, regardless of cultural variations in low, middle and high countries (Black & Aboud, 2011).

An obvious extension of the principles of responsive parenting is to the feeding context. Responsive feeding (RF) refers to a bidirectional feeding process, where caregivers provide prompt, emotionally supportive, contingent, and developmentally appropriate responses to their children's hunger, appetite and satiation cues during feeding (Black & Aboud, 2011) (see Figure 1.7). In addition to the potential positive outcomes from responsive parenting, research on RF suggested that RF could promote children's attentiveness and interest in feeding, sensitivity to their own internal hunger and satiation cues, ability to express their needs with clear and meaningful signals, as well as successful progression to the independent feeding (Black & Aboud, 2011).

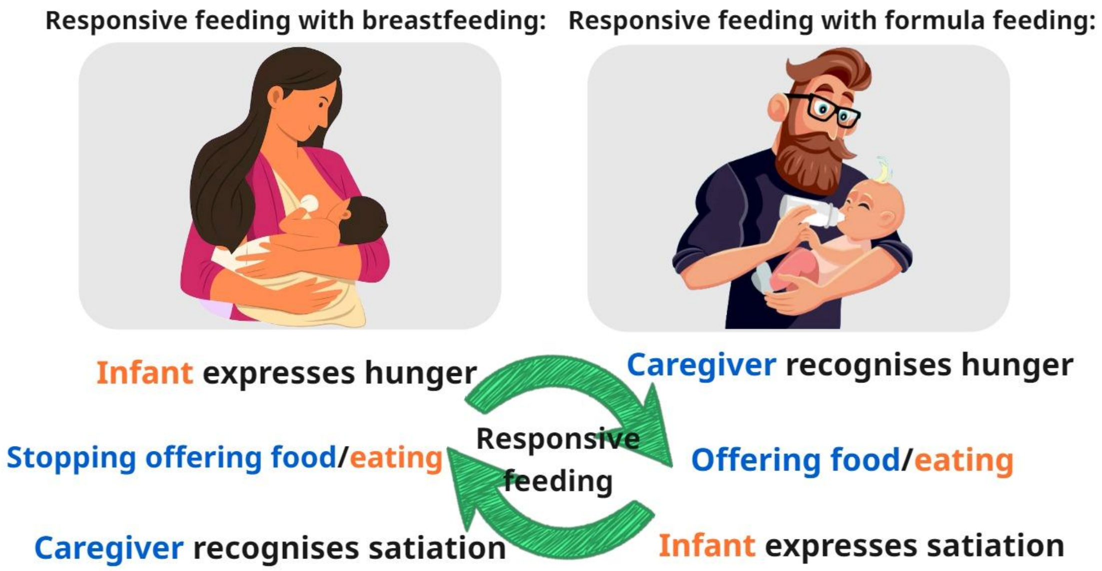


Figure 1.7. Schematic of responsive feeding with breastfeeding (on the top left) and formula feeding (on the top right), and an illustration of the bidirectional process of responsive feeding between the caregiver (blue ink) and the child (orange ink).

Parental responsivity plays an essential role in feeding in the early stage as caregivers (mainly mothers) learn to interpret their children's hunger and satiation cues, so they can initiate or terminate the feeding accordingly (Shloim et al., 2018). Recently, Eidhin et al. (2025) conducted a systematic review to identify behaviour change techniques and theoretical frameworks used in responsive parenting and feeding interventions for parents of children under 2 years old, and to evaluate their potential role in improving parental RF practices and preventing childhood obesity. Synthesised results showed that a variety of behaviour change techniques, such as instructions on how to perform a behaviour, tangible tools or resources acting as prompts or supports for RF, as well as behavioural change theories including Social Cognitive Theory were employed in the intervention design with promising results in improving parental behaviours and reducing childhood obesity risk (Eidhin et al., 2025).

For instance, during both milk feeding (Lakshman et al., 2015; Paul et al., 2014) or complementary feeding (Daniels et al., 2009; Paul et al., 2014; van der Veek et al., 2019), interventions were developed in large-scale RCTs through educational resources and experiential learning with theoretically framed materials embedded in the *NOURISH trial* (Daniels et al., 2009), *INSIGHT trial* (Paul et al., 2014), *Baby Milk trial* (Lakshman et al., 2015), and *Baby's First Bites trial* (van der Veek et al., 2019) (see Table 1.1).

Trial	Educational resources / Instructions delivered to parents	Supplementary materials offered to parents	Theories/Framework embedded
INSIGHT trial (Paul et al., 2014)	Home delivered (with home visits) coaching with guidance on identifying infant hunger, satiation, distress cues, delaying solids, age-appropriate portion size, alternatives to food for soothing, repeated exposure to vegetables, structured mealtimes.	Feeding diaries, growth charts, structured lesson materials.	Grounded in Responsive Parenting framework; informed by self-regulation theory and developmental psychology.
NOURISH trial	Group-based educational sessions	Fridge magnets, cue cards, and	Social Cognitive Theory (self-efficacy,

(Daniels et al., 2009)	for first-time mothers. Instructions in RF practices, delaying solids, portion sizes, repeated exposure to healthy foods, and avoiding coercive feeding.	handouts to reinforce RF at home.	modelling), Theory of Planned Behaviour (intentions, attitudes).
Baby's First Bites trial (van der Veek et al., 2019)	Home delivered (phone calls and home visits) guidance on *what* to feed (vegetable introduction) and *how* to feed (maternal sensitivity during mealtimes).	Materials on structured mealtime and feeding guides to support vegetable exposure and maternal sensitivity.	Attachment Theory (maternal sensitivity, secure feeding interactions)
Baby Milk trial (Lakshman et al., 2015)	Home delivered instructions on formula feeding practices, recognizing satiety cues, and avoiding overfeeding.	Feeding diaries, formula preparation guides, and written materials to support responsive bottle-feeding.	Social Cognitive Theory and responsive parenting framework.

Table 1.1. An overview of parenting/feeding instructions delivered, supplements provided to parents, and theories embedded in the intervention design of the *INSIGHT trial*, *NOURISH trial*, *Baby First Bites trial*, and *Baby Milk trial*.

However, mixed results have been found regarding the intervention effectiveness on promoting parental sensitivity and responsiveness to child appetitive cues, child healthy eating patterns, and managing child weight growth. For example, children from the responsive parenting intervention group of the *INSIGHT trial* had a lower BMI z-score by 3 years old (Paul et al., 2018) and lower BMI from age 3 to 9 years compared to the control group (Paul et al., 2025). But group differences appeared to dissipate over time and cross-sectional analyses reported no differences in the prevalence of overweight or obesity at child age 3 (Paul et al., 2018), 5, 6, and 9 years (Paul et al., 2025), and no group differences in BMI z-scores from 5 to 9 years old (Paul et al., 2025). Nevertheless, mothers in the intervention group reported less pressure to eat, reduced offering food to soothe, and greater use of structure-based feeding when children were 12 months old compared to mothers in the control group (Savage et al., 2018). Paul et al. (2019) also reported that intervention mothers in a nested subsample were more likely to report RF practices and fewer nonresponsive practices, with 60% of them showing more sensitive feeding such as teaching their children signs to indicate appetite ("more" and "all done") (Paul et al., 2019). Thus, compared to infants in the control group, those in the intervention group were more likely to use "all done" to express satiation (Paul et al., 2019). Overall, responsive parenting or RF interventions revealed a positive impact on infant weight outcomes including less rapid weight gain (L. Daniels et al., 2012; Lakshman et al., 2018; Savage et al., 2016) or lower BMI z-scores (L. Daniels et al., 2012; Paul et al., 2018).

On the other hand, nonresponsive feeding is characterised by the lack of reciprocity between caregivers and their children, such as caregivers exerting excessive control and taking charge of feeding (controlling/pressuring) or ignoring their child's appetitive cues and nutritional needs (uninvolved), or the child exerting control over eating without appropriate parental regulation (indulgence) (Black & Hurley, 2010). In a longitudinal cohort study with Australian parents of infants aged under 6 months at baseline, Burnett et al. (2022) indicated that infant high FR and low SR were prospectively associated with more non-responsive feeding practices, such as persuasive feeding and using food to calm by the time infants were 12 months. More importantly, cross-lagged models using structural equation modelling revealed that infant appetitive traits, particularly FR were related to higher infant BMI z-scores, while parental non-responsive feeding practices might influence infant BMI z-scores indirectly through the impact on infant appetitive traits (Burnett et al., 2022).

To summarise, evidence suggests that children may benefit from responsive parenting and RF in various ways. For example, the short-term benefits of RF include children's increasing attention and ability to express their own internal hunger and satiation cues, and eating in an independent, competent manner during family mealtimes. The long-term benefits may involve enhanced psychosocial, cognitive, and language development, in addition to self-regulation of food intake, healthy eating patterns and weight growth. Therefore, parental RF practices serve as a potentially modifiable behaviour to reduce the risk of overweight and obesity. Focusing on promoting RF might be an effective intervention or educational resource in preventing childhood obesity and establishing children's healthy eating behaviours.

1.3 Impact of individual characteristics on feeding practices

As illustrated above, parental sensitivity may depend on their ability to understand infant communication of appetitive cues including hunger, appetite, and satiation during feeding. This ability, which varies in parents, has been reported to be related to the extent which parents are able to “tune in” (i.e., recognise and respond) to their own internal appetite and affect cues (Yu, Fildes, et al., 2025). The ability to recognise communicative cues is particularly important as it serves the fundamental and essential role of being able to respond to other’s needs (Brewer et al., 2016). In the feeding context, parents might struggle to provide timely and appropriate responses to their children’s needs due to poor recognition of infant cues and communication (de Cock et al., 2016), which leads to non-responsive feeding practices – a risk factor of childhood obesity. One reason that caregivers may not respond to infant appetite cues is that they have difficulty “decoding” their infant’s expressions and overt behaviours at mealtimes. In part, this could be due to lack of clarity in communicating on the infant’s side, but it could also be attributed to a lack of insight into the caregiver's own appetite cues. For example, if a caregiver has poor interoceptive awareness or weak responsiveness to satiety, this may contribute to the confusion in recognising and responding to the hunger, appetite and satiation cues of others, including their infants. To investigate this proposal, it is necessary to assess interoceptive awareness as a general construct and specific behavioural constructs such as satiation and satiety responsiveness.

1.3.1 Measuring satiation: the validation of the Reasons Individuals Stop Eating Questionnaire short version (RISE-Q15) in a UK-based sample

Recently a satiation framework has been proposed by Cunningham and Rolls (2021) to redefine satiation that indicates a series of complex processes leading to the termination of eating. To investigate these processes in more depth, the Reasons Individuals Stop Eating Questionnaire (RISE-Q) has been developed to identify individual differences in reasons to stop eating, with five latent factors identified named Decreased Food Appeal (DFA), Physical Satisfaction (PS), Planned Amount (PA), Self-Consciousness (SC) and Decreased Priority of Eating (DPE) (Cunningham et al., 2021). Research revealed that sensitivity to signals of satiation, whether associated with food appeal or physical satisfaction, may represent a more general ability to recognise and respond to internal cues. For example, interoceptive sensitivity has been measured in terms of an accurate perception of heart rate, which reflects a relatively stable capacity to detect changes in visceral processes such as interoceptive cues generated by the stomach (Herbert et al., 2013). Strong interoceptive sensitivity is associated with intuitive eating behaviours involving reliance on internal hunger and satiation cues, eating for physical hunger not emotional reasons, as well as a healthy BMI (Herbert et al., 2013). Therefore, a weak or reduced ability in recognising and responding to interoceptive sensations including internal hunger and satiation cues may contribute to overeating and potentially obesity.

To validate the RISE-Q in a UK-based sample, Chawner and his colleagues conducted a study in which they successfully replicated and extended the construct validity of the RISE-Q factors as reported in the original study (Chawner et al., 2022). Confirmatory factor analysis supported the original five-factor structure of the RISE-Q, but the model fit was improved by a new short form with 15-item (i.e., RISE-Q15). Utilising the respecified model (RISE-Q15), the structural equation model was used to examine the relationship between individual's sensitivity to internal satiation cues, AEBQ Satiety Responsiveness, and RISE-Q15 subscales. Overall, Satiety Responsiveness was associated with RISE-Q15 Decreased Food Appeal; whereas an individual’s sensitivity to internal satiation cues was associated with RISE-Q15 Physical Satisfaction (Chawner et al., 2022). Findings revealed that the RISE-Q15 may be a more sensitive measure of specific meal termination behaviours compared to generic traits measured by existing questionnaires (Chawner et al., 2022).

Individuals vary in their ability to recognise and respond to their own internal hunger and satiation cues. In addition, this may be associated with the extent to which individuals can decode/translate and respond to infant appetitive cues such as hunger and satiation during mealtimes. Therefore, the RISE-Q15 was used throughout the present project which allowed a further exploration regarding the association between individuals’ ability in “tuning in” to their own internal satiation cues, their intuitive eating behaviours, and their ability to recognise and respond to infant hunger and satiation cues during feeding (see Chapter 4 and 5).

1.3.2 The association between maternal mental health, wellbeing and their feeding practices

In addition to interoceptive awareness, RF may depend upon the caregiver’s mental health. Existing research has shown that mental health problems are often related to parental interactions with their children across a variety of domains, such as play (Stein et al., 2001) and feeding (McPhie et al., 2014).

Tronick (2005) proposed the Dyadic States of Consciousness Model in which the parent-child dyad was considered an affective communication system with mutual, conscious and dynamic regulations. However, Tronick (2005) reported mothers experiencing depressive symptoms struggled to understand their children's affective communications, and thus failed in attuning to their children's cues. This resulted in a pervasive negative affect due to misinterpretation and miscommunication between the dyad. More generally, the affective states and behaviours of children with mothers experiencing depressive symptoms were described as less vital, responsive and assertive compared to those with non-depressed mothers (Tronick, 2005). As a result, Tronick (2005) suggested that these interactions in turn would reduce maternal self-efficacy and sense of parenting adequacy, which were associated with shared experience of reciprocal satisfaction between the parent-child dyad.

In the feeding domain, parents reporting mental health issues used more controlling, or less sensitive, feeding interactions with their children in both clinical and non-clinical samples (Blissett & Haycraft, 2008, 2011; Elias et al., 2016; Goulding et al., 2014; Haycraft & Blissett, 2008; Haycraft et al., 2013). For example, mothers who reported symptoms of stress, depression, or anxiety were more likely to demonstrate nonresponsive feeding styles involving forceful, uninvolved, indulgent and restrictive feeding practices (Hurley et al., 2008). Haycraft (2020) reported that the presence of maternal anxiety and depression were associated with greater self-reported use of controlling feeding practices including food restriction for weight control, emotion regulation, and using food as a reward, in addition to less modelling in feeding. Similar findings have been reported in an observational study where mothers who reported greater symptoms of depression were found to implement a more controlling, less sensitive feeding style, such as the use of more verbal and physical pressure to get their children to eat; meanwhile, they also offered more incentives or conditions to encourage eating (Haycraft et al., 2013).

Another caregiver's characteristic found to be associated with their RF practices is alexithymia (Yu, Fildes, et al., 2025). Alexithymia is defined as a stable trait involving individual's reduced capacity to identify and describe emotions and bodily sensations and exhibiting an externally oriented thinking style with a constrained imaginary life (Taylor, 1984). Based on results of content analysis, Taylor (1984) found individuals with alexithymia reported limited use of emotional vocabulary which indicated the presence of a communicative disorder. In clinical studies, participants with alexithymia demonstrated problems in verbalising emotions and feelings, in addition to having an impoverished inner emotional life (Taylor et al., 1991; Taylor et al., 1985). Moreover, alexithymia was described as a general deficit of interoception that captures difficulties in processing both affective and non-affective interoceptive cues, such as hunger, arousal, fatigue, temperature, and heartbeat (Brewer et al., 2016; Brewer et al., 2019).

Based on the intrinsic role in social-emotional processing, several studies have investigated the impact of alexithymia on neurodevelopmental and neuropsychiatric conditions that affect social and emotional understanding (Berthoz et al., 2011; Bird & Cook, 2013). Findings illustrated a complex relationship between alexithymia and other mental health problems or clinical disorders. For example, as both a cause and consequence of autistic behaviours, alexithymia is highly prevalent in autism spectrum disorder (ASD), with approximately half of individuals with ASD experiencing alexithymia (Poquérusse et al., 2018). Oakley et al. (2022) reported that due to the negative influence of alexithymia (i.e., difficulty in identifying and describing feelings), individuals with ASD reported greater difficulties in social communication and anxiety symptom severity. Similarly, Morie et al. (2019) reported that alexithymia could impair an individual's ability in emotional regulation, thereby exacerbating symptoms of anxiety and depression in individuals with ASD. Additionally, alexithymia also co-occurs with clinical disorders that are associated with poor interoception. For instance, elevated levels of alexithymia were reported in individuals with feeding and eating disorders (Carano et al., 2006; Rozenstein et al., 2011), which are characterised by decreased sensitivity or awareness of interoceptive cues such as hunger and satiation (Brewer et al., 2016).

In the parenting and feeding domain, high maternal alexithymia was related to higher self-reported maternal depression and a lower mother-infant relationship qualities in a free play observation in comparison with low maternal alexithymia (Yürümez et al., 2014). In a recent online study, compared to caregivers who scored low on alexithymia, those with high scores on alexithymia reported lower scores on recognising and responding to their own, as well as their infants' hunger and satiation cues, which may lead to fewer RF practices and less positive mealtime experiences (Yu, Fildes, et al., 2025).

In conclusion, the proposal to support caregivers to apply more sensitive and responsive parenting practices, as a way of promoting healthy child development, needs to take account of both episodic and more stable attributes of caregivers which may influence parenting styles and feeding practices (such as mental health and wellbeing illustrated in this chapter).

In recent years, parents have turned to technology to support them in caring for their child to achieve optimal health, development and growth. Smartphone technology and specialist apps permit parents to personalise their parenting journey, recording child weight, illness events, dietary intake and more. In this context, parents may access immediate dietary, mental health and emotional advice and support. In the next section, digital approaches which set out to promote responsive parenting and feeding are considered.

1.4 Digital approaches to child health and feeding

Digital-based resources, including mobile apps and eHealth programmes, are widely used by new parents in seeking both informational and emotional support for infant care (e.g., feeding, growth tracking, and sleep), parental self-care (e.g., mental health and physical activity), and peer support (Virani et al., 2021). Despite the volume of digital-based resources (such as websites and mobile phone applications) offering parents support to learn more about healthy and sensitive parenting, few appeared to be evidence-based. Therefore, there is an ongoing need for effective and accessible resources for parents which have been tested in trials, and therefore evidence-based, to address difficulties during feeding and promote healthier child development (Jäggi et al., 2025).

The strengths of digital-based interventions as identified in previous literature include: (a) lower cost in development and operation; (b) self-administration in ways to interact with materials; (c) structured learning which helps to achieve personal learning goals and foster parental self-efficacy; (d) tailored information to promote individual progress (Ebata & Dennis, 2011). Without the geographical limitation or time constraints, it allows parents to receive professional guidance and support with self-directed pace in time, as well as to share their experiences with other users, obtain peer support and develop virtual communities around specific parenting topics (Lomanowska & Guitton, 2016; McDaniel et al., 2012). Parents have reported that on delivering parenting information, they preferred digital-based interventions over intensive home visits or parenting group programmes (Metzler et al., 2012). While being involved in the digital-based parenting programme, parents often reported high satisfaction with the digital-based services at similar or higher scores than those reported in the face-to-face parenting programme (B. S. Russell et al., 2016). Findings from a review also showed that web-based interventions on promoting children’s healthy eating patterns could enhance parental engagement and improve intervention effectiveness (Gomes et al., 2021).

Digital-based interventions have been widely used in behaviour change interventions and efficacy is promising (Wantland et al., 2004). For example, Battrick et al. (2023) conducted a study to evaluate the effectiveness of a digital-based intervention on promoting RF practices through daily text messages among mothers of children aged 12-24 months. Mothers reported reduced negative affect during feeding and increased use of RF practices, while the results remained significant when controlling for child avoidance/approach traits (Battrick et al., 2023). The findings supported the feasibility and impact of low-cost, scalable digital-based intervention targeting RF practices. Therefore, providing parents with appropriate digital-based interventions with accessible, reliable, evidence-based resources on sensitive parenting or RF practices is critical, since they may serve as potential tools to effectively bridge educational and service delivery gaps with positive child development outcomes. However, the following questions remain: a) to what extent caregivers recognise and respond to infant appetite cues; b) in what ways might caregiver characteristics and infant eating traits influence recognition and responsiveness to infant cues; and c) what specific impact does alexithymia have on decoding infant cues?

1.5 Aims and objectives of the thesis

This chapter has outlined the complex and profound association between parental capacity in recognising and responding to infant appetitive cues, parental sensitive and responsive feeding practices, the development of children's eating behaviours, and the prevention of early childhood obesity. Whilst each element promotes our understanding of how caregivers' attributes influence their responsiveness to infant appetitive cues, taken together they may also help to understand the wider context that each research question of the present thesis addresses. The overarching aims of the thesis are: 1. To better understand how parental perception and ability in understanding infant cues communication (“baby translator”) influence their RF practices; 2. To investigate to what extent parental attributes such as eating traits and wellbeing are associated with their ability to recognise and respond to infant appetitive cues; 3. To explore challenges in improving parental sensitivity and responsiveness to infant appetitive cues, and potential strategies in promoting healthy feeding interactions as well as positive experiences during family mealtimes.

The following chapter of the thesis will evaluate the effectiveness of digital-based interventions on the promotion of parental responsiveness in feeding (Chapter 2), before reviewing the research methods used in the present thesis (Chapter 3). The following specific research questions are addressed in the given chapters (see Table 1.2).

Chapter	Study aim	Research questions
2	To investigate the association between digital-based interventions targeting at promoting responsive feeding and infant growth, weight status and parental feeding behaviours	What is the effectiveness of digital-based interventions promoting responsive feeding on infant growth, weight status, and feeding behaviours?
4	To explore how well infant communication cues expressed during early and late stages of mealtimes are recognised, and to assess whether infant cue recognition differs according to caregiver characteristics.	1. Are infant communication cues during mealtimes universally recognised with a good level of consensus? 2. Are group differences apparent in the ability to recognise infant mealtime communication cues, for example are parents more “accurate” than non-parents? 3. Are there individual differences in the ability to recognise

		communication cues in infants, predicted by satiety responsiveness or intuitive eating behaviours? 4. Are there individual differences in the ability to recognise communication cues in infants predicted by affect, ASD and mental health status?
5	To explore the extent to which caregivers' alexithymia, sensitivity towards their own satiation, in addition to their child's appetitive traits, predicted RF behaviours during mealtimes.	1. Will caregivers with alexithymia score lower on self-reported RF practices, and report more difficulties with mealtimes compared to those with low scores on alexithymia? 2. Will caregivers who have high scores on RF practices also report more positive experiences of mealtimes, with fewer challenges and distress? 3. Will caregivers who have higher sensitivity to their own internal satiation cues, who score high on intuitive eating and reasons to stop eating (which are more interoceptive than contextual), have higher responsiveness towards their child as measured by high scores for sensitivity to their child's hunger and satiety cues during feeding? 4. Will caregivers' RF practices be predicted by their own ability to "tune in" (i.e., recognise and respond) to their own appetite cues (e.g., eating traits), and to their child's appetite cues as well as their children's eating traits?

		5. Will alexithymia influence caregivers' RF through reduced sensitivity to infant appetitive cues during mealtimes?
6	To explore the impact of alexithymia on parental sensitivity and positive feeding experience, as well as how caregivers who scored high on alexithymia have adapted their feeding practices as their child grows.	1. Do caregivers with alexithymia notice and comment on both contextual cues, and affective cues from their child to guide their feeding practices? How is the communication between caregivers and their child during mealtimes? 2. What struggles/difficulties do caregivers with alexithymia report experiencing when feeding their child, and what are their reported coping strategies? 3. In what ways do caregivers with alexithymia report adapting their feeding practices as their child develops?

Table 1.2. An overview of study aims and research questions in individual chapters using a variety of methods (desk research, online survey and online interview).

Finally, the thesis concludes a general discussion which synthesises findings from these studies in relation to existing literature and provides some general conclusions and insights into the relationship between the “baby translator” idea and parental responsiveness to infant appetitive cues (Chapter 7). The outline of this thesis is presented in Figure 1.8.

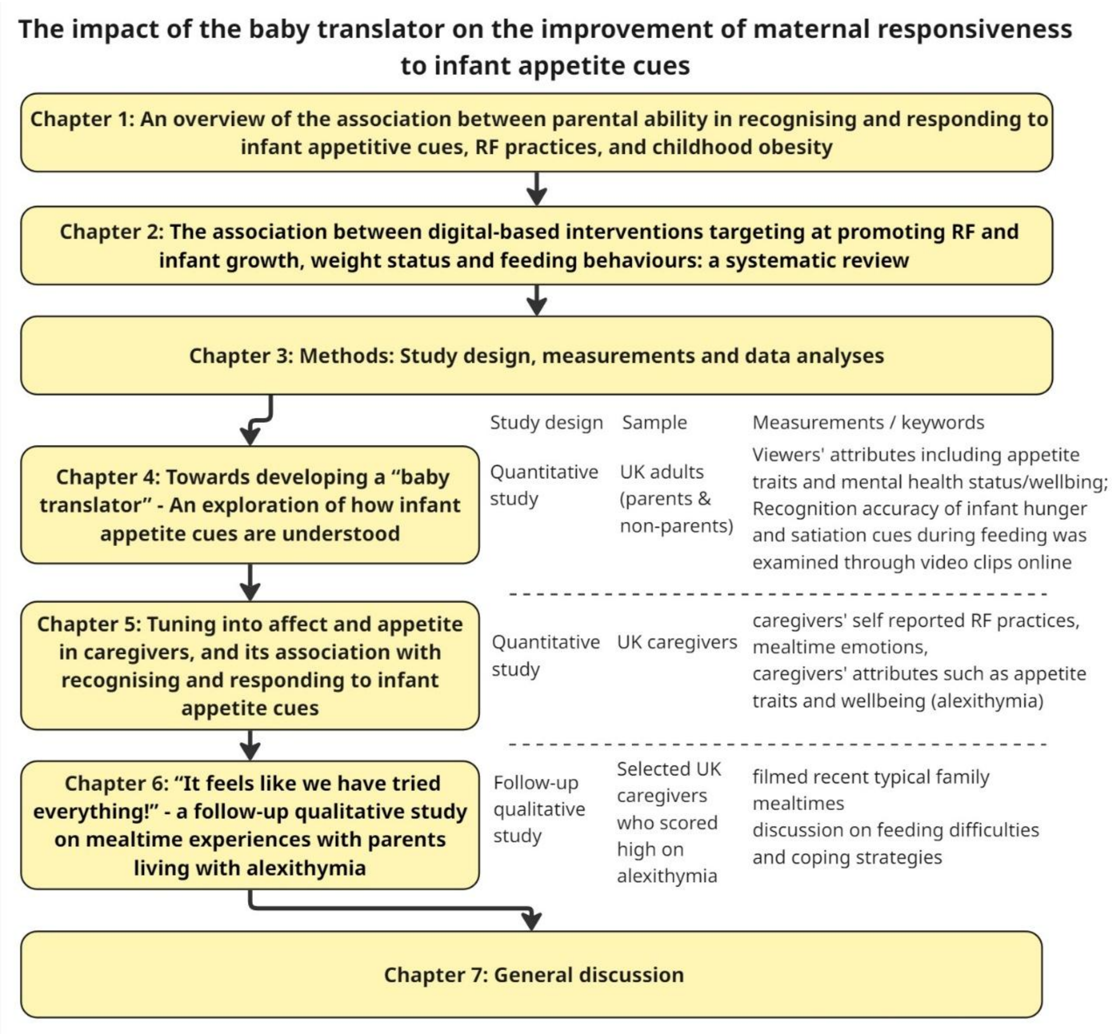


Figure 1.8. Outline of chapters in this thesis.

Chapter 2

The association between digital-based interventions targeting at promoting responsive feeding and infant growth, weight status and feeding behaviours: a systematic review

Chapter 2: The association between digital-based interventions targeting at promoting responsive feeding and infant growth, weight status and feeding behaviours: a systematic review

Abstract

Intervention and experimental studies have developed ways to promote responsive parenting or feeding, with a view to improve child health outcomes including prevention of obesity. Digital-based interventions are favoured in health behaviour change programmes, however, their effectiveness in promoting healthy and responsive feeding behaviours is unclear. Three main databases (OVID, EBSCO, and Web of Science) were systematically searched up to June 2024. Randomised controlled trials (RCT) reporting digital-based interventions or in person interventions on promoting responsive parenting or feeding were included. Only three studies assessed all required domains (RCT, digital based intervention, responsive parenting or feeding). During screening and full text analysis, studies were re-categorised: Group 1: RCT with digital-based intervention (N = 3, with 4 reports). Group 2: RCT with in person intervention (N = 6), and Group 3: experimental/qualitative studies with digital-based interventions targeting RF (N = 5). Synthesised results from Groups 1 and 2 revealed that parental RF practices may be modifiable, but the intervention effectiveness on child weight change, eating behaviours or dietary change was inconsistent and diminished after age 3-year. Results indicated a need for interventions to include elements derived from behaviour change theory and to develop designs to achieve longer-term, sustainable effects. Overall, a robust, theory-driven comprehensive design is needed to effect change in promoting responsive feeding practices, with the overall aim to prevent childhood obesity.

2.1 Introduction

Feeding practices in early infancy are important since they lay the foundation of healthy eating habits for life (Hetherington et al., 2011). During the first 1000 days of life, healthy eating for mothers during pregnancy and postnatally for infants is recognised as a critical period for nutrient intake and infant growth, but also for childhood obesity prevention (Engle & Pelto, 2011). RF is a dimension of infant-caregiver interaction which involves prompt, contingent and developmentally appropriate responses from parents towards the infant's hunger and satiation cues (Black & Aboud, 2011). Existing research reported that RF could help infants and young children develop self-regulation of their energy intake by identifying their own hunger and satiety cues (Birch & Fisher, 1998; Birch et al., 1991), but this ability is also influenced by feeding practice and the interaction with the environment (DiSantis et al., 2011).

According to the BST, the gene-environment interaction influences risk of obesity (Llewellyn & Wardle, 2015). Findings from systematic reviews revealed that infants and young children who have inherited an avid appetite or low sensitivity to satiety tended to overeat in response to the food environment, thus, they were more likely to have high BMI and gain weight quickly (A. Kininmonth et al., 2021; A. R. Kininmonth et al., 2021).

Parental feeding styles play a crucial role in determining children's eating patterns and growth (Shloim, Edelson, et al., 2015). For example, indulgent feeding practices were significantly associated with higher child BMI after controlling for correlates including child temperament, child age, parental affect and parental BMI (Hughes et al., 2008). However, while researchers focused on effective interventions and strategies to promote responsive parenting and feeding behaviours, Redsell et al. (2021) reported that there was little or inconsistent guidance on how to promote RF practices appropriately. This was explained, in part, through a lack of comprehensive, robust theoretical underpinning. Conflicting professional advice (e.g., formula feeding volumes), cultural and social norms, as well as variability in parental attitudes (e.g., child autonomy vs parental control) and skills (e.g., child cues recognition) also helps to explain that feeding guidance was not uniformly applicable or clear (Redsell et al., 2021)

Research has investigated the genetic and environmental influence on appetite during infancy, such as the longitudinal studies of the Gemini twin birth cohort (Johnson et al., 2011; Llewellyn et al., 2010). There are also a variety of RCTs which showed that interventions on parenting and feeding may successfully contribute to children's healthier eating patterns and reduce the risk of childhood obesity. This includes the *NOURISH trial* (Daniels et al., 2009), the *INSIGHT trial* (Paul et al., 2014), *Baby's First Bites trial* (van der Veek et al., 2019), the *Baby Milk trial* (Lakshman et al., 2015), and the *Sleep SAAF trial* (Lavner et al., 2019). However, most of these studies utilised home visits or in-person strategies to promote positive parenting or RF. Little is known about the effectiveness of any digital-based technique on developing parental responsiveness and the impact on infant growth. The objective of this review, therefore, was to address the research question: What is the effectiveness of digital-based interventions promoting responsive feeding on infant growth, weight status, and feeding behaviours?

2.2 Methodology

The present systematic review followed the PRISMA guidelines and was pre-registered on PROSPERO (registration number: CRD42021291983).

2.2.1 Search strategy and eligibility criteria

The following databases were first searched in October 2021, and this was then updated in June 2024: Ovid (including EMBASE, Maternity & Infant Care Database, MEDLINE, and PsycINFO), EBSCO (including CINAHL, Child Development & Adolescent Studies, and Bibliography of Asian Studies), and Web of Science. Search terms were developed based on the PICOS framework (**P**opulation, **I**ntervention, **C**omparison, **O**utcomes, and **S**tudy design) with relevant key words and were searched for within relevant titles and abstracts. The search strategy is available (see Appendix A1). The reference list for relevant publications was developed by manually adding additional studies that were not identified in the search results.

Studies were included if they were RCTs, pilot studies or feasibility trials. Studies were also required to provide a quantitative result of the association between the promotion of RF, and outcomes in terms of infant growth, weight status and/or feeding behaviours. The population of interest was healthy infants aged under 24 months of age. Studies were excluded if they were qualitative studies, literature reviews, not published in English or they did not include digital-based interventions. Study eligibility was assessed and agreed within the research team.

2.2.2 Data extraction and assessment of study quality

Data were extracted using Data Extraction and Assessment Form for RCT from the Cochrane library (summarised in Table 2.1, Table 2.2, and Appendix A). Descriptive data on the study characteristics, summary of findings and additional information for studies included in this systematic review were collated and then presented below (i.e., 2.3 Results section). For those studies without reported outcomes, original authors were contacted to obtain the required data.

2.2.3 Risk of bias assessment

The risk of bias was assessed using the ROB2, a revised Cochrane tool that investigates the risk of bias in RCTs (Sterne et al., 2019). Five domains were evaluated for each study, including 1) Randomisation Process, 2) Deviations from Intended Interventions, 3) Missing Outcome Data, 4) Measurement of the Outcome, and 5) Selection of the Reported Result. S.Y. responded to the signalling questions in terms of risk-of-bias judgments. Rating conflicts were discussed and reached a consensus within the research team.

2.2.4 Data analysis and synthesis

Both quantitative and qualitative data were collected and analysed, followed by narrative synthesis to summarise findings from this review. Several ongoing studies were identified during searching and only the study protocols were available. Original authors have been contacted to obtain further information.

2.3 Results

2.3.1 Literature search results

Overall, during the first search, the search strategy originally identified 2518 papers. After duplicate removal, there were 2393 publications remained with additional records identified through other sources. 2367 were excluded during the title and abstract screening and 26 were included in the full-text assessment for eligibility. After review, only 1 study met the eligibility check and other 25 papers were excluded with a variety of reasons (studies without digital based intervention (N = 13), study protocol (N = 4), physiologic intervention (N = 4), clinical trial (N = 1), qualitative study (N = 1), conference paper (N = 2)).

This review was updated in June 2024 with the same search term but limited in published year (from 2021 until current). This search yielded 36 papers in total. After screening, 5 papers met the eligibility check. The study selection process was presented in Figure 2.1 via the PRISMA flow diagram for updated systematic reviews.

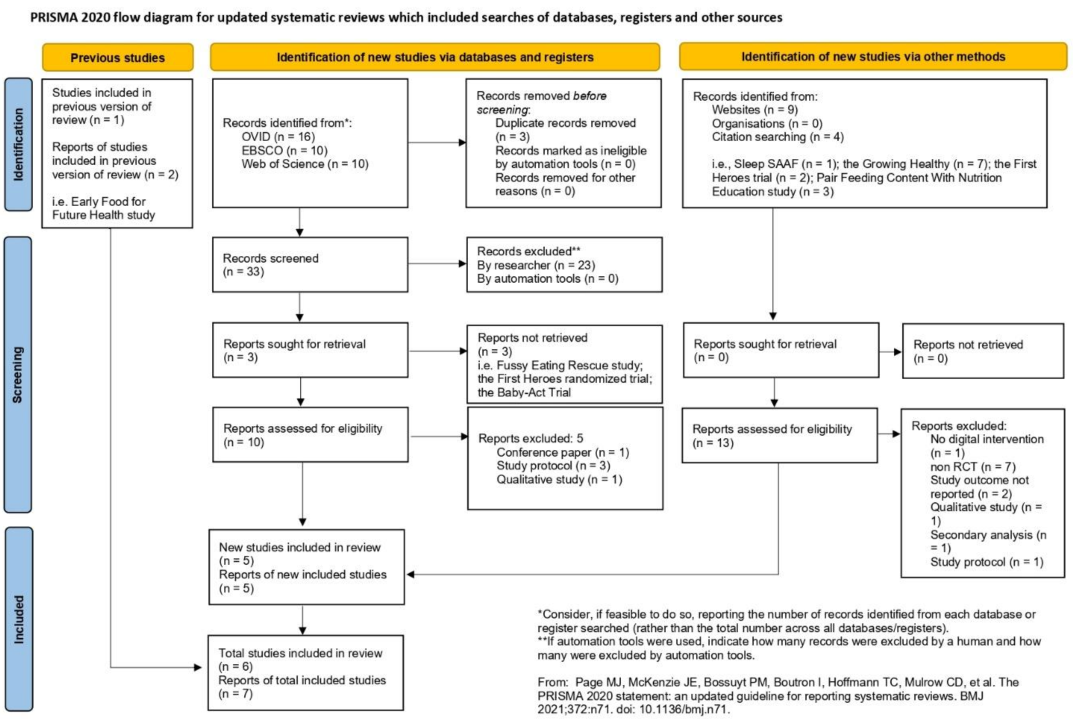


Figure 2.1. PRISMA flow diagram for the present systematic review study.

However, during the first screening, even though many studies used home visits or an in-person strategy, their study objectives were associated with our review question (i.e., intervention effectiveness on promoting responsive parenting or feeding), such as the *INSIGHT trial* (Paul et al., 2014), and *NOURISH trial* (Daniels et al., 2009). On the other hand, although some studies were not conducted as RCT, the effectiveness of a digital-based intervention was evaluated and authors had provided valuable suggestions regarding user experience or upon the potential improvement of a digital-based intervention to promote RF, such as the *Growing Healthy* study (Denney-Wilson et al., 2015). Therefore, it was decided for completeness to include and summarise these studies based on the review question in the present study.

To guide this review, studies have been re-categorised into different groups during the full-text screening stage (see Figure 2.2 for the group allocation). RCTs with digital-based intervention consisted of **Group 1** for data synthesis. **Group 2** included large-scale RCTs with home visits or in-person interventions which focused on the impact of promoting responsive parenting and feeding on child weight status and eating behaviour development. Finally, **Group 3** included studies that contained digital-based interventions but were not RCT (e.g., experimental studies). Results are discussed in the following sections.

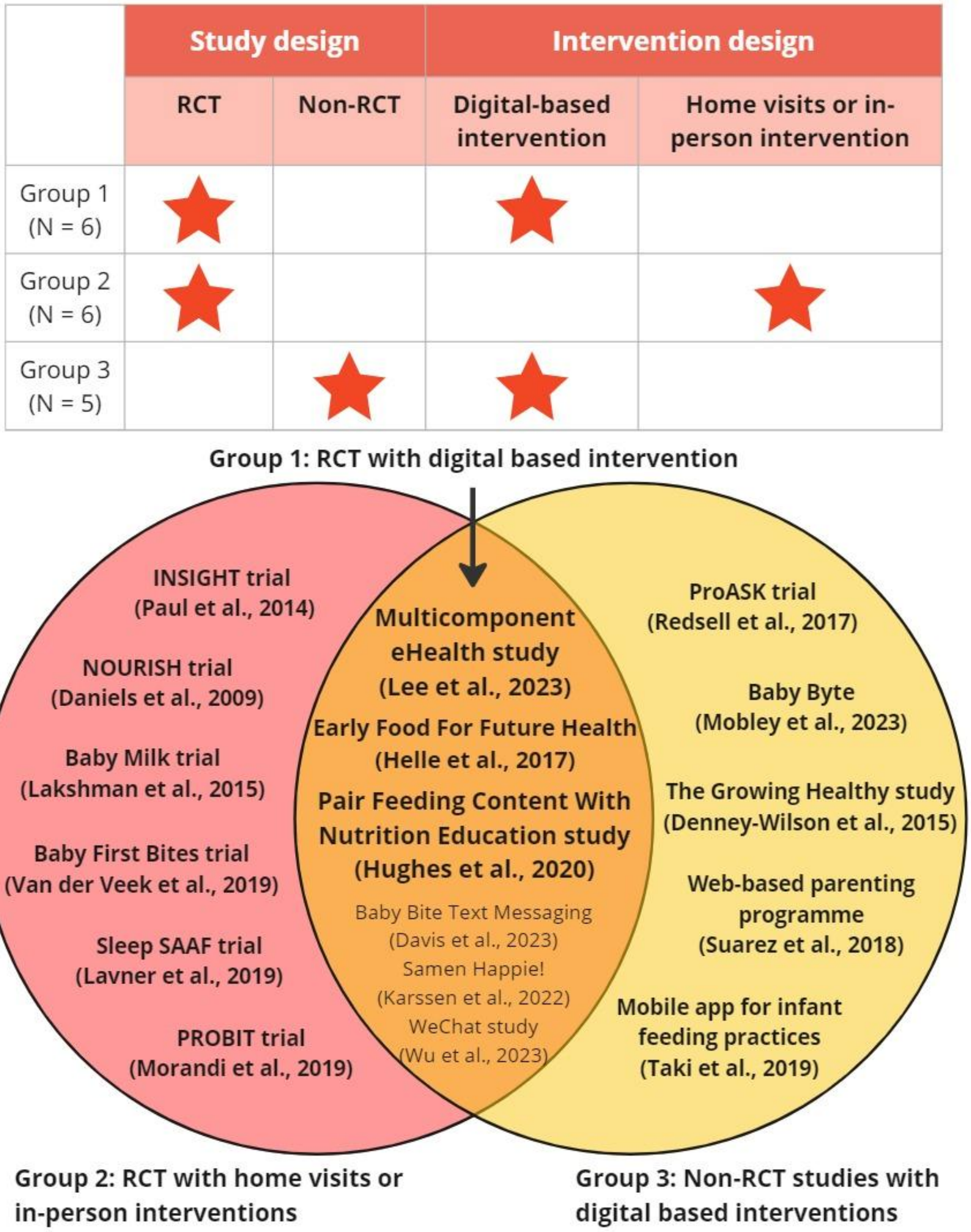


Figure 2.2. Illustration of studies allocated to different groups based on study designs. Three eligible studies in Group 1 for data extraction and risk of bias assessment were marked with **bold font**.

2.3.2 Characteristics of Group 1: RCTs with digital-based interventions on promoting RF

Most studies have been published within the last 10 years except for the *NOURISH trial* (Daniels et al., 2009). Studies were conducted in USA, Norway, the Netherlands or China. Most studies were individual RCT, two were cluster

RCT. The sample size ranged from 38 to 1610. Participants in these studies received digital-based interventions with a minimum of 8 weeks up to 1 year duration. Participants in the control group received general nutrition, routine care, acted as a waitlist control or acted as a compared group to the intervention group.

However, only **three studies** published across **four papers** included measurements to evaluate parental RF practices with digital-based interventions (Helle et al., 2019a, 2019b; Hughes et al., 2023; Lee et al., 2023), whereas other three studies (i.e. *Baby Bite Text Messaging* project, *Samen Happie!* programme, and *WeChat* study) included measures for child weight change or dietary patterns, as well as user experience assessment rather than focusing on the development of parental RF practices (Davis et al., 2023; Karssen et al., 2022; Wu et al., 2023). Therefore, data extraction and the risk of bias assessment were conducted for the three eligible studies with four reports in total. Key study characteristics are presented in Table 2.1 below.

Both the *Early Food for Future Health* study (Helle et al., 2019a, 2019b) and the *Baby Bite Text Messaging* project (Davis et al., 2023) aimed to recruit young children in their study (3-5 months at the enrolment, and newborns respectively). Children recruited in the *Samen Happie!* (Karssen et al., 2022) programme and the *WeChat study* (Wu et al., 2023) were all aged between 5-20 months old. The *multicomponent eHealth study* (Lee et al., 2023) aimed to recruit children aged 1-3 years and the mean age was 26.5 ± 8.5 months. In the *Pair Feeding Content With Nutrition Education* study (Hughes et al., 2020), children were older than in the other studies with a mean age of 4.5 ± 1.9 years, due to larger age range in the recruitment process (children aged between 2-8 years).

Intervention delivery frequency and duration varied between studies. Researchers in the *WeChat study* (Wu et al., 2020) distributed programme materials at baseline and then conducted 1-and 2-month follow-ups. Compared to the *Multicomponent eHealth study* (weekly programme materials for a total of 8 weeks) (Lee et al., 2023) and the *Pair Feeding Content With Nutrition Education* study (9 weekly sessions) (Hughes et al., 2020), other studies had longer duration. For example, in the *Early Food for Future Health (Helle et al., 2019a, 2019b)*, participants had access to a webpage with 7 monthly short video clips, while the *Samen Happie!* programme (Karssen et al., 2022) shared the same intervention duration (i.e., 12 months) with the *Baby Bite Text Messaging* project (Davis et al., 2023).

In these three studies, researchers reported different effectiveness success. No sustained intervention effects were found on child anthropometric outcomes or maternal feeding practices in the *Early Food for Future Health* programme (Helle et al., 2019a, 2019b). As for the *multicomponent eHealth* study*,* Lee et al. (2023) reported that parents in the intervention group had significant improvements in self-efficacy and RF practices, such as less parental pressure to eat and parental use of food to soothe or reward, improved parental modelling on healthy eating and involvement of the child in meal planning and preparation. Intervention group children had significant improvements in fruit and vegetable intake over the course of two months.

When comparing the online and in-class approaches in delivering feeding content in low-resourced communities, Hughes and her colleagues demonstrated equal effectiveness (Hughes et al., 2023). Consistent effects were observed across both delivery methods for encouraging children to try new foods, use of child-centred feeding practices (i.e., greater responsiveness from caregivers), child involvement in food preparation, as well as understanding the number of presentations often necessary for child acceptance of a new food. A summary of the findings from these studies is presented in Table 2.2.

2.3.3 Risk of bias assessment

According to the search results and eligibility assessment, data extraction and risk of bias (ROB) assessment for 3 studies with 4 reports were conducted (see Figure 2.3). The overall ROB assessment reported low risk for one report in addition to some concerns for other three reports. They were judged low risk of bias regarding the *Domain 1: Randomisation Process* and *Domain 3: Missing Outcome Data*. There are some concerns for *Domain 2: Deviations from Intended Interventions*, as well as *Domain 4: Measurement of the Outcome*.

The main concerns regarding Domain 2 involved judgement on "*unknown deviation from the intended intervention from the trial context*" and how researchers coped with missing data imputation. Whereas the main concerns of Domain 4 came from the rating on "*the outcome could have been influenced by knowledge of intervention received by participants*"; in particular, "whether or not the outcome was influenced" was "not mentioned" in the corresponding studies. Three reports were considered low risk of bias in *Domain 5: Selection of the Reported Result* while one report stated some concerns. In addition, all studies used intention to treat.

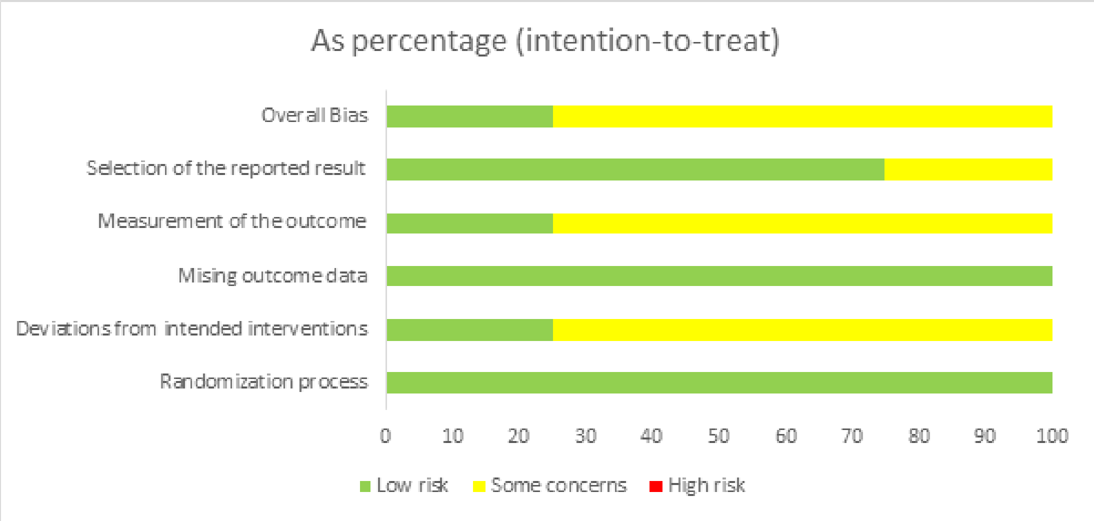


Figure 2.3. Risk of bias assessment of eligible studies (N = 3) with corresponding reports (N = 4) on each dimension based on the ROB2 tool.

2.3.4 Characteristics of Group 2: RCTs with home visits, in-person interventions, and responsive parenting or feeding measures

Studies allocated to Group 2 were RCTs conducted in USA, Australia, UK and Italy. Sample size ranged from N = 212 (Lavner et al., 2019) to N = 698 (Daniels et al., 2009). These studies used either feeding guidance (Daniels et al., 2009; Lakshman et al., 2015; van der Veek et al., 2019) or a responsive parenting framework (Lavner et al., 2019; Paul et al., 2014) as the intervention. Meanwhile, safety or attention control was used as a comparison in the control group. Study outcomes included child anthropometrics such as maternal feeding practices, child weight change or BMI z-score, infant intake or eating behaviours (see Appendix A2 for study characteristics summary).

The success of each intervention differed across studies. Van Vliet and her colleagues reported that the intervention in the *Baby First Bites trial* was not effective in improving infant self-regulation on energy intake or increasing infant vegetable intake, but parental sensitive feeding behaviour and less pressure to eat were reported at a later stage of feeding, such as less pressure to eat (van Vliet et al., 2022). Additionally, child BMI z-score did not differ between groups. Overall, the video-feedback intervention, and the combination of video-feedback to parents and repeated exposure to vegetables for infants were associated with parental RF practices, but interventions were not effective in promoting infant eating behaviours or healthy weight status (van Vliet et al., 2022).

Similarly, mixed results for different outcomes were also reported in the *INSIGHT trial, NOURISH trial* and *Baby Milk trial*. For example, in the *INSIGHT study*, most mothers in a sub-group of the sensitive parenting group (63.6%) reported teaching their infant signs to communicate. In the follow-up studies, children in the intervention group had reduced rapid weight gain at age 1 year, a lower mean BMI z-score at age 3 years, and a lower proportion of overweight throughout all follow up studies relative to the controls (Paul et al., 2018). However, cross-sectional outcomes revealed no significant group differences in BMI z-score over overweight/obesity prevalence at child age 5, 6, 9 years (Paul et al., 2025). In the *NOURISH trial*, there were no group differences for child BMI at age 2 years, but mothers in the intervention group applied more responsive feeding practices. Similar findings were reported in the *Baby Milk trial*, *Sleep SAAF trial* and *PROBIT trial.* In the *Sleep SAAF study*, intervention mothers reported less use of food to soothe and less pressure in feeding (Lavner et al., 2022), and intervention mothers in the *PROBIT study* reported more feeding on demand at 3-month of child age (Morandi et al., 2019), indicating that RF intervention could be effective in promoting healthy feeding behaviours. However, there was no difference in infant weight gain or prevalence of obesity between the intervention group and the control group after infants reached 1 year old (see Appendix A3 Summary of findings of RCT with home visits or in-person interventions). This suggests that changing caregiver behaviour is ***not sufficient*** to produce sustained beneficial outcomes for infants.

2.3.5 Characteristics of Group 3: non-RCT with digital-based interventions and responsive parenting or feeding measures

In Group 3, a variety of research designs were captured including a non-randomised quasi-experimental study (Denney-Wilson et al., 2015), feasibility trial (Redsell et al., 2017; Suárez et al., 2018), survey (Taki, Russell, Lymer, et al., 2019), and interview-based study (Mobley et al., 2023; Taki, Russell, Lymer, et al., 2019) conducted in UK (Redsell et al., 2017), USA (Mobley et al., 2023), Spain (Suárez et al., 2018) and Australia (Denney-Wilson et al., 2016; Taki, Russell, Lymer, et al., 2019). Sample size of studies ranged from N = 29 to N = 646. These experimental studies investigated the feasibility and acceptability of using digital technology to promote responsive parenting or feeding practices, in addition to the impact on child weight status. Study characteristics of Group 3: studies with digital-based intervention are presented in the Appendix, A4.

Study ID and trial name	Design	Participants	Settings	Intervention	Comparison	Outcome measures
Multicomponent eHealth study **(Lee et al., 2023)**	RCT	73 parents with children aged 1-3y, with an average age of 26.5±8.5m. N (Intervention) = 37 N (Control) = 36	Low-income families in the South Plains of Texas, USA	Social Cognitive Theory based 8-week programme with educational videos, cooking tutorials, reminder texts, and biweekly provision of fruits/vegetables. Focused on RF practices (encouragement, modelling, involvement) vs non-RF (pressure, restriction, emotional feeding), components included: 1) Weekly educational videos with reflective questions, 2) SMART goal-setting for feeding practices, 3) cooking tutorials with provided ingredients/utensils, 4) text message reminders.	Control: a booklet about general nutrition recommendations for children.	Primary outcomes: child food intake, physical activity, sedentary behaviour, screen time. Secondary outcomes: **Responsive and non-responsive feeding practices** (by Comprehensive Feeding Practices Questionnaire) Parental psychosocial attributes of nutrition knowledge, attitudes, and self-efficacy.
Early Food for Future Health	RCT	Parents (mostly mothers) of infants aged 3-5m. At randomisation N (Intervention) = 360	Norway	Delivered via email/webpage, the intervention group had access to educational resources with 7 monthly	Control: routine care from their local child health clinic with regular	Primary outcomes: **Maternal feeding practices and feeding styles** (by

(Helle et al., 2017; Helle et al., 2019a, 2019b)		N (Control) = 358 1st follow-up at infant age 12m: N (mothers completed questionnaires) = 455 N (intervention) = 236 N (control) = 219 Maternal age (intervention) = 30.9±4.4y Maternal age (control) = 30.2±4.1y 2nd follow-up at infant age 24m: N (mothers completed questionnaire) = 295 N (intervention) = 152 N (control) = 143 Maternal age (intervention) = 31.2±4.4y Maternal age (control) = 30.5±4.2y		short video clips of 3–5min duration, addressing specific infant feeding topics including RF, appropriate food-types and textures, how taste-preferences evolve, and monthly cooking films and age-appropriate baby food recipes from child age 6-12m.	consultations at child age 6, 8, 10 and 12m.	Infant Feeding Questionnaire) **Child eating behaviours** (by CEBQ) and willingness to try new foods (by Child Food Neophobia Scale); Dietary intake (by Food Frequency Questionnaire); Mealtime routines (based on the NOURISH trial); Secondary outcome: child anthropometry. 2nd follow-up study (at 24m infant age): **Maternal feeding practices/styles** (by Child Feeding Questionnaire and Parenting Feeding Style Questionnaire) Child dietary intake, mealtime routines

						Child eating traits (by CEBQ) Child anthropometry
Pair Feeding Content with Nutrition Education study **(Hughes et al., 2023; Hughes et al., 2020)**	RCT	At randomisation (3 conditions): 530 participants with child aged between 2-8y (mean 4.5y) N (In-class) = 166 N (Online) = 168 N (Control) = 196 Mothers: 89% Fathers: 4% Total sample mean age in years (M±SD): 36.3±8.3 Child age in years (M±SD): 4.5±1.9	Low-income families in USA: Colorado and Washington	In-person **nutrition education** classes*: **Eating Smart · Being Active*** **(ESBA)**, consisted of **9 weekly** lessons delivered in small group settings by paraprofessionals (peer educators from the community) who share similar social backgrounds. Intervention groups also received RF contents: ***Food, Feeding, and Your Family*** **(FFYF):** 1) 7 short videos (2–9 min) on RF, portion sizes, trying new foods, mealtime routines, etc. 2) Online activities + infographics delivered via text message links.	**Control**: in-person ESBA alone	Food Parenting Inventory Caregiver's Feeding Style Questionnaire: authoritative, authoritarian, indulgent, and uninvolved Feeding Knowledge Questionnaire

				Content adapted from the SEEDS programme, which had shown success in promoting RF and reducing obesity risk in Hispanic families. **Online group**: in-person ESBA + a mobile phone-based version of FFYF **In-class group**: in-person ESBA + an in-person version of FFYF		
The Baby Bites Text Messaging Project **(Davis et al., 2023)** To test whether theory-informed text messages improve infant feeding practices and prevent early	RCT + interview	RCT: 38 participants of newborns N (Intervention) = 21 N (Control) = 17 Parental mean age in years (intervention): 26.7±4.5 N (father) = 0 N (mother) = 21 Parental mean age in years (control): 27.1±7.5	Urban low-income families in Texas, USA	Gain-framed text messages (which emphasised positive benefits of a behaviour rather than the negative consequences of not doing it, based on the Health Belief Model) with advice promoting **healthy feeding** delivered for 12m. Frequency: 4 times per week for the first 4w of study enrolment, decreasing to	Control group: usual paediatric nutrition care + infant safety messages (car safety, sun safety etc) Twice a week for the first 4w, once a week from 5-8w, and every 2w for the remainder	Infant weight-for-length percentiles and z-score Feeding practices (such as breastfeeding and introduction of solid foods, measured at 0–2w (baseline), 2–4m, 6–9m, and 12m) Parental attitudes

obesity compared to usual care.		N (father) = 2 N (mother) = 15 Interview: 15 parents (mean age: 26.1±7.3y) of infants less than 1m old.		twice a week by 5w, and once a week from 8w to 12m of infant age.	of the study (up to 12m of life).	
***Samen Happie!* programme** **(Karssen et al., 2022)** Designed to promote healthy parenting practices and child weight development, particularly among families with lower SES.	RCT	357 Dutch parents with infants aged 5–15m old N (App condition) = 179 N (Waitlist-control) = 178 App condition: Child age in months, (M±SD): 9.7±2.3 Control condition: child age in months, (M±SD): 10.0±2.2	Netherlands	Access to the *Samen Happie!* app for 12m, with five age-based modules (: 7–12, 12–15, 15–18, 18–24, and 24–28m) covering diet, sleep, activity, parental wellbeing, and child temperament. Each age-based module provided parents with **information** (i.e. lessons) and **exercises** (i.e. challenges) about **healthy parenting practices** with respect to child energy balance-related behaviours, as well as parental wellbeing and child temper (only lessons.	Waitlist control group, with access to the app at the end of the trial.	12m programme (T0: baseline), data was collected at: T1: 6m follow up T2: 12m follow up Child BMI Parental BMI Parental depressive symptoms (by Edinburg Postnatal Depression Scale) App use App acceptability (adapted from the Mobile App Rating Scale)

WeChat study **(Wu et al., 2023)** To evaluate whether a WeChat-based self-assessment with tailored feedback reports could improve complementary feeding (CF) and movement behaviours among children aged 6–20m in rural China.	Two-armed cluster randomised mutually controlled trial	106 clusters with 1610 caregivers with infant aged between 6-20m old were randomised into **feeding group** (53 clusters, 800 children) and **movement behaviour group** (53 clusters, 810 children) at a 1:1 ratio. Feeding group: Child gender N (Male) = 392 N (Female) = 408 Age in months N (6-11) = 297 N (12-20) = 503 Primary caregiver relationship N (Mother) = 655 N (Father) = 46 N (Grandparents) = 85 N (Others) = 14 Age in years (median (IQRs)) = 28 (25, 33)	257 villages in Datong County, Qinghai Province, China The cluster unit was based on villages. A village with at least 16 children was regarded as a cluster. Several small villages (<16 children) nearby were aggregated to form clusters.	Feeding group: CF recommendations Movement behaviour group: movement behaviour recommendations CF recommendations included introduction of complementary food at 6m, continued breastfeeding up to 2y or beyond; minimum dietary diversity (eating at least 5 of 8 food groups every day); food texture and frequency for different age groups; importance of the introduction of animal source food; micronutrient supplement. The movement behaviour intervention contained knowledge and behaviour recommendations on: at least 120 min of physical activities for infants aged 6–11m and 180 min for young	The feeding group acted as a control for the movement behaviour group and vice versa.	Primary outcome for CF measure: proportion of diet related measures including minimum dietary diversity, meal frequency, food variety, and continued breastfeeding at 12–23m at baseline, 1 month follow-up and 2 months follow-up in both groups. Primary outcome for movement behaviour measure: proportion of children who met the recommendation of physical activity measures, sleep duration and screen time during the last 24h and during the last 2 weeks.

		Movement behaviour group: Child gender N (Male) = 427 N (Female) = 383 Age in months N (6-11) = 293 N (12-20) = 527 Primary caregiver relationship N (Mother) = 628 N (Father) = 48 N (Grandparents) = 114 N (Others) = 20 Age in years (median (IQRs)) = 29 (24, 34)		children aged 12–23m; at least 60 min of outdoor time for young children aged 12–23m; less than 1h of physical restraint; recommended sleeping time for different age groups and no screen time for children younger than 2 years.		Secondary outcome: frequency of 7 groups of complementary food during the last month, the change of caregiver's knowledge on feeding and movement behaviour in both groups. Third outcome: caregivers' information source on CF & movement behaviour, and evaluation of self-assessment tool regarding user experience and programme feasibility at the second follow-up.

Table 2.1. Study characteristics of Group 1 (RCT with digital based interventions targeting at promoting parental RF).

Study ID	Was the intervention successful?	Summary of key findings
Multicomponent eHealth study **(Lee et al., 2023)** To evaluate a theory-based, multicomponent eHealth intervention designed to 1. Improve child health behaviours (diet, activity, screen time); 2. Enhance parental psychosocial attributes (knowledge, self-efficacy, attitudes); 3. Promote healthy (responsive) feeding practices	**Mixed** (Improved parental RF practices and self-efficacy; increased child vegetable and fruit intake; no effect on child physical activity, sedentary behaviours, or parental nutrition knowledge and attitudes.)	• Intervention improved **self-efficacy** and **comprehensive feeding practices**. Intervention parents reported higher **encouragement, child involvement in meal planning and preparation, modelling, parental use of food to soothe or as a reward, pressure to eat, and restriction for weight**. The control group showed a significant decrease in the *mean score* of comprehensive feeding practices. Comprehensive feeding practices differed between groups at post-intervention. • Within group: Intervention children had **significant improvements** in **fruit** and **vegetable intake** over the course of 2m. • Between group: intervention children significantly increased their daily **intake of fruit and vegetable**s and decreased **use of screen time**, compared to the control group. • No significant group differences in changes of child physical activity, sedentary behaviours, and parental nutrition knowledge and attitudes.
Early Food for Future Health **(Helle et al., 2019a, 2019b)** To evaluate whether a scalable eHealth intervention (videos +	**Mixed** (Positive effects on child dietary variety, fruit/veg intake, and mealtime routines at 12m, no effect on maternal feeding	• At **12m** of infant age: intervention children were served vegetables/fruits more frequently (*p*=.035), had tasted a wider variety of vegetables (*p*=.015) compared to controls, more likely to eat family breakfast (*p*=.035) and dinner (*p*=.011), and less likely to be playing or watching TV/tablet during meals (*p*=.009) compared to control children.

recipes) delivered to parents during infancy (6–12m) could: 1. Improve child eating behaviours and dietary intake 2. Promote healthy mealtime routines 3. Strengthen maternal feeding practices 4. Prevent later childhood overweight/obesity	practices or child anthropometry outcomes. At child 24m of age, no impact on BMI or any sustained intervention effects were found)	• No group differences for child anthropometry (weight/length) or maternal feeding practices were found. • More than 80% of the intervention parents reported viewing all/most of the video clips addressing infant feeding topics and indicated that the films were well adapted to the child's age and easy to understand. • At **24m** of infant age: no sustained group differences in child fruit and vegetable intake, having breakfast with family ⩾4 times/week. Dietary patterns and mealtime routines at child age 24m were consistent and in the same direction as at 12m, but between-group differences were not significant. No group differences in child anthropometric outcomes (**BMI, weight-for-age**).
Pair Feeding Content with Nutrition Education study (Hughes et al., 2023; Power et al., 2024) To evaluate engagement and outcomes/changes on parental RF practices in a mobile-based childhood obesity prevention programme for low-income families in USA	**Yes** (As ESBA served as the general nutrition education for all study groups, both online and in-class FFYF promoted parental RF: encouraging new foods, family meals, responsiveness to fullness cues and reduced controlling practices/pressure to eat)	• **Online** and **in-class** FFYF were equally effective in delivering feeding content in low-resourced communities (control = ESBA only, intervention = ESBA + FFYF). Consistent effects were seen across the two delivery methods for encouraging children to **try new foods**, **increased responsiveness to children's hunger and fullness cues, reduced pressure to eat**, structured mealtimes such as greater **child involvement in food preparation**. • ESBA (nutrition education) alone was insufficient in promoting feeding practices. FFYF which focused on RF contents produced measurable

		improvements in parental feeding practices. ESBA + in-class FFYF group reported strongest and most consistent improvements in feeding knowledges and practices compared to controls. • In the secondary analysis on engagement (Power et al., 2024), in the online group (ESBA + digital FFYF), despite high levels of in-person ESBA lessons attendance (70% average; 1/3 attended all 9 lessons), participants only accessed 47% of the FFYF videos (online content). Significant improvements in parental feeding practices were found **only among parents who accessed at least half of the videos**. Parents who accessed **few/no videos** showed outcomes **similar to controls,** indicating dosage matters that digital delivery can be effective but only with sustained engagement.

Table 2.2. Summary of findings of 3 eligible studies in the Group 1 (RCT with digital based intervention on promoting parental RF and with child weight related or eating behaviour outcomes).

2.4 Discussion

This is the first review to systematically investigate the effectiveness of digital-based interventions on the improvement of maternal responsiveness, caregiver feeding behaviours (primarily mothers) and infant growth via RCTs. Four reports regarding three studies (Helle et al., 2019a, 2019b; Hughes et al., 2023; Lee et al., 2023) complied with the defined criteria, with mixed results of the intervention effectiveness reported. Three reports were judged as having some concerns in the ROB assessment mainly in the *Deviations from Intended Interventions* and *Measurement of the Outcome*. Results from this review demonstrated the importance of the delivering context in the trial (Hughes et al., 2023), whether outcomes measured will be influenced by participants' existing knowledge (Lee et al., 2023), problems in retaining participants and appropriate imputation analysis (Helle et al., 2019b). This might contribute to more comprehensive trial designs and achieve low risks in the ROB assessment.

2.4.1 Effectiveness of digital-based interventions in RCTs (Group 1)

There are only a small number of RCTs which included a digital-based intervention and evaluated the development of maternal responsiveness, healthy feeding practices, or child weight regulation. Promising results were reported but the intervention effectiveness was not consistent across studies, which might be explained by different study designs. The *Multicomponent eHealth study* (Lee et al., 2023), the *Pair Feeding Content With Nutrition Education study* (Hughes et al., 2020) and the *Early Food for Future Health* study (Helle et al., 2019a, 2019b) shared some similarity in the intervention materials. For example, knowledge-based contents on nutrition, infant age-appropriate foods, and feeding topics were delivered to participants in the intervention group. Compared to the **monthly** delivered short videos from child age 6 to 12 months in *Early Food for Future Health* study (Helle et al., 2019a), both the *Multicomponent eHealth study* (Lee et al., 2023) and the *Pair Feeding Content With Nutrition Education study* (Hughes et al., 2023) reported positive intervention effect on child eating patterns based on the **weekly** delivered lessons for 8 or 9 weeks, indicating that intervention delivery frequency and duration might have an impact on the ultimate effectiveness across studies.

With improved feeding practices reported by Lee et al. (2023) and Hughes et al. (2023) based on weekly delivered intervention materials for a short period of time (8 weeks and 9 weeks respectively), both studies demonstrated good short-term effectiveness. In contrast, no sustained effects were found in maternal RF behaviours and child weight related outcomes in RCTs with a longer duration, such as the *Early Food for Future Health* study (Helle et al., 2019a, 2019b), the *Baby Bite Text Messaging* programme (Davis et al., 2023) and the *Samen Happie!* study (Karssen et al., 2022) in Group 1.

2.4.2 Effectiveness of face-to-face interventions in RCTs (Group 2)

Positive impact was reported on caregiver feeding practice from **face-to-face interventions** in RCTs included in Group 2. The effects were small but were also not consistent across studies. It is worth noting that besides targeting feeding, some studies included multiple elements in the design. For example, the *INSIGHT trial* intervention consisted of four components around the following behavioural states: “Drowsy”, “Sleeping”, “Fussy”, “Alert and Calm” (Paul et al., 2014), and the *Sleep SAAF study* contained “Sleeping”, “Crying” and “Playing” in the programme (Lavner et al., 2019). Therefore, it is not possible to identify the most effective predictor of the behavioural outcomes. More sensitive feeding behaviours (Daniels et al., 2014; Paul et al., 2019; van Vliet et al., 2022) and fewer negative feeding approaches were found, such as pressure to eat (van Vliet et al., 2022) and using foods to soothe (Magarey et al., 2016). This suggests success in changing parental feeding practices, though not necessarily differences in infant weight change.

In the *INSIGHT* follow-up studies, less rapid weight gain was reported, and infants were less likely to have childhood obesity in the intervention group; however, the intervention effect was not sustained after children reached 3 years and onwards (Paul et al., 2025; Paul et al., 2018). With motor skills and communication skills development, infants may have different needs at different ages, change their diet with age-appropriate foods such as solid foods, become more involved in the family meal, and display different eating behaviours. On the other hand, Ruggiero et al. (2021) reported that interventions were more effective at limiting exposure to unhealthy foods for children who were more tuned in to their internal satiety cues, and intervention mothers used less pressure to eat compared to mothers in the control group when children had low food responsiveness. Overall, responsive parenting interventions might protect against parental non-RF practices to certain child eating traits such as satiety responsiveness and food responsiveness (Ruggiero et al., 2021), and tailoring interventions to child specific eating traits may enhance the intervention effectiveness via helping parents understand and decode children's cues, maintaining feeding/mealtime structure, and avoiding controlling feeding practices even when child eating traits trigger parental feeding concerns.

As Magarey et al. (2016) particularly suggested in the *NOURISH trial*, environmental factors such as greater parental work hours, fewer meals prepared and consumed at home, and substantial life changes beyond 2 years (e.g., birth of siblings, increased autonomy, commencement of day-care or schooling) may result in the limited intervention impact and the decline in dietary quality at long-term follow-up. This can make it difficult for parents to maintain protective feeding practices in the early stage of life.

2.4.3 Synthesising findings across Group 1 and 3 on intervention effectiveness and programme design

In the present review, a number of behaviour change techniques (BCTs) or theories were identified in studies with digital-based interventions, such as Social Cognitive Theory (Helle et al., 2017; Lee et al., 2023), Self-determination Theory (Hughes et al., 2020), Health Belief Model (Davis et al., 2023), or other behaviour change frameworks (Denney-Wilson et al., 2015; Karssen et al., 2022; Redsell et al., 2017). However, the inconsistent intervention effectiveness might be partly explained by the findings from a meta-analysis conducted by Prestwich et al. (2014). Results showed that 56% of interventions targeting health behaviour change (such as physical activity and dietary patterns) reported a theory base, however, 90% of them did not report links between their BCTs with specific theoretical constructs, and 91% of them did not report links between the specified constructs with BCTs (Prestwich et al., 2014).

Neither the type of BCTs such as Social Cognitive Theory and Transtheoretical Model, nor the extent of theory use yielded meaningful impact on the intervention effect size (Prestwich et al., 2014). Therefore, findings from this review suggested that the inclusion of theoretical components may not necessarily result in effective interventions. However, where there is a strong input from theory linked to BCTs in the intervention development, with rigorous testing of theoretical mechanisms, this may contribute to impactful digital-based interventions on promoting behaviour change.

Delivery frequency also varied between studies - online resources were usually delivered to participants weekly (Davis et al., 2023; Denney-Wilson et al., 2015; Lee et al., 2023), or monthly (Helle et al., 2017; Hughes et al., 2020). In the *Samen Happie!* study, participants were provided access to new online materials when their child reached a certain age (in months) (Karssen et al., 2022). Overall, improved maternal self-reported RF practices were reported by Lee et al. (2023) and Hughes et al. (2023), whereas other studies reported no significant difference of the target RF behaviours pre and post intervention, or no sustained effect on child weight control (Davis et al., 2023; Denney-Wilson et al., 2016; Helle et al., 2019a, 2019b; Karssen et al., 2022). By synthesising findings, the intervention effectiveness may be influenced by the delivery intensity, programme tailored for individual needs (e.g., participants baseline motivation and readiness, low-income families), multi-component approaches, and sustained parental engagement that maintains behaviour change.

Although qualitative studies were excluded during screening, qualitative research has provided valuable additional data on parental interest, perceptions, and experience regarding using digital technology to improve RF practices (see Appendix A4 for study characteristics). For instance, to facilitate the programme development, intervention acceptability and fidelity, the *Growing Healthy programme* (Denney-Wilson et al., 2016) and the *ProAsk study* (Redsell et al., 2017) included additional interviews with parents, and the *Baby Bites Text Messaging Project* contained open-ended questions in the survey (Davis et al., 2023). Interviews were also conducted to investigate parental preferences for mHealth app contents and user experience (Mobley et al., 2023; Taki, Russell, Wen, et al., 2019). This could be valuable feedback for digital-based interventions as caregivers indicated high likelihood of using resources to promote healthy infant feeding behaviours (Mobley et al., 2023), and they believe they would benefit from personalised feedback (Mobley et al., 2023; Redsell et al., 2017; Taki, Russell, Wen, et al., 2019).

In addition, findings showed concerns that may help explain variability in intervention effectiveness, including low participant retention in the follow-up studies (Helle et al., 2019a, 2019b), problematic protocol adherence and intervention fidelity (Redsell et al., 2017). Factors which influenced participant engagement in the study was identified. For example, in a qualitative study with 24 mothers investigating maternal views on factors influencing their engagement in participating in an mHealth feeding programme named *Growing Healthy*, early recruitment was considered significant and necessary to promote parental engagement since it might increase the intervention exposure (Litterbach et al., 2017). Some parents reported that their milk feeding plan (breastfeeding or formula feeding) was set prior to joining the programme, which might limit behavioural change opportunities from the study intervention (Litterbach et al., 2017). This is an important target as desired feeding behaviours are more likely to be observed if the programme is launched from early postpartum or during pregnancy (Silver et al., 2022; Taki et al., 2017). Parental state of readiness (Silver et al., 2022), existing parenting experiences (Taki et al., 2017), non-judgemental support from healthcare professionals (C. G. Russell et al., 2016), as well as credible source of information (Litterbach et al., 2017; Taki et al., 2017) are all critical for participant engagement and for achieving behaviour change. Understanding infant developmental needs may act as “sticky hooks” as intervention content should be tailored to infant age, stage of development, milk feeding and complementary feeding methods (Litterbach et al., 2017).

Pickard et al. (2024) suggested that some children might be born with avid appetite since eating traits are highly heritable. Therefore, it is important to provide tailored information on healthy, positive and responsive feeding practices to parents, especially those whose child already displays less favourable eating behaviours. Evidently it is challenging to translate changes in parental behaviours to infant outcomes as shown by the studies reviewed here where responsive parenting can be increased, but this does not necessarily produce a change in infant behaviour and weight status.

Qualitative studies showed that participants favoured the 24/7 accessible source with “bite-sized contents”, since parents experienced the time that traditional sources of support were unavailable or difficult to access (Litterbach et al., 2017; Silver et al., 2022). In-time answer to a certain feeding question is one of the key advantages of mHealth programmes over face-to-face behavioural change intervention, which largely contributed to user engagement.

Lastly, few studies in this review conducted implementation checks, programme satisfaction assessment, process evaluation, and interviews which could facilitate the integration of quantitative and qualitative methods in a trial. The combination in design may yield rich data about intervention development, stakeholder engagement, and profound study outcomes analysis that neither method could accomplish alone.

As discussed in Chapter 1, RF is a bidirectional process which involves both the caregiver and the child, and caregivers’ characteristics might have a critical impact on the feeding interaction between the dyad. The ability to provide sensitive and responsive parenting varies between individuals. For example, how mothers interpret infant hunger and satiation cues may vary according to their own weight status (BMI), education, and mental health, as well as their infant’s temperament, breastfeeding experience and external pressures such as time of day (McNally et al., 2016). Some infants might be less expressive during mealtimes by nature, while caregivers reported in the qualitative data that they found it more difficult to identify hunger and satiation cues during feeding in less-expressive infants (Yu, Birtill, et al., 2025). According to the BST, the obesogenic environment does not affect children equally due to the latent gene-environment interaction, and therefore children who inherited an avid appetite profile are inclined to develop obesogenic eating behaviours (Llewellyn et al., 2023). Additionally, Yu, Fildes, et al. (2025) suggested that after controlling for milk feeding methods (breastfeeding or formula feeding) and complementary feeding approaches (traditional weaning or baby-led weaning), caregivers’ alexithymia had an inverse impact on their awareness of infant hunger and satiation cues during feeding. Both the caregivers' and their children's characteristics and attributes should be treated carefully in the study design or the programme development to promote the intervention effectiveness. In addition, consideration of *behavioural mechanisms* for long term behaviour change must be incorporated into trials aiming to change parenting and feeding practices (Nielsen et al 2018).

2.4.4 Strengths and limitations

This is the first systematic review to investigate the effectiveness of digital-based interventions promoting RF on infant growth, weight status, and feeding behaviours. In summary, few studies met the eligibility criteria. However, due to the small number of studies eligible for consideration, the pool of studies was expanded to include both in-person RCT and qualitative data. Thus, this review benefited from synthesising outcomes from a variety of studies (Group 1, 2 and 3) and summarising the effectiveness of intervention promoting RF on child outcomes in different contexts (digital-based vs face-to-face interventions, RCT vs non-RCT). In addition, variability in outcomes suggests that effectiveness may depend not only on intervention contents, but also on how support is structured, delivered, and aligned with caregivers' capacities to perceive and interpret feeding-related cues. This review also has limitations. Due to the small number of trials included, it was hard to conduct a meta-analysis and a narrative approach was used to synthesise findings. Three more studies met the inclusion criteria during screening, however, only study protocols were published with no further data available.

2.5. Conclusion

Findings suggested that although digital-based interventions are acceptable to parents, cost-effective, and scalable, they may require further refined, more theoretically focussed designs to achieve a more effective influence on behavioural and weight outcomes. Whether interventions are theory-based or built on BCTs, the transfer from improved parental RF practices to benefits in child weight change or to dietary pattern is influenced by multiple aspects of the infant and parents in behavioural change, including individual characteristics (e.g., eating traits) and contextual factors (e.g., parental motivation in intervention implementation) Digital based interventions are scalable and accessible, therefore worth investigating further. As such, future research could examine the potential of digital-based interventions which includes behaviour change theory or theory-embedded frameworks to improve caregiver responsiveness towards infant hunger and satiation cues during feeding. The inclusion of tailored intervention contents beyond generic programmes (such as nutrition education), consideration of parental characteristics (such as knowledge/readiness, personal needs, socioeconomic status), and follow-up sessions may facilitate sustained intervention effects, in the hope of promoting healthy maternal RF beliefs and behaviours and ultimately preventing childhood obesity.

Chapter 3

Methods: Study design, measurements and data analyses

Using FIBFECS (Hetherington et al., 2016) in coding infant liking and wanting.
Still image captured from the training materials and animated for this thesis.

Chapter 3. Methods: Study design, measurements and data analyses

Due to the complex aims of understanding and examining the relationship between individuals' ability in recognising and responding to their own internal satiation cues, their characteristics such as appetite traits, wellbeing, and RF practices, in addition to their children's appetite traits, various research methods, techniques and statistical analyses were utilised throughout the thesis. This chapter will provide an introduction to each method and statistical analysis approach used, materials and measurements used, overview of participants involved in individual study, in addition to the open science policy applied in each study.

3.1 Impact of COVID-19 pandemic on the choice of methods and study design

Due to the worldwide COVID-19 pandemic and the following lockdowns, it was not possible to conduct studies of maternal sensitivity to child hunger, appetite and satiation cues, and maternal responsive feeding practices in person. As a result, the research studies developed for this PhD were adapted to be completed online. Changes included research questions, study designs, data collection, and participant recruitment.

For example, the best way to investigate different aspects of responsive feeding is to film mealtime interactions at home, then to code the interaction between caregivers and infants. Previous research using a longitudinal observational design involved visiting families in their homes and filming mealtime interactions. It was reported that mothers who demonstrated greater awareness of, and sensitivity to, infants' mental states (thoughts, feelings and desires), were more responsive and involved during feeding, than mothers who were less sensitive (Farrow & Blissett, 2014). Therefore, to measure caregiver's response to infant hunger, appetite and satiation cues, our original research plan may include inviting participant to complete one typical feeding episode at home or in the lab while the mother-child dyad interactions would be recorded for coding purposes. Instead, in the project execution, participants were invited to view infant hunger and satiation cues on their digital devices and rate their accuracy of recognition (Chapter 4). Then finally some caregivers were invited to film their typical family mealtimes in the home setting and to then share this video with the research team, instead of the researcher visiting participants and set up devices in their homes or inviting participants to complete the feeding in the lab.

The research depended heavily on self-report via validated questionnaires (Chapters 4-6) and on interviews with caregivers using mealtime filmed interactions as a prompt for discussion.

3.2 Methods

Mixed methods were used in Chapter 4 to Chapter 6, to address a variety of research questions presented in Chapter 1, Table 1.2. The study design and methods used for each study were based on the existing literature and previous study results.

3.2.1 Pilot study

When working on the study design and the protocol of the first “Baby Translator” study, the plan was to include short video clips of infant displaying interest or disinterest in eating during mealtimes and explore if infant appetitive cues are universally understood by individuals. During the study, participants would be invited to view these video clips and answer an open-ended question: “what did you notice when watching this video”, followed by a still image captured from the short video clip with one question: “which of the following best represents the baby’s communication?”. Four options were generated: A) “interested in eating”; B) “disinterested in eating”, C) “fussy, frustrated and/or impatient”; or D) “I am not sure”. However, it is natural for infants to display fussiness and/or frustration while they refuse the spoon. Therefore, a question occurred: would participants consider option B and C confounding for infants who display disinterest in eating? Therefore, a pilot study was conducted to examine the feasibility of the study design during March 14th to March 28th, 2022, which allowed specific development on components of the first study.

In the pilot study, participants were offered one short video clip (length: 10 seconds) of infant displaying interest in eating as an example. Then they were invited to view 6 short video clips (length: 10-13 seconds) of infant displaying disinterest in eating and answer the question: “Which of the following best represents the baby’s communication?”. Video clips of infants displaying interest or disinterest in eating were developed by Prof Marion M Hetherington and the Danone company in a collaboration. The filming process and the settings were standardised and completed by a professional film crew (see below for the still images as an example). These materials are all available on the parenting app “My Unique Moments” (https://mum-consumer.danone.com/) owned by Danone.

Figure 3.1. Still images taken from video clips developed by Danone as an example of infant display interest (left) or disinterest (right) in eating (used with permission).

A convenience sample was used where colleagues and families were invited to participate. Overall, a sample size of 28 participants was reached, with the majority aged between 25 and 34 years old. The gender split and parental status were equivalent in the sample (see Table 3.1). Only 7 participants had children under 18 in their household while participating in the pilot study.

Participant characteristics	N (%)
Gender	
Male	13 (46.4%)
Female	15 (53.6%)
Age group	
18-24	1 (3.6%)
25-34	12 (42.9%)
35-44	5 (17.9%)
45-54	9 (32.1%)
55-64	1 (3.6%)
65+	0
Parental status	
Parents	14 (50%)
Non-parents	14 (50%)
Do you have children under 18 in your family?	
Yes	5 (17.9%)
No	23 (82.1%)

Table 3.1. Participant characteristics of the pilot study (N = 28).

A frequency table showed that participants could correctly understand what the infant was communicating in most of the video clips (see Table 3.2). There was a discrepancy between individuals' responses in BABY1, BABY3 and BABY4 as participants reported the emotional cues that the infant expressed in the video clips ("C: Fussy, frustrated and/or impatient"). For example, exploratory crosstabulation showed that among 15 participants who reported the emotional cue of BABY1, 11 of them were non-parents, which may indicate that non-parents might be more aware of infant emotional cues rather than appetite cues (see Table 3.3).

Video clip ID		Interested in eating	Disinterested in eating	Fussy, frustrated and/or impatient	I am not sure
BABY1	Frequency (N = 28)	2	9	15	2
	Percent (%)	7	32	54	7
BABY2	Frequency (N = 28)	0	26	1	1
	Percent (%)	-	93	4	4
BABY3	Frequency (N = 28)	2	16	8	2
	Percent (%)	7	57	29	7
BABY4	Frequency (N = 28)	4	1	20	3
	Percent (%)	14	4	71	11
BABY5	Frequency (N = 28)	0	20	3	5
	Percent (%)	-	71	11	18
BABY6	Frequency (N = 28)	0	24	1	3
	Percent (%)	-	88	4	11

Table 3.2. Frequency table of participants' answer based on each video clip.

		Interested in eating	Disinterested in eating	Fussy, etc.	I am not sure.	Total
Parental status	Parents	2	6	4	2	14
	Not parents	0	3	11	0	14
Total		2	9	15	2	28

Table 3.3. **BABY1** * Parental status Crosstabulation (N = 28).

Qualitative data was also collected from participants. For example, "*some babies in the video clips seemed introvert who didn't show obvious behaviours. Thus it was more difficult to understand what the baby wanted at that moment*". Some participants reported mixed cues that they observed in the video clips, such as for BABY4, "*he seemed frustrated*" and "*he was trying to push the food*" or "*reach the bowl*". A few participants commented that their response to the questions were "*based on parenting experience*" or they "*followed their instinct*". One participant reported that when watching the video clips for the first time, the speaker of the device was turned off and all video clips were played in silence. The participant watched the video clips for the second time on another device with the sound and suggested that "*my answers to the questions stayed consistent - watching with or without sound did not change my view of what the baby was communicating*". One mom of an 8-month-old infant reported that "*by watching how other babies express themselves when feeling full in the video clips, I realised babies around the world show very similar behaviours to reject the spoon".*

The results suggested that regardless of parenting experience, it was easy for individuals to recognise infants' emotional cues during feeding. Including option C: "Fussy, frustrated and/or impatient" separately might have a confounding effect on responses since infants could express emotional cues altogether with hunger and satiation cues. Viewers may struggle to choose an appropriate answer to the research question (i.e. which of the following best represents the baby's communication". The aim to use examples of interest and disinterest in eating sampled from the beginning and end of a meal respectively was met. Viewers captured both appetitive cues and emotional cues (such as turning head away, infant crying or agitation) which were considered indicators of satiation and the termination of feeding. The pilot showed that participants could recognise cues with ease but that an option should be retained while participants were not sure about their observation or noticed mixed cues of the infants (i.e. "D. I am not sure"). Therefore, the study design of the first "Baby Translator" study was revised with findings from the pilot study. Participants would be invited to view video clips of infant displaying interest or disinterest in eating during mealtimes. After watching each video, to capture more data on viewers' observation of infant appetitive cues, subtle behaviours, and contextual information, participants would be asked an open-ended question: "What did you notice when watching this video?", followed by questions regarding the infant emotion intensity, appetite, and appetite intensity (see Figure 3.2 for illustration of revised study design).

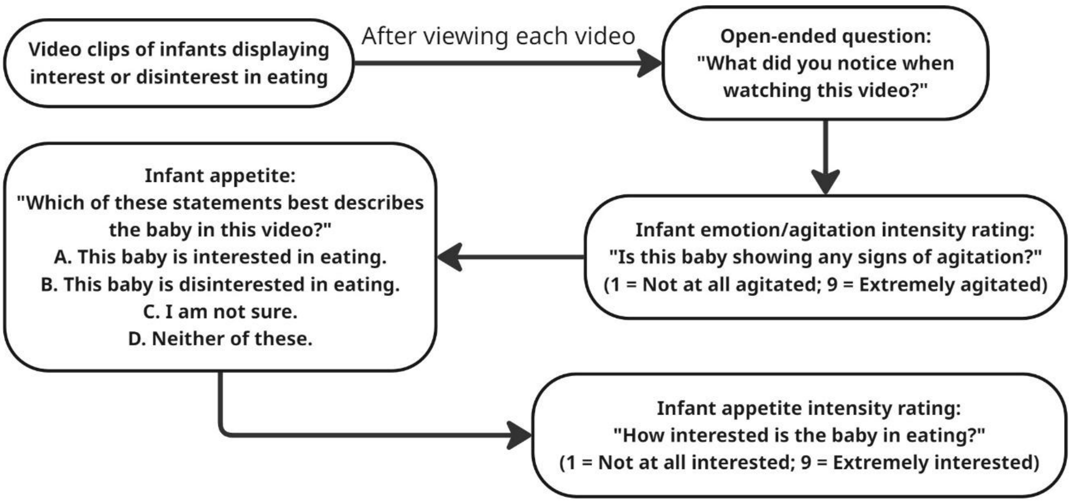


Figure 3.2. Revised study design and procedures of exploring if infant appetitive cues during mealtimes were understood by individuals in the first Baby Translator study.

3.2.2 Online survey

To explore research questions 4.1 – 4.4: “how infant communication during mealtimes are understood, whether these are universal and are associated with viewer attributes”, in addition to research questions 5.1 – 5.4: “to what extent caregiver’s responsive feeding practices are associated with their sensitivity towards their own internal satiation cues, alexithymia and their children’s appetitive traits” (see Chapter 1, Table 1.2, research questions for Chapter 4 and 5), video clips of infant displaying interest/disinterest in eating and accompanying questions with validated questionnaires were presented to participants using the online platform “Qualtrics” (https://www.qualtrics.com/). Online survey allows different question types where both quantitative and qualitative data can be collected. It also allows a variety of media or materials to be embedded throughout the survey, such as video clips, still images, and URLs. By conducting online surveys, the geographical limitation can be minimised, while researchers are more likely to have a diverse sample (Lefever et al., 2007). Meanwhile, quantitative data can be collected with validated questionnaire to test research questions 4.1 – 4.4, and 5.1 – 5.5 (see Table 1.2), as well as associations between important constructs, for example, whether caregivers’ ability to detect and respond to their own internal satiation cues is associated with their ability to recognise their infant’s appetitive cues during mealtimes. The results can also be complemented by open-ended questions included in the survey, where participants can provide contextual data with a wider perspective on feeding, observation, or mealtime experiences which are not measured by questionnaires.

When developing the online survey and analysing the data, multiple approaches have been used to acquire and maintain valid responses from participants, such as attention check, IP address check, as well as the duration of completion (Yu, Birtill, et al., 2025; Yu, Fildes, et al., 2025). However, one limitation of online survey is that researchers rely on participants being honest and genuine. There might be recall bias when answering certain questions, for example, when caregivers are asked to provide their child's appetitive traits when the child is younger (Yu, Fildes, et al., 2025). In addition, depending on participants and their devices used to answer the online survey, qualitative responses may be short and brief, resulting in less rich data than expected – such as answers to "What did you notice when watching this video" (Yu, Birtill, et al., 2025), and to "Describe the most recent mealtime you had with your children – what was it and how did you feel?" (Yu, Fildes, et al., 2025). However, it does not rule out the power and convenience of using online survey in conducting a research project.

2.2.3 Online interview

To explore the mealtime experiences of caregivers with high scores on alexithymia, a qualitative study was conducted using one-to-one semi-structured, video-elicited online interviews (Chapter 6). This study aimed to investigate the relationship between caregivers' mealtime emotions, feeding practices in terms of feeding challenges, feeding strategies, as well as the adaptation caregivers had with child growth. With real-life examples collected through interviews, caregivers could reveal and reflect on their feeding practices, in addition to how they respond to their child's appetitive cues during mealtimes. Based on the qualitative data, the research team was able to critically evaluate mealtime experiences of caregivers who scored high on alexithymia, as well as drew original conclusions according to what caregivers reported during the interviews such as challenges they have encountered or difficulties that they were not able to address in feeding.

3.3 Materials and measures

3.3.1 Video clips of infants display interest and disinterest in eating included in the first Baby Translator study (Chapter 4)

To examine whether infant appetitive cues including hunger, desire to eat, and satiety cues are universally understood, 10 short video clips of infants displaying interest (5 videos) or disinterest (5 videos) in eating during mealtimes were included in the first Baby Translator study (Yu, Birtill, et al., 2025). In this study, video recordings of caregiver-infant feeding interactions during a typical mealtime were collected from a study conducted in New Zealand (Rapson et al., 2021) and from one personal contact from the United States. All video clips were evaluated based on the quality (such as whether the caregiver-infant dyad was clear in the frame) and coded with the Feeding Infants: Behaviour and Facial Expression Coding System (FIBFECS) (Hetherington et al., 2016) by trained researchers. Overall, each video clip included in the study lasted approximately 10 seconds, in which infants showed distinctive hunger or satiation cues (see Figure 3.3).

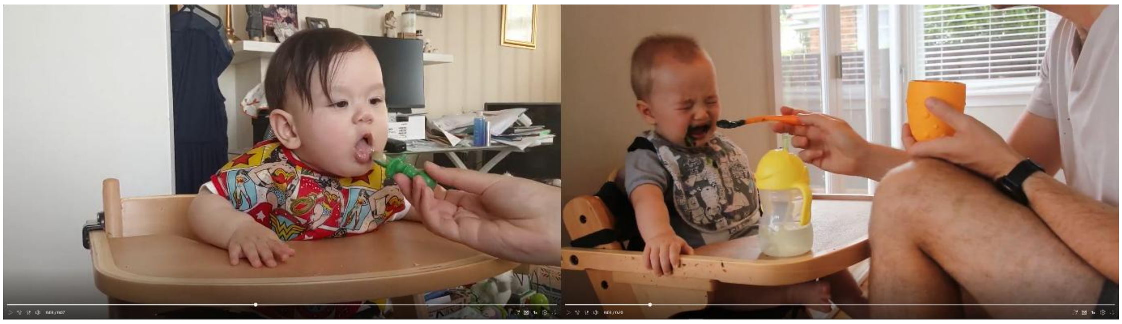


Figure 3.3. Still image taken from video clips included in the first Baby Translator study as an example of infant display interest (left) or disinterest (right) during typical mealtimes.

3.3.2 Video clips of caregiver-infant dyad mealtime interaction, and qualitative data from the open-ended question (collected from the second Baby Translator study, Chapter 5) included in the third Baby Translator study (Chapter 6)

To investigate mealtime experiences of caregivers with high scores on alexithymia in the follow-up qualitative study (Chapter 6), participants were invited to film a typical feeding in the home setting and share the video clip via Microsoft OneDrive with the research team in the first stage of their participation. Participants who expressed interest in participating in the study received a filming guideline via email and a unique Microsoft OneDrive link for them to upload their mealtime video recordings. All received video clips were analysed and coded with FIBFECS. Short video clips (mean: 107 seconds) were taken from the original mealtime recordings and presented to participants during the one-to-one interviews (see Figure 3.4), to facilitate the discussion regarding typical feeding practices, caregivers' observation of child appetitive cues, as well as caregivers' reflection on their feeding journey.

In addition, a qualitative component from the previous study was included during the interview. In the previous study, participants were invited to share their most recent mealtime experiences through an online survey (Yu, Fildes, et al., 2025). Their answers to the open-ended question were presented during the interview to facilitate the discussion regarding feeding challenges they encountered, coping strategies they applied, and adoptions they made in response to their child's growth (see Figure 3.5).

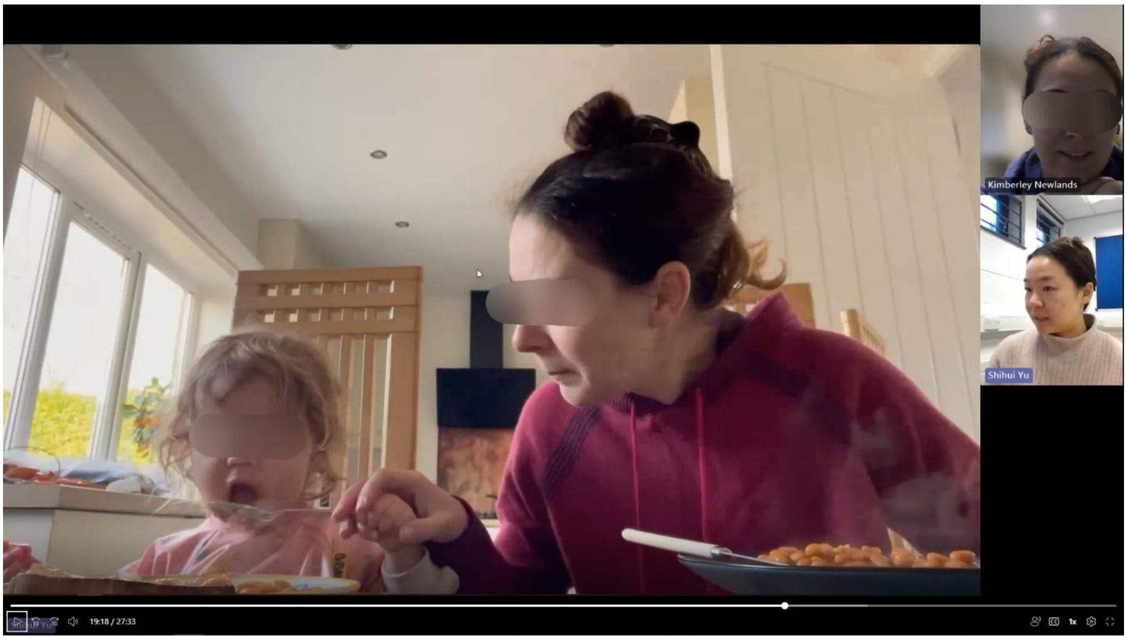


Figure 3.4. Still image taken from the interview where the participant was watching the short video clip of their typical family mealtime with the researcher together.

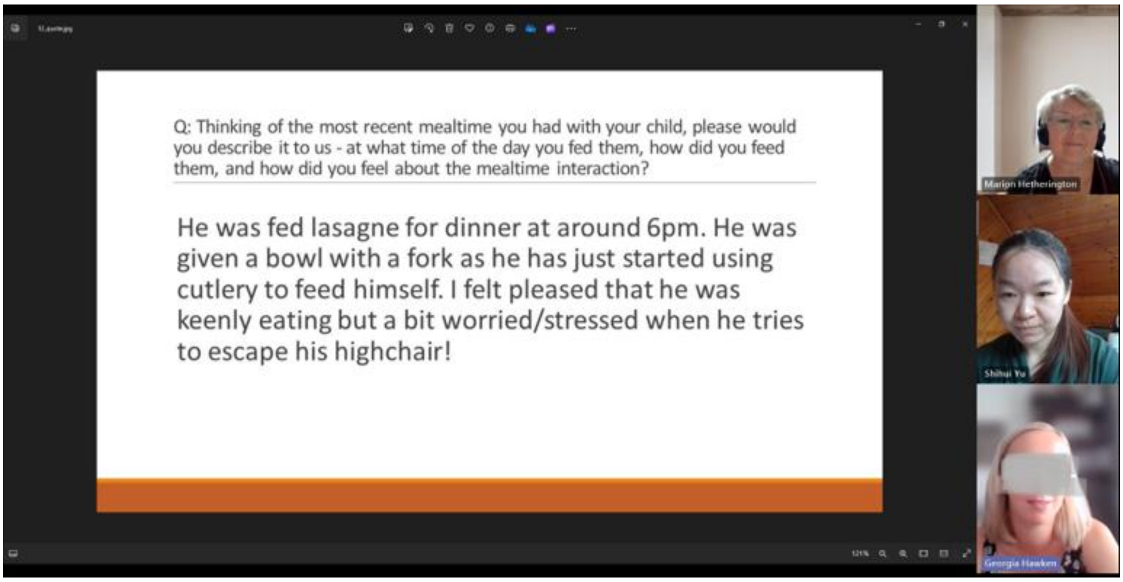


Figure 3.5. Still image taken from the interview where participant was having a reflection about their feeding experiences over time based on the quote from the previous study.

3.3.3 Questionnaires

Specific validated questionnaires were included in the studies to address predictors and outcome variables of interest. It allowed the exploration of associations between participants' characteristics or traits, such as participants' recognition and responses to their internal appetite cues and to what extent they were able to identify their infants' hunger and satiety cues during feeding. It also allowed an observation of whether participants scored high or low on specific measures such as alexithymia, and other mental health conditions that are known to be associated with alexithymia.

While questionnaires generally consist multiple subscales, only subscales relevant to the specific research questions were included in the corresponding studies and were detailed below (see Table 3.4).

	Name of the questionnaire	Authors and the published year	Traits/Characteristics measured	Chapter involved
Appetite traits	Adult Eating Behaviour Questionnaire	Hunot et al. (2016)	Adult appetitive traits: food approach (e.g., FR), and food avoidant (e.g., SR).	4 & 5
	Intuitive Eating Scale–2	Tylka and Kroon Van Diest (2013)	Adult intuitive eating behaviours in terms of the reliance on hunger and satiety cues to guide their eating behaviours.	4 & 5
	Reasons Individuals Stop Eating Questionnaire short version	Chawner et al. (2022)	Adults' reasons to stop eating in a typical meal episode as responses to their own internal satiation cues.	4 & 5
	Child Eating behaviour Questionnaire for Toddlers	Herle et al. (2016)	Children's appetitive traits: food approach (e.g., FR), and food avoidant (e.g., Food Fussiness).	5
Wellbeing	20-item Toronto Alexithymia Scale	(Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994)	Alexithymia in adults	4 & 5 & 6

	The Autism-Spectrum Quotient Short Form	Hoekstra et al. (2011)	Autistic traits in individuals with normal intelligence	4
	The State-Trait Anxiety Inventory	Spielberger (1983)	Trait anxiety	4
	The State-Trait Depression Questionnaire	Krohne et al. (2002)	Trait depression	4
Caregivers RF practices and mealtime emotions	The Infant Feeding Questionnaire	Baughcum et al. (2001)	Caregivers' beliefs and behaviours on their RF practices	5
	The Mealtime Emotions Measure for Parents	White et al. (2022)	Caregivers' emotions and feelings experienced during their family mealtimes	5

Table 3.4. An overview of the questionnaires used and what they measured in the thesis.

3.3.4.1 Appetite traits measurement

The Adult Eating Behaviour Questionnaire (AEBQ) (Hunot et al., 2016) is a self-reported measure of adults' appetitive traits, including food approach (such as FR) and food avoidant (such as SR). There are eight subscales in the original measurement, however, only relevant subscales were included in the studies according to specific research questions.

The Intuitive Eating Scale–2 (IES-2) (Tylka & Kroon Van Diest, 2013) is a self-reported tool to assess adults' capability of eating in response to internal hunger and satiety cues, rather than contextual or emotional cues. The average score represents to what extent individuals reply on their internal hunger and satiety cues to guide their eating behaviours. To address our research questions, only one subscale from the IES-2 named Reliance on Hunger and Satiety Cues was included in our studies.

The Reasons Individuals Stop Eating Questionnaire short version (RISE-Q15) (Chawner et al., 2022) is a self-reported measure of individuals' response to their own satiation cues during a typical mealtime. It is a shorter version (15 items in total) of the original tool: Reasons Individuals Stop Eating Questionnaire (RISE-Q) (Cunningham et al., 2021). It contains five subscales measuring different dimensions as the reason for individuals to stop eating for internal and contextual cues.

The Child Eating behaviour Questionnaire for Toddlers (CEBQ-T) (Herle et al., 2016) is a measure of children's appetitive traits, including food approach (such as FR) and food avoidant (such as Food Fussiness). It was developed originally with infants aged 18 months old, based on the validated and widely used Child Eating Behaviour Questionnaire (Jane Wardle et al., 2001). The CEBQ-T is a modified version especially for toddlers and relies on caregivers to report their child's eating traits.

3.3.4.3 Wellbeing measurement

The 20-item Toronto Alexithymia Scale (TAS-20) (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994) is a self-administered measure of alexithymia containing three dimensions: Difficulty Identifying Feelings, Difficulty Describing Feelings, and Externally Oriented Thinking. Each item is scored on a 5-point Likert-type scale (1 = strongly disagree; 5 = strongly agree) and the overall score ranges from 20 to 100, with higher scores indicate greater alexithymia. Additionally, TAS-20 uses cut-off scoring with scores of 52–60 indicating potential alexithymia, and scores above 60 indicating present alexithymia.

The Autism-Spectrum Quotient Short Form (AQ-S) (Hoekstra et al., 2011) is a 28-item measure to evaluate autistic traits in individuals with normal intelligence. It is a shortened version of the 50-item Autism-Spectrum Quotient (AQ), developed to maintain the validity and meaningful factor structure of the original AQ. Two main areas of autistic traits are assessed through AQ-S including social behavioural difficulties, and fascination for numbers and/or patterns. To address research question 4.4 (see Chapter 1, Table 1.2), two subscales named "Social Skills" and "Routine" were included in the first Baby Translator study (Chapter 4).

The State-Trait Anxiety Inventory (STAI) (Spielberger, 1983) is a self-reported assessment which includes separate measures of state and trait anxiety. With different scales, it differentiates between individual's temporary experiences of anxiety symptoms (state) and the general, stable, long-term experienced anxiety feelings (trait). It contains 40 items in total (20 items each for state and trait anxiety measures) on a 4-point Likert scale, with higher scores indicating higher state or trait anxiety. To address research question 4.4 (see Chapter 1, Table 1.2), general anxiety rather than state anxiety of the participant was measured in the first Baby Translator study (Chapter 4).

The State-Trait Depression Questionnaire (ST-DEP) (Krohne et al., 2002) is a self-reported tool to assess both state and trait aspects of depression. It distinguishes between individual's transient experience of depressive symptoms (state) and general, enduring, long-term tendency or predisposition towards depressive sentiments (trait). There are two subscales named Euthymia (positive affect, 5 items) and Dysthymia (negative affect, 5 items) within each measurement. Higher scores on either scale indicates greater severity of state or trait depression. To address research question 4.4 (see Chapter 1, Table 1.2), only items to measure trait depression were selected in the first Baby Translator study (Chapter 4).

3.3.4.2 Responsive feeding practices and mealtime emotions measurement

The Infant Feeding Questionnaire (IFQ) (Baughcum et al., 2001) is a measurement of caregivers' feeding practices during the first few years of a child's life. This tool was originally developed with infants aged between 11-23 months. Caregivers need to retrospectively complete 20 items measuring both their feeding practices (such as their awareness of infant's hunger and satiety cues during feeding) or beliefs (such as their concerns about infant weight) that may lead to childhood obesity.

The Mealtime Emotions Measure for Parents (MEM-P) (White et al., 2022) is self-reported tool to capture caregivers' emotions and feelings experienced during their family mealtimes. This was originally adapted from the 13-item Mealtime Emotions Measure for Adolescents (White et al., 2015) and developed to understand how parents' emotions relate to their food parenting practices. It contains 16 items and to complete the MEM-P, participants report the frequency of certain emotions they experience (such as happy or anxious), and whether parents feel in control of their emotions during family mealtimes, and their confidence in dealing with child distress.

3.4 Participants

In the pilot study, participants were recruited both in person and online via social media who constituted the convenient sample. For online surveys (Chapter 4 and Chapter 5), participants were recruited online via prolific (https://www.prolific.com/) and were compensated for their time via the platform. In the first Baby Translator study (Chapter 4), to investigate if infant communications during feeding were generally understood (research questions 4.1 – 4.4, see Table 1.2), individuals aged between 18 and 59 who were UK residents were recruited (N = 198). In the second Baby Translator study (Chapter 5), to explore the association between parental RF practices and their recognition and response to their internal appetitive and affect cues (research questions 5.1 – 5.4, see Table 1.2), caregivers who aged 18 and above, fluent in English, UK residents, had at least one infant between 6 to 24 months old in the household were recruited (N = 447). Caregivers with preterm infants, or infants with chronic, medical conditions which may affect feeding were excluded in the corresponding study.

To explore mealtime experiences and challenges of caregivers with high scores on alexithymia (research questions 6.1 – 6.4, see Table 1.2), in the qualitative follow-up study, participants were selected according to their TAS-20 scores and recruited via email based on the previous study (Yu, Fildes, et al., 2025), where they left the consent at the end of the survey and indicated they were happy to be contacted for future studies. Overall, caregivers who scored between 52 and 74 on TAS-20 (N = 14) were recruited to complete the third Baby Translator study (Chapter 6).

3.5 Open science principles

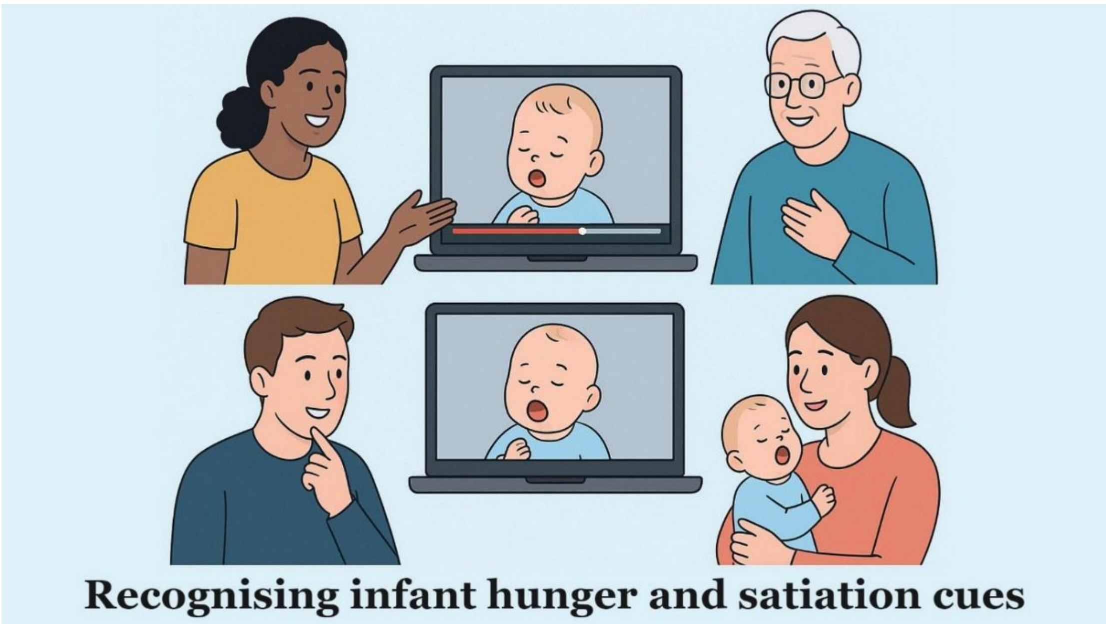
Throughout the PhD project, ethical approvals were granted by the School of Psychology Ethics Committee, University of Leeds before the launch of each study. In addition, studies were all pre-registered on the Open Science Framework (OSF: https://osf.io/) (see Table 3.5).

	Ethical approval reference	OSF
Baby Translator 1st study (Chapter 4)	PSYC-541	https://osf.io/vjubk/
Baby Translator 2nd study (Chapter 5)	PSCETHS-680	https://osf.io/5asn7/
Baby Translator 3rd study (Chapter 6)	PSCETHS-1086	https://osf.io/3v5bw/

Table 3.5. Ethical approval and pre-registration references.

Chapter 4

Towards developing a "baby translator" – an exploration of how infant appetite cues are understood



Chapter 4. Towards developing a “baby translator” – an exploration of how infant appetite cues are understood

Abstract

Caregivers’ feeding practices shape their child's eating patterns and subsequent health. Research shows that sensitive feeding is linked to healthy development and self-regulation but depends on caregiver responsiveness to infant needs and appetite cues. Responsive feeding (RF) is influenced both by characteristics of the caregiver and expressiveness of the infant. To investigate how infant communication is understood and whether recognition of appetite cues is associated with the viewer’s eating traits, mental health and wellbeing, an online study was conducted. Participants (N = 200) aged 18 – 55 years were recruited in June 2022 via Prolific. Recognition of infant appetite cues was measured by participant responses to video clips of infants (N = 10) being fed during mealtimes (sampled at the start and end of a meal). Caregiver satiety responsiveness, intuitive eating, alexithymia, autism spectrum disorder, and mental health were assessed by validated questionnaires. Results showed a high consensus in identifying infant appetite cues, with no significant correlations with parenting status, eating traits or mental health, except for one subscale of alexithymia - Difficulty Describing Feelings ($r = -.15$, $p = .03$). Open-ended descriptions of mealtime cues showed that positive affect was observed early in the meal and more negative affect at the end of the meal. Infant cues signalling interest in eating were generally well recognised and were not significantly correlated with individual differences of the viewer except alexithymia. Further research to assess the association between alexithymia, responsiveness to infant communication cues and RF practices is warranted.

4.1 Introduction

Early nutritional experience contributes to the development of healthy eating patterns (Black & Aboud, 2011; Mennella & Ventura, 2011). For example, infant eating traits and innate predispositions interact with feeding exposures in early life to shape food preferences and eating habits (Mennella & Ventura, 2011). Caregiver feeding practices during the first two years of life are known to be associated with child body weight status (Spill et al., 2019). However, the extent to which caregiver responsiveness to their child's appetite cues influences infant appetite regulation in the first two years is not clear (DiSantis et al., 2011). The ability to regulate energy intake is linked to eating traits in children aged 4 to 7 years (Carnell & Wardle, 2007), which are highly heritable (Llewellyn et al., 2012); as well as the age of the child, for instance, the ability to demonstrate short-term energy regulation in response to a preload appears to diminish in infancy between 11m and 15 m (Brugaillères, Issanchou, et al., 2019) and the greatest reduction in this ability was associated with the eating trait of parental reported food responsiveness (Brugaillères, Chabanet, et al., 2019). The authors of these studies suggested that when caregivers adjusted the rate of offering food to their infant according to the size of the spoonful, these infants were better able to compensate (Brugaillères, Chabanet, et al., 2019). This latter evidence indicates the potential for responsive feeding to support energy regulation.

Sensitive or responsive parenting requires caregivers to be able to distinguish infant hunger cues from other distress cues; therefore, they are able to feed in response to infant hunger, while applying other non-food approaches with distress infants display that is not hunger-related (Savage et al., 2018). When applying in the feeding context, responsive feeding (RF) refers to prompt, contingent and developmentally appropriate responses from caregivers to infant's eating traits, and state-related hunger, appetite and satiety cues (Black & Aboud, 2011). The assumption is that responsive and sensitive feeding practices will result in a healthy child with a healthy body weight, but this outcome will depend on the characteristics of the caregiver, those of the child and the bidirectional nature of the interaction between the two. Evidence from the APPETItE Study (Pickard et al., 2022), assessed the relationship between adult eating profiles, their child's eating profile (at 3-6 years old), and any mediating effect of parental feeding practices (Pickard et al., 2024). The authors found no effect of parental feeding practices on the relationship between adult and child avid and avoidant eating profiles, indicating the strength of heritable appetite traits (Llewellyn et al., 2023). Responsive feeding may therefore be dependent on the complex interplay between caregiver, child and environmental factors.

Efforts have been made to investigate whether teaching RF practices might influence infant eating, weight and health outcomes. A series of randomised controlled trials have been undertaken to promote RF through educational and experiential learning interventions in the NOURISH (Daniels et al., 2009), INSIGHT (Paul et al., 2014), Baby Milk (Lakshman et al., 2015), and Baby's First Bites (van der Veek et al., 2019) trials. These interventions targeting RF during milk feeding (Lakshman et al., 2015; Paul et al., 2014) and complementary feeding (Daniels et al., 2009; Paul et al., 2014; van der Veek et al., 2019) were developed to promote sensitive parenting, responsive feeding, healthy eating and to reduce the risk of early childhood obesity. Mixed results have been found in terms of the effectiveness of the intervention on child weight status and parental feeding practices. For example, children who had been involved in the INSIGHT trial had a lower mean Body Mass Index (BMI) z-score from the intervention compared to control by age 3 years, but the prevalence of overweight and obesity did not differ across the two groups (Paul et al., 2018). The INSIGHT trial provided evidence - that RF could be enhanced through the intervention (Savage et al., 2018) - showing that intervention mothers were more likely to report RF practices and fewer non-responsive practices. Also, more than 60% of mothers from the intervention arm reported more sensitive feeding practices by teaching their infant appetite signs, such as “more” and “all done” (Paul et al., 2019). As a result, infants in the intervention group were more likely to use “all done” to express satiation than the control group (Paul et al., 2019). Overall, infant outcomes benefitted from responsive parenting or RF interventions, such as less rapid weight gain, or lower BMI z-score (L. Daniels et al., 2012; Daniels et al., 2014; L. A. Daniels et al., 2012; Lakshman et al., 2018; Magarey et al., 2016; Paul et al., 2018; Savage et al., 2016).

RF is bidirectional, and so interpretation of cues may be complicated by ambiguous signals given by infants aged between 0-6 months or, in the pre-linguistic stage, by few vocalisations and obvious signals including hunger cues (Price et al., 2012). Infants may show a mixture of hunger and satiety cues during feeding, leading to maternal uncertainty regarding feeding cessation (Price et al., 2012). The potential ambiguity of infant cues together with the possibility of caregiver’s uncertainty might produce discordant responsiveness. An example of discordancy is feeding an infant in the absence of hunger cues or in the presence of satiety cues (DiSantis et al., 2011). Caregivers may miss or misinterpret signals of hunger and satiety in the first 2 years of infancy, and report that “deciphering” infant communication cues is “not an exact science” (McNally et al., 2016). Indeed, it is the disconnect between infant cues and parental responsiveness to these cues that may contribute to accelerated weight gain and the development of overweight in the early years (DiSantis et al., 2011). How mothers interpret hunger and satiety cues expressed by their baby may vary according to their own weight status (BMI), their wellbeing, their own eating traits (Pickard et al., 2024) and their experience of breast or formula feeding (McNally et al., 2016). For example, mothers with experience of post-natal depression were more likely to offer foods to soothe their babies (Cox et al., 1987). Mothers who breastfeed, in comparison with formula-feeding, were more likely to report noticing and attending to their child signalling hunger and satiety cues during milk feeding (Hetherington & McNally, 2020). Caregivers of infants aged 0–12 months reported adapting their use of routine to their chosen feeding method (breast, mixed or formula), with longer duration breastfeeding mothers more likely to adopt an infant-led pattern and mothers using formula at birth or a short breastfeeding duration adopting a more parent-led pattern of feeding (Brown & Arnott, 2014).

Individuals also vary in their ability to respond to their own internal hunger and emotional state. For instance, the concept of “interoceptive sensitivity” represents a stable trait in recognising changes in visceral processes that trigger interoceptive signals from organs including the stomach (Herbert et al., 2013). In the domain of appetite, this construct represents the individual’s capacity to sense appetite-related internal sensations. Strong interoceptive sensitivity is associated with both a healthy BMI and intuitive eating behaviours in adults (Herbert et al., 2013). Thus, a caregiver’s ability to de-code/translate and respond to infant appetite cues may be related to their own interoceptive awareness, i.e. awareness of and response to their own appetite, including sensitivity to internal satiation cues (Chawner et al., 2022), and internal emotional states. Alexithymia refers to a stable trait whereby individuals experience difficulties identifying and describing feelings and exhibit an externally oriented thinking style (Bagby et al., 2020). Existing literature suggests the prevalence of alexithymia is approximately 10% within the general population (de Zwaan et al., 1995). However, prevalence varies in different samples, such as adolescents, or in clinical settings. Research suggests alexithymia is linked to autistic spectrum disorders (ASD) (Berthoz et al., 1999; Liss et al., 2008). Emerging evidence indicates that half of those with ASD are thought to have alexithymia, which is considered both a cause, and a consequence of autistic behaviours (Poquérusse et al., 2018). Alexithymia also frequently co-occurs with other disorders that are associated with poor interoceptive sensitivity or decreased perception of hunger and satiety cues, such as eating disorders (Brewer et al., 2016). Ahrnberg and colleagues found maternal alexithymia is associated with less sensitive caregiving behaviours and poorer quality of feeding such as a weak feeding structure (Ahrnberg et al., 2021). Mothers without alexithymia reported higher scores on regulating mealtime interactions through tuning into their child's affective and behavioural states.

The overall aim of this study was to explore how well infant communication cues expressed during early and late stages of mealtimes are recognised and to assess whether infant cue recognition differs according to caregiver characteristics. This aim was underpinned by the proposal that fostering an understanding of the basics of mealtime infant communication (“baby translation”) may then be applied to enhance RF during mealtimes and potentially benefit parents and infants. To this end, a secondary objective of this study was to verify and validate a series of video clips of infants during mealtimes as a potential resource to promote RF. To achieve this, firstly, participants’ ability to determine infant’s interest/disinterest in eating during meals was assessed. Secondly, predictors of recognising infant's interest/disinterest in eating were explored, including parenting experience, BMI, sensitivity to satiation, intuitive eating behaviours, individual's affect, ASD and mental health. Finally, participants’ ratings of infant appetite intensity and agitation during the video extracts were compared, to assess variation by video extract (i.e., differing infant expressiveness) and participant (rater) characteristics.

4.2 Methods

4.2.1 Participants and study design

Participants were invited to complete an online survey via Prolific (https://www.prolific.co/) which was advertised as “Understanding babies during mealtimes” in June 2022. Participants were told that the general aim of this study was to develop ways to understand what infants are communicating during mealtimes and they were invited to watch some video clips. Inclusion criteria for participants were that they had to be aged between 18 and 55 years old, residents of the UK, fluent in English and without any cognitive impairment. Those who agreed to participate completed the survey which was hosted via Qualtrics (https://www.qualtrics.com/uk/). Two questions for attention check were included in the survey, such as “I have been to Mars many times” with “Never” - “Always” on a 7-point Likert scale (which mirrored answers to the Reasons Individuals Stop Eating Questionnaire short version), and “To show that you are paying attention, please select "Almost always" option as your answer”. In addition, participant IP address, time used to complete the survey, sample distribution and outliers were checked to ensure data quality.

Based on previous research investigating the recognition of emotional facial expressions in adults (Dodich et al., 2014), and the nature of an exploratory study, we aimed to recruit between 150 (Dodich et al., 2014) and 300 participants (Zheng et al., 2011). In the end, we achieved a sample size of 200. This survey took approximately 15 minutes to complete, and participants were compensated for their time via Prolific. Ethical approval for this study was granted by the University of Leeds, School of Psychology Ethics Committee (Reference: PSYC-541). The protocol of this study was pre-registered on the Open Science Framework (OSF): https://osf.io/vjubk/.

4.2.2 Procedure

This survey contained four sections (see Figure 4.1). Participants read from the digital display a page providing brief information explaining the procedure and asking for consent to participate. Anyone who may have had concerns about watching mealtime videos with infants was asked to opt out. Section 1 of the survey consisted of general demographic questions, then Section 2, which consisted of video clips of 5 infants filmed at the beginning of a meal representing “interest in eating” or “hunger”, and 5 infants filmed at the end of the meal representing “disinterest in eating” or “satiation”. Video presentation was randomised. After watching each video clip, participants were asked an open-ended question about what they noticed in the video, whether the infant was interested/disinterested in eating during the meal, before rating appetite intensity and agitation. Section 3 and 4 consisted of a series of questionnaires measuring participant characteristics such as satiety responsiveness, intuitive eating behaviours, ASD traits, alexithymia, and general mental health.

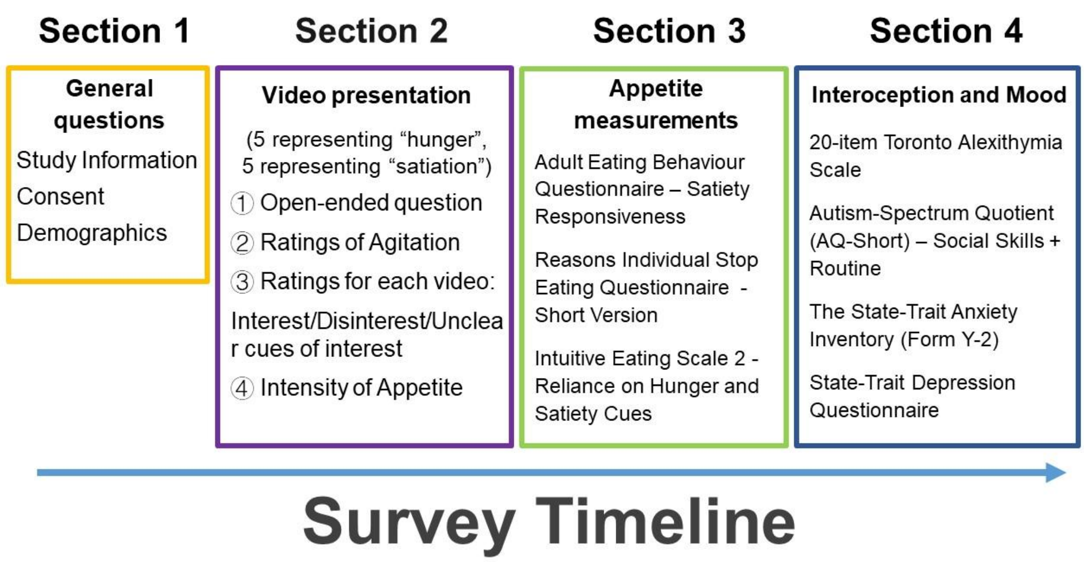


Figure 4.1. Baby Translator Online Survey Timeline.

4.2.3 Materials

4.2.3.1 Video clips

Prior to this study, the researcher (S.Y.) was trained with Feeding Infants: Behaviour and Facial Expression Coding System (FIBFECS) (Hetherington et al., 2016). It is a video coding tool developed to measure infant liking and wanting during complementary feeding, using 13 behavioural and facial expression items to assess infant food preferences.

Video recordings of infant-caregiver feeding interactions during typical mealtimes were collected during a study based in New Zealand (Rapson et al., 2021) and from one informal contact outside of the trial from the US. Video clips were initially evaluated and coded based on the quality (such as whether the caregiver-infant dyad was close to the camera and clear in the frame) and the clarity of infant cues during mealtimes. The six babies (three boys and three girls) presented in video clips were aged between 6 to 9 months (mean age 8.5 ± 1.1 months), drawn from diverse ethnic origins (Asian, Māori and Caucasian), and were spoon-fed with solid foods. The clips focussed on the infant, on their response to the food offered and the amount of food remaining in the bowl was not in view. Videos of the six infants during mealtimes were analysed and coded with the FIBFECS (Hetherington et al., 2016) by trained researchers and eventually 10 short video clips were extracted for the purpose of this study. In total, 5 video extracts were taken at the start of the meal which conveyed interest in eating (hunger cues) including reaching for the food, leaning forward and rapid acceptance of food offered. Then 5 video extracts representing satiation cues, including the following cues - turning head away, pushing the spoon away and arching the back were selected. Each video extract lasted approximately 10 seconds. Videos were selected based on clear behavioural coding outcomes, namely where babies demonstrated interest or disinterest in eating at the beginning and end of a meal respectively. Viewers were not aware of the timing of the meal when answering the survey and could not see how much food was in the serving bowl. Four out of six infants appeared twice, presenting both interest and disinterest in eating. Two infants appeared once for either interest/disinterest in eating in the video clip.

Participants were asked the following questions about each video: “What did you notice when watching the video?”, this was an open-ended question; then “Which of these statements best describes the baby in this video?”. They were asked to choose from 4 statements to describe infant interest/disinterest in eating: “This baby is interested in eating”, “This baby is disinterested in eating”, “Neither of these”, or “I am not sure”. For further analysis, “Recognition of the infant’s interest/disinterest in eating” was generated on a simple binary scale with 1 for correct, and 0 for all other answers including incorrect recognition, and selecting one of the following statements: “Neither of these” and “I am not sure”. The total score for each group of videos (interest N = 5; disinterest N = 5) was considered the recognition accuracy, with a score of 10 reflecting 100% correct across both types of communication.

The second question asked participants “how interested is this infant in eating”, using a Likert Scale from 1 to 9 (where 1 = Not at all interested, to 9 = Extremely interested) to describe infant appetite intensity. Next, for agitation ratings (“Is this baby showing any signs of agitation?”), a 9-point Likert scale (1 = Not at all agitated; 9 = Extremely agitated) based on the valence and arousal dimensions of the International Affective Picture System (IAPS) (Bradley & Lang, 1994; Lang et al., 1997) was used. The IAPS tool was developed to study emotion and attention and for the present study intensity of agitation ratings were anchored by 1 = Not at all agitated, to 9 = Extremely agitated.

4.2.3.2 Appetite traits measurements

The order of questionnaire items was randomised in the survey.

To measure sensitivity to feelings of fullness, one subscale from the Adult Eating Behaviour Questionnaire (AEBQ) (Hunot et al., 2016) namely Satiety Responsiveness (SR) was included. Poor satiety responsiveness is linked to overeating and to excess body weight. SR is measured using 4 items such as “I often get full before my meal is finished”, anchored on a 5-point Likert scale ranging from 1 = Strongly agree to 5 = Strongly disagree.

To measure intuitive eating behaviours, one subscale from the Intuitive Eating Scale-2 (IES-2) (Tylka & Kroon Van Diest, 2013) named Reliance on Hunger and Satiety Cues was used. It contains six questions, such as “I rely on my fullness (satiety) signals to tell me when to stop eating”, with scores to each item on a 5-point Likert scale ranging from 1 = Strongly disagree to 5 = Strongly agree. The average score reflects individuals’ trust in their internal hunger and satiety cues and reliance on these cues to guide their eating behaviour.

To measure individual sensitivity to internal and external satiation processes, participants completed the Reasons Individuals Stop Eating Questionnaire short form (i.e., RISE-Q15) (Chawner et al., 2022). The RISE-Q15 consists of 15 items with answers anchored on a 7-point frequency scale ranging from 1 = Never to 7 = Always. Participants were asked how often each statement reflects a reason they stop eating at a typical dinner meal at home. The score for each of the five subscales (Decreased Food Appeal, DFA; Physical Satisfaction, PS; Planned Amount, PA; Self-Consciousness, SC; Decreased Priority of Eating, DPE) was calculated as the mean of each of the items in each subscale respectively.

Together these questionnaires provide measures of individual differences in sensitivity to internal cues of hunger, appetite and satiation/satiety.

4.2.3.3 Behavioural traits measurements

To assess potentially relevant autistic traits, two subscales named “Social Skills" and “Routine” from the Autism-Spectrum Quotient Short Form (AQ-S) (Hoekstra et al., 2011) were used. Questions assessing personal preference and habits were asked such as “I prefer to do things the same way over and over again”. Participants responded to each statement on a 4-point Likert scale anchoring from ‘‘1 = Definitely agree’’; ‘‘2 = Slightly agree’’; ‘‘3 = Slightly disagree’’ and ‘‘4 = Definitely disagree’’. The scoring was reversed for items in which an ‘‘agree’’ response is characteristic for autism and was summed up.

To assess trait anxiety, only form Y-2 (20 items) from The State-Trait Anxiety Inventory (STAI) (Spielberger, 1983) was used. This was measured to assess general anxiety rather than state anxiety of the participant. Participants were invited to respond to each statement such as “I feel nervous and restless.” or “I feel pleasant.” on a 4-point frequency scale anchoring from (1) “Almost never” to (4) “Almost always”, with higher score indicating higher trait anxiety.

To measure trait depression, the State-Trait Depression Questionnaire (ST-DEP) (Krohne et al., 2002) was used. It is a self-report measure with 2 subscales including 20 items in total to evaluate state depression or trait depression. In this study, 5 items from the Euthymia and 5 items from Dysthymia measuring trait depression were selected. Participants needed to respond to each statement such as “I feel gloomy.” on a 4-point frequency scale anchoring from (1) Almost never, (2) Sometimes, (3) Often to (4) Almost always.

To measure alexithymia, 2 subscales from the 20-item Toronto Alexithymia Scale (TAS-20) (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994) were used. TAS-20 is a self-report measure of alexithymia with 3 subscales and 20 items in total. Each of the twenty items is rated on a 5-point Likert scale ranging from 1 = Strongly disagree to 5 = Strongly agree. Two selected subscales were: Difficulty Describing Feelings subscale with 5 items, such as “It is difficult for me to find the right words for my feelings”, and Difficulty Identifying Feelings subscale with 7 items, such as “I am often confused about what emotion I am feeling”.

4.2.4 Data analyses

Based on the ordinal data from answering infant interest/disinterest in eating (choose from 4 statements to “Which of these statements best describes the baby in this video?”), non-parametric analyses were used to examine associations between recognition scores and individual characteristics of the viewer. Spearman’s rho was used to evaluate the relationship between individual's BMI, eating traits, behavioural traits and their recognition score. The Sign Test was applied to compare the total sum of recognition scores between interest and disinterest extracts (two related samples).

To explore group differences between participants, a repeated measures Analysis of Variance (ANOVA) was conducted on the interval data regarding ratings of infant appetite (9-point Likert Scale to "how interested is this infant in eating") and on agitation (9-point Likert Scale to “Is this baby showing any signs of agitation?”). For example, the ANOVA compared main effects of participant group (parent, no parenting experience), by stage of the meal (early, late) by video clip (5 clips in each meal stage). This was done to compare ratings of appetite and agitation by parenting status and between stage of meal (early vs late), partly as a manipulation check (appetite ratings would be rated as more intense in the early stage of a meal) and to test for group differences in ratings. Further, Ordinal Logistic Regression was conducted to explore if an individual's sensitivity to satiation cues, alexithymia, ASD and mental health status could successfully predict their ability to recognise infant interest/disinterest in eating. Qualitative data from the open-ended question were coded according to appetite, affect and other content. A tool named Affective Norms for English Words (ANEW) (Bradley & Lang, 1999) provides a collection of normative emotional ratings for many English words, so that positive or negative valence could be coded from participant responses.

4.3 Results

4.3.1 Participants

Two hundred adults completed the survey. Two respondents were excluded due to errors observed in answers. Participants were mostly between 25-44 years old (M = 34.3, SD = 9.2), predominately female (73%) and white (83%). Participants were mostly educated to undergraduate degree level or higher (52%), had a household income less than £50,000 (59%), and had a normal weight (45%). Most of participants did not study or work with infants or young children (87%) but 68% of them had experience in feeding an infant. More than half of the participants (54%) had no children in their household whereas 46% of our participants had at least one child in their household. Full participant characteristics are presented in Table 4.1.

Participant characteristics	N (%)
Sex	
Male	47 (24%)
Female	145 (73%)
Prefer not to say	6 (3%)
Age group	
18-24	34 (17%)
25-34	68 (34%)
35-44	64 (32%)
45-59	30 (15%)
Missing	2 (1%)
Education	
Some high school or less, high school diploma or equivalent (GED)	28 (14%)
Some college education	46 (23%)
Associate Degree (AA) or vocational licence	16 (8%)
Bachelor’s degree (BA, BS)	66 (33%)
Graduate or professional degree (MA, MSc, PhD, MD, JD)	37 (19%)
Prefer not to say	5 (2.5%)

Household income	
< £25,000	48 (24%)
£25,000 to £49,999	69 (35%)
£50,000 to £74,999	36 (18%)
> £75,000	21 (11%)
Prefer not to say	24 (12%)
Body Mass Index (BMI)	
Underweight (BMI < 18.5)	10 (5%)
Normal (18.5 ≤ BMI < 25)	89 (45%)
Overweight or obese (BMI ≥ 25)	56 (28%)
Missing	43 (22%)
Ethnicity	
Asian or Asian British	17 (9%)
Black or Black British	6 (3%)
White	165 (83%)
All others	10 (5%)
Study or job involves working with infants and/or young children	
Yes	26 (13%)
No	172 (87%)
Have experience in feeding an infant	
Yes	134 (68%)
No	64 (32%)
Currently the number of children in the household	
Have 1 or more children at home	92 (46%)
Have no children at home	106 (54%)

Table 4.1. Participant characteristics (N = 198).

4.3.2 Recognition of infant communication – interest/disinterest in eating

Results showed that there was a high consensus in understanding infant interest/disinterest in eating, but this varied by individual video clips (see Table 4.2). The recognition score of participants was higher when infants were showing disinterest in eating (4.7 ± 0.6) compared to interest in eating (4.5 ± 0.8) (Sign Test Z value = 3.24, $p < .001$). In addition, findings suggested the mean intensity of agitation of disinterest in eating was overall higher than interest (see Figure 4.2).

	Interest in eating (N = 5)					Disinterest in eating (N = 5)				
Video ID	V1	V3	V5	V8	V10	V2	V4	V6	V7	V9
Infant ID*	372*	009*	358*	381*	370	381*	002	372*	009*	358*
Infant gender	Female	Male	Male	Male	Female	Male	Female	Female	Male	Male
Infant age (weeks) in the video	36	39	36	36	36	36	28	36	39	28
Recognition score for individual infant (M ± SD)	.96 ± 0.2	.97 ± 0.2	.87 ± 0.3	.86 ± 0.4	.87 ± 0.3	.95 ± 0.2	.93 ± 0.3	.96 ± 0.2	.95 ± 0.2	.95 ± 0.2
Overall "accuracy" (total score out of 5) (M ± SD)	4.5 ± 0.8					4.7 ± 0.6				
Mean scores of agitation (M ± SEM)	1.4 ± 0.1	2.3 ± 0.1	1.6 ± 0.1	1.8 ± 0.1	2.8 ± 0.1	7.3 ± 0.1	2.9 ± 0.1	3.5 ± 0.1	6.0 ± 0.1	4.0 ± 0.2
Mean scores of appetite intensity (M ± SEM)	7.7 ± 0.01	7.6 ± 0.1	6.9 ± 0.1	6.6 ± 0.1	6.6 ± 0.1	1.6 ± 0.1	1.7 ± 0.1	1.8 ± 0.1	1.8 ± 0.1	1.7 ± 0.1

Table 4.2. Participant recognition scores for infants' interest and disinterest in eating and agitation and appetite intensity rating scores by video extract (N = 198). *Same baby for both extracts (start of the meal/end of the meal).

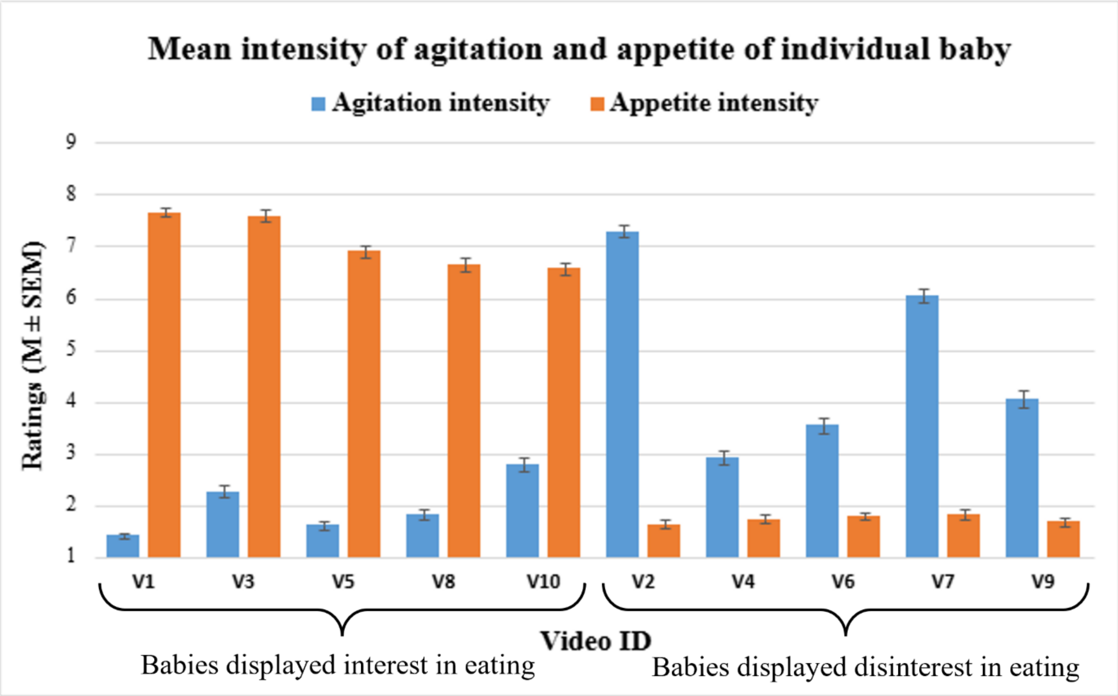


Figure 4.2. Mean ratings of infant agitation intensity and appetite by video extracts.

ANOVA revealed that no main effect of group (parenting status) on ratings of appetite and agitation. However, as predicted, appetite intensity was rated as significantly higher for the early stage of the meal compared to the later stage of the meal (showing greater interest in eating early on compared to later); and agitation was significantly higher during the later stage of eating compared to earlier (see Figure 4.2), and these ratings varied by video clip.

Qualitative data revealed that negative affect words were expressed more in response to the disinterest extracts than in the interest in eating extracts. Based on the ANEW tool (Bradley & Lang, 1999), participants were more likely to describe infants who were interested in eating with words scoring high in Valence and Arousal, such as "happy" and "laughter" (see Figure 4.3). Whereas to describe infants that were disinterested in eating, words scoring low on Valence and Arousal were most frequently used including "tired", "upset", "bored" and "unhappy" (see Figure 4.3).

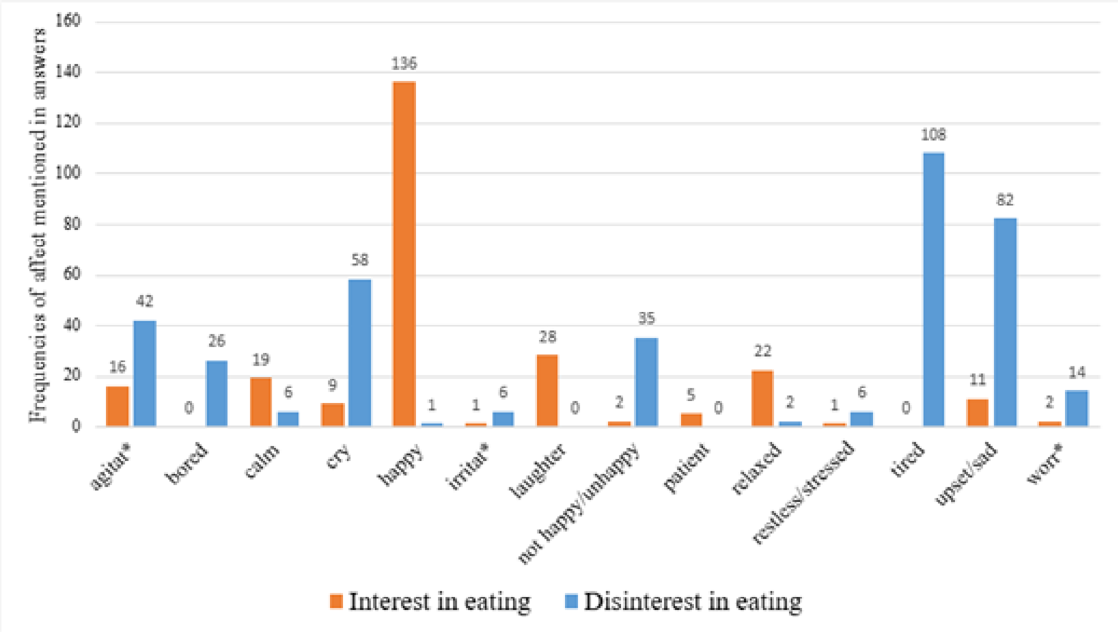


Figure 4.3. Frequencies of common affect words mentioned in response to the open-ended question. Agita* includes agitated, agitation; irritat* includes irritated, irritation; worr* includes worry, worried, worries.

There was a difference in descriptions of how infants behaved or appeared. For example, eight of 200 participants noted food on the face of the baby in V2: "*The baby is covered in food, he really does not want any*"; "*Baby looks grumpy and isn't in the mood to eat (although has clearly already had some food)*"; "*The baby has a lot of food around its mouth and seems to not want to eat the food offered*"; "*Baby crying, lot of food on face*". Most comments on this video extract referred to the affect of the baby, but the additional reference to the context of food on the face of the baby suggests either they do not like the food (a common description from participants) or that it was the end of a meal, and they did not want more (another frequent observation).

Also, compared to other video extracts, several participants struggled to determine whether the baby in V10 was interested or not in eating, by responding with "neither of these" or "I am not sure". In this case, ANOVA reported significant differences between participants with different parenting status. Individuals who had previous feeding experiences compared to those who didn't, and who had at least one child in their house compared to those who did not, were more likely to believe that this baby was interested in eating and give higher ratings on the appetite intensity. While they were also more likely to give a lower score on the agitation (see Appendix B1). Qualitative data supported that some participants thought the infant in V10 was relatively "*calm*" and "*relaxed*", "*did not seem to enjoy*", "*did not like the taste*", "*baby is not sure*" or "*baby gave mixed messages*". Participants were also able to capture other features of the babies. For example, some participants reported that they noticed babies in V4 and V9 "*look quite young*", "*too young for food*", or "*seems young and unsure of what they are expected to do with the food".*

4.3.3 Correlation results

Descriptive statistics of individual's appetite traits and wellbeing, in addition to internal reliability of measures included in the present study were summarised (see Appendix B2). An inverse correlation was observed between infant cue recognition scores and the RISE-Q15 subscale of Decreased Food Appeal (DFA, rho = -.15, p = .034). Higher recognition of infants' cues of interest/disinterest in eating was linked to the viewer's reliance on the decline in the pleasantness and attractiveness of food as the reason for stop eating. However, this was a weak association. No other significant correlations were found between recognition scores, BMI or any of the measures of satiety responsiveness or intuitive eating behaviours (see Table 4.3).

Subscales measuring sensitivity to satiation and intuitive eating behaviour were significantly correlated with each other (see Table 4.3), as would be expected. Participant's intuitive eating behaviour was significantly associated with their Satiety Responsiveness (r = .29, p < .001); and with RISE-Q15 Physical Satisfaction cues (PS, r = .47, p < .001) and RISE-Q15 Decreased Food Appeal (DFA r = .20, p = .006). In addition, there was a weak relationship between participant's BMI and their score on RISE-Q15 Decreased Food Appeal (DFA r = -.17, p = .04), but this too was a weak association.

	1. AEBQ-Satiety Responsiveness	2. RISE-Q15_Physical Satisfaction	3. RISE-Q15_Decreased Food Appeal	4. IES-2_Reliance on Hunger and Satiety Cues	5.BMI
Recognition score	-.12	.03	-.15*	.01	.03
1	-	.22**	.40**	.29**	-.08
2	-	-	.11	.47**	-.07
3	-	-	-	.20**	-.17*
4	-	-	-	-	-.10

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 4.3. Correlations between the recognition score for infant communication, appetite traits from the AEBQ, RISE-Q15, IES-2 and BMI (N = 198).

No association was found between recognition scores and any of the measures of trait anxiety, depression, or autistic spectrum symptoms (see Table 4.4). Participants' recognition scores were inversely correlated with Difficulty Describing Feelings from the TAS-20 which measured alexithymia traits (rho = -.15, *p* = .036), but this was a weak effect.

	1. TAS20-Difficulty describing Feelings	2. TAS20-Difficulty Identifying Feelings	3. Trait anxiety (STAI)	4. Trait depression (ST-DEP)	5. AQS – Routine + Social Skills
Recognition score	-.15*	-.12	.00	.01	-.01
1	-	.59**	.43**	.43**	.30**
2	-	-	.68**	.62**	.33**
3	-	-	-	.91**	.39**
4	-	-	-	-	.33**

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 4.4. Correlations between recognition score and psychological measurement of alexithymia subscales, state anxiety, state depression and Autism-Spectrum Quotient-Short form subscale (N = 198).

4.3.4 Generalised linear models

Most participants scored high on infant cue recognition (see Table 4.5). To explore factors that could be correlated with viewers' ability to recognise infant interest/disinterest in eating, participants who scored 7 and below were combined into one group (N = 11). Therefore, 4 groups of participants were identified (score “10”, “9”, “8”, “7 and below”).

Recognition Score	N (%)
10	105 (53.0)
9	58 (29.3)
8	22 (11.1)
7	7 (3.5)
6	2 (1.0)
5	2 (1.0)
Missing	2 (1.0)

Table 4.5. Participant’s infant cue recognition score of 10 video clips (N = 198). Two were missing due to a system error when scoring the video and this was reported by participants.

Ordinal Logistic Regressions were performed with 3 different models, to explore relationships between infant cue recognition and: 1) parenting or caregiving experience (i.e., participants with or without feeding experience, study or work with or without children, with or without children in the household); 2) BMI, sensitivity to satiation cues and intuitive eating; and 3) wellbeing traits. However, no associations were found.

4.4 Discussion

The present study investigated individuals’ general ability to recognise infant interest and disinterest in eating cues during mealtimes and whether recognition was associated with participant characteristics, such as parenting experience, BMI, eating traits, and psychological traits. Overall, there was high consensus on what infants were communicating during mealtimes in relation to interest and disinterest in eating cues. Infant cue recognition scores were weakly and inversely associated with alexithymia, and with one subscale of the RISE-Q15 namely Decreased Food Appeal. Participants rated infants displaying interest in eating cues as having lower levels of arousal than those displaying disinterest in eating. Similarly, it was demonstrated that interest in eating was linked with positive affect and disinterest with negative affect. Overall, participants characterised video extracts at the beginning of the meal as more positive, with less agitation than those filmed at the end of the meal.

As a potential learning resource, the video clips were limited by the lack of variability in participants' ability to recognise the infant appetite cues shown. Ideally, a responsive feeding resource would offer the opportunity to "learn" how to recognise hunger, appetite and satiation. However, the opportunity to acquire recognition was reduced by the ceiling effect of an already high consensus among participants, and by the lack of variability in infant cues, which were only recorded at the start and end of mealtime occasions. Recordings of more subtle and nuanced transition cues, capturing the gradual transition from interest to disinterest in eating filmed across the full duration of mealtimes may allow for greater variation in cue recognition and should be considered for future development and validation of responsive feeding resources.

As expected, measures of intuitive eating were associated with sensitivity to internally focused satiation processes. The more participants reported "tuning-in" to their satiety responsiveness, the more they relied on internal hunger and satiety cues to guide their own eating. This provides further support for a previous validation study in which an aggregated construct named "sensitivity to internal satiation cues" was identified (Chawner et al., 2022). It represents an individual's ability to detect and respond to their own internal sensations of hunger, appetite and satiation. However, in the present study these characteristics did not correlate with the participant's ability to identify infant appetite cues during mealtimes.

Results also showed that there was a good level of consensus in identifying infants' interest or disinterest in eating, but that recognition varied by video clips – by characteristics of the infant not the viewer - infant age, degree of expressiveness and temperament. In the video extracts, some infants appeared more expressive of desire to eat or reluctance to eat; whereas others were described through qualitative data, as "*calm*", "*quiet*" or "*less expressive*", and viewers reported this was "*more challenging*" to identify the infant communication. This could be due to different levels of hunger/satiety or to differences in temperament or eating traits (Llewellyn et al., 2010). Infant expressiveness will vary in the short term, for example as satiety develops and in the long term as communication skills develop. The contrast between affect and agitation ratings from the beginning to the end of a meal, supports the idea that as satiation develops, the transition to disinterest in eating is expressed through negative affect and more agitation. Thus, infants are expressing disinterest to caregivers if they are still offering food at this stage.

A potential explanation for the high consensus in recognising infant interest or disinterest in eating is that video extracts in our survey were chosen based on infants giving clear, typical and distinct appetite cues (hunger vs satiation cues). Whereas in real time, de-coding and translating infant cues may be challenging due to infant ambivalence or mixed hunger and satiety cues. For example, Price et al. (2012) reported that most mothers were able to recognise infant hunger cues including sucking on hands, fussiness and crying. Some mothers supplemented with formula after breastfeeding cessation due to perceived hunger cues immediately following, and they were unsure whether they should stop feeding or if the infant was still hungry. One mother said her baby gave hunger cues “even coming off a long time on the breast” so that she decided to offer formula afterwards (Price et al., 2012). In addition, the transition to disinterest in eating is more gradual and less obvious in real time, compared to the distinct extracts selected for this study.

Alexithymia was found associated with individual’s ability to recognise infant appetite cues. The greater difficulties an individual has in expressing their emotions and feelings, the less likely they were to recognise infant appetite cues. This suggests some parents with alexithymia might find infant hunger, appetite and satiation cues hard to distinguish. Similar results were reported in a longitudinal study whereby the more mothers were in tune with their child’s thoughts, desires and feelings, the more likely they were to provide sensitive and responsive parenting (Farrow & Blissett, 2014). Parent's tuning-in with their infant's needs was found to be predictive of more sensitive and responsive caregiving behaviours (Degotardi & Sweller, 2012; Li et al., 2014; Meins et al., 2001), rather than merely focusing on the act of feeding. Caregiver consideration of their infant's thoughts and intentions may directly promote the use of more responsive and engaged parenting at mealtimes, fostering a focus on their child's overall experience during feeding. Thus, elevated caregiver sensitivity may promote awareness of infant hunger and satiation cues and generate a more responsive feeding strategy.

Providing more structured mealtimes and responding to infant appetite cues, were associated with improved communication during mealtimes (Shloim, Rudolf, et al., 2015), but this must be paired with diets which are high in nutrients, such as vegetables, fruits and wholegrains to affect body weight (Perez-Escamilla et al., 2017). Also, differences in behavioural susceptibility to obesity (Llewellyn et al., 2023), temperament and eating traits (e.g., fussy eating) (Dovey et al., 2008) may affect infant expressiveness during mealtimes. On the other hand, there are other potential determinants that might be associated with caregiver's feeding practices, such as caregiver concern about child weight (Spill et al., 2019), the amount of food a child consumes (Pesch et al., 2016; Spill et al., 2019), children's general sleeping pattern (Murcia et al., 2019), and ecological factors including food security/insecurity (Berge et al., 2020). Responsive feeding interventions may change how infants are fed but do not necessarily change what and how much infants are fed (Hernandez et al., 2024).

In the present study, wellbeing and mental health status were associated, and except for one subscale from TAS-20, these measures were not related to infant cue recognition scores. This could be explained by the general population sample. Recruitment was not targeted at those with impaired interoceptive awareness, alexithymia, or depression, and therefore the sample of included participants with each of these characteristics was relatively low, limiting power to detect associations. Most importantly, based on the high “accuracy” in recognition, there was little variation in the current sample which may limit the opportunity to assess individual differences in recognition scores. Future studies could increase the sample size and include more participants with alexithymia (Yu et al., 2024) and could test the potential of these video clips as a learning resource for parents with alexithymia.

The strength of this study is that the video extracts were coded to ensure that infant interest and disinterest in eating were clearly discernible. However, there were limitations. First, video extracts included in our survey were not standardised by the age of the infant. Infants varied in age from 28 weeks to 39 weeks, younger infants were described as less expressive in the qualitative data. Compared to younger infants, older infants may be more able to provide clearer, or more recognisable, hunger and satiation cues, which in turn may be associated with patterns of mealtime interactions over time. Previous literature suggested that in early infancy, infant temperament has a significant impact on parental feeding practices (Schneider-Worthington et al., 2022). In our study, different infant characteristics were observed in video clips, but infant temperament was not measured. It is worth noting that infants in video clips were all offered age-appropriate solid food, namely vegetables. Overall, some recognition scores may have been affected by infant response to the vegetable, their age, stage, and tendency to be more or less expressive. Second, our video clips were sampled from the beginning and later stages of a meal where appetite cues were most obvious and clear. Extracts taken from across the meal might capture more nuanced changes in appetite during mealtimes, and offering other foods might alter cues expressed. Third, participant recognition of infant appetite cues was measured through the survey and these videos may perform better than the more subtle changes in cues which occur during real time. Finally, “clues” to the stage of the meal may have been given by food remaining on the face of the baby, an observation reported for V2 (disinterest). Though with infants this age, this could happen at any stage of the meal, when foods are either disliked or unfamiliar. Future studies might benefit from standardising across clips to ensure that this clue is not given. Our participant sample was predominantly white, female, and most had an annual household income over £25,000. Therefore, cautious interpretation is needed in generalising these findings to more diverse populations, such as lower-income households, or culturally diverse communities. Another limitation is that only 2 subscales from TAS-20 were included due to the exploratory nature of the study, this prevented an investigation of those with frank alexithymia using the cut-offs for the total scale. In addition, postnatal depression might also be associated with recognition of infant cues as it is known to affect responses to infant facial expression (Stein et al., 2010), but we did not measure this in our study. Instead, we measured state depression which had no link to recognition. Finally, this exploratory study relied on self-report and findings were correlational, future studies of real time, observed communication within an intervention trial may reveal mechanistic change, going beyond simple associations.

4.5 Conclusion

In summary, infant communication in this study was identifiable with a high level of accuracy with some variability in response according to infant viewed but less so by viewer. This was in line with an observational study conducted in a naturalistic setting, in which researchers suggested that observed child clarity of cues was not related to maternal sensitivity to cues or child temperament (Byrne et al., 2018). Potential associations between participant attributes and their recognition of infant appetite cues were only found for one subscale of alexithymia measurement. Overall, infant communication of their needs (desire to eat or not) was clearly recognised and this was true regardless of parenting status or the individual characteristics measured in this study. Further studies are needed to examine whether the ability to de-code or translate infant cues is consistent during early infancy, varies at different stages of the meal, and whether there are differences between breastfed and formula-fed infants. It is worth exploring the construct of alexithymia further and its impact on responsive feeding, to investigate potential determinants of responsive feeding practices and how caregivers respond to infant appetite cues in real life settings.

Chapter 5

Tuning in to affect and appetite in caregivers, and its association with recognising and responding to infant appetite cues

Chapter 5. Tuning in to affect and appetite in caregivers, and its association with recognising and responding to infant appetite cues

Abstract

Positive mealtime interactions shape infant eating patterns potentially promoting appetite regulation. This study investigated whether caregivers who “tune-in” to their own internal affect and appetite cues, can also recognise and respond to their infant's appetite cues via responsive feeding (RF). Caregivers (N = 445; mean age: 33.5 ± 4.7yr) with children aged 5-28m participated in an online survey in August 2023. Caregivers’ RF practices, mealtime emotions, eating traits, alexithymia (impaired capacity to identify and express emotions) and their infant’s eating traits were administered using validated questionnaires. Recent mealtime experiences were described through an open-ended question. Caregivers who relied on interoceptive cues in eating scored high on recognising infant appetite cues (R^2 = 0.11, F(1, 396) = 5.40, p < .001). Whereas caregivers with alexithymia reported poorer ability to recognise infant appetite cues (R^2 = 0.12, F(7, 399) = 7.53, p < .001) and less positive mealtime emotions (R^2 = 0.12, F(7, 399) = 7.49, p < .001) compared to those without alexithymia. Caregivers’ capacity to “tune-in” to their own internal satiation cues inversely mediated the relationship between caregivers’ alexithymia and their recognition of infant mealtime appetite cues. Infant eating traits (Food Responsiveness and Satiety Responsiveness) were associated with parental use of food to calm. Overall, RF was associated with mealtime emotions, parental ability to “tune-in” to their own affect (alexithymia) and appetite, and child’s appetitive traits. Developing caregiver’s awareness and responsiveness to their own and their child’s affect and appetite cues may promote RF practices

5.1 Introduction

Infant mealtimes involve the provision of nutritious foods and the opportunity for bidirectional communication between the caregiver and the child. Positive mealtime interactions relate to a number of environmental or social elements, such as mealtime settings, positioning, child participation or engagement, mealtime distractions, verbal communication during mealtimes, food provided, and parental responsiveness to child appetitive cues (Shloim, Rudolf, et al., 2015). It is demonstrated that infants are increasingly capable of communicating sophisticated appetitive cues, such as hunger and satiation (Hetherington, 2017). Being able to identify and then respond to a child's appetitive cues is important since positive mealtime interactions may influence which foods are eaten, how much the child eats, and the development of eating patterns (Daniels et al., 2009; Lakshman et al., 2015; Paul et al., 2014; van der Veek et al., 2019). In a longitudinal observational study, mothers who reported greater awareness of, and sensitivity to, infants' mental states (thoughts, feelings and desires), were more responsive and involved during feeding, than mothers who were less sensitive (Farrow & Blissett, 2014).

Parental sensitivity to infant cues may depend on the extent to which parents are able to recognise and respond to their own internal cues including affect and appetite. This ability varies in caregivers, and in some there is a reduced capacity to identify and express emotions and bodily sensations, known as alexithymia (Taylor, 1984). In clinical studies, patients with alexithymia showed an apparent inability to verbalise feelings, a reality-based concrete cognitive style, and impoverished inner emotional and fantasy lives (Taylor et al., 1991; Taylor et al., 1985). Previous research suggested that alexithymia is substantially a communicative disorder, which has been studied through the content analysis of speech, with alexithymic patients reported to use limited emotional vocabulary (Taylor, 1984). In a study that followed a structured clinical procedure and included free play observation, high maternal alexithymia was associated with higher depression and lower mother-infant relationship quality compared to low maternal alexithymia (Yürümez et al., 2014). Evidence from the FinnBrain Cohort study indicated that high maternal alexithymia scores were related to weak maternal sensitivity, and poor negative emotion regulation which were measured through video recorded mother–infant free play interaction in a laboratory setting (Ahrnberg et al., 2021).

In the appetite domain, The Trust Model originally proposed by Satter (1986) emphasizes the division of feeding responsibility between caregivers and children. Here responsive feeding (RF) practices that both recognise and respond promptly to a child's hunger and satiety cues, will promote their appetite regulation and may reduce obesity risk (Eneli et al., 2008). Parents who trust in their child's ability to "self-regulate food intake by recognizing hunger, appetite, and satiety cues within the context of regular eating patterns" (Eneli et al., 2008, p. 2179), will enhance self-regulation of appetite. In contrast, non-responsive feeding may impair the expression of internal satiation cues overriding the ability to self-regulate (Hurley et al., 2011).

Caregivers' feeding practices are influenced by both caregiver's characteristics such as body mass index (Shloim, Edelson, et al., 2015) and those of the child such as their weight status and appetitive traits (Moore et al., 2007; Webber et al., 2010). Twin studies demonstrate that parents feed their twin children differently depending on each child's eating behaviours (Farrow et al., 2009; Harris et al., 2016; Kininmonth, Herle, Tommerup, et al., 2023). Additionally, caregivers adapt their feeding practices in response to their children's appetitive traits. For example, Miller et al. (2020) found that non-responsive feeding practices, such as overt restriction and food reward, were adopted in response to children's avid appetite traits including Food Responsiveness and Emotional Overeating. Similarly, within the INSIGHT trial which assessed the sustained effects of a responsive parenting intervention, maternal feeding practices were modified by child eating traits (Ruggiero et al., 2021).

Eating traits have been aggregated and named "sensitivity to internal satiation cues", which indicate an ability to "tune in" to internal appetite cues in adults (Chawner et al., 2022). This construct reflects a general capacity to recognise and respond to internal satiation cues involving eating mindfully, attending to changes in physical satisfaction and food appeal during satiation development (Chawner et al., 2022), and is shown to be associated with intuitive eating which refers to an awareness and trust of internal hunger and satiety cues used to determine when and how much to eat (Tylka & Kroon Van Diest, 2013). The ability to recognise and respond to internal appetite cues may have implications for how mothers feed their infants and their motives to continue or to stop feeding in a single meal. Some mothers may encourage their child to exert control over food intake and they will stop feeding on noticing signs of disinterest or fullness (McNally et al., 2019). Similarly, parents may be aware that, for them, foods taste less pleasant as the meal progresses, and they may apply this to their infants by offering a variety of foods when disinterest in one food is observed (McNally et al., 2019).

To expand our understanding of how infant appetite cues are perceived, we previously investigated the role of individual differences. In response to video clips of infants demonstrating hunger and satiety cues, recognition was accurate but greater alexithymia scores were correlated with lower recognition of infant appetite cues (Yu, Birtill, et al., 2025). This online study indicated the need to explore alexithymia specifically in caregivers of young children, its association with RF practices and the experience of mealtimes at home, including affective tone during meals.

Therefore, the overall aim of the present investigation was to explore the extent to which caregivers' alexithymia, sensitivity towards their own satiation, in addition to their child's appetitive traits, predicted RF behaviours during mealtimes. Quantitative approaches were applied to investigate these dynamics, with a particular focus on integrating caregivers' lived experiences. There were four hypotheses (H1-H4):

H1 - Caregivers who score high on alexithymia will score low on self-reported RF practices and report fewer positive mealtime emotions compared to those with low scores on alexithymia.

H2 - Caregivers who have high scores on RF practices will also report more positive experiences of mealtimes, with fewer challenges and distress.

H3 - Caregivers who have higher sensitivity to their own internal satiation cues, who score high on intuitive eating and reasons to stop eating which are more interoceptive than contextual, will have higher responsiveness to their child as measured by high scores for sensitivity to their child's hunger and satiety cues during feeding.

H4 – RF will be predicted by the caregiver's own ability to recognise and respond to a) their own appetite cues, and b) to their child’s eating traits. Alexithymia will influence RF practices through reduced sensitivity to caregiver’s own appetite cues.

To explore how caregivers who score high on alexithymia report their mealtime experiences and emotions, and whether their communication of experiences is different from caregivers without alexithymia, a qualitative component was included to investigate the emotional tone and relational dynamics of caregiver-infant mealtime interactions, by analysing caregivers' reflections on their most recent feeding experiences.

5.2 Methods

5.2.1 Participants and design

In this study, we aimed to recruit 500 participants via the Prolific platform (https://www.prolific.co/).

The sample size was determined based on the prevalence of alexithymia in the general population, where around 10% of people having problematically high alexithymia (Luminet et al., 2018). To enable a sufficient sample of caregivers with alexithymia, we planned to recruit approximately 500 caregivers to reach a sample of 50 with clinical threshold alexithymia.

The inclusion criteria were UK residents aged 18 and above, fluent in English, have at least one infant between 6 to 24 months old in the household. Caregivers with twins or multiple birth children were welcome to participate. Caregivers with full-term infants with chronic, medical conditions which may affect feeding (e.g. neuro-developmental disorders), or caregivers with preterm infants, or those who failed the engagement and attention checks were excluded from the study. Participants were compensated via Prolific for their time.

The study protocol was pre-registered on the Open Science Framework (OSF): https://osf.io/5asn7/.

This study used both quantitative and qualitative data collection via Qualtrics (https://www.qualtrics.com/uk/). The study was advertised as "**Exploring emotions and communication during mealtimes**" with four sections which took approximately 12 minutes to complete. Section 1 consisted of general demographic questions including parenting status and child information. Section 2 consisted of measurements of caregiver and child appetite traits. Section 3 consisted of caregivers' self-reported RF practices, and their emotional responses experienced during family mealtimes. Section 4 consisted of measurements of caregivers' response to satiation cues, intuitive eating behaviour, and alexithymia.

The survey concluded with an open-ended question where caregivers were invited to provide detailed reflections on recent mealtime experiences, which could offer insights into the emotional and relational dynamics of feeding interactions. By capturing these narratives, the qualitative component enriched the study by complementing the quantitative findings, offering a deeper understanding of caregivers' lived experiences and the contextual factors that influence RF practices.

This study was approved by the University of Leeds School of Psychology Research Ethics Committee (Reference: PSCETHS-680).

5.2.2 Procedure

First, participants were informed about the study and invited to consent to participate (timeline is presented in Figure 5.1). Next participants completed the following: **Section 1** asked general demographic questions about the caregiver and their child(ren) in their household. Participants were asked to refer to one specific infant within the target age group (6 to 24 months old) to complete following sections (5 min). For twins or triplets, caregivers were asked to select one of their children for the purpose of this study. **Section 2** presented the Child Eating Behaviour Questionnaire for Toddlers, followed by the Adult Eating Behaviour Questionnaire (3 min). **Section 3** contained the Infant Feeding Questionnaire and the Mealtime Emotions Measure for Parents (4 min). In **Section 4,** participants were asked to complete the Reasons Individuals Stop Eating Questionnaire short version, the Intuitive Eating Scale 2, as well as the

20-item Toronto Alexithymia Scale (5 min). Questionnaire items were randomised within the sections.

This survey ended with an open-ended question: “Thinking of the last mealtime you had with your child, can you describe at what time of the day you fed them, how did you feed them, and how did you feel about the mealtime interaction?” Participants who submitted their questionnaire were thanked, paid and offered an opportunity to register their interest in future studies via a separate contact form.

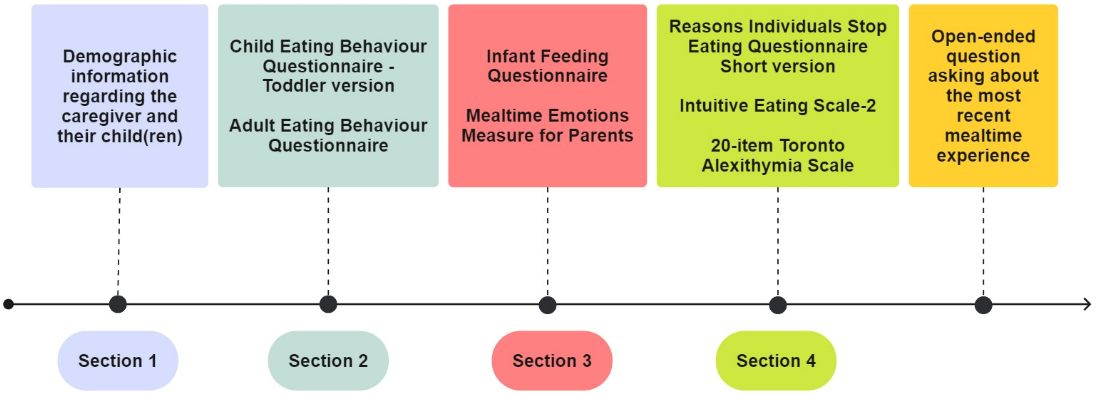


Figure 5.1. Timeline of study procedure following informed consent.

5.2.3 Measures

5.2.3.1 Responsive feeding practices

To measure caregivers’ self-reported RF practices, the Infant Feeding Questionnaire (IFQ) (Baughcum et al., 2001) was used. It is a tool with 20 items evaluating early feeding practices or beliefs that might lead to childhood obesity, originally used with infants aged between 11-23 months. It contains 7 constructs such as Awareness of Infant’s Hunger and Satiety Cues, Feeding Infant on a Schedule, Using Food to Calm, Infant’s Fussiness, Social Interaction during Feeding, in addition to constructs measuring caregivers’ concerns about infant hunger and weight. Caregivers rated items on a 5-point Likert scale e.g., "Did you worry that he was not eating enough?" from (0) Never to (4) Always. The rating scales for questions on feeding beliefs such as "He knew when he was hungry" were anchored from 0-disagree a lot to 4-agree a lot. Mean scores were calculated for each subscale.

5.2.3.2 Caregivers' emotions in typical family mealtimes

To capture how caregivers emotionally experience mealtimes with their family, the Mealtime Emotions Measure for Parents (MEM-P) (White et al., 2022) was used. MEM-P is a self-report tool with 3 constructs: Anxiety; Stress and Anger; and Efficacy to examine caregivers' emotional responses experienced during family mealtimes, adapted from the 13-item Mealtime Emotions Measure for Adolescents (White et al., 2015). For the MEM-P parents report frequency of recognising emotions, whether parents feel in control of their emotions, and their confidence in dealing with child distress. It contains 16 emotional responses on a 7-point Likert Scale (1 = Never to 7 = Always).

5.2.3.3 Alexithymia

To measure **alexithymia**, the 20-item Toronto Alexithymia Scale (TAS-20) (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994) was used. TAS-20 is a self-report measure of alexithymia containing three dimensions: Difficulty Identifying Feelings, Difficulty Describing Feelings, and Externally Oriented Thinking. It has 20 items and each of them is rated on a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). TAS-20 uses cut-off scoring with scores of 52–60 indicating potential alexithymia, and scores above 60 indicating present alexithymia. Therefore, the higher the individual scores, the more alexithymia traits are present, and the more certainty there is that the response reaches the clinical threshold for alexithymia.

5.2.3.4 Appetite traits

To assess **children's eating behaviour traits**, 5 subscales from the Child Eating behaviour Questionnaire for Toddlers (CEBQ-T) (Herle et al., 2016) were included. The CEBQ-T is a modified version especially for toddlers based on the validated and widely used Child Eating Behaviour Questionnaire (Jane Wardle et al., 2001). The CEBQ-T was originally developed with infants aged 18 months old. In this study, Food Responsiveness (FR, 4 items), Satiety Responsiveness (SR, 5 items), Slowness in Eating (SE, 4 items), Enjoyment of Food (EF, 4 items), and Food Fussiness (FF, 6 items) were included. In the CEBQ-T, FR measures parental perceptions of infant's responsiveness to food cues and external eating; such as "My child's always asking for food". SR measures items such as “My child gets full before his/her meal is finished”. SE consists of items that assess a child’s speed of eating. EF, in addition to FR, reflects eating in response to environmental food cues. FF measures the tendency to be highly selective about which foods are eaten. A 5-point Likert scale (1 = Never, 5 = Always) was used for caregivers to report how frequently their infant demonstrates these eating traits.

To measure **caregivers’ appetite traits**, 5 subscales from the Adult Eating Behaviour Questionnaire (AEBQ) (Hunot et al., 2016), which are parallel to child appetitive traits measurements, named Food Responsiveness (FR, 4 items), Enjoyment of Food (EF, 4 items), Satiety Responsiveness (SR, 4 items), Slowness in Eating (SE, 4 items) and Food Fussiness (FF, 5 items) were included. SR measures individuals’ sensitivity to feelings of fullness. Poor SR is linked to overeating and overweight. Items are asked such as “I often get full before my meal is finished”. Whereas FR indicates the respondent’s food approach and response to external food cues (“I often feel hungry when I am with someone who is eating”). Scores are anchored on a 5-point Likert scale ranging from (1) Strongly agree to (5) Strongly disagree.

To measure **intuitive eating behaviours**, a subscale from the Intuitive Eating Scale–2 (Tylka & Kroon Van Diest, 2013) named Reliance on Hunger and Satiety Cues was used. It contains 6 questions, such as “I rely on my fullness (satiety) signals to tell me when to stop eating”, with scores to each item on a 5-point Likert scale ranging from (1) Strongly disagree to (5) Strongly agree. The average score reflects individuals’ trust in their internal hunger and satiety cues and reliance on these cues to guide their eating behaviours.

To measure an individual’s **response to their own satiation cues**, the Reasons Individuals Stop Eating Questionnaire short version (RISE-Q15) (Chawner et al., 2022) was included. It contains 5 subscales (Decreased Food Appeal, Physical Satisfaction, Planned Amount, Self-Consciousness, and Decreased Priority of Eating) and each of them consists of 3 items, such as “my stomach is full”, “the food is no longer pleasant”, anchored on a 7-point frequency scale ranging from (1) Never to (7) Always. The average score represents a general capacity to recognise the reasons for stopping eating via internal and contextual cues, whereas the DFA and PS indicate an ability to respond to interoceptive cues.

5.2.4 Data analysis

5.2.4.1 Quantitative data

Firstly, we characterised our sample by using descriptive data on demographics of caregiver and then child. The age, gender and feeding methods for each child were recorded. Milk feeding during the first three months of life was recorded with six options: “a. Breastfeeding only”, “b. Mostly breastfeeding, with some formula-feeding”, “c. Equal amount of breastfeeding and formula-feeding”, “d. Mostly formula-feeding and some breastfeeding”, “e. Almost all formula-feeding” and “f. Formula-feeding only”. To help with the statistical analysis, responses were dichotomised into “Entirely or mostly breastfeeding” (a+b), or “Equally, entirely or mostly formula feeding” (c+d+e+f). Similarly, complementary feeding was reported from the following five options: “a. Exclusively spoon feeding”, “b. Mainly spoon feeding with some finger foods”, “c. A combination of spoon feeding and baby-led weaning”, “d. Mainly baby-led weaning with some spoon feeding”, “e. Exclusively baby-led weaning”. Responses were again subsequently grouped as “Exclusively or mostly spoon feeding” (a+b), “A combination of spoon feeding and baby-led weaning” (c), “Exclusively or mostly baby-led weaning” (d+e) (see Table 5.1).

To test H1 and H2, correlation analyses were conducted between individual’s alexithymia score, their RF practices, and their experienced family mealtime emotions. Due to the potential association between caregivers’ alexithymia and their ability to identify and report their mealtime emotions, only Efficacy from MEM-P was included in the corresponding analyses. It contains five items concerning mealtime experiences related to caregivers being prepared, comfortable, in control of their own emotions, and confident in dealing with any child distress. Next, hierarchical regression analyses were performed, with caregivers’ gender, age, education background, feeding method in the first 3-month of infant age, complementary feeding approach, infant gender, and infant age controlled in the corresponding models.

To test H3, correlation analyses were applied to investigate the association between caregivers' general appetite traits, their sensitivity to internal satiation cues, and caregivers' RF practices. Then hierarchical regression was conducted with a variety of measures regarding individual's responsiveness to satiation entered. Hunot et al. (2016) demonstrated that SR is a highly heritable and stable eating trait. Substantial evidence reported that intuitive eating is stable over a 3-week period (Tylka, 2006; Tylka & Kroon Van Diest, 2013; Tylka et al., 2024). Therefore, followed covariates in the regression, SR was added into Model 2, Reliance on Hunger and Satiety Cues was added into Model 3. RISE-Q15 measures individual's capacity to rely on their satiation to stop eating which might vary by meals (Chawner et al., 2022), Model 4 added Physical Satisfaction, followed by Decreased Food Appeal. Same covariates as H1 were controlled in the corresponding model.

To test H4a and H4b, multivariate multiple regression analysis was conducted to assess the relationship between parent-reported child appetitive traits and caregivers' RF practices. Confirmatory Factor Analysis (CFA) was performed to examine the latent variable Caregiver's Ability to Tune-in to Own Satiation Cues (with Reliance on Hunger and Satiety Cues, and Physical Satisfaction). To assess goodness of model fit, chi square/degree of freedom ($\chi 2/df$), the Comparison fit index (CFI ≥ 0.95), the Tucker-Lewis fit index (TLI ≥ 0.95), Root mean square error of approximation (RMSEA < 0.08) and Standardised root mean square residual (SRMR < 0.08) were used holistically. With the identified CFA model, Structural Equation Modelling (SEM) was further conducted to explore the impact of caregivers' alexithymia on their awareness of infant hunger and satiety cues through reduced ability to "tune in" to their own appetite cues. Composite Reliability (CR) and Average Variance Extracted (AVE) were calculated to assess the reliability and validity of the corresponding construct. Data were tidied and analysed via SPSS v29 and SPSS AMOS 29. Results were considered significant at $p < 0.05$.

5.2.4.2 Qualitative data

Responses to the open-ended question were collated from Qualtrics and uploaded to Microsoft Excel for Relational Content Analysis (Busch et al., 2005; Krippendorff, 2019), which explored the relationships among identified concepts in a text. Through Content Analysis, the study sought to identify key themes related to feeding timing, methods, and emotional aspects, and how these perceptions influenced their RF practices.

Firstly, responses were read and then analysed to identify recurring themes and patterns. In the second stage, the units of meaning and the set of categories for coding were defined to reflect the core aspects of mealtime interactions. Next, a set of rules for coding included organising the units of meaning into the previously defined categories. Lastly, the researcher (SY) coded the dataset then formulated themes, and summarised the qualitative data. Discrepancies were resolved through discussion with the other authors.

Based on participants' alexithymia scores measured by TAS-20, the cumulative percent indicated that the third tertile scored between 53 and 74. Therefore, the first tertile and the third tertile were identified as two subgroups, which allowed the exploration of the qualitative data between caregivers who scored high on alexithymia, compared to those who scored low on alexithymia. Binary coding was applied to the dataset. Participants scored 1 if their answers to the open-ended question contained descriptors of positive affect; and 0 if their answers did not contain any descriptors of positive affect. The same coding approach was applied with descriptors of negative affect. Moreover, participants scored 1 if they indicated responsive feeding practices such as allowing their child to take control over the spoon, caregivers' observation of child appetitive cues, feelings generated from mealtimes; participants scored 0 if they simply described the foods offered during mealtimes, or their answers did not contain the previous elements and showed an externally oriented thinking style.

Chi-square test of independence was applied to investigate if participants who scored high on alexithymia differed in reporting positive and/or negative affect, and mealtime interactions during feeding from those who scored low on alexithymia. Qualitative insights were used to contextualize and deepen the interpretation of the quantitative findings, emphasising how caregivers' emotional and relational dynamics during mealtimes influenced their responsive feeding behaviours.

5.3 Results

5.3.1 Participants

Overall, 445 eligible responses were received from caregivers (mean age: 33.5 ± 4.7yr, age range from 19 to 49yr). Participant characteristics are presented in the Table 5.1. Most were white, female and married. Most (41.3%) had been educated to degree level; and most had above average household income (https://www.ons.gov.uk/) Infants were mostly breastfed during the first three months (57%), using both spoon feeding and baby led weaning was most common (70%), mean age of infants was 16.5 ± 6.3 months (range: 5 to 28m), 53% of them were male. In our sample, 14.4% participants (N = 64) were identified as experiencing alexithymia according to the TAS-20 cut-off point.

Participant characteristics	N (%)
Gender	
Male	110 (24.7%)
Female	334 (75.1%)
Missing	1 (0.2%)
Age group	
18-24	8 (1.8%)
25-34	265 (59.6%)
35-44	163 (36.6%)
45-50	9 (2.0%)
Education	
Some high school or less	8 (1.8%)
High school diploma or equivalent (GED)	50 (11.2%)
Some college education	81 (18.2%)
Associate degree (AA) or vocational licence	25 (5.6%)
Bachelor's degree (BA, BS)	184 (41.3%)
Graduate or professional degree (MA, MSc, PhD, MD, JD)	94 (21.1%)
Prefer not to say	3 (0.7%)
Household income (average = £34,500, UK 2023[1])	
< £25,000	31 (7.0%)
£25,000 to £49,999	138 (31.0%)
£50,000 to £74,999	151(33.9%)
> £75,000	112 (25.2%)
Prefer not to say	13 (2.9%)
Marital status	
Single parent	21 (4.7%)
Co-habiting	163 (36.6%)

[1] Office for National Statistics, ONS https://www.ons.gov.uk/

Married	261 (58.7%)
Ethnicity	
Asian or Asian British	19 (4.3%)
Black or Black British	16 (3.6%)
White	403 (90.6%)
Any other groups	7 (1.6%)
Feeding method in the first 3 months	
Entirely or mostly breastfeeding	254 (57.1%)
Equally, entirely or mostly formula feeding	190 (42.7%)
Missing	1 (0.2%)
Complementary feeding approach in the first few months	
Exclusively or mostly spoon feeding	95 (21.3%)
A combination of spoon feeding and baby-led weaning	156 (35.1%)
Exclusively or mostly baby-led weaning	158 (35.5%)
Prefer not to say / Missing	36 (8.1%)
Feeding routine	
I fed my baby whenever they cried, got fussy or seemed hungry.	284 (63.8%)
My baby was fed on a flexible schedule (e.g. every 3-4 hr).	150 (33.7%)
My baby was fed on a rigid schedule (e.g. I woke them up to eat on time).	11 (2.5%)
Return to work before the baby was 6-month old	
Yes	65 (14.6%)
No	378 (84.9%)
Prefer not to say	2 (0.4%)
Alexithymia status	
Yes (score above 60 on TAS-20)	64 (14.4%)
No (score 0-60 on TAS-20)	381 (85.6%)
Infant gender	
Male	236 (53.0%)
Female	208 (46.7%)
Prefer not to say	1 (0.2%)

Table 5.1. Participant characteristics (N = 445).

5.3.2 Correlation analyses

Descriptive statistics of parental responsive feeding practices, mealtime emotions, individual's appetite traits and wellbeing, in addition to internal reliability of measures included in the present study were summarised (see Appendix C1). Individuals who scored high on Alexithymia were less likely to rely on internal satiation cues to guide their eating behaviours (r = -.18, $p < .001$ for Physical Satisfaction from RISE-Q15; r = -.20, $p < .001$ for Reliance on Hunger and Satiety Cues from IES-2), had high Decreased Food Appeal measured by RISE-Q15 (r = .21, $p < .001$, see Appendix C2); and low scores on awareness of infant hunger and satiety cues during mealtimes (r = -.30, $p < .001$, see Appendix C3). Moreover, associations were found between parent-reported child appetitive traits and caregivers' RF practices. For example, child appetitive traits were associated with parental concerns about infant undereating or overeating and weight status (see Appendix C4). Correlation analyses were conducted to examine the relationship between the caregiver's awareness of infant appetite cues during feeding (measured by IFQ-Awareness of Infant Hunger and Satiety Cues), positive mealtime emotions (measured by MEM-P-Efficacy), and a number of participant attributes and feeding methods (including caregivers' gender, age, education background, feeding method in the first 3m, complementary feeding approach, infant gender and age) to determine covariates in the following analysis (see Appendix C5). No correlations were found, however, participant attributes and feeding methods were controlled in the following regression analyses to avoid spurious relationships between variables.

In the present study, variables representing parental responsive feeding practices (such as parental awareness of infant appetite cues, feeding infant on a schedule, and parental using food to calm) were selected to enter the regression analyses based on individual hypothesis, internal reliability check and correlation results.

5.3.3 Hierarchical Regression analyses

To test the first hypotheses, two hierarchical regressions were conducted separately to explore the relationships between caregiver alexithymia and their awareness of infant's hunger and satiety cues, and positive emotions during mealtimes. Caregivers' gender, age, education background, feeding method in the first 3m, complementary feeding approach, infant gender, and infant age were controlled for in both regressions. After controlling for covariates, alexithymia significantly predicted caregivers' awareness of infant hunger and satiety cues, $R^2 = 0.12$, $F(7, 399) = 7.53$, $p < .001$ (see Appendix C6). In the second regression model, caregivers' alexithymia remained predictive of their mealtime positive emotions after controlling for covariates, $R^2 = 0.12$, $F(7, 399) = 7.49$, $p < .001$ (see Appendix C7).

Hierarchical regression was also used to test the second hypothesis, that RF practices will be associated with more positive experiences of mealtimes. In addition to the covariates included previously, caregivers' alexithymia score was added to Model 2. Three subscales from the IFQ were included to capture RF practices: Awareness of Infant's Hunger and Satiety Cues, Feeding Infant on a Schedule, and Using Food to Calm Infant's Fussiness. Awareness of infant's Hunger and Satiety Cues was associated with caregivers' positive mealtimes emotions ($b_{Awareness} = 0.71$, $p < .001$). Using Food to Calm Infant's Fussiness was inversely associated with positive mealtime emotions ($b_{Fussiness} = -0.14$, $p = .019$). After controlling for covariates and caregiver's alexithymia (Model 2 in the Table 2), caregiver's Awareness of Infant Hunger and Satiety Cues remained predictive of their positive mealtime emotions ($b_{Awareness} = 0.56$, $p < .001$) but Using Food to Calm was no longer significant in Model 2. Caregiver's Awareness of Infant Hunger and Satiety Cues, in addition to alexithymia, explained a significant proportion of variance in their positive mealtime emotions ($R^2 = 0.19$, $F(8, 396) = 9.71$, $p < .001$) (see Table 5.2).

	Model 1		Model 2	
Variable	B [SE]	β	B [SE]	β
Constant	2.69 [0.49]		4.17 [0.78]	
IFQ – Awareness of Infant Hunger and Satiety Cues	0.71 [0.09]	0.37***	0.56 [0.09]	0.29***
IFQ – Feeding Infant on a Schedule	-0.04 [0.10]	-0.02	-0.02 [0.10]	-0.01
IFQ – Using Food to Calm Infant's Fussiness	-0.14 [0.06]	-0.11*	-0.10 [0.06]	-0.08
Caregiver's gender			-0.19 [0.11]	-0.08
Caregiver's age			0.00 [0.01]	-0.01
Caregiver's education			0.03 [0.04]	0.04
Infant gender			0.10 [0.10]	0.04
Infant age			0.00 [0.01]	0.00
Feeding method in the first 3m			0.10 [0.11]	0.05
Complementary feeding approach			0.07 [0.07]	0.05
Caregiver's alexithymia			-0.02 [0.01]	-0.24***
R^2	0.14		0.19	
F	23.48***		9.71***	
ΔR^2			0.06	
ΔF			4.02***	

Note: N = 408. SE = Standard Error

*p<.05; **p<.01; ***p<.001

Table 5.2. Hierarchical Linear Regression reporting predictors of caregivers' positive emotions during mealtimes.

Hierarchical regression was used to test the third hypothesis, that higher caregiver sensitivity to their own internal satiation cues, higher intuitive eating and interoceptive reasons for eating cessation are associated with higher sensitivity to infant hunger and satiety cues during mealtimes. Same covariates as hypothesis 1 were included. Overall, Model 5 accounted for approximately 11% of the variance in caregivers' Awareness of Infant Hunger and Satiety Cues, $F(1, 396) = 5.40$, $p < .001$. The addition of Decreased Food Appeal did not account for a significant increase in Model 5, $\Delta F(1, 396) = 1.06$, $p = .305$, but caregivers' Satiety Responsiveness, intuitive eating, Physical Satisfaction and their gender were predictive of their Awareness of Infant's Hunger and

Satiety Cues. In summary, mothers who are more tuning into their internal satiation cues and intuitive, who rely more on gastric fullness to guide their eating behaviours, are more likely to recognise their infant's hunger and satiety cues during mealtimes and respond accordingly (see Table 5.3).

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	B [SE]	β	B [SE]	β	B [SE]	β	B [SE]	β	B [SE]	β
Constant	3.78 [0.30]		3.87 [0.31]		3.03 [0.34]		2.86 [0.34]		2.90 [0.34]	
Caregiver's gender	0.10 [0.06]	0.09	0.12 [0.06]	0.10	0.15 [0.06]	0.12*	0.13 [0.06]	0.11*	0.13 [0.06]	0.11*
Caregiver's age	0.00 [0.01]	0.00	0.00 [0.01]	0.00	0.00 [0.01]	0.02	0.00 [0.01]	0.02	0.00 [0.01]	0.01
Caregiver's education	-0.02 [0.02]	-0.04	-0.02 [0.02]	-0.05	-0.02 [0.02]	-0.05	-0.02 [0.02]	-0.05	-0.02 [0.02]	-0.05
Infant gender	0.05 [0.06]	0.04	0.05 [0.06]	0.04	0.03 [0.06]	0.03	0.02 [0.05]	0.02	0.02 [0.05]	0.02
Infant age	0.00 [0.01]	0.04	0.00 [0.01]	0.04	0.00 [0.01]	0.03	0.00 [0.00]	0.03	0.00 [0.00]	0.03
Feeding method in the first 3m	0.06 [0.06]	0.06	0.07 [0.06]	0.06	0.08 [0.06]	0.07	0.08 [0.06]	0.07	0.08 [0.06]	0.07
Complementary feeding approach	0.02 [0.04]	0.02	0.01 [0.04]	0.02	0.03 [0.04]	0.04	0.02 [0.04]	0.02	0.02 [0.04]	0.03
AEBQ – SR			-0.04 [0.04]	-0.05	-0.06 [0.04]	-0.09	-0.09 [0.04]	-0.13**	-0.08 [0.04]	-0.11*
IES2 – RHSC					0.20 [0.04]	0.26***	0.14 [0.04]	0.18***	0.13 [0.04]	0.17**
RISE-Q15 – PS							0.12 [0.03]	0.24***	0.12 [0.03]	0.24***
RISE-Q15 – DFA									-0.03 [0.03]	-0.05
R^2	0.00		0.00		0.06		0.11		0.11	
F	1.01		1.01		4.01***		5.83***		5.40***	
ΔR^2			0.00		0.06		0.05		0.00	
ΔF			1.02		27.45***		20.50***		1.06	

Note: N = 408. SE = Standard Error

**p*<.05; ***p*<.01; ****p*<.001

Table 5.3. Hierarchical Linear Regression reporting predictors of caregivers' Awareness of Infant Hunger and Satiety Cues during mealtimes.

Multivariate multiple regression was used to examine the fourth hypotheses, that caregivers' RF practices measured by IFQ - Feeding Infant on a Schedule, and IFQ - Using Food to Calm Infant's Fussiness were associated with caregivers' eating traits, and with their child appetitive traits. Covariates were the same as H1. Results showed that CEBQ-T measured child FR and SR, but not FF, were predictive of caregivers' using food to calm (see Appendix C8). Feeding method in the first 3-month of infancy was associated with caregivers' using food to calm (b = -0.42, $p < .001$). Complementary feeding approach in the first few months was related to caregivers' using food to calm, but the relationship was weak (b = 0.12, $p =.037$). No significant associations were found between caregivers' SR, intuitive eating and interoceptive reasons to stop eating and their Feeding Infant on a Schedule, or their Using Food to Calm Infant's Fussiness (data not shown). No relationship was found between child appetitive traits and caregiver's Feeding Infant on a Schedule (data not shown).

5.3.4 Structural Equation Modelling

To explore the association between caregivers' alexithymia and their awareness of infant's hunger and satiety cues through reduced sensitivity to their own appetite cues, confirmatory factor analysis (CFA) was performed to examine the latent variable "caregiver's ability to tune-in to own satiation cues" which consisted of Reliance on Hunger and Satiety Cues from IES-2, and Physical Satisfaction from RISE-Q15. Structural equation modelling (SEM) was conducted to examine the relationship between variables proposed in the model (see Figure 5.2).

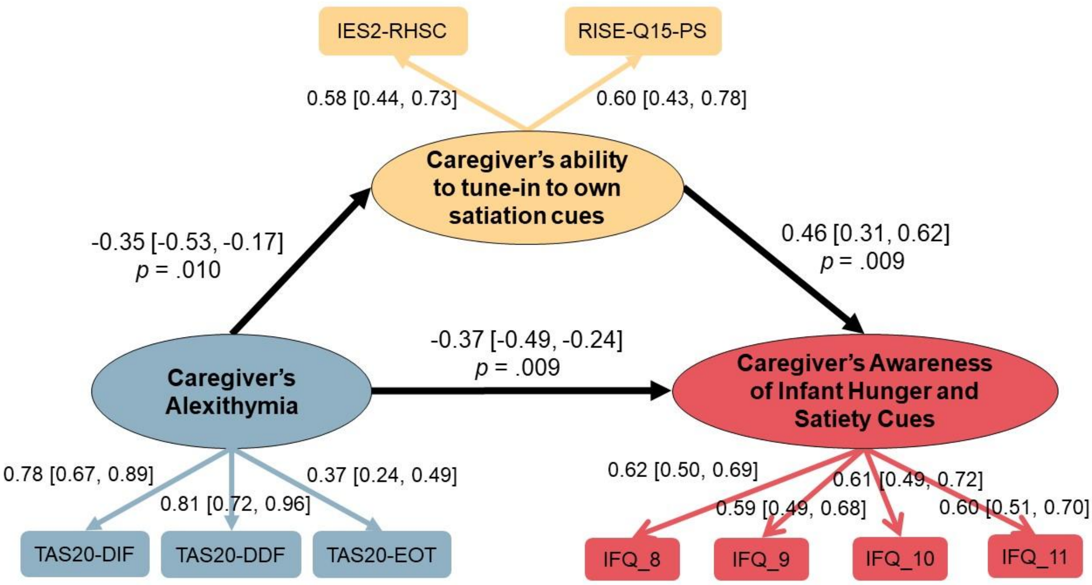


Figure 5.2. SEM model testing the structure of relationships between caregiver's alexithymia, ability to tune-in to internal satiation cues and their awareness of infant hunger and satiety cues during mealtimes. Standardised estimates are reported with bias-corrected bootstrapped confidence intervals.

SEM results demonstrated the partial mediation with standardised beta coefficients reported for the factor loadings onto latent variables and the relationships between each variable. All factor loadings onto latent variables were significant ($p < .001$). Overall model fit using the robust estimator was good ($\chi 2$ (df = 24) = 54.15, $p < 0.001$, CFI = 0.96, TFI = 0.94, RMSEA = 0.05). However, the CR value fell below the threshold of 0.6 (CR = 0.52) (Bagozzi & Yi, 1988), and the latent variable explained 35% of the variance (AVE = 0.35). Caregiver's alexithymia has an inverse association with their ability to tune in to their own internal satiation cues, as well as their Awareness of Infant Hunger and Satiety Cues during mealtimes (r = -0.35, p = .01; r = -0.37, p = .009 respectively). Positive relationship was observed between caregiver's ability to tune-in to own satiation cues and their ability to recognise infant hunger and satiety cues (r = 0.46, p = .009).

5.3.5 Qualitative data

Descriptions of a single, most recent mealtime interaction were analysed and content collated into frequently used themes and topics. From relational content analysis four themes were identified and are summarised below.

5.3.5.1 Affect

The affective tone of the comments was generally positive, with descriptions such as "*happy*", "*relaxed*", "*pleasant/pleased*", "*fun*", "*calm*", the caregiver-infant dyad "*enjoyed*" the mealtime or their infant "*enjoyed*" the food, with "*happy"* being the most frequently mentioned descriptor. Negative affect was also captured. Some parents described feelings of "*frustration*" or "*pressure*", arising from "*child being fussy*", a lack of eating or food refusal, or child mealtime behaviours including "*screaming*", "*throw foods*", "*won't sit in the highchair*" or "*act up at times*". Other negative descriptors included "*stress*" due to "*meal preparation*" or "*concerns of choking*".

5.3.5.2 Infant appetite cues

Participants reported a variety of behavioural and verbal signs indicating that their infant's interest or disinterest in eating. Infants expressed interest in eating with "*yummy*" or vocalisation, and "*done*" or scream for satiation. Some parents described that their child "*reached*" or "*picked up*" foods, "*leaned in*", "*opened mouth*", and "*woke up with cries*" to show hunger. On the contrary, children "*refused the food/spoon*", "*threw/played with foods*", "*closed mouth*" or "*waved hands*", and "*tried to escape from the highchair*" when they were full. A small number of mixed behaviours signs were observed by participants. For example, a caregiver reported "*my child was still moaning so I offered more foods which was refused*"; whereas some children "*seemed more interested in playing despite clearly still wanting food, for example subsequently finishing the food*". Moreover, participants' RF practices were captured through comments indicating parental awareness of their child's appetite cues, such as "*I feel like he knew he was full*", "*my daughter feeds on demand*", and "*I won't force him to eat if he isn't hungry or interested in the food".*

5.3.5.3 Feeding methods

Spoon-fed and baby-led weaning were both observed in the sample. Some caregivers offered control to their child, encouraging them to feed themselves because they "*like the child to have control over what he eats*" or "*enjoy leaving her to eat at her own pace*". They believe that this is "*completely developmental*", allows their child to "*feel and play with foods"* and "*explore their meals*". Some caregivers reported that they were "*spoon feeding initially then the child took over*". In thinking of the use of spoons, a few caregivers stated that their child is self-fed but "*if I offer to spoon feed, she'll eat more*" or "*I wanted her to eat more*". In this case, the spoon is used as means to ensure more food is consumed, in addition to self-feeding.

Participants mentioned they enjoyed "*sitting/eating as a family*" and they would "*share same food*" during mealtimes. The variety and nutritional value of foods were noted by parents, offering "*a selection of foods*" and that they would "*feel guilty*" if it was not nutritious enough or not home-made. Participants reported that they actively encouraged their child to eat or try new foods (e.g., "*he didn't eat a lot of it, but he did try all the food so that pleased me*).

5.3.5.4 Mealtime environment and interactions

Parental reflections on the feeding environment and mealtime interactions were well represented within the qualitative data. For example, participants mentioned they valued the time that they could "*spend together as a family*", especially *after work;* that they enjoyed "*watching*" or "*observing*" their child during mealtimes. Different approaches were discussed to enhance verbal communication and connection during meals ("*chat about our day/things around*", "*try to make him laugh*" and "*sing*"). Self-reflections on positive interactions and parental intention to improve child engagement during mealtimes were observed, such as *"I find it really relaxing to take that time to focus on nothing else but my daughter*". Notably, qualitative data revealed various feeding environment. Some caregivers intended to make mealtime interactive and fun "with nursery rhymes", while some caregivers reported their experiences with TV (e.g., "*she was distracted by the TV which helps her eat more sometimes*", "*we didn't interact much because we were watching TV*"). A number of caregivers illustrated the desire of distraction-free mealtimes so their child can focus on the meal (e.g., "*I turned the TV off so there were no distractions for us both*"). Overall, caregivers expected and enjoyed good interactions during mealtimes, even if they were aware of "*the mess*" their infant would create through eating and the "*clean-up*" afterwards.

The chi-square test of independence revealed that there was no significant association between two groups of participants and their use of positive affect (χ^2 (1, N = 320) = 2.67, p = .103), or negative affect (χ^2 (1, N = 320) = 1.95, p = .163) in describing their most recent mealtime experiences, or their self-reported mealtime interactions regarding caregivers being responsive during feeding (χ^2 (1, N = 320) = 1.65, p = .199).

5.4 Discussion

This study investigated the relationships between caregiver attributes including alexithymia, sensitivity towards own satiation cues, and child appetitive traits with caregivers' mealtime emotions and responsive feeding (RF) practices. Our first hypothesis was supported, indicating higher caregiver alexithymia scores were associated with fewer RF practices and less positive mealtime experiences. Partial support for the second hypothesis indicated that greater awareness of infant hunger and satiety cues (but not other aspects of RF practices) was associated with more positive mealtime experiences. The third hypothesis was again supported with results indicating caregiver satiety responsiveness, intuitive eating and physical satisfaction, all associated with their awareness of infant hunger and satiety cues during mealtimes. Finally, partial support was found for hypothesis four with child appetitive traits (higher food responsiveness and higher satiety responsiveness) positively associated with caregiver using food to calm their infant but not feeding on a schedule. These findings supported the proposal that caregivers who were more responsive during mealtimes, were more likely to experience positive emotions during meals. However, caregivers who scored high on alexithymia reported lower levels of being responsive in feeding, in addition to fewer positive mealtime emotions, compared to those who score low on alexithymia.

SEM results suggested that alexithymia was associated with reduced caregivers' awareness of infant's hunger and satiety cues via reduced sensitivity to caregivers' own appetite cues. Caregivers who scored high on alexithymia were less likely to recognise and attend to their infant's appetite cues during feeding; meanwhile, this inverse association was related to caregivers' reduced ability to recognise and respond ("tune in") to their own satiation cues. This finding supports the proposal that alexithymia is a general deficit of interoception, including non-affective interoceptive states (Brewer et al., 2016).

The ability to recognise both affective and non-affective cues is particularly important serving as the basis to respond to another's needs (Brewer et al., 2016). An impaired ability to "decode" infant cues may relate to overall RF practices. For example, parents may apply non-responsive feeding practices such as coercive strategies if they are concerned that their child is not eating enough (Birch et al., 1991).

The present SEM results, such as the CR value and AVE value, also revealed that the reliability of the proposed construct, named "Caregivers' Ability to Tune-in to Their Own Internal Satiation Cues" needs to be interpreted with caution and could be improved. This may be due to Reliance on Hunger and Satiety Cues from the intuitive eating measurement and Physical Satisfaction from RISE-Q15 were measuring different aspects of individual's sensitivity to their interoception. Additionally, Reliance on Hunger and Satiety Cues is a trait that is stable for over 3-week period (Tylka, 2006; Tylka & Kroon Van Diest, 2013; Tylka et al., 2024). Whereas Physical Satisfaction from the RISE-Q15 reflects an individual's response to satiation during a typical eating episode and a tendency towards eating cessation for reasons of gastric fullness (e.g., "I stop eating at a typical dinner meal at home because my stomach is full"). Moreover, the results relied on participants' self-reported answers. The reliability of the proposed construct could be improved by including more objective measures, for example, laboratory assessments of appetite responses.

Caregivers of infants with high Food Responsiveness (FR) and high Satiety Responsiveness (SR) were more likely to use food to soothe compared to those whose children scored lower on FR and SR, partially supporting findings from previous observational and intervention studies that eating traits indicating an avid appetite were associated with less responsive maternal feeding practices (Daniels et al., 2014; Morrison et al., 2013; Rodgers et al., 2013). The bidirectional association between parental feeding practices and child eating behaviours revealed that parental feeding practices were not simply a predictor or a consequence of certain child appetitive traits (Costa & Oliveira, 2023). For example, high infant FR was associated with increased parental use of food to control children's behaviours (Edwards et al., 2024; Kininmonth, Herle, Haycraft, et al., 2023). Researchers from the longitudinal Gemini cohort study reported that non-responsive feeding practices including coercive feeding or parental over-control may undermine their child's capacity to identify their internal hunger and satiety cues (Kininmonth, Herle, Haycraft, et al., 2023). Our findings indicated that less desirable feeding practices were used in a home setting as a response to infants displaying higher levels of FR and SR.

Existing literature demonstrates that mothers need to assign intent to their child's signals and to interpret them in a timely and accurate way so that their response is both sensitive and appropriate (Farrow & Blissett, 2014; Meins, 1999). The importance of interactions in shared family mealtimes, involving verbal language and body language has been reported by Van der Heijden and Wiggins (2025), which is associated with what, when and how much caregivers and their children eat. Caregivers who "tune in" to their child expressing needs, satisfy their child and provide healthy interaction, rather than merely focusing on the act of feeding.

Participants with higher alexithymia scores did not differ from those with lower alexithymia scores in frequency of reported positive or negative affect or indicators of responsive feeding when describing their mealtime experiences. This may be because although participants with higher alexithymia scores may have differed in their general ability to identify and express their emotions and feelings, the open-ended question specifically asked "how did you feel" as a clear prompt. The binary coding only indicated whether or not they were aware of their affect during the given feeding occasion, rather than to what extent they were good at identifying and describing their emotions and feelings (i.e., alexithymia). However, multiple approaches to enhance mealtime interactions were recorded in our qualitative data, such as less environmental distraction, verbal communication during feeding, and increasing child involvement in food preparation or the family meal. This supported the finding from an earlier observational study that having mealtime structure might be an effective strategy to promote parental role modelling healthy eating and reduce child fussy eating (Powell et al., 2017). The acknowledgement of the bi-directional interaction between caregiver-infant dyad during feeding could contribute to the development of tailored interventions and healthier feeding guidance (Moore et al., 2007; Webber et al., 2010). These findings have highlighted the importance of caregiver's capacity to understand the intention underlying infant appetite cues so they could offer prompt, contingent and appropriate response to their infant. In addition, the results demonstrated the association between caregiver's ability to tune in to own satiation cues and their recognition of infant hunger and satiety cues, specifically highlighting the negative impact from caregiver's alexithymia on RF practices. The present study suggested that strategies to enhance caregiver's awareness and responsiveness to infant affect and appetite may improve RF practices and healthy mealtime interactions.

5.5 Strengths and limitations

One strength of this study was its size, and so is the first study appropriately powered to explore the associations between caregiver's RF practices, caregiver's psychological attributes including tune-in to internal satiation cues, alexithymia, and mealtime emotions. Another strength is the inclusion of an open-ended question about mealtimes, which permitted additional insight beyond the quantitative measures regarding the tone and content of feeding experiences thorough the freedom to report any aspect of mealtime interactions. This then added context to the quantitative measures of RF. The inclusion of TAS-20 enabled further analyses of alexithymia within the sub-group. Moreover, good internal association observed between caregivers' SR, intuitive eating, and satiation response provided evidence to support the identified aggregated construct which represents an individual's "sensitivity to internal satiation cues" in prior research (Chawner et al., 2022).

However, the study is limited by its single “snapshot” of a mealtime and a lack of representativeness of the sample. Additionally, with reliance on self-report, combined with time constraints and large sample size, it was not possible to ask participants to film their feeding practices at home to support their response to the open-ended question. This prevented a validation on self-reported measures of responsiveness to infant appetite cues with observational evidence (Bergmeier et al., 2015), which might introduce recall-bias in describing the mealtime interactions. Another limitation lies in the nature of the online survey where researchers rely on participants being genuine and honest. In addition, the EOT scale from TAS-20 reported low internal consistency (Cronbach’s alpha = .47, see Appendix C1). In the original validation study, the Cronbach’s alpha value of EOT was .66, .60, .52, and .65 respectively (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994). Kooiman et al. (2002) also reported in a critical review of the literature and a psychometric study of the TAS-20 that the Cronbach’s alpha of EOT ranged from .45 to .76 in most studies. Overall, the total scores of TAS-20 were used in the statistical analysis, but the low internal consistency of EOT still needs to be interpreted with caution. Finally, caregivers' autism spectrum disorder, depression, or other mental health conditions that are known to be more prevalent in individuals with alexithymia were not assessed in the present study.

5.6 Conclusion

Caregivers with high scores on alexithymia reported fewer RF practices and experienced less positive mealtime emotions, compared to those with low scores on alexithymia. Positive mealtime emotions were observed among caregivers scoring high on RF practices. Mothers who were “in-tune” with their own internal satiation cues, were more likely to recognise their infant hunger and satiety cues during feeding, than those who were less responsive to internal cues. Overall, caregivers were more likely to use food to calm in response to their child displaying high SR and FR. Most importantly, alexithymia was associated with caregivers’ awareness of their infant’s hunger and satiety cues during feeding through reduced awareness of their own internal appetite cues. Future studies could investigate the barriers for caregivers with alexithymia to apply RF practices, and how caregivers could be supported to help children to develop healthy eating behaviours (Saltzman et al., 2018) in addition to positive mealtime experiences.

Chapter 6

"It feels like we have tried everything!" - a follow-up qualitative study on mealtime experiences with parents with high levels of alexithymia

Chapter 6. “It feels like we have tried everything!” - a follow-up qualitative study on mealtime experiences with parents with high levels of alexithymia

Abstract

Alexithymia refers to a general deficit in interoception whereby individuals struggle to identify and describe emotions and feelings and exhibit an externally oriented thinking style. In our previous research, high caregivers' alexithymia scores were associated with poor awareness of infant hunger and satiety cues during feeding. The present study aimed to explore mealtime emotions, parental sensitivity, and feeding practices of caregivers who scored high for alexithymia. A qualitative study was conducted using one-to-one semi-structured, video-elicited interviews, with participants selected based on their scores on the 20-item Toronto Alexithymia Scale (TAS-20, mean: 59.4 ± 5.4, range from 53 to 74) from a previous study. Overall, 12 mothers and 2 fathers of children aged 18-36 months (mean age = 26 ± 7m; 7 boys, 7 girls) completed the interview, including discussion of a mealtime reported one year earlier and of a recently filmed typical mealtime interaction. Reflexive thematic analysis revealed that participants perceived mealtimes as more than feeding, as an important social activity. Participants reflected on specific challenges such as their child's food sensory needs but felt that feeding resources were unhelpful. Multiple coping strategies were described as a means of “doing their best”. Progress with feeding was both reported and noticed during observations of the video-clips. In conclusion, caregivers with high alexithymia scores described mealtimes as challenging, adopting a variety of ways to meet feeding challenges and adapting to their child’s appetite cues as they grew. Caregivers with high levels of alexithymia may benefit from tailored responsive feeding support beyond generic feeding guidelines to improve their mealtime experience.

6.1 Introduction

During early life, infants express a variety of behavioural and affective cues to their mothers to signal nutritional needs, such as hunger cries, orientation towards the breast, mouthing, agitation and distress (Hetherington, 2017). Responsive feeding (RF) requires sensitive parenting, which involves caregivers providing a prompt, emotionally supportive, contingent, and developmentally appropriate response to their child's hunger and satiety cues (Black & Aboud, 2011). Mealtime interactions are bidirectional with infants encouraged to communicate their needs, which prompts a response by parents which in turn contributes to healthy appetite regulation (Black & Aboud, 2011). Appetite regulation in infancy has the potential to promote a healthy weight gain trajectory and reduced risk of childhood obesity (Eneli et al., 2008; Redsell et al., 2021). However, the ways in which parents interpret their child's cues and communications might be determined by multiple external components or internal attributes of both the caregiver and their child (Satter, 1995). For example, feeding practices could be influenced by caregivers' body mass index (Shloim, Edelson, et al., 2015), or child's weight status and appetitive traits (Moore et al., 2007; Webber et al., 2010). Results from a discordant twin study using data from the British Gemini birth cohort showed that mothers appeared to adapt their feeding strategies according to their children's eating behaviours, with higher child "Food Fussiness" significantly associated with more maternal pressure to eat and instrumental feeding practices (Harris et al., 2016). In a longitudinal randomised controlled trial of Australian families, non-responsive feeding practices such as using food as a reward and persuasive feeding at child age 2 years were prospectively positively associated with child emotional overeating at 3.7 years (Jansen et al., 2015).

One characteristic of caregivers which may affect their capacity to apply RF practices is alexithymia. The construct of alexithymia is defined as a stable trait that relates to an individual's reduced capacity to identify and describe emotions and bodily sensations, in addition to a constrained imaginary life (Taylor, 1984). In clinical studies, participants with alexithymia report problems in verbalising emotions and feelings, and having an impoverished inner emotional life (Taylor et al., 1991; Taylor et al., 1985). Content analysis of speech revealed that individuals with alexithymia show limited use of emotional vocabulary, suggesting the presence of a communicative problem (Taylor, 1984). Alexithymia presents as a general deficit of interoception which involves difficulties processing non-affective interoceptive cues including hunger, arousal, and fatigue (Brewer et al., 2016). Given that RF relies on caregivers' appropriate recognition and response to infant appetite cues, this interoceptive deficit may compromise caregivers' responsiveness.

An individual's ability to recognise both affective and non-affective cues is particularly important since it serves a fundamental feature of being able to respond to the needs of others (Brewer et al., 2016). In the feeding context, caregivers might struggle to offer timely and appropriate responses to their child's needs linked to limited recognition of child cues and communications (de Cock et al., 2016). Results from a free play observation indicated high maternal alexithymia was associated with maternal depression and a lower mother-infant relationship quality, compared to low maternal alexithymia (Yürümez et al., 2014). In a laboratory setting with video-recorded mother-infant free play interactions, high maternal alexithymia was associated with weak maternal sensitivity and poor maternal negative emotion regulation (Ahrnberg et al., 2021).

In a recent online study, alexithymia was associated with individuals' poorer recognition of infant hunger and satiety cues through video clips (Yu, Birtill, et al., 2025). Furthermore, caregivers who scored lower on alexithymia tended to score higher on recognising and responding (i.e., "tuning in") to their own internal satiation cues (Yu, Fildes, et al., 2025). Results also showed that mothers who scored higher on "tuning in" to their own internal satiation cues reported higher scores on recognising their infant's hunger and satiety cues during feeding compared to those who were less "tuned in" to their own internal state (Yu, Fildes, et al., 2025). These findings aligned with previous literature suggesting that maternal consideration of their child's thoughts, intentions, and needs was predictive of more sensitive and responsive parenting practices (Degotardi & Sweller, 2012; Farrow & Blissett, 2014; Li et al., 2014; Meins et al., 2001).

Some successful parenting intervention programs which aimed at enhancing caregiver sensitivity used video clips from the mother-child interactions to provide personalised feedback. For example, 68 Turkish mothers with children aged 9-30 months were included in a randomised controlled trial to test the effectiveness of the Video-feedback Intervention to Promote Positive Parenting Sensitive Discipline (VIPP-SD) (Alsancak-Akbulut et al., 2021) . Findings demonstrated significant improvement in maternal sensitivity and reduction in physical intrusiveness including fewer maternal controlling behaviours in intervention mothers (Alsancak-Akbulut et al., 2021). By systematically reviewing evidence from 25 randomised controlled trials, the employment of the VIPP-SD resulted in benefits in multiple domains, such as consistent improvement in parental sensitive responsiveness across diverse samples (e.g. low-income families, autism risk), positive attitudes in parenting/feeding and higher self-efficacy in intervention groups (van Ijzendoorn et al., 2023). In addition, intervention children were more likely to develop secure attachment relationships with their parents, indicating that VIPP-SD may be a reliable, evidence-based intervention that promotes parental sensitivity, parenting attitudes, and child attachment security for healthy development (van Ijzendoorn et al., 2023).

It has been demonstrated that variation in infant appetite is partially genetically determined and present from birth (Llewellyn et al., 2010). However, the environment remains important since the interplay of genetic factors and environmental factors has a significant impact on individuals' appetite and displayed eating behaviours (Llewellyn & Fildes, 2017). For children, family mealtimes and social eating is a typical occurrence, where their eating behaviours and food intake are influenced by multiple factors. Shared mealtimes involving language and social interaction, including the ways children are fed can help determine what and how much children eat (Van der Heijden & Wiggins, 2025). It has been proposed that appropriate feeding practices help and support children's development, allowing them to eat in response to their needs, while others encourage children to override internal appetite cues (Satter, 1995). It is important to understand the impact of alexithymia on everyday feeding interaction and mealtime communication, including the nature of any challenges. The aim of this follow-up study was to explore the impact of alexithymia on parental sensitivity and positive feeding experience, as well as how caregivers who scored high on alexithymia have adapted their feeding practices as their child grows.

In line with previous studies, which have used “video-elicited" interviews to encourage reflection on feeding interactions (McNally, 2018). The present qualitative study involved one-to-one interviews with video clips taken from a recently recorded mealtime to explore the following research questions:

A) Do caregivers with alexithymia notice and comment on both contextual cues, and affective cues from their child to guide their feeding practices?
B) What are the struggles/difficulties and related coping strategies caregivers with alexithymia report when feeding their child?
C) How do caregivers with alexithymia report adapting their feeding practices as their child develops?

6.2 Methods

6.2.1 Participants

Participants were recruited from the previous study (Yu, Fildes, et al., 2025) (Chapter 5), in which they were asked if they would be interested in participating in a further study “Identifying your baby's hunger and satiety cues during feeding in a home setting”. Overall, 244 participants gave consent with a valid email address, of whom 98 caregivers were eligible for the study. Eligibility was determined by the caregivers’ alexithymia score on the 20-item Toronto Alexithymia Scale (TAS-20) (Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994). The TAS-20 is a self-report measure of alexithymia containing three dimensions: Difficulty Identifying Feelings, Difficulty Describing Feelings, and Externally Oriented Thinking. It has 20 items and each of them is rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). TAS-20 uses cut-off scoring with scores of 52–60 indicating *potential alexithymia*, and scores above 60 indicating *present alexithymia*. Therefore, the higher individual scores, the more alexithymia traits are present, and the more certainty there is that the response reaches the clinical threshold for alexithymia. In total, 33 participants with alexithymia (TAS-20 scores above 60) and 65 with potential alexithymia (TAS-20 scores ranged from 52 to 60) were eligible for inclusion in the present study.

The targeted sample size for the semi-structured interviews was 15. Participants were paid £20 in total (£10 for completing the filming task, and £10 for completing the interview) with a digital voucher.

6.2.2 Study design

This qualitative study was conducted as a follow-up of the previous study (Yu, Fildes, et al., 2025) with one-to-one semi-structured online interviews using video-elicitation techniques via Microsoft Teams. Participants were recruited by email and provided an information sheet outlining the aims of the present study – which was to “investigate the relationship between caregivers’ mealtime emotions, their sensitivity towards their child’s hunger and satiety cues, and their feeding practices".

The present study consisted of two stages: participants replied via email with consent to participate. Then they were invited to film a typical mealtime in a home setting to complete Phase 1. In Phase 2, participants were interviewed and asked open-ended questions regarding their typical mealtime experiences. The video, and their previous answers to an open-ended question asking about the most recent mealtime experience they had with their child in the first study (Yu, Fildes, et al., 2025) (see Figure 6.3 in the 6.3 Results section under Theme 5 for an illustration) served as elicitation prompts that encouraged participants to revisit their most recent mealtime experiences. This process enabled them to articulate tacit aspects of feeding, such as challenges, adaptive strategies, and coping resources that are often difficult to express in conventional interviews.

The study protocol was pre-registered on the Open Science Framework (OSF): https://doi.org/10.17605/OSF.IO/3V5BW.

6.2.3 Procedure

First, participants who had agreed to be contacted were sent an email informing them about the study. In the filming guidelines, participants were instructed to choose from breakfast, lunch, or dinner to film one typical mealtime at home, while other family members can also be included at the same time. Guidelines on the seating position, as well as the camera position, were illustrated with figures so that both the child and the main caregiver were clear in the video clip (see Appendix D1). Once they consented to participate, the filming guidelines and the secure OneDrive link were shared with them.

During **Phase 1**, participants were invited to film one typical mealtime at home and upload the video clip (mean length received: 20 min) via a OneDrive link. Participants were then invited to join a one-to-one online interview arranged to suit the caregiver’s schedule. The mealtime video clips were reviewed and edited by the research team prior to the interview. To analyse and code video clips, the Feeding Infants: Behaviour and Facial Expression Coding System (FIBFECS) (Hetherington et al., 2016) was used. This is a validated video coding tool to measure infant food preferences (e.g., liking and wanting) through 6 behavioural measures and 7 facial expressions (Hetherington et al., 2016). A section of the original video clip in which infant appetite cues were expressed and, in which the caregiver interacted with their child, was selected.

In **Phase 2**, during the interview, participants' answers to an open-ended question from the previous study (Chapter 5) regarding a recent mealtime experience were presented (see Figure 6.3), followed by a discussion about their current feeding experience and any adaptation while their child grows. Next, a shortened video clip (mean length: 107s) edited from the recent mealtime video shared by participants was presented to facilitate caregivers' observation and reflection of their feeding interaction and mealtime experience (see study procedures in Figure 6.1; see interview questions in Appendix D2).

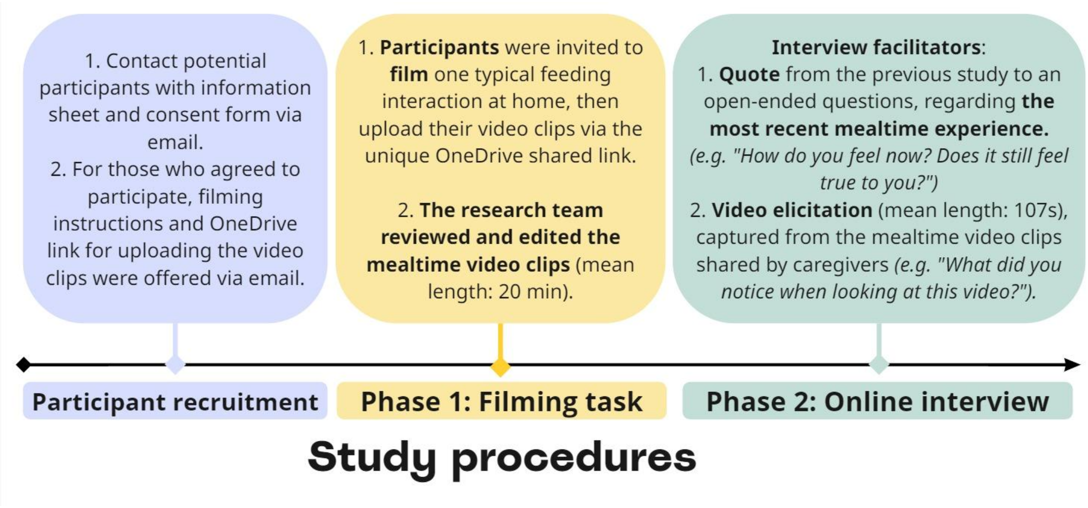


Figure 6.1. Study procedure from recruitment to phases 1 and 2 of the study

6.2.4 Data collection

All data were collected between August and December 2024 via MS Teams. Interviews were recorded and conversations were transcribed using the Transcription function in MS Teams. Recordings were replayed and transcriptions were amended for accuracy. One of the senior members of the project (MMH) was present during 6 out of the 12 interviews as an observer. After transcriptions were cleaned and corrected, the last author (MMH) helped with the sense check to ensure clarity, coherence, and credibility of the analytic process, which was aided by being present during half of the interviews.

6.2.5 Data analysis

Descriptive statistics were calculated for demographic variables using SPSS v29 (IBM Corp., Armonk, N, USA). Reflexive Thematic Analysis (RTA) was used to identify themes of interest (Braun & Clarke, 2021). RTA is a form of thematic analysis which is interpretivist and centres the researcher's perspective as a valuable component of the analysis. The analysis was conducted by SY, a postgraduate researcher aged 29 years, with some research experiences in exploring the association between caregivers' interoceptive sensitivity, their RF practices, and infant appetite cues displayed during mealtimes. All project members have a research-focused, academic background in infant feeding and personal experience of feeding infants and conducting qualitative research.

The six phases of thematic analysis (Braun & Clarke, 2006) were conducted. By conducting interviews, the researcher (SY) was familiar with the content of the interview. Additionally, reading and re-reading the transcripts helped the researcher have an overall understanding of the dataset and develop initial ideas. In the second phase, an inductive approach was applied to generate “data-driven” codes without a set of *a priori* themes or an existing conceptual framework. This technique of “open-coding” (Braun & Clarke, 2013) allowed an exploration of the latent meaning, rather than decoding the semantic meaning of real-life feeding experiences that caregivers shared; it also promoted a constructivist interpretation of the conversations with caregivers. In the third phase, initial themes were developed based on the coding, and then discussed within the research team. Next, the candidate themes were reviewed and further refined multiple times, with a thematic "map" generated to address the research questions. The fifth phase consisted of defining and refining the scope and focus of each theme. Lastly, compelling data extracts were selected to support the analysis of the research questions and literature, and to complete the study report.

The theme development was achieved by collating data in MS Excel and then visualising themes, codes and quotes using a MIRO digital board (Miro©2025, RealtimeBoard, Inc., available at: https://miro.com/) to illustrate the thematic contents. An example of how raw data was used to develop codes and formulate themes is illustrated in Table 6.1. Reporting for the study followed the Standards for Reporting Qualitative Research (O’Brien et al., 2014).

ID	Raw data	Codes	Code description	Themes	Theme description
11	"It's an important time of the day that we normally try and get us to **sit at tables together**, **have that conversation**, because you don't get much time in the day as we are always busy."	Sit and eat as a family	Participants reported that mealtimes are a critical time for the family to sit at the table together, have conversations, eat as a family to have a positive and pleasant mealtimes.	**Mealtime is more than feeding, it's a social activity**	Participants showed how much they value mealtimes. For them, mealtimes were more than being functional or providing foods, but a social activity where they could enhance the family bonding and connection.
1	"I still find myself getting frustrated when she refuses to eat the things that we know she likes as well, as that really **keeps us on our toes, keeps us guessing**."	Transient/ fluid liking	Participants reported that their children's liking of certain foods might be changing day by day, which made selecting foods difficult.	**Mealtime in reality: behind the door**	Participants reported their real-life feeding experiences, their true feelings during mealtimes, as well as challenges and difficulties they have encountered.

Table 6.1. Examples of how raw data was used to develop codes and themes.

6.3 Results

6.3.1 Participant characteristics

Of all potential participants who scored high on alexithymia from the previous study and gave permission for further contact (N = 98) (Yu, Fildes, et al., 2025), 22 expressed an interest in participating in the present study. Overall, 14 caregivers (2 fathers and 12 mothers) of children aged 18-36 months (mean age = 26.2 ± 6.7m; 7 boys, 7 girls) with TAS-20 scores between 53-74 (mean: 59.4 ± 5.4) completed this study. In addition, 2 mothers who scored above 60 on TAS-20 reported that due to personal reasons, including one who self-reported an autism spectrum diagnosis, they could not join the online interview but were able to answer questions via email. Therefore, both provided a video clip of their typical family mealtimes and a written script to the adapted interview questions. Their reflective written accounts and videos were treated as equivalent qualitative materials, contributing to the overall thematic analysis. A summary of participant demographics is provided in Table 6.2. The recruitment process is presented in Appendix D3. More detailed participant characteristics are provided in the Appendix D4.

ID	Participant gender	Participant age in years	Participant TAS-20 score	Child gender	Child age in months
1	Male	42	62	Girl	36
2	Female	31	74	Girl	35
3	Female	38	65	Boy	18
4	Female	34	59	Boy	27
5	Female	33	56	Boy	29
6	Female	32	55	Boy	20
7	Female	30	58	Girl	35
8	Male	33	60	Girl	32
9	Female	30	60	Boy	27
10	Female	29	55	Girl	18
11	Female	31	59	Boy	28
12	Female	44	53	Girl	22
13	Female	29	54	Boy	32
14	Female	36	62	Girl	23

Table 6.2. A brief summary of participants' age (yr), TAS-20 score, child gender and child age (m).

Independent sample t-test revealed no significance in TAS-20 scores of those parents who completed the study, compared to those eligible participants who did not participate in the present study (data not shown). Through the conversation, all participants shared their general feeding experiences, feelings towards their typical family mealtimes, day-to-day difficulties and specific challenges experienced in feeding their children, as well as their coping strategies and responses to child appetite. In thinking of the existing struggles and feeding progress, some participants provided an earnest reflection on their child's growth and their feeding practices during the interview. While contributing to the five themes, as indicated in Table 6.1, codes that were relevant to research questions were selected and discussed in the present study. In the following sections, quotes from participants were presented followed by the corresponding theme and code. See Figure 6.2 for an illustration of the five themes identified in the present study with selected codes.

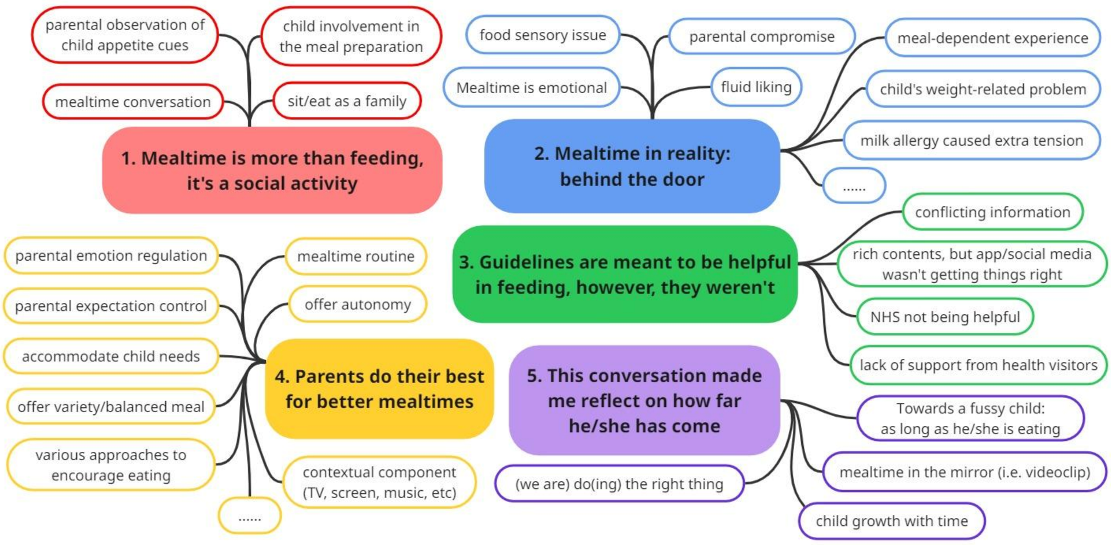


Figure 6.2. Five themes identified in the present study, presented in coloured boxes with bold font. Several selected codes are linked to the themes with solid lines.

6.3.2 Theme 1: Mealtime is more than feeding, it's a social activity.

Caregivers viewed mealtime as more than feeding, as a social and relational activity. They described mealtimes as an opportunity to sit together and eat as a family, have mealtime conversations and social interactions. Caregivers suggested it was important to have the child involved in the meal preparation, which helped their children feel engaged and develop a good relationship with foods.

"*It's an important time of the day that we normally try and get us to sit at tables together, have that conversation, because you don't get much time in the day as we are always busy*" [ID 11] [Theme1, code: sit/eat as a family];

"*It's something from the very beginning I've always been really quite aware that I want to sit down for the two main meals. Even if they're not eating very much, it's about having that consistency of sitting to the table and talk. Even just talking about the food will help with language skills as well*" [ID 12] [Theme1, code: sit/eat as a family];

"*He is now getting more and more keen to be involved in the cooking process. If he knows I'm cooking, he will drag over the chair and wants to get involved... We've invested in some kiddie toddler knives that he can come and chop some bits and pieces. He's developing that side of it … He thought it was so exciting … He just wants to be part of what you are doing*" [ID 5] [Theme1, code: child involvement in the meal preparation].

In addition, caregivers noted child appetite cues during mealtimes, "*(with my child growing older) I still get joy watching her try new foods, especially ones I wasn't sure she would like*" [ID 14] [Theme1, code: parental observation of child appetite cues]. These cues were used when making decisions about when to introduce solid foods during complementary feeding: "*He started weaning just before 6-month because he was sitting up and was showing the signs. I kept it until then because I know that was the recommended time*" [ID 9] [Theme1, code: parental observation of child appetite cues].

6.3.3 Theme 2: Mealtimes in reality: behind the door

During the interview, participants shared their feelings during typical family mealtimes, as well as a variety of struggles they had during meals such as food sensory issues, and the balancing working schedule and mealtimes. Participants described mealtimes as emotional, usually challenging, and that feeding could be very hard. The experience varied and was often meal-dependent: "*No two mealtimes are the same*" [ID 10] [Theme 2, code: meal-dependent experience], "*My child is quite a good eater but she does have her odd days*" [ID 7] [Theme 2, code: meal-dependent experience]. Several caregivers reported that their child was described as "underweight" by health visitors or other healthcare professionals when younger which made the feeding stressful: "*It's quite difficult to take*" [ID 1] [Theme 2, code: mealtime is emotional]; "*I did go a bit loopy with it*" [ID 5] [Theme 2, code: mealtime is emotional]. A few mothers shared the same feeling that "*it's quite hard to balance the snacks and the mealtime*" [ID 9] [Theme 2, code: balance between meal(time) and snack]. Some caregivers admitted that they had to make a compromise in feeding due to working hours or schedule, while some caregivers perceived food availability and food waste as an influence in their daily feeding.

"*Stress, stressful is probably my main word to describe mealtimes. That's really negative but that's the honest truth... I don't really know how and what other people's mealtimes are behind closed doors. They could have exactly (the) same problems as me. No one is wanting to really speak about it when you are with other mums. No one wants to have that kind of frank conversation, while one wants to just talk about how perfect things are*" [ID 2] [Theme 2, code: mealtime is emotional];

"*Trying to feed her was like a constant struggle*" [ID 1] [Theme 2, code: mealtime is emotional];

"*We are all neurodivergent to varying degrees... Autism and food sensory issues play a huge part in mealtimes in our household...It was easier when I was at home on maternity leave but since returning to fulltime work, I am out of the house so much that there's not much time for making intricate meals*" [ID 3] [Theme 2, code: food sensory issue];

"*Our work schedules are not conventional. Only Sunday we can all eat together... She probably eats more processed foods than we would like, things like frozen chicken nuggets. They're supposed to be good... Things being easy together is a big part of our mealtime. It's difficult to make full meals from* *scratch especially when you are eating in different times*" [ID 8] [Theme 2, code: parental compromise in feeding];

"*It's incredibly frustrating when you pay for foods with your own money, make something from scratch, and then it doesn't get eaten or gets wasted... especially with food prices being so expensive at the moment, it's just infuriating*" [ID 9] [Theme 2, code: food waste].

Moreover, caregivers with a child with allergies or intolerance shared specific issues for example one whose child was lactose intolerant commented: "*He was my first baby, I didn't really know that was a thing that could happen. Like a cat allergic to fish... We didn't know what's happening with him. He would scream all day and he would be in pain a lot, we could see that*" [ID 10] [Theme 2, code: milk allergies bring extra tension].

Trying new things, a child going through a fussy stage and throwing foods, and dining-out were also challenging. Additionally, a child's changing, fluid food preferences, were described as a concern. For example, "*I still find myself getting frustrated when she refuses to eat the things that we know she likes as well as that really keeps us on our toes, keeps us guessing*" [ID 1] [Theme 2, code: fluid liking, fickle child].

Caregivers observed and appreciated the independence their child showed during mealtimes such as "he loves feeding himself". Some participants acknowledged that "*every child's personality is so different*" [ID 6] [Theme 2, code: every child is different], "*some were very easy to feed and others could have similar problems to what we have occasionally*" [ID 1] [Theme 2, code: every child is different]. Positive experience of a child being a good eater was observed. For example, having a fussy child "eats what we give to her" and that made the caregivers "feel good"; another caregiver said "*she is such a good eater...She is always waiting for my son who is fussy to finish so that she can pick off his plate*" [ID 7] [Theme 2, code: positive experience from child being a good eater]. Additionally, caregivers noticed how differently their child might eat in the nursery compared to at home. One father described that his child "*might eat things that she won't eat at home...She loves nursery and eats really well there, better than she does at home. Maybe because she's with all the* *friends...The nursery has a proper chef. He makes big batches of things. It's easier and then all the kids have the same. We cannot do that at home*" [ID 8] [Theme 2, code: feeding in nursery vs home]. Even with the app where the nursery reported foods served and what was eaten by the child, two mothers particularly mentioned the app is "handy and important", but they did not receive enough information: "*I don't really know, is it (his eating) better than here at home? It's quite difficult to know*" [ID 9] [Theme 2, code: feeding in nursery vs home], "*I'm always a bit dubious as how accurate the amount they recorded that he's eating there*" [ID 13] [Theme 2, code: feeding in nursery vs home].

6.3.4 Theme 3: Guidelines are meant to be helpful in feeding; however, they weren't.

The third theme captured caregivers' experiences with support sought from outside the home. For example, reading guidelines on feeding from the National Health Service (NHS), asking health visitors for advice, and looking at posts from social media influencers on infant feeding. Caregivers noted that existing resources, which are intended to be useful, were experienced as unhelpful in coping with challenges they encountered during feeding. For example, conflicting information which made caregivers overwhelmed.

"*I had got myself a bit 'information overloaded' and there was just quite a lot of conflicting information*" [ID 5] [Theme 3, code: conflicting information];

Participants also reported complex attitudes towards social media and the additional pressure it had on their daily feeding practices, "*it is hard to justify the time and the cost to make the food (from the recipe)*" [ID 3] [Theme 3, code: rich contents, but app/social media wasn't getting things right], or "*some of them are a bit gimmicky … they are just trying to make it look pretty or just for views*" [ID 7] [Theme 3, code: rich contents, but app/social media wasn't getting things right].

Social media influencers by comparison to what was experienced at home, could suggest that caregivers were not "**doing well enough**", making social media "**the last resort**" for dealing with mealtime difficulties.

"*If I decide to follow an influencer, I think it's going to put additional pressure to follow that strictly...I feel there's enough stress without the additional pressure of following somebody on social media and doing it*" [ID 1] [Theme 3, code: rich contents, but app/social media wasn't getting things right];

"*I started following a couple of ladies and saw plates of food they created every day, like things made from scratch. In the morning their breakfast was like various berries and porridge with seeds on it...To be honest, more often than not, it made me feel like I wasn't doing enough or I wasn't good enough... How on earth does any mother do this on a daily basis and work? That was just unbelievable… It actually made me feel worse. It seemed so fake and I thought it can't be real life...I couldn't deal with it. So I've completely blocked that out my life because I think that was a negative influence on my motherhood journey*" [ID 2] [Theme 3, code: rich contents, but app/social media wasn't getting things right].

Some stressful experiences with external resources from the NHS website or from health visitors were mentioned. For example, the NHS guidance on feeding practices; lack of support for specific problems including child being underweight, milk allergy or food sensory issues; and the ways they could have been better supported. Participants mentioned that NHS guidelines may give a good basis especially for first time caregivers. They could benefit from knowing "*what you should and shouldn't do"* [ID 11] [Theme 3, code: NHS not being helpful]. Whereas one mother suggested that the breastfeeding guidelines on NHS website need to be updated, "*in terms of the pressure that people feel they are under...People should have the support to be able to breastfeed...(NHS) need to embrace other things*" [ID 9] [Theme 3, code: NHS not being helpful]. Some participants pointed out that feeding guidelines served as "*one size fits all, where sometimes the circumstances change that*" [ID 13] [Theme 3, code: NHS not being helpful]. They acknowledged that it was important and necessary to give a bit of flexibility when following the guidelines, and to hear real life experiences.

It is worth noticing that one mother with ASD who shared their written script with the research team (rather than having an online interview) reported that all her three children have different levels of neurodivergence and food sensory issues. For her, she really struggled to find any feeding guidelines that worked for her family.

"*It's difficult to get specific advice for special needs because a referral to a dietician is very hard to get. The NHS is so stretched...General feeding suggestions have tended not to work for us in the past; it feels like we have tried everything!... Past experience with my older children tells me that there isn't much help out there and you just have to muddle through yourself*" [ID 3] [Theme 3, code: NHS not being helpful];

This aligned with the experience of other caregivers that resources intended to help caused additional stress:

"*I couldn't really articulate and I was quite upset because the health visitor could actually come and observe a mealtime so they could see our problems. If I didn't get the advice from my own health visitor, where else could I go? What's the point in going anywhere else?… (Besides) my child was underweight and quite a late walker. I was thinking goodness is this because she was not getting enough nutrients? They (health visitors) kept reassuring me it was all fine. But for someone to say that to me, she kept hopping on about gold top milk...I am still concerned about our mealtimes but she never asked or contacted me again. I have never had a consistent health visitor which really didn't help me either...It's a bit disappointing and I don't know if that's the local authority issues*" [ID 2] [Theme 3, code: lack of support from professionals].

6.3.5 Theme 4: Parents do their best for better mealtimes

Parents described efforts to "do their best for better mealtimes", and this formed the fourth theme. Several different strategies and actions were described to support enjoyable and healthy mealtimes for their children. Ways to respond to their children's appetite cues and needs were described; these included ways to encourage eating, and coping strategies for dealing with challenges in feeding.

For example, sharing the same meal encouraged their child to eat more and made the mealtime much easier. Meanwhile, other approaches were mentioned such as offering a variety of foods and then offering the same food repeatedly, buffet style, and feeding through play. One mother reported that she let her child decide what to have by playing with a homemade pastry pinwheel. The use of tricks, bribery, or feeding by stealth were reported in response to challenging eating occasions. For example, "*I have to come up with ways to trick him into opening his mouth, because once he tastes them, he does realise he likes the food after all*" [ID 3] [Theme 4, code: bribery/tricks to encourage eating]. One mother noted that a lot of bribery was involved in their mealtimes because of her fussy child. "*Things like 'you eat your tea, you might get a sweetie or pudding later on', it often worked quite well*" but the success rate also varied since "*my child is getting old enough to know that she will get that anyway regardless of what happens. Also I think we are a bit of a soft touch when it comes to treats and things like that. But bribery does occasionally work as well, to get her to eat a few more spoons*" [ID 2] [Theme 4, code: bribery/tricks to encourage eating]. A strong willingness was evident in "*getting the right guidance*" and "*doing the right thing for the right age*" [ID 13] [Theme 4, code: do the right thing in feeding]. They appreciated feeding resources that were trustworthy and helpful, such as the NHS weaning seminar and other "structured and regimented" guidelines, which "are backed up by research". Some of them demonstrated the importance of having a mealtime routine, as well as offering autonomy to their child, so that the child had control over what and how much to eat.

"*I was very much trying to go by the book*" [ID 2] [Theme 4, code: do the right thing in feeding];

"*I had done plenty of research... Breastfeeding has not always been easy but I've no regrets about persevering with it! My son is now 18 months and still breastfeeding at night so we are still going strong*" [ID 3] [Theme 4, code: do the right thing in feeding];

"*I'm quite keen to be quite consistent. I think that's really vital for kids"* [ID 5] [Theme 4, code: mealtime routine];

"I wanted to let him lead the way. (After the experience with my first child) this time I thought 'let's do what you want to do'... I'm just trying to remain calm

during mealtimes and go with the flow, let him do what he wants” [ID 6] [Theme 4, code: offer autonomy].

The importance of caregiver’s own expectation control, emotional regulation, as well as not giving additional pressure to their children during feeding was reflected in participants' frequent reference to provide a better mealtime. In particular, caregivers showed how they learned to manage the balance between what they wanted as caregivers and what their child needed in terms of eating (e.g. "*It doesn't matter as long as he's trying it... it was more about them trying rather than the amount*" [ID 11] [Theme 4, code: parental expectation control]).

“I don't want to get worked up because that's not an appropriate reaction... That's about my frustration of things not working out as I want them to. So I would say that I have adjusted my expectations slightly and tried to be a bit more flexible with my approach, my reaction to how she eats and what she eats” [ID 1] [Theme 4, code: parental emotion regulation];

“*I think at the dinner table, if I'm frustrated, I have to make sure I'm calm so he will then be calm and eat... If I'm not calm, it's not helpful for him*” [ID 9] [Theme 4, code: parental emotion regulation];

“*I used to be like 'try and eat as much as you can' with my son. He was so fussy and that kind of put him off a bit more. So now as long as my kids think they're full, that's fine. I don't try and force them to eat it, because that's not going to help anyone*” [ID 7] [Theme 4, code: avoid extra pressure in feeding].

Caregivers were responding to and accommodating their own and their child’s needs in eating, such as eating at different times due to caregivers’ working schedules, cooking foods separately due to the food sensory issues of the child, eating separately as a consequence of the neurodivergence and food disgust of children with ASD, and having safe foods that they know their child would always eat. Contextual components were also mentioned by caregivers to regulate the mealtime. Some caregivers insisted that they should have a screen-free mealtime: “*I don't think that's healthy for children*” [ID 12] [Theme 4, code: contextual components], whereas some caregivers reported their mealtime dilemma (e.g., “*she is not eating if she is not happy*” [ID 2]) and used a screen or nursery rhyme to help their child to remain seated – “*stay sat down for longer”* [ID 4] [Theme 4, code: contextual components], or to “*get her to actually eat her meal*” [ID 2] [Theme 4, code: contextual components]. They expressed their concerns such as “*I felt like she was not engaged in any way with the food*” [ID 2] [Theme 4, code: contextual components], “*he has got used to having a screen when eating which isn't ideal*” [ID 4] [Theme 4, code: contextual components], but it worked as a successful method or the last resort to get their child to eat especially on challenging days.

It was acknowledged that working in the early years sector with lots of experience with children helped caregivers understand behaviours and communications of their own children, or having their first child contributed to less stressful family mealtimes while they had the second child based on caregivers' learning trajectory on parenting. Also, some benefit from online recipes for inspiration or for age-appropriate foods, and online peer support from social media that “worked like a little community” was also reported.

“*I work for an eating disorder charity.....I'm trying not to push him to eat because I'm very aware of what that can develop into*” [ID 9] [Theme 4, code: impact from caregiver’s job on feeding];

“*I found social media a godsend for inspiration of what I make for mealtimes*” [ID 13] [Theme 4, code: helpful online resources for feeding].

6.3.6 Theme 5: This conversation made me reflect on how far she/he has come.

The fifth theme incorporates notions of progress in feeding. Specifically what caregivers have learned in the intervening time since the earlier study. Participants noticed changes in feeding practices, prompted by reading what they had previously written about their most recent mealtime experience one year ago in the previous study (example see Figure 6.3), as well as watching the short mealtime video clip that they provided recently during the interview (example see Figure 6.4). Some spontaneous reactions of recognition were expressed from the previous statement to the current mealtime experience, some participants did not remember what they had written. For example: “*I can* *still relate to a large majority of this. It's funny, I don't even remember doing this*" [ID 2] [Theme 5, code: child growth with time], "*Oh God, yes I did remember the experience. I couldn't remember how long ago. But trying to escape from the highchair was a regular thing. That's really interesting, this quote brings back some memories for me*" [ID 9] [Theme 5, code: child growth with time]. When being invited to view the mealtime video clip, one mother immediately commented "*OK, that's cringe*" [ID 2] [Theme 5, code: mealtime in the mirror (i.e. videoclip)] but with a smile. By comparing their day-to-day mealtimes to what they experienced a year ago, participants were able to illustrate to what extent their feeding strategies had changed, and how much their child had grown in terms of appetite expression, independence, and self-control in eating.

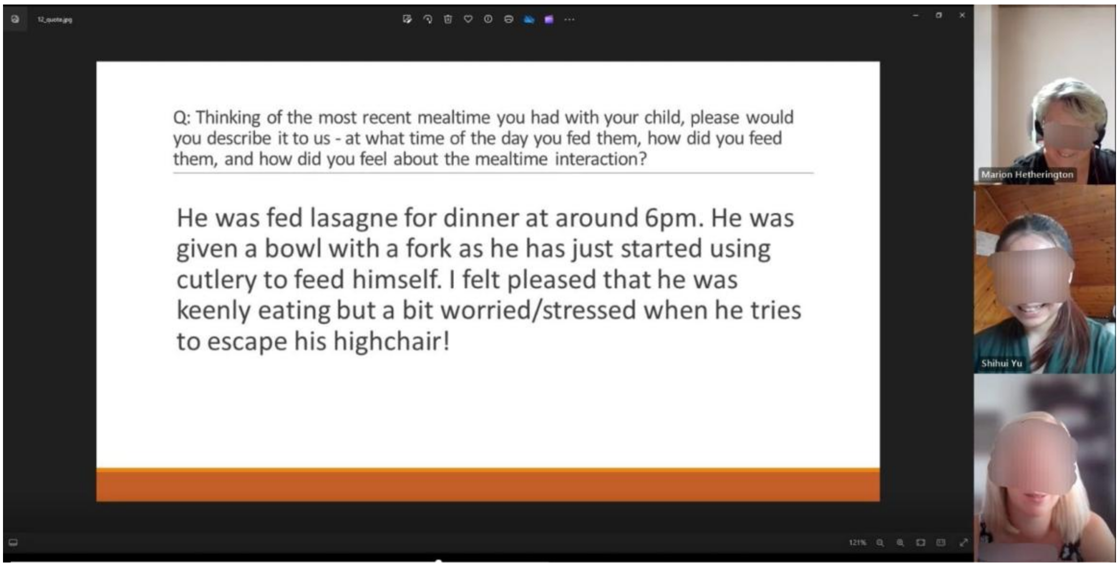


Figure 6.3. Still image captured from an interview where the participant was reading the quote they had written from the previous study and discussing how their mealtime experiences had changed with time.

"*OK, that's very interesting. I wasn't aware that it had changed, but now you told me what I said previously. There has been a slight shift. I think I'm at the point now where I'm happy that she's eating something, so even if she's just eating a little bit of everything, that's good enough for me*" [ID 1] [Theme 5, code: towards a fussy child – as long as he/she is eating];

"*I think in the weaning stage maybe we didn't do as well as we could have done. With hindsight, we didn't do enough messy play and that would probably* *be my biggest regret from weaning... We do still have to devote a lot of our attention to get her to eat but nowhere near what it was a year ago... We're in a much better place that she is more open and adventurous. I do feel we made progress. It's moving in the right direction rather than the wrong direction*" [ID 2] [Theme 5, code: (we are) do(ing) the right thing];

"*Nowadays I don't think at this stage I've got any kind of worries or difficulties with my kid. I think it's a lot easier and more relaxed now. You can just enjoy mealtime a bit more... I knew it was a case of time that you get a bit more confident with your child with what they can manage*" [ID 12] [Theme 5, code: child growth with time].

Observations of the mealtime interactions were reported by some participants after watching the short video clip (see Figure 6.4). A few caregivers noticed their child's activity in ways they may not be aware of: "*I've never noticed, I didn't realise she got that good at using her cutlery. It's good!*" [ID 8] [Theme 5, code: mealtime in the mirror (i.e. videoclip)], "*I noticed how active she actually is when she's eating. You don't always see that when you are moving around in mealtimes*" [ID 10] [Theme 5, code: mealtime in the mirror (i.e., videoclip)]. Facilitated by provided materials during the conversation and caregivers' personal mealtime experiences, some participants talked about their learning trajectory in parenting and feeding, their feelings evoked from the reflection, and suggested that the growth was reciprocal for both the caregiver and their child.

Figure 6 4. Still image captured from an interview where the participant was watching the short video clip of their typical family mealtimes and noticing what was happening during the meal.

“(In the mealtime video clip) *it seems like I'm putting a little bit of pressure on her, a little bit more than I was aware of at the time...I was trying to encourage her a bit more beyond the point where she was getting distracted. Again, I don't want to force her because that was obviously the wrong thing to do, but she just needs a little bit more encouragement each time. And I suppose we'll be a lot happier if she could eat just a bit more*” [ID 1] [Theme 5, code: mealtime in the mirror (i.e., videoclip)];

Two mothers particularly summarised the importance of “learning” and “reflecting” in feeding:

“*This conversation certainly made me reflect on* ***how far she has come*** *because I think we too often reflect on the negatives about the mealtimes... I think as parents you learn from your mistakes, and I do need to be more appreciative and grateful about the fact that she is so willing to eat... I know it's been a journey and this conversation has really enlightened me actually on how much things have changed ...and it makes me quite proud*” [ID 2] [Theme 5, code: (we are) do(ing) the right thing];

“You need to do your own research, get the basics and then use your own judgement and instincts outside of that, go from what you are comfortable with

because feeding is so nerve wracking... It's been a lot of learning that just picked my battles with mealtimes... Now I think I'll be a bit more relaxed with my second child, because we have been there, done that, and I know what I do" [ID 13] [Theme 5, code: (we are) do(ing) the right thing].

A few participants also emphasised how important it was for them to learn and adapt their feeding practices and the benefits they observed in their child:

"Now I have changed my thought... I think I have created the weird (food sensory) issue with my first child, now with my second, as long as he is eating, as long as he has a healthy weight, then I'm fine with it. I'm a lot more relaxed... Now it is nice to watch him enjoying mealtime and thinking they interact well together, the positive relationship between them. Seeing it that way makes me think: Oh, I think we're doing the right thing" [ID 6] [Theme 5, code: (we are) do(ing) the right thing];

"I think my first child taught me to be less controlling around feeding... with my second, I learned to just relax, let her explore food at her own pace and it's paid off in the long run because she's got a much more various diet than my first kid will probably ever have" [ID 10] [Theme 5, code: (we are) do(ing) the right thing].

6.4 Discussion

Overall, caregivers with high levels of alexithymia in this follow-up study indicated that they perceive family mealtimes as a social activity where they have the chance to enhance family bonding by sitting and eating together. Facilitated by their answers on mealtime experience for the earlier study, participants reviewed their parenting experiences, how they had adapted their feeding practices in response to their child's developing appetitive cues, acknowledged their children's growth in temperament and improved motor skills. Participants considered their mealtimes stressful, with lots of emotional investment and challenges such as their child's food sensory issues. Coping strategies were reported as solutions to mealtime difficulties, or to accommodate their child's needs. For example, both general (e.g., the use of repeated exposure) and "tailored" techniques (e.g., the use of pastry pinwheels to encourage child engagement and fun in meal planning) were described to encourage eating. After reviewing the short video clip of their typical family mealtime, caregivers with high levels of alexithymia noticed the satiation cues of their child which were overlooked during the meal. Through reflection on their practices, participants emphasised the reciprocal learning process of the caregiver-child dyad during interactions, the reassurance of knowing that they were “doing the right thing” in feeding, and the importance of embracing their progress as mealtimes improve.

Findings from the previous study showed that caregivers’ capacity in recognising and responding to their own satiation cues reduced the impact of alexithymia on their ability to decode their infant’s hunger and satiation cues during feeding (Yu, Fildes, et al., 2025). Results from the present study indicated an important role of video elicitation which helped caregivers with high levels of alexithymia notice previously overlooked child satiation cues. In addition, the reflection on mealtime experiences and feeding practices fostered a sense of progress and reassurance for participants. Thus, by improving understanding and sensitivity towards their interoceptive cues, parents with high levels of alexithymia may become more aware of and engaged with their child's appetitive and affective cues. Consequently, caregivers were more likely to satisfy their child’s needs, provide appropriate responses and mealtime interactions, rather than mainly focusing on food provision. In general, children can benefit from watching attentive caregivers who are teaching and modelling how to recognise and respond to internal hunger and satiation cues during mealtimes. In a study with video observations in a childcare setting, Ramsay et al. (2010) explored caregivers’ mealtime communication regarding preschoolers’ internal and non-internal hunger and satiation cues. Results showed that some caregivers tried to get their children to eat with an emphasis on non-internal cues, such as cueing the amount of food served and remaining without evaluating children’s internal state (Ramsay et al., 2010). This may result in a detrimental effect on promoting children's sensitivity to internal cues and undermining self-regulation skills during mealtimes (Johnson, 2000).

Our findings align with a previous study in which Thompson et al. (2021) investigated parental perspectives on the ideal and the reality of family mealtimes. Parents of preschool children highlighted the importance of being together for the meal, as well as offering healthy foods to their children. Challenges in achieving an ideal family mealtime included having a fussy child, negative parental role-modelling in vegetable intake, and parental work schedules that required them to be out of the house at mealtimes. Parents reported solutions such as having flexible meal timings in response to scheduling conflicts, promoting child engagement in meal planning, and using positive role-modelling to encourage their children to "build good habits" and eat healthy foods. Overall, they considered it challenging to attain ideal family meals with conflicts between unrealistic parental expectations and child mealtime behaviours. Thus, results showed that with or without alexithymia, parents may experience similar mealtime difficulties and may employ universal coping strategies.

Vaughn et al. (2016) suggested that decisions parents make around feeding their children can be categorised into three different practices: coercive control feeding, structure-based feeding, and autonomy-promoting feeding. Coercive control feeding is associated with parental use of controlling feeding practices such as pressuring their child to eat, whereas structure-based feeding and autonomy-promoting feeding are involved with providing children a structured and healthy mealtime environment and teaching children to have control over their own eating (Musher-Eizenman et al., 2019). In the present study, tension was identified between parental expectations of how much they wanted their children to eat, and parental desires to be child-centred in how much or what parents actually offered to their child. For parents of “good eaters” (such as ID5, ID8, and ID12), the experiences reported were often positive as the feeding strategies mainly focused on fostering child independence during mealtimes. In contrast, parents with a fussy child (such as ID1, ID2, and ID3) expressed experiences that were similar to each other in offering foods that they knew their child would like and consume. However, it usually came with additional stress and effort in getting their fussy child to “just eat something”. Similar parental feeding patterns were reported in an earlier study, where mothers “firmly believed” they knew the “right amount” to provide to their child; meanwhile, they knew or expected what their child would and would not eat

(Johnson et al., 2015). Children with fussy eating are likely to display complex eating behaviours (Farrow & Blissett, 2006b; Haycraft et al., 2011). While child fussiness may be transient and resolved over time (Mascola et al., 2010), it may also exist as a long-term issue for some families and cause feeding concerns and nutritional risk (Galloway et al., 2005), with coercive feeding practices or instrumental strategies involved in order to encourage or to pressure the child to eat more, as a strategy to manage difficult child behaviours (Rodgers et al., 2014).

Results from a recent cross-sectional study showed that parental active engagement in feeding is associated with structure-based feeding as well as autonomy-promoting feeding (Sherrard & Tan, 2022). In the present study, parents demonstrated their engagement through sitting at the table together during mealtimes, having conversations, and involving their child in the meal preparation. However, due to food sensory issues, having a fussy child, caregivers' working schedules, and convenience factors, parents reported that they were compelled to make different meals or separate feeding schedules from the rest of the family, which might lead to reduced parental engagement in feeding during mealtimes. Similar practices have been reported by Brannen et al. (2013) who also suggested that this may hinder the opportunity for the entire family to sit around the table simultaneously, with parents modelling appropriate eating behaviours and table manners. Parents have a significant modelling effect on their children's food intake and mealtime behaviours (Blissett, 2018). For instance, maternal modelling was associated with child increased enjoyment of food and lower fussiness (Palfreyman et al., 2015). Hence, strategies and encouragement for parental active engagement and positive role-modelling may promote better mealtimes and healthy child eating behaviours.

Research has been focused on the impact of mealtime structures on child eating behaviours. For example, minimising potential distraction in the home environment is considered an approach of structure-based feeding, as well as a key element for healthy family mealtimes (Jones, 2018). In an observational study conducted in the home setting, children demonstrated lower food fussiness where no distractions were present (such as TV) during mealtimes or where they had higher engagement in food choice or meal preparation (Powell et al., 2017). Moreover, in the present study, parents reported meal-dependent experiences, varied food acceptance rates, in addition to numerous strategies to encourage eating. Findings aligned with previous literature that child food acceptance can vary day by day; those initially rejected might be accepted later after repeated neutral exposure (Birch & Marlin, 1982). Compared to children who received rewards, those who were allowed to explore foods were more likely to try new foods and eat them again (Birch et al., 1984). Rolls (1986) also suggested that given autonomy, children are likely to eat a variety of foods and to maintain a nutritionally adequate diet over time. In summary, with attentive and responsive caregivers, children are allowed to actively engage in the process of achieving tasks autonomously with concrete and repeated experiences during mealtimes, and "do best with feeding" eventually (Satter, 1995).

A few mothers advocated the importance of breastfeeding and indicated that although it was difficult for various reasons, they “persisted” until their child was at least two years old. One mother particularly commented that support for breastfeeding was essential and specifically needed by her. Our findings supported the previous research that longer duration of successful breastfeeding was associated with sustained social support, such as periodical follow-up contact with the physician or health visitor, delaying the return to work, working part-time instead of full-time, and being able to express milk at the workplace (Satter, 1990). However, a mismatch was reported by different parents between their feeding practices in reality and what feeding guidelines suggested (from NHS, healthcare professionals, and/or social media). Their concerns about unhelpful feeding resources and emotional strain resonated with findings from a national survey on maternal experiences in maternity care and infant feeding support in England. Mothers indicated that they had "learned the hard way" or in some way "failed" in parenting on account of inconsistent advice, and a lack of postnatal support from the organisation and staff (Redshaw & Henderson, 2012). Results across studies demonstrated maternal expectations and needs in receiving help on feeding, while professional support was not accessible or unhelpful in some circumstances, leading to additional distress for caregivers.

It is worth noting that while caregivers appreciated the convenience and peer support offered by digital resources such as social media and mobile apps, some criticized them and articulated what they considered to be the downside of social media. They described the content creators' posts as unrealistic, that they felt additional pressure to conform. One mother particularly emphasised that due to the postnatal depression she experienced and her understanding of other mental health conditions, caregivers should be aware of "the risk of tracking things via apps" and "be cautious of being rigid". Our findings partially supported what Srivastava et al. (2022) reported in their qualitative study that caregivers considered media as "a double-edged sword", a "nightmare" when parents sought out information relevant to breastfeeding.

In the epidemiology domain, genetic studies showed that alexithymia is not only substantially heritable (Picardi et al., 2011), but also shares a genetic relationship and aetiology with sensory sensitivity, which relates to almost all sensory domains (Yorke et al., 2025). Meanwhile, unshared environmental factors are also a major determinant for alexithymia, which may include but not limited to pathological family interactions, dysfunctional family environment in childhood, poor family expressiveness, and perceived dysfunctional parenting (Picardi et al., 2011). Furthermore, results from a qualitative study revealed that individuals with alexithymia demonstrated a less sophisticated communication vocabulary, as well as less nuanced and less vivid descriptions of interpersonal relations (Meganck et al., 2009). This might have a negative impact on the child's language development through mealtime conversations with poor interactions, as emotion words in the language processes act as critical components in children's development of emotion concepts (Hobson et al., 2019). Overall, it is of importance to offer support on feeding to caregivers who score high on alexithymia, devise effective environmental interventions to reduce alexithymic traits or promote their interoception awareness so they can enjoy their mealtimes and have healthy interactions with their children.

To summarise, elevated caregiver sensitivity in recognising and responding to their own appetitive and affective cues may promote their awareness of their children's hunger and satiation cues during feeding, which consequently generates more RF practices. Future research could focus on developing training resources or interventions on feeding especially for parents with high alexithymia scores, or who are less likely to recognise and respond to their own interoceptive cues. In addition, feeding guidelines and training programs should go beyond general resources so that parents could possibly benefit from tailored support. For example, healthcare professionals might benefit from training to support parents with high levels of alexithymia to provide structured mealtimes, to perform autonomy-promoting feeding practices, or to be “good enough”. Furthermore, parental modelling has been applied to encourage expected child behaviours during mealtimes in other research (Sweetman et al., 2011; Trofholz et al., 2018). Providing parents with guidelines and encouragement for role-modelling through mealtime interactions might serve as promising feeding strategies.

6.5 Strengths and limitations

The first strength is that this is a follow-up of a previous study and participants were selected based on their alexithymia scores. This allowed the further investigation of feeding experiences and mealtime interactions of caregivers who struggled in recognising and expressing their own interoceptive cues. The second strength of this study is that video elicitation and quotes from the previous study (Yu, Fildes, et al., 2025) were included to minimise caregivers' recall bias, to facilitate their reflection and observation on their feeding practices and typical family mealtime interactions. However, our target sample was caregivers with alexithymia (TAS-20 scores > 60). Due to the difficulties in the recruitment, for example, individuals with alexithymia found it challenging to express themselves during the interview or while facing the camera, in addition to their childcare responsibilities, we eventually had a self-selected sample with caregivers who scored high on alexithymia (52 < TAS-20 scores ≤ 74). The second limitation is that other measurements of caregivers' wellbeing were not included, such as Autism Spectrum Disorder (ASD), anxiety and depression, which may occur with alexithymia (Poquérusse et al., 2018). The research team was only able to know when participants revealed concurrent mental health conditions during the interview (including ASD and postnatal depression in the present study). The third limitation is that although we have collected data on children's eating traits such as satiety responsiveness, food responsiveness, and food fussiness in the previous study (Chapter 5), these quantitative child level variables were not incorporated into the analytic process. This was due to the design of the present study as an exploratory qualitative study using reflexive thematic analysis. Additionally, another limitation is that we did not systematically collect diagnostic information about children’s developmental or feeding related conditions. It is therefore possible that some children may have experienced specific challenges related to neurodivergence, sensory processing differences, or clinically significant feeding difficulties (e.g., Avoidant/Restrictive Food Intake Disorder) that could influence mealtime interactions independently of parental alexithymia. Future work could explicitly examine how parental alexithymia interacts with child eating traits, child eating profiles, and/or child developmental needs in influencing their mealtime experiences. The forth limitation is that participants all identified as White British. Therefore, findings are not generalisable to a wider population.

6.6 Conclusion

Overall, five themes identified in the present study revealed that caregivers with high scores on alexithymia reported that mealtimes were challenging. They experienced specific difficulties beyond typical feeding challenges, such as child’s sensory needs, child weight concerns, parental control over feeding, and lack of support in feeding. Discussion with caregivers who scored high on alexithymia was enhanced by the video-elicitation and quotes from the previous study. The results showed struggles participants experienced which they were unable to solve at the same time, as a result it provided additional pressure in turn. Our findings also captured parental reflection on their feeding progress, as well as the identity acknowledgement as caregivers. These views imply a person-centred approach and caregivers' willingness to apply multiple strategies to provide better mealtimes to their child. Caregivers with high score on alexithymia may benefit from tailored support in helping them to recognise and respond to appetitive and affective cues of both themselves and their child, so to improve their mealtime experiences and interactions.

Chapter 7

General discussion

Chapter 7. General discussion

Responsive parenting and responsive feeding have been the focus of interventions. Our systematic review concluded that mixed results were reported from large-scale RCTs in promoting parental responsive parenting or feeding on child weight related outcomes (Daniels et al., 2015; Lakshman et al., 2018; Paul et al., 2025; van Vliet et al., 2022) and the development of child eating behaviours (Magarey et al., 2016; Ruggiero et al., 2021; van Vliet et al., 2022). Intervention effectiveness varied, and targeting parental responsiveness towards infant appetite cues during feeding was both complex and multi-faceted. These mixed results may be accounted for with reference to differences in intervention content and framework, to biopsychological factors (e.g., caregivers' attributes), the feeding environment (e.g., family mealtime experiences), to wider societal components (e.g., professional support on feeding). Moreover, while *caregiver* behaviour changed in some of the interventions, this was not sufficient to see sustained effects on *infant* behaviour or weight. These findings demonstrated the importance of designing multi-component, user-centred interventions that adapt to caregiver and child variability, emphasising flexible and iterative solutions rather than one-size-fits-all approaches.

In this thesis, three studies using quantitative and qualitative methods were designed to investigate individual differences in recognising infant appetitive cues during mealtimes and their association with parental RF practices. Overall, these three studies illustrated that parental ability to recognise and respond to interoceptive cues was related to their RF practices and mealtime emotions. Addressing these factors requires that those caring for young children “tune in” to their own internal appetite and affect cues and encourage appropriate response which may serve as positive modelling to infants. Therefore, this chapter particularly aims to provide a synthesis of findings from Chapters 2 – 6, discussing the main findings in the context of the current literature. Implications of these studies for future practice and research are also considered.

7.1 Recap of aims and main findings

The first aim of this thesis was to explore the effectiveness of digital-based interventions promoting RF on infant growth, weight status, and parental feeding behaviours (Chapter 2). The second aim was to assess how well infant appetite cues during early and late stages of mealtimes are understood by UK adults, and whether this recognition varies between individuals (Chapter 4). Next, the third aim was to investigate caregivers' tendencies to tune in to their own appetite and affect (alexithymia), and how this related to their ability to recognise and respond to infant appetite cues during mealtimes (Chapter 5). Finally, a follow-up qualitative study was conducted with the aim of exploring mealtime experiences and feeding challenges of parents living with alexithymia (Chapter 6). The key findings from each chapter in this thesis are summarised in the following sections and Figure 7.1.

7.1.1 Chapter 2: Synthesising existing evidence from the studies on promoting responsive parenting or feeding with digital-based or face-to-face intervention for future research

This review systematically examined the effectiveness of interventions promoting RF on infant growth, weight status, and parental feeding behaviours. Across studies with digital-based and face-to-face interventions, parental self-reported RF improved, but the intervention effects on children's weigh gain and dietary patterns were inconsistent. Findings showed that the intervention effectiveness might be determined by a variety of components of the study design, such as delivery intensity, study duration, caregivers' previous parenting experience or feeding knowledge. However, parents were generally positive towards digital-based techniques in offering parenting or feeding support via qualitative data (Litterbach et al., 2017; Mobley et al., 2023). To conclude, digital-based applications which are personalised to the needs of specific families have potential to support responsive parenting and RF but the evidence base to support this goal is not yet convincing. Digital advances in app development are far ahead of the evidence base to support the app content. These review findings speak to limitations of a "one-size-fits-all" approach to supporting parents, where needs vary considerably from family to family. The gap between potential and evidence suggests opportunities for applying design research methods such as co-design, iterative prototyping, and human-centred evaluation to create interventions that align with families' real-world needs.

Overall, digital-based interventions can complement professional advice and provide tailored support, but alone they are insufficient to improve consistently parental feeding behaviours, dietary patterns and child weight status. Digital-based interventions which are co-produced with parents to recognise their specific needs should be developed and tested for effectiveness in influencing RF practices. The integration with face-to-face support, earlier antenatal engagement, booster sessions, appropriate dosage, and sustained engagement strategies may contribute to the intervention effectiveness. More importantly, taking account of both caregivers' and their children's characteristics to ensure that apps are personalised and specific to parents' needs.

7.1.2 Chapter 4: Exploring how well infant appetite cues are understood by individuals

Individual differences in recognising infant hunger and satiation cues during early and late stages of mealtimes were tested through video clips in an online survey (Yu, Birtill, et al., 2025). Results revealed a high consensus in recognising infant hunger and satiation cues, and this ability was not associated with gender, parenting status, previous feeding experiences, individual's appetite traits (e.g., SR) or mental health conditions (e.g., trait depression), except for alexithymia. Qualitative data from answers to the open-ended question on observation of mealtime cues indicated that positive affect of the infant (e.g., happiness) was observed accompanying infant hunger cues during early mealtimes; whereas more negative affect of the infant (e.g., feeling upset) was reported while infants displayed satiation cues at the end of the meal. Qualitative data also revealed that some babies might be less expressive by nature, which makes their intention more difficult to be understood during feeding. Overall, infant cues signalling interest/disinterest in eating were well recognised, which was not determined by individual differences except for alexithymia of the viewer. From a design perspective, these findings suggested that digital tools may support caregivers with alexithymia by providing external visual or interactive cues that enhance their recognition of subtle infant appetite signals tailored to different child temperament.

7.1.3 Chapter 5: Investigating caregivers' ability in tuning in to internal appetite and affect, and its association with recognising and responding to infant appetite cues

Caregivers with infants aged 6-24 months were asked via online survey about their RF practices, mealtime emotions, eating traits, alexithymia, in addition to their infants' eating traits using validated questionnaires (Yu, Fildes, et al., 2025). Recent mealtime experiences were collected through an open-ended question. Findings showed that firstly, caregivers who relied on interoceptive cues to guide their eating behaviours scored higher on recognising infant appetite cues during feeding. Secondly, caregivers with alexithymia reported reduced ability in recognising infant appetite cues and less positive mealtime emotions compared to those without alexithymia, which might lead to fewer RF practices. Next, SEM revealed that caregivers' ability in "tuning in" to their own internal satiation cues inversely mediated the association between caregivers' alexithymia and their recognition of infant appetite cues during feeding. Moreover, infant eating traits such as Food Responsiveness and Satiety Responsiveness were associated with parental use of food to calm. In summary, caregivers' RF was associated with mealtime emotions, their ability in tuning in to their own appetite cues and affect (alexithymia), and their children's eating traits. This illustrated a design opportunity that interventions could incorporate personalisation and scaffolding for caregivers with alexithymia. Interfaces could be personalised to individual caregiver profiles or needs, such as providing reflective feedback to support parental recognition of internal and infant cues, potentially promoting positive mealtime experiences and RF practices.

7.1.4 Chapter 6: A follow-up study with caregivers with high alexithymia scores regarding their mealtime interactions and feeding experiences

A qualitative study was conducted to explore mealtime experiences, feeding challenges and coping strategies of caregivers with high scores on alexithymia using one-to-one semi-structured, video-elicited interviews. Participants were selected based on their scores on the TAS-20 from the previous study (Yu, Fildes, et al., 2025). Five themes were identified through reflexive thematic analysis. Results showed that caregivers with high scores on alexithymia perceived mealtimes as a social activity where they could sit as a family, eat together, have conversations and enhance the family connection. Caregivers indicated that their mealtimes involved a lot of emotional investment, stress, and challenges such as their child's food sensory needs. Multiple coping strategies were reported as a means of "doing their best" to their mealtime difficulties, or to accommodate their child's needs. While seeking support from healthcare professionals, online resources, and/or social media, they reported that feeding resources were unhelpful. Facilitated by their previous answers to the open-ended questions on recent mealtime experience a year ago in the previous study (Yu, Fildes, et al., 2025), caregivers reflected on their parenting experiences and how they had adapted their feeding practices in response to their child's developing appetite cues. By reviewing the short video clip of their typical family mealtime, caregivers reported their observation of their child's appetite cues (e.g. the child was enjoying the mealtime, or child satiation cues overlooked by the caregiver). They also acknowledged the importance of mealtime interactions and the reassurance for them to know that they were "doing the right thing" in feeding.

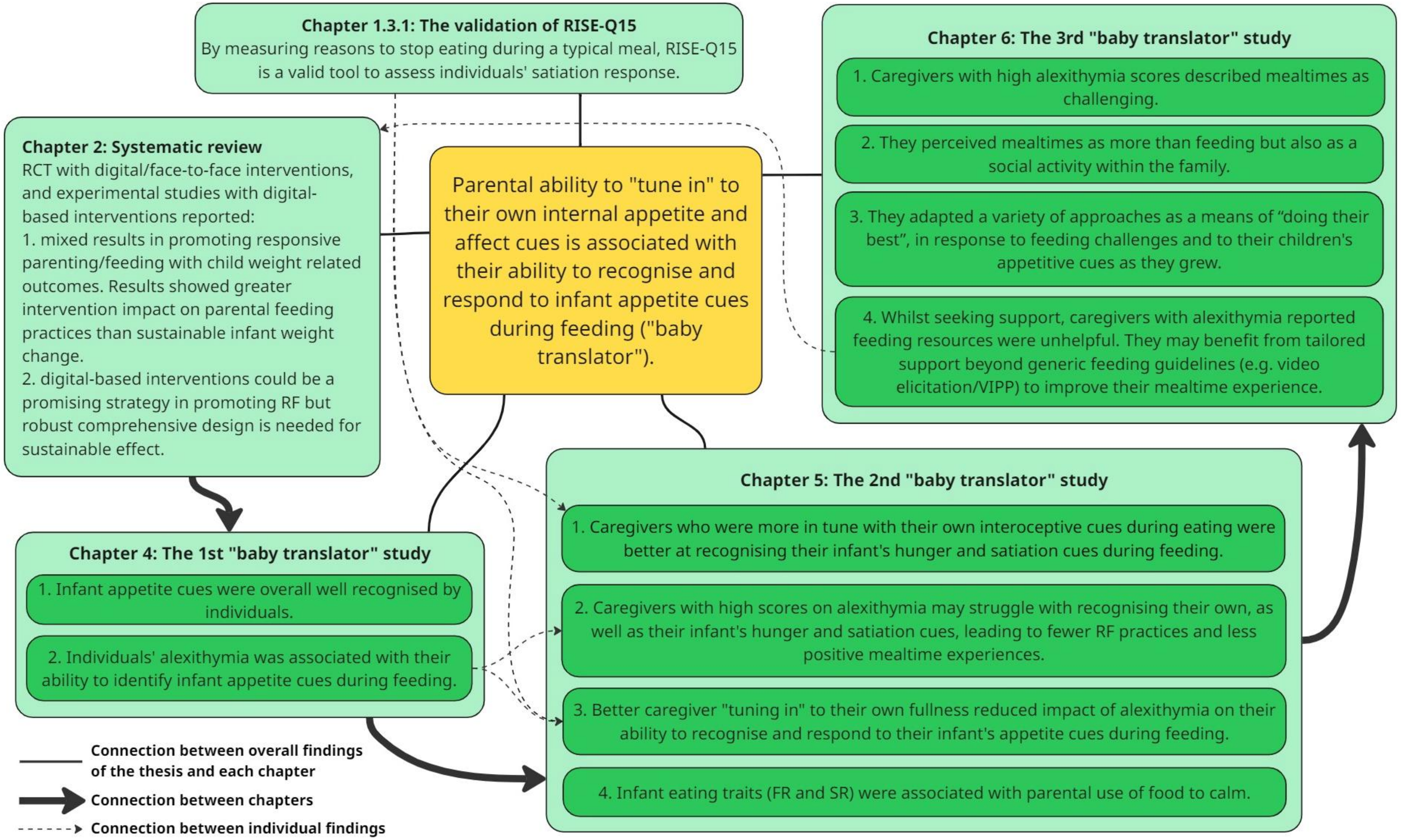


Figure 7.1. Overview of findings of this thesis.

7.2 Synthesis of findings

Five important themes are prominent across chapters of this thesis. They are: 1) SR of RF interventions demonstrated greater impact on feeding practices than sustainable infant weight change; 2) caregivers' ability to "tune in" to their own internal satiation cues aided their ability in recognising and responding to infant appetite cues; 3) caregivers' alexithymia influenced their RF practices and mealtime experiences; 4) children's eating traits and caregivers' RF practices interact; 5) tailored support for caregivers with alexithymia is needed. Each of these themes will be discussed in the following sections.

7.2.1 Systematic review of RF interventions demonstrated greater impact on parental feeding practices than sustainable infant weight change

Findings from the systematic review revealed that overall, in both studies with digital-based and face-to-face interventions, greater positive impact on parental feeding practices was reported than on sustainable infant weight change or eating patterns development (see Appendix E1). For example, both the *INSIGHT trial* and the *NOURISH trial* reported improved parental RF practices and less controlling behaviours, but intervention effectiveness declined with mixed success for infant weight outcomes. For example, findings from a series of follow-up studies of the *INSIGHT trial* revealed that intervention children reported slowed weight gain at 6 months of child age, lower overweight/obesity prevalence at 1 year (Savage et al., 2016) and 2 years of child age (Paul et al., 2018), but the group differences diminished by the time children reached 3 years of age and up to 9 years (Paul et al., 2025; Paul et al., 2018). In the *INSIGHT trial*, child BMI was lower in the intervention group from 3-9 years old but there was no group difference in child BMI z-scores (Paul et al., 2025). Similarly, children in the intervention group of the *NOURISH trial* showed less rapid weight gain and lower BMI z-score by 14 months old (L. Daniels et al., 2012); however, child BMI z-scores were no longer significantly different between groups at 2 years old (Daniels et al., 2014), and the overweight/obesity prevalence did not differ between groups at child 5 years old (Daniels et al., 2015).

In the *Baby Milk Trial*, despite the success in reducing milk intake at infant age 3, 4, 5 and 6 months, intervention infants showed slowed weight gain by 6 months but the intervention effect on weight gain was no longer observed when children reached 1 year old (Lakshman et al., 2018). Similarly, in the *Baby First Bites* study, mothers in the intervention group consisting of both repeated vegetable exposure and video-feedback in infant feeding reported more sensitive feeding behaviours, less pressure to eat compared to the control group at child age of 18 months (van Vliet et al., 2022). However, van Vliet et al. (2022) reported no significant intervention effects on child BMI z-scores, vegetable intake improvement or child self-regulation of energy. In the *Multicomponent eHealth* study, intervention children showed increased vegetable and fruit intake compare to those in the control group (Lee et al., 2023). Similarly, intervention mothers in the *NOURISH trial* reported higher liking of vegetable and fruit of their children compared to the control group (Magarey et al., 2016). In addition, in the *INSIGHT trial*, intervention children showed lower emotional overeating than controls at 2.5 years old (Ruggiero et al., 2021). Whereas in the *NOURISH trial*, intervention children showed higher SR at 2 years old (Daniels et al., 2014) and at 5 years than controls, but the difference was small across time (Magarey 2016). They also reported lower emotional overeating and fussiness at 2 years compared to the control group (Daniels et al., 2014) but the differences were no longer significant at age 3.7 and 5 years (Magarey et al., 2016). More importantly, although significant time effects were reported on child eating traits (including FR, SR, emotional overeating and fussiness) across groups, which indicated developmental changes in eating traits independent of intervention, there was no significant time x group interaction across early childhood (Magarey et al., 2016). Findings suggested that eating traits may differ between intervention and control groups, but this cannot be entirely attributed to the intervention effects since there were no group by time interactions.

In contrast, a few studies demonstrated non-sustained intervention effects on fruit and vegetable intake, child self-regulation of energy intake, or mealtime routines (Helle et al., 2019a, 2019b; Morandi et al., 2019; van Vliet et al., 2022). Nevertheless, it is worth noting that both face-to-face and digital-based interventions yielded a positive impact on parental RF practices (L. Daniels et al., 2012; Daniels et al., 2014; Daniels et al., 2015; Hughes et al., 2023; Lee et al., 2023; Paul et al., 2019; Ruggiero et al., 2021), sensitive parenting (van Vliet et al., 2022), or parental self-efficacy (Lee et al., 2023; Morandi et al., 2019). The inconsistent results in child weight change, dietary pattern, and promising influence on parental feeding behaviours may indicate that there is no “rule of thumb” in the intervention design. As children grow, in addition to parental RF practices, other factors may also affect child eating behaviours and weight status, such as the obesogenic environment and genetic factors (e.g. metabolic factors) discussed in Chapter 1. This may suggest that weight status in early childhood (e.g., from 12 months and onwards) is influenced by multiple factors beyond parental feeding practices. These findings underscore the need to develop multi-layered intervention systems that integrate user experience, environmental context, and behavioural nudges rather than relying on single factor approaches.

As illustrated in Chapter 1, BST suggested that the interplay between genetic factors and environmental factors can influence individuals' appetite, and ultimately their weight status (Llewellyn & Fildes, 2017) (see Figure 1.1). Recently, to explore the bidirectional relationships between child eating traits (e.g., FR, SR) and their BMI, Costa et al. (2021) conducted a study with a large sample of children aged 7-10 years (N = 4264) from the Generation XXI birth cohort. Cross-lagged analysis revealed a strong association between child BMI and eating traits. Specifically, while children with high BMI at age 7 were more likely to develop high FR, enjoyment of food, emotional overeating, and low SR, these eating traits might become more pronounced by age 10, indicating that higher BMI may prospectively influence eating traits over time (Costa et al., 2021). In addition, Costa et al. (2021) proposed a number of factors to explain this relationship, including biological factors that lead to increased appetite, obesogenic environments that promote eating, and parental perceptual bias (e.g., parents may perceive children with higher BMI as having avid appetite). Thus, during childhood, compared to children with low BMI, those with high BMI might be more vulnerable to the obesogenic environment due to high food approach eating traits (FR, enjoyment of food, emotional overeating) and low

SR. On the other hand, eating traits in children might be responsive to weight status, rather than solely innate determinants of subsequent weight gain. A short-term intervention on feeding practices or behaviour change may not overpower these strong influences on child weight status.

7.2.2 Caregivers' ability to "tune in" to their own internal satiation cues, and their ability to recognise and respond to infant appetite cues

The association between individuals' satiety responsiveness (measured by AEBQ), intuitive eating behaviours (measured by IES-2) and reasons to stop eating as satiation response (measured by RISE-Q15) was consistent across the "baby translator" studies in chapters 4 and 5. Therefore, a latent construct named "caregivers' ability in tune-in to internal satiation cues" was developed (Chapter 5). It represents an ability to detect and respond to internal sensation of hunger, appetite and satiation, rather than rely on external cues (such as time of the day, portion size or social occasion) to guide eating behaviours. Adults were generally good at recognising infant appetite cues via video clips (Chapter 4). However, caregivers who were in tune with their interoceptive cues were more likely to identify infant appetite cues during feeding (Chapter 5). In thinking of RF practices this requires prompt and appropriate response to their child's signals of hunger and fullness. However, some parents may notice these cues yet offer more food due to concerns about the amount eaten, or avoiding food waste (Chapter 6). Parents not recognising or responding to these cues, over time, may lead to child weight problems through nonresponsive feeding practices (Faith et al., 2004; Stifter et al., 2011). For example, results from a longitudinal study reported that maternal low sensitivity to infant feeding cues at 6 months of age was positively associated with infant's higher weight gain at 12 months (Worobey et al., 2009).

It is worth noting that after watching the short mealtime video clips during the interview, caregivers with alexithymia commented that at the end of the meal, they noticed that they had overlooked the satiation cues from their child and were still encouraging their child to eat more (Chapter 6). Studies revealed that excessive parental control over feeding, such as pressure to eat and restrictive feeding, may be inversely associated with under- or overfeeding which leads to feeding problems including infant weight gain (Farrow & Blissett, 2006a) and children's reduced ability to self-regulate energy intake (Johnson & Birch, 1994).

7.2.3 Caregivers' alexithymia, their RF practices and mealtime experiences

Scores on alexithymia were associated with the ability to recognise infant interest/disinterest in eating through video clips (Chapter 4). Additionally, caregivers' alexithymia was inversely related to their recognition of infant appetite cues during feeding and their positive mealtime experiences. Better caregivers' ability in tuning in to their own satiation cues may reduce the negative impact of alexithymia on their recognition and response to their infants' appetite cues during feeding (Chapter 5). With real-life experiences, caregivers with high scores on alexithymia reported that their family mealtime was challenging, that they adapted a variety of coping strategies as solutions to feeding challenges (Chapter 6).

According to our findings, caregivers' alexithymia may influence the quality of parenting/feeding through reduced capacity to accurately perceive, interpret, and respond to their children's signals and communications (Chapter 5 and 6). This capacity features a construct named parental sensitivity (Ainsworth et al., 2015), which does not focus only on behavioural sensitivity (i.e., appropriate behavioural responses), but also on the appropriateness and awareness of the emotional climate of the caregiver–infant interactions (Easterbrooks et al., 2012). Thus, this capacity plays a crucial role in providing a timely and appropriate response to the child (Ainsworth et al., 2015), as well as in the social-environmental influences, particularly parental language and modelling during interactions for children's learning and especially their social understanding (McMahon & Bernier, 2017). Furthermore, Meins (1997) proposed that caregivers who are in tune with their children's views and needs have the capacity to recognise their infant's cognitive potential and provide appropriate developmental challenges, to maximise their learning opportunities, particularly in terms of social cognition and emotion understanding. On the other hand, a child's capacity to regulate emotions, cognitive attention and arousal develops in the context of caregiving and interactions with their caregivers from early infancy; hence, it is determined by the bidirectional signalling and understanding of emotions (Bornstein et al., 2012).

However, alexithymic traits are exhibited through difficulties in emotional awareness regarding identifying not only individual's own, but also other's emotions and feelings (Taylor, 1984). In the parenting and feeding domain, inadequate recognition of emotions and feelings may affect caregivers' capacity to respond to their child's cues appropriately and timely, which is a key element in sensitive parenting (de Cock et al., 2016). For example, Ahrnberg et al. (2021) conducted a study with an observed free-play situation in the lab to investigate the association between maternal alexithymic traits and the quality of maternal caregiving behaviours during early infancy. Findings showed that maternal difficulty in describing feelings (measured by TAS-20) at 6 months postpartum was associated with lower maternal sensitivity in terms of creating and maintaining positive and emotionally responsive behaviours towards the child at 8 months postpartum; and maternal higher scores on Externally Oriented Thinking (measured by TAS-20) at 6 months postpartum were significantly associated with a poorer ability to regulate their own negative emotions during the caregiver-infant interaction at 8 months postpartum (Ahrnberg et al., 2021). In another longitudinal study consisting of observed natural feeding, as well as general play occasions in the family home, Farrow and Blissett (2014) reported that maternal capacity in tuning in to their infants' intentions, views and feelings at 6 months of infant age was significantly associated with positive and sensitive maternal behaviours during feeding at 1 year of infant age. Results suggested that mothers who were less attuned to their infant's emotional responses may consider mealtimes as more functional with a focus on food provision, rather than a social occasion involving positive mealtime interactions, which, therefore, could lead to insensitive and nonresponsive feeding practices (Farrow & Blissett, 2014).

In addition, alexithymia is often associated/co-occurring with other mental health conditions such as ASD (Poquérusse et al., 2018), anxiety (Marchesi et al., 2004), depression (Honkalampi et al., 2000), which are known risk factors for poor quality of parenting (Ahrnberg et al., 2021). For instance, maternal depressive symptoms was associated with more intrusiveness and withdrawal (Tronick & Reck, 2009) and less structuring parental behaviours (Hakanen et al., 2019), as well as problems in parental emotional regulation (Riva Crugnola et al., 2016). Thus, there might be a more complicated mechanism from alexithymia on caregivers' ability to provide sensitive parenting and responsive feeding.

7.2.4 Child eating traits and caregivers' RF practices interact

Findings from Chapter 5 revealed that child eating traits (FR and SR) were positively associated with parental use of food to calm. Furthermore, in the follow-up study, caregivers with alexithymia reported their difficult family mealtimes involving feeding their fussy child, their strategies to encourage eating or to accommodate their child's needs (e.g., underweight, food sensory needs), as well as how they adapted their feeding practices as their child grew or between siblings in response to different child characteristics (e.g., eating traits, child temperament) (Chapter 6).

It is common for children to go through a phase of fussy/picky eating which often starts around 18-24 months (Birch & Fisher, 1998). They may display certain behaviours such as refusing new and previously liked foods, showing avoidance towards healthy foods (e.g., fruits and vegetables) and family meals (Dovey et al., 2008; Harris et al., 2019). In this thesis, parents with high scores on alexithymia reported similar child behaviours during the interviews and perceived them as additional stress in feeding (Chapter 6). Findings from a cross-sectional survey with parents of children aged 2-5 years showed that parental greater use of more controlling feeding practices was associated with their concern about children's fussy eating (Harris et al., 2018). Wardle et al. (2005) also reported that feeding practices in response to child food neophobia or fussiness were associated with subsequent child centred consequences, such as children's reduced autonomy and self-regulation around eating, as well as less healthy eating behaviours (e.g., children's fruit and vegetable intake). Research suggested that it takes up to 15 exposures of a new food for children to taste or accept (Birch & Marlin, 1982) and a further 10-15 exposures to generate liking for the food (Wardle et al., 2003). This learning process of children may be associated with food neophobia which is a developmental response occurring around 2 years of child age (Dovey et al., 2008). Parents may respond to food rejection by accepting this and no longer offering that food after a few attempts, which results in a narrow diet of the child by "giving up too soon" (Aldridge et al., 2009; Cashdan, 1994). Thus, Aldridge et al. (2009) demonstrated the importance of parental control over food acquisition, availability and provision within the home environment from an early age of their children, which may contribute to a greater dietary variation in later childhood and more positive mealtime experiences.

Furthermore, the BST proposed that children's poor appetite and low interest in eating are related to underweight and weight faltering which sits at the other end of the weight spectrum from obesity and rapid weight gain (Llewellyn et al., 2023). Underweight and slow weight gain in infancy and early childhood may cause great concerns for parents (Gueron-Sela et al., 2011; Lee et al., 2019). Consequently, these parental concerns could in turn lead to the development of negative mealtime interactions with children who experience persistent difficulties in eating that yield poor weight gain or significant loss of weight over time (Gueron-Sela et al., 2011). It is worth noting that BST demonstrated inherited variation in appetite regulation as "a critical causal factor over and above poor parenting" (p.7) (Llewellyn et al., 2023). For example, research has focused on fussy eating as an important determinant of childhood underweight, with cut-off scores derived for Food Fussiness from CEBQ with high sensitivity and specificity to identify children with clinically significant selective eating (Steinsbekk et al., 2017). More importantly, Food Fussiness demonstrated high heritability estimates of the same order of magnitude as those observed for SR and FR (Gibson & Cooke, 2017). This supported the claim that a broad range of eating behaviours are under strong genetic influence (Llewellyn & Fildes, 2017), that parental feeding practices such as restriction or pressure to eat may be in response to inherent child eating traits (Shloim, Rudolf, et al., 2015). More importantly, Herle et al. (2020) reported heterogeneous developmental trajectories in child eating behaviours in a large-scale longitudinal study in the UK. For example, overeating in early childhood was significantly associated with child high BMI z-score at age 11, whereas persistent undereating and fussy eating were significantly related to low BMI z-score at 11 years old, indicating the importance of parental longitudinal monitoring of child eating behaviours rather than single time-point regulation (Herle et al., 2020).

In summary, the synthesised findings from Chapter 5 and 6 that child eating traits associated with parental feeding practices demonstrates how parents may adopt specific, and sometimes inappropriate/non-responsive, feeding practices to ensure that their child eats an adequate range or amount of food. Since parental feeding practices in early infancy can shape children's eating behaviours and health outcomes (Burnett et al., 2022), which may track into later life (Ventura & Birch, 2008), parents may therefore benefit from feeding guidelines that help them to understand the amount of food their child needs, characteristics of children’s eating behaviour traits (such as poor appetite and fussy eating), then provide support to help facilitate healthy eating and growth.

7.2.5 Tailored support for caregivers with alexithymia is needed

Mixed results were observed regarding the effectiveness of both face-to-face and digital-based interventions on promoting responsive parenting/feeding (Chapter 2). Programmes involved were heterogeneous in terms of the type of intervention delivered (e.g. intervention materials, targeted behaviours and outcomes), the intensity and duration of delivery. Comprehensive design is needed for sustainable effect on the impact of promoting RF practices on positive child outcomes (Chapter 2). During the interviews with caregivers with high scores on alexithymia, participants revealed difficulties in feeding, and conflicting attitudes towards traditional feeding support (e.g., support/guidelines from NHS, healthcare professionals including health visitors, general practitioners) and digital-based feeding support (e.g., social media, mobile apps). Limited access to the public services, contradictive advice from healthcare professionals, general feeding guidelines not being helpful were the main parental concerns. While feeding resources on social media were considered additional pressure and last resort, these contents (age-appropriate foods and recipes) could be accessible and inspiring for day-to-day parenting, and online peer support was helpful and reassuring for participants. Findings indicated a potential contribution for design research, such as developing interventions that combine evidence-based content with socially supportive, customisable, and context-sensitive digital interfaces may enhance parental engagement and confidence in feeding (Chapter 6).

Findings from a review showed that difficulties related to infant feeding and children's eating behaviours by parents are very common (Mitchell, Farrow, et al., 2013) and stress around difficult family mealtimes can have a detrimental impact on both the caregiver and their child's emotional and psychological wellbeing (Blissett et al., 2007; Mitchell, Farrow, et al., 2013). On the other hand, parents and caregivers have reported a lack of effective, credible resources to support them with feeding their children at critical time point during early infancy, such as the transition to solid foods (Mitchell, Farrow, & Haycraft, 2013). Haycraft et al. (2020) also suggested that despite the research evidence was clear about the optimal approach to support the development of children’s eating behaviours, this information was slow in transferring to parents and caregivers who need evidence-based advice.

However, regardless of the mixed results from studies promoting responsive parenting and feeding, digital-based interventions still hold promise in delivering effective, cost-effective, efficient, and highly scalable behaviour change programmes (Mitchell, Farrow, et al., 2013; Murray et al., 2016). In the parenting and feeding domain, digital-based interventions can address typical barriers compared to traditional interventions, such as delivery time, location of daytime childcare (Virudachalam et al., 2016). For example, Boswell et al. (2019) conducted a study using an online survey with parents of children aged 2-5 years old to explore their attitude towards participating in online and social media-based feeding interventions. Parents reported that a combination of online platforms (e.g., websites, email, Facebook) was the most preferred method of intervention delivery, followed by a combination of online and face-to-face approaches (Boswell et al., 2019).

Furthermore, to help parents reduce controlling feeding practices and maternal anxiety in feeding, Haycraft et al. (2020) conducted an experimental study with 25 mothers of children aged 6 months to 4 years to evaluate the effectiveness of a digital health intervention (website/app) over 4 weeks named Child Feeding Guide. Significant reductions were reported in parental pressure to eat, restrictions for child weight control and maternal anxiety, and mothers reported positive user experiences (Haycraft et al., 2020). More recently, another digital, mobile-based RF intervention was developed to support Australian parents of children aged 6 months to 3 years in feeding (Baxter et al., 2024). Different from the Child Feeding Guide which employed behaviour change theory (Haycraft et al., 2020), Baxter et al. (2024) adopted the design thinking in addition to co-design with parents and health professionals in the Eat, Learn, Grow study. As a result, parents and experts considered this intervention highly acceptable and accessible, with tailored programme materials focusing on RF (recognising infant hunger and satiation cues), practical strategies for families facing food insecurity, and digital delivery that fits into busy, resource constrained lives (Baxter et al., 2024). Although investigation on long-term effect is needed for both studies, the Child Feeding Guide demonstrated the translation from theory-driven research into practice with measurable impact (Haycraft et al., 2020); whereas Eat, Learn, Grow study illustrated acceptable and context-sensitive interventions with co-design involved (Baxter et al., 2024) (see Table 7.1 for an overview and comparison).

Feature	Eat, Learn, Grow study (12 short interactive lessons for parents) (Baxter et al., 2024)	Child Feeding Guide (4-week programme) (Haycraft et al., 2020)
Approach	Design thinking (empathize, define, ideate, prototype, test) Co-design with parents and experts.	Behaviour change theory (Information-Motivation-Behavioural Skills Model, Self-Determination Theory, self-efficacy)
Target sample	Australian families with children 6–36m, especially those vulnerable to food insecurity.	UK parents of children 6m-4y, general population.
Focus	Promotes RF in contexts of food insecurity and economic hardship.	Reduces controlling feeding practices (e.g., pressure, restriction, food as reward).

	Addresses both *what* and *how* to feed.	Support responsive parenting and feeding strategies.
Format	Mobile-first microlearning modules (short, visual, interactive lessons). SMS delivery, low data cost.	Website + app with interactive tools, tracking features, evidence-based advice.
Development process	Iterative codesign: workshops, interviews, mealtime observations, surveys, and expert review.	Iteratively refined with parent and professional feedback; content authored by child feeding experts.
Content style	Brief, visual, plain language; contextually sensitive to hardship; flexible and reassuring.	Evidence based explanations of pitfalls (e.g., pressure, restriction, rewards) + recommended alternatives (e.g., exposure, modelling, responsiveness).
Programme evaluation	Highly acceptable to parents. Prototypes tested positively. Final intervention includes 12 modules.	Reduced maternal anxiety Less pressure to eat Less restriction for weight control
Strengths	Deeply empathetic, co-created with disadvantaged families. User-centred, tailored to real world constraints.	Demonstrated measurable behaviour change in naturalistic use. Scalable, low cost, credible digital support.
Limitations	Still in development/early testing Lack of long-term outcomes	Small sample (25 mothers) Short evaluation period (4 weeks)

Table 7.1. A comparison of essential features of the Eat, Learn, Grow study (Baxter et al., 2024) and the Child Feeding Guide (Haycraft et al., 2020).

Overall, while findings suggested that digital-based interventions may be a promising approach to intervene with parents to promote their feeding practices, there is a need to provide specific support to parents with mental health challenges and to those with high alexithymia scores and/or experience great stress during family mealtimes. Tailoring the delivery format, contents, and mode of interaction to parents' specific needs and preferences, rather than offering generic feeding guidelines, serve as an important factor in improving the effectiveness of RF related interventions.

7.3 Strengths and limitations of the thesis

The studies involved in this thesis used mixed designs and a variety of data analysis methods to address multiple research questions (presented in Table 1.2). These design and research methods include systematic review of existing literature (Chapter 1), pilot study with a convenience sample (Chapter 2), online surveys with open-ended questions with UK adults (Chapter 3) and caregivers (Chapter 4), one-to-one semi-structured video-facilitated interviews with caregivers scoring high on alexithymia (Chapter 6). Contextual data regarding mealtime experiences were collected to complement individual traits measured through validated questionnaires (Chapter 5). During the follow-up study, video observation of a typical family mealtime and the reflection of a previously collected quote on recent mealtime experiences extended the discussion of participants' feeding experiences (Chapter 6). Together, these chapters captured some of the complexity of parental RF practices whilst addressing important research gaps and questions (Chapter 1). Findings from each chapter complement each other and deepen our understanding of factors associated with parental responsiveness towards infant appetite cues, despite the wide range of methods and materials used.

The chapters also provide novel findings by investigating the relationship between caregivers' ability in "tuning in" to their interoceptive cues and their RF practices (Chapter 5), in addition to parental reported mealtime challenges, coping strategies, and progress they made in feeding their child (Chapter 6). As RF practices of caregivers with high scores on alexithymia have not been studied previously, these studies provide insight into the importance of the sensitivity in parenting/feeding, and how caregivers with alexithymia may benefit and improve their RF practices.

Despite the strengths of multiple methods used and the novel findings, this thesis contains limitations. First, due to the COVID lockdown and the change of research methods, it was not possible to test the effectiveness of educational feeding resources on parental responsiveness to child appetitive cues as planned. Therefore, it is not known to what extent caregivers with alexithymia could benefit from learning to improve their RF practices. Secondly, these studies are cross-sectional which leads to correlational results. Additionally, in the studies with online surveys (Chapter 4 and 5), self-reported measures and reporting biases may have a negative impact on the data validity. Future research may benefit from longitudinal design with observations, in addition to parental self-reported measures. Thirdly, the difficulty in recruiting caregivers with alexithymia slightly altered the target sample of the third “baby translator” study (Chapter 6). We aimed to recruit participants with alexithymia, whose TAS-20 scores were above 60 (i.e., the cut-off score for having alexithymia). However, due to low response, with some participants indicating that they had difficulties in communicating through interviews, the final sample consisted of caregivers with high scores on alexithymia (52<TAS-20 score<74, with 52<TAS-20 score<60 indicating “potential alexithymia”). Cautious interpretation is needed when generalising findings with caregivers with alexithymia, since further study is warranted to explore if they experience severe difficulties that were not yet reported in Chapter 6, particularly with self-selected participants. Moreover, during the study, a few caregivers spontaneously revealed that they suffered from other mental health conditions including ASD and postnatal depression, which were not measured in the study (Chapter 5 and 6). This indicates that their RF practices and mealtime experiences may be influenced by more complicated mechanisms than alexithymia.

7.4 Implications

Few studies have previously examined how caregivers’ ability to “tune in” to their own appetite and affect cues may affect their RF practices. Therefore, this thesis presents novel insights in promoting parental sensitivity in identifying interoceptive cues, and its association with their recognition and response towards child appetite cues, and to improve their family mealtime experiences. These findings have implications regarding parental RF practices for both parents and healthcare professionals. These implications also point to opportunities for intervention design that can operationalise these insights into concrete resources, tools, or structured feedback mechanisms for caregivers. Firstly, developing caregivers’ awareness and appropriate response to their own and their child's appetite and affect cues may be associated with elevated parenting sensitivity, and may facilitate a more responsive style of feeding practices. Parents can shape children's eating behaviours, food acceptance and preferences through positive modelling, repeated exposure, and education on recognising and responding appropriately to their internal appetitive cues. However, interventions shouldn't simply focus on helping caregivers to recognise infant appetite but also help address other barriers to RF practices and motivations to get infants to eat in a way that is not aligned to their appetitive cues.

In this thesis, video elicitation appeared to be helpful for parents with high scores on alexithymia in reviewing their feeding practices and mealtime interactions. This may indicate the potential of video elicitation-based techniques, such as the Video-feedback Intervention to Promote Positive Parenting and Sensitive Discipline (VIPP-SD) in promoting responsive parenting/feeding behaviours. Programmes using VIPP-SD focus on capturing positive moments, sensitive parenting behaviours through recordings and help parents to see their child's perspective (Juffer et al., 2017). For example, successful outcomes were reported by Alsancak-Akbulut et al. (2021) in a RCT with VIPP-SD, with 68 Turkish mothers of children aged 9-30 months. Mothers in the intervention group (N = 40) received four biweekly home visits using video-recorded mother-child interactions in addition to two booster sessions. Intervention mothers showed a significant increase in maternal sensitivity and decrease in intrusive behaviours (e.g., parental controlling) compared to mothers in the control group; and the group differences remained at the 3-month follow-up (Alsancak-Akbulut et al., 2021).

A meta-analysis of 12 RCTs conducted by Juffer et al. (2017) suggested that VIPP-SD was effective in promoting parental sensitive caregiving and positive discipline, with a variety of positive parental and child outcomes reported including improved parenting quality and parental self-efficacy, increased child responsiveness and attachment, children's greater autonomy during mealtimes and fewer behaviour problems. Also, van Ijzendoorn et al. (2023) reported evidence from reviewing 25 RCTs that both parents and their children could benefit from the employment of VIPP-SD, including consistent improvement in parental responsiveness across diverse samples (e.g., low-income families, autism risk), positive attitudes in parenting/feeding and higher self-efficacy in intervention groups. Meanwhile, intervention children were more likely to develop secure attachment relationships with their parents (van Ijzendoorn et al., 2023). In conclusion, VIPP-SD might be an effective and practical approach with tailored intervention design to improve responsive parenting or feeding of caregivers living with alexithymia.

It is worth noting that Zeegers et al. (2019) conducted a quasi-experimental study with clinically referred mothers (with diagnosed mood, anxiety, post-traumatic stress disorder, or other disorders) of infants aged 0-48 months, to evaluate the effectiveness of a 8-9 week group-based mindful parenting training with mothers on the improvement of maternal behaviours and the mother-child interaction quality. Results showed that the mindful training not only reduced maternal stress but also enhanced maternal acceptance and sensitivity towards child signals, as well as the dyadic synchrony, which overall promoted better emotional communication and responsiveness between mothers and children (Zeegers et al., 2019). The positive outcomes indicated that mindful parenting interventions might be promising and suitable for parents with psychopathology, such as alexithymia, to promote their ability to "tune in" to their child's cues, decode the communication and meet their child's needs.

Second, caregivers with alexithymia may experience difficulties in identifying both affective interoception (i.e., emotions) and non-affective interoception (e.g. hunger, fatigue, arousal), whereas the ability to recognise these states is particularly important for individuals to respond to others' needs (Brewer et al., 2016). Due to this general deficit of interoception, caregivers with alexithymia are at high risk of applying insensitive parenting behaviours and are likely to experience barriers in adopting RF practices. From the child's perspective, some children are less expressive by nature which may offer more pressure and challenges for parents in serving as the "baby translator" and understanding child intentions (see Figure 7.2). This could be problematic in RF since infants who display fewer appetite cues during feeding (e.g., disengagement and satiation) may have parents who are less responsive to their needs, as these infant cues do not reliably elicit parental caregiving responses (Ventura et al., 2024). In contrast, for infants who do not clearly communicate their satiation, parents lack the cues to guide their feeding practices, especially on when to stop feeding (Ventura et al., 2024). However, TAS-20 is a cost-effective, relatively short questionnaire and low burden to participants which could be applied in maternity clinics to screen and identify caregivers with alexithymia within the general population for preventive health care.

Left: mother with alexithymia (i.e. general deficit in interoception) which may reduce her ability in recognising and responding to her child's cues.

Right: a child who is less expressive by nature, which makes it difficult for parents to interpret child intentions.

Figure 7.2. Parental and child characteristics influence mealtime tone and affect. Figures were generated by OpenAI-ChatGPT and adopted for this thesis.

In addition, in a review which synthesised 50 years of research on alexithymia, Luminet and Nielson (2025) investigated the etiology and effective treatment for alexithymia. They suggested that psychosocial interventions (such as emotion-focused therapy, mentalisation-based approaches, as well as mindfulness-based interventions) and cognitive approaches (which target at attention to internal states, or emotion vocabulary) help individuals with alexithymia, by improving emotional awareness, emotional language, bodily sensation and expression, interoception, and reflective functioning (Luminet & Nielson, 2025). Although alexithymia is multidimensional and interventions may target at different facets of alexithymia (Difficulty Identifying Feelings, Difficulty Describing Feelings, Externally Oriented Thinking), they can effectively reduce alexithymia scores (Luminet & Nielson, 2025). Therefore, caregivers with alexithymia may benefit from early, precise and personalised intervention or educational resources on parenting/feeding, particularly on understanding and responding to their own internal cues as well as infant appetite cues during feeding, in addition to tailored tangible support beyond generic feeding guidelines, to promote RF practices and foster healthy eating behaviours in their children.

7.5 Future research

Based on evidence from this thesis, future research could focus on developing an intervention to promote alexithymic caregivers' sensitivity to their interoceptive cues, and whether this improves their recognition and response to child appetitive cues during feeding; subsequently, whether they are able then to provide more RF practices. Design-led research methods, such as co-design with caregivers and iterative prototyping, may be essential in developing and refining such interventions in ways that are acceptable and meaningful to them. This could start from developing credible educational resources on recognising appetite and affect cues of themselves as adults, and of infants and young children. Digital-based interventions might be an optimal approach in which educational resources and social support could be embedded for caregivers with alexithymia. Further design research could contribute by exploring how digital formats, interaction flows, and feedback mechanisms influence caregivers' engagement with and understanding of appetite and affect cues.

Cut-off scores of the "Food Fussiness" from CEBQ have been used to identify children with clinically significant selective eating (discussed above in chapter 7.2.3). Based on existing findings regarding the relationship between child eating traits and parental feeding practices, similar work could be undertaken for FR and SR. Altogether, they can be applied to screen and identify infants and young children with certain eating traits such as low interest in eating, fussy eating, or avid appetite. These children might be prone to under- or overeating; thus, they are at high risk of underweight or overweight, respectively. Research may focus on early prevention instead of later treatment, for children to develop healthy eating behaviours from early life.

Considering the interaction between genetic factors (i.e., eating traits discussed above) and environmental factors in shaping an individual's appetite, future studies could investigate the impact of regulating external/contextual factors on RF practices and mealtime experiences of alexithymic parents. For example, feeding guidelines disseminated by researchers or public health authorities could focus on elements that are easy to monitor in the obesogenic environment and provide appropriate instructions, such as food availability in the household, portion sizes offered to the child, and parental modelling of healthy eating during family mealtimes. The focus on both internal and external cues has potential to provide an optimum, positive effect on the development of child eating behaviours.

7.6 Conclusion

This thesis used a variety of methods and perspectives to examine factors associated with parental RF practices. Associations between caregivers' ability to tune in to their own interoceptive cues and their ability to recognise and respond to infant appetite cues ("baby translator"), along with real-life feeding experiences (i.e., challenges and coping strategies) of caregivers with high alexithymia scores were explored. Firstly, the systematic review concluded that the effectiveness of digital-based and face-to-face interventions on promoting parental RF practices was inconsistent. Variable success was reported in improving parental RF practices which may reflect parental confidence and perception of competence. However, even if RF changes, this may not result in changes in child weight gain or dietary patterns. Secondly, infant interest/disinterest in eating displayed at the early/late stage of feeding through video clips was generally well recognised by individuals. However, recognition scores were lower among viewers who scored higher for alexithymia. Thirdly, caregivers with high alexithymia scores reported fewer RF practices and less positive mealtime emotions compared to those with low alexithymia scores. Caregivers who were more in tune with their own internal appetite and affect cues were more likely to recognise their infant appetite cues during feeding, compared to those who were less responsive to interoceptive cues. Moreover, better caregiver "tuning in" to their own satiation cues reduced the impact of alexithymia on their ability to recognise and respond to infant's appetite cues during feeding. Furthermore, caregivers with high alexithymia scores reported that their family mealtimes were challenging, which involved a variety of difficulties and coping strategies for better mealtimes.

Taken together, findings from this thesis indicate that parental RF practices depend on their infant appetite recognition, while parents vary in this ability. More importantly, parental ability to tune in to their own internal appetite cues and affect (i.e., alexithymia) influences their ability to recognise and respond to infant appetitive cues. Parental RF practices are also associated with their child' eating traits and available accessible support on feeding. In summary, findings demonstrated the importance of promoting parental sensitivity and awareness of their own internal state, their interoceptive cues in terms of appetite and affect, particularly for caregivers with alexithymia. It also suggests the need for effective intervention and reliable educational resources on improving parental responsiveness to both their own and their children's appetitive cues, which may contribute to more RF practices and the development of healthy child eating behaviours. The findings therefore provide a strong empirical foundation for future design work aimed at translating these psychological insights into accessible, supportive interventions for caregivers.

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Appendices A: Chapter 2

Set	Search Statement
1.	(("infant*" or "mother" or "parent" or "mom" or "bab*" or "child") and ("app" or "app-based" or "web-based" or "digital" or "digital-based" or "smartphone" or "mobile phone" or "mHealth" or "internet" or "online" or "responsiveness" or "responsive feeding") and ("obes*" or "growth" or "weight" or "adiposity" or "feeding practice" or "hunger" or "satiety" or "appetite cue*" or "solid food" or "complementary feeding" or "weaning")).mp. [mp=ti, ab, hw, tn, ot, dm, mf, dv, kw, fx, dq, nm, kf, ox, px, rx, an, ui, sy, tc, id, tm, mh]
2.	limit 1 to english language
3.	limit 2 to humans
4.	limit 3 to "all infant (birth to 23 months)"
5.	limit 4 to randomized controlled trial
6.	limit 5 to last 10 years
7.	remove duplicates from 6

Appendix A1: Search strategy of the systematic review conducted on OVID. The syntax used in this search strategy was adjusted where necessary according to the requirements of different databases.

Study ID and trial name (based on the study protocol)	Design	Participants	Settings	Intervention	Comparison	Outcome measures
Baby's First Bites trial **(van der Veek et al., 2019)**	RCT	243 mother-child pairs Mean age at baseline (M±SD): Mother (y): 31.0±4.7 Child (wk):20.1±3.9	Netherlands: Lab-based, conducted from 2 study locations (Wageningen and Leiden University) and carried out in 4 provinces (Zuid-Holland, Noord-Holland, Gelderland and Utrecht).	A **repeated vegetable-exposure intervention** promoting vegetable consumption (RVE) ("*what*" to feed in complementary feeding, with exposure to target vegetables in the first 19 days of weaning). Five phone calls were offered at child age 4–6, 8, 13 and 16 mo to motivate parents to expose children to vegetables. Each phone call focused on a different theme involving risk factors and determinants that may influence children's vegetable consumption: knowledge, attitude, self-efficacy, skills, modelling, availability of vegetables, beliefs of the parent, positive reinforcement, and costs. Interveners were explicitly not allowed to give advice on *how* to feed the infant to avoid overlap with the VIPP-FI	Attention control group (AC): exposure to fruits and a sweet vegetable (carrots) during the first 19 days of weaning. Five phone calls were offered at age 4–6, 8, 13 and 16 mo on development of the child, scheduled while the intervention sessions in the RVE, VIPP-FI and COMBI conditions took place. Researchers were explicitly not allowed to give any advice on *what* and *how* of complementary feeding (mothers were referred to their youth health care centre or the Dutch Nutrition Centre if they asked specific questions). Researchers were	**Primary outcome**: 1. Vegetable intake; 2. Vegetable liking (recorded in the diary using 9-point Likert scale); 2. Child self-regulation of energy-intake (by SR and FR via BEBQ, CEBQ-T); 3. Child eating in the absence of hunger (measured by the researcher with a home-based paradigm during the home visit). **Secondary outcome**: 1. Child eating behaviour (by BEBQ, CEBQ-T); 2. Maternal feeding behaviour including maternal responsiveness to child satiety cues, maternal pressure to eat, etc (by videotapes coded for maternal sensitive feeding using the Ainsworth scale (Ainsworth et al., 2013), and questionnaires including Responsiveness to Child

				intervention. If mothers asked, they were referred to their youth health care centre or the website of the Dutch Nutrition Centre where parents get standard advice available for the general public. A **parenting intervention** to promote **sensitive feeding** behaviour (VIPP-FI) ("*how*" to feed in complementary feeding, with exposure to fruits and a sweet vegetable (carrots) during the first 19 days of weaning). The goal of VIPP-FI was to increase mothers' sensitive reactions to her child's hunger and satiety cues and to increase sensitive discipline and autonomy support during feeding. Five home-visits were offered using video-feedback at child age 4–6, 8, 13 and 16 mo to promote sensitive feeding. Core principles of VIPP: 1. provide positive feedback to mothers to promote maternal modelling and sensitive reactions to infant needs;	instructed to simply inquire after the development of the child, using a semi-structured interview, listen to mothers and show interest and empathy. Topics that were discussed concern the **general development of the child** (e.g., sleeping behaviour, motor development, language development) as well as what the mother's experiences were with the complementary feeding of her child. **Study comparison**: RVE group vs VIPP-FI group vs RVE + VIPP-FI combined group (COMBI*) vs AC	Feeding Cues Scale (Hodges et al., 2013), Infant Feeding Style Questionnaire (Thompson et al., 2009), Comprehensive Feeding Practices Questionnaire (Musher-Eizenman & Holub, 2007), and Feeding Practices and Structures Questionnaire (Jansen et al., 2014)). **Other measures:** 1. demographics; 2. maternal depression (Center for Epidemiologic Studies Depression Scale); 3. maternal vegetable intake (Food Frequency Questionnaire); 4. maternal anthropometrics; 5. maternal self-efficacy in feeding (Parental Feeding Self-Efficacy Questionnaire) 6. maternal emotions during feeding (measure designed for this study) 7. structure of family meals 8. maternal perception of feeding (by Five Minute Speech Sample); 9. child temperament (Infant Behaviour Questionnaire-Revised, and Early Childhood Behaviour Questionnaire)

				2. improve maternal sensitivity - mothers were trained from the second session on observing and interpreting child cues (how does the child signal hunger, satiety, etc). To avoid overlap with the RVE group, interveners were explicitly not allowed to give any advice on *what* type of food to offer. If mothers asked, they were referred to their youth health care centre or the Dutch Nutrition Centre. Participants were randomised over 4 conditions to attend 5 one-to-one sessions (phone calls and/or home visits) spread over the first year of eating solid foods (child age 4–16m)	*Families in the COMBI received five phone calls for the RVE intervention and five home visits for VIPP-FI, at the same moments as in the two separate interventions.	10. general parenting styles (observed maternal intrusiveness during mealtimes, and observed maternal sensitivity and intrusiveness during free-play situations measured by Ainsworth et al. (2013), and Comprehensive General Parenting Questionnaire (Sleddens et al., 2014))
INSIGHT trial (Paul et al., 2014)	RCT	316 first time mothers and full-term newborns At randomisation N (Parenting group) = 145	Penn State Milton S. Hershey Medical Centre in Hershey, Pennsylvania, USA	4 **home visits** in the first year after birth at infant age 3–4, 16, 28, and 40 weeks, followed by annual clinical-based research centre visits at ages 1, 2, and 3 years. A responsive parenting framework was developed with obesity prevention	Safety group: The home safety visits were designed to be equal in length and intensity to the intervention group (4 home visits in the first year and 3 annual follow-up visits) and to avoid messages that	**Primary outcome**: BMI Z-score at 3yr Outcomes by categories: 1. Anthropometrics and Biological Specimens (infant weight and length/height trajectory, mother weight and height, etc);

		N (Safety group) = 146 Maternal age (intervention, y, M±SD): 28.7 (4.6) Maternal age (control, y, M±SD): 28.7 (4.9)		guidance delivered at each visit that correspond to four infant/toddler behaviour states: **Sleeping**, **Fussy**, **Alert and Calm**, and **Drowsy**. E.g. 1. Drowsy and sleep: guidance on sleep hygiene. 2. Fussy: guidance on not using food to soothe or as a reward, child temperament, using modelling and emotion coaching to promote healthy emotional development. 3. two sub-categories in the Alert and Calm category: 1) Active, Social Play: guidance on developmentally appropriate physical activity, parental modelling of behaviour, and limit setting (e.g. through consistent discipline). 2) Feeding: instructions on recognition of infant hunger and satiety cues, appropriate portion sizes, using food for hunger only, nutrition for children, parental modelling.	could affect energy balance. A developmentally appropriate home safety intervention was delivered by visiting nurses, designed within the framework of the four behavioural states (Sleeping, Fussy, Alert and Calm, and Drowsy). E.g. 1. Drowsy and Sleep domains: prevention of Sudden Infant Death Syndrome; 2. Fussy: strategies to prevent Shaken Baby Syndrome, treatment of fever and other first aid remedies, etc. 3. Alert and Calm: food safety, choking hazards, furniture safety etc.	2. Infant/Child Behaviour (sleep, dietary intake, food frequency, temperament, appetite and eating behaviours measured via BEBQ and CEBQ, food neophobia, etc); 3. Parenting (feeding to soothe by Stifter et al. (2011), infant feeding mode by Fein et al. (2008), self-efficacy, feeding practices and styles by Infant Feeding Style Questionnaire (Thompson et al., 2009), and structure and control feeding); 4. Maternal Psychosocial Variables and Behaviour (Postpartum depression by Cox et al. (1996), Restrained/disinhibited eating by Stunkard and Messick (1985), eating habits and family food environments, sleep, dietary intake and food frequency, trait anxiety by Speilberger et al. (1983), health literacy) 5. Family context (home environment by observation, family functioning,

						playtime and activity, food insecurity, etc) 6. Background, demographics, and covariates (Demographics and Health, Development knowledge by MacPhee (1981))
NOURISH trial (Daniels et al., 2009)	RCT	698 first time mothers (mean age 30±5yrs) and healthy term infants aged 4±1m Intervention group: N (mothers) = 325 Age at delivery (years, M±SD): 30.2±5.3 Maternal BMI: 25.8±5.1 Control group: N (mothers) = 346 Age at delivery (years, M±SD): 29.9±5.3 Maternal BMI: 26.2±5.5	Brisbane and Adelaide, Australia.	Assessments and intervention commenced when the infants were 4-7m old and was conducted at existing child health clinics. The intervention provided anticipatory guidance via 2 modules of 6 fortnightly **group parent education and peer support sessions** (N=10-15 mothers/primary carers per group), followed by 6m of regular maintenance contact. Module contents: a) introduction of solids, b) emergence of autonomy and independence. Both modules aimed at promoting authoritative parenting practices and feeding styles, maternal recognition of and trust in	Control groups had self-directed access to services at child health clinics (**usual care**), which included growth measurements, written and web-based materials, a telephone help line and, in some cases, individual appointments (limited due to staff availability).	**Baseline**: infants 4-7m **Time 2** (follow-up at 9m of programme): infant aged 13-16m **Time 3** (follow-up at 18m of programme): infant aged 22-29m **Infant/child:** 1. child weight & growth 2. food intake (food records) food preference (by Wardle tool adapted to Australian target foods (J. Wardle et al., 2001)) 3. eating traits (CEBQ) **Maternal:** 1. feeding style and practices (Infant Feeding Questionnaire by Baughcum et al. (2001), and Child Feeding Questionnaire by Metcalf et al. (2007)) 2. parenting skills (4 brief scales from the Longitudinal Study of Australian Children

				child cues of hunger and satiety; and consistent, responsive use of developmentally-appropriate structure and limits. Group sessions included interactions and strategies consistent with a cognitive behavioural approach to enhance maternal self-efficacy and to build supportive feeding environments. Intervention participants received a **workbook** to ensure optimal intervention dose, monitor strategies attempted at home, and to encourage retention. **Fridge magnets with the key message** from each module were provided.		measuring warmth, irritability, consistency and overprotection) 3. maternal BMI
The Baby Milk trial (Lakshman et al., 2015)	RCT	669 healthy full-term formula-fed infants N (intervention) = 340, mean age in mo (M±SD): 2.3±1.0;	England Clinical settings, home visits available if needed.	Intervention was delivered one-to-one (location was not specified: at home or clinics) by trained research nurses to infants from the trial enrolment (infant 2-14w old, baseline) up to 6m of age through: a) 3 face-to-face interactions (30–45 min, at baseline, age 4, and 6m),	Attention control: same number of contacts with research nurses. General information about formula-feeding (bottles, teats, sterilisation making up feeds) were discussed. The 4-6 weekly phone calls (15–20 min, at	**Primary outcome**: change in weight SD score from birth to 12m. Other outcomes: Demographics, anthropometrics such as parents' weight and height, milk feeding practices by Lakshman et al. (2011), temperament, appetite and eating behaviours,

		N (control) = 329, mean age in mo (M±SD): 2.3±1.0		b) 2 telephone contacts (15–20 min, at age 3 and 5m), c) written materials: 2 leaflets (on knowledge about amounts of formula-feeds, hunger cues, growth charts and rapid weight gain, parental self-efficacy), and stickers (with the new recommendations) to put on formula milk powder tins. Infants were followed up to age 1 year (for outcome measures) Intervention design was based on Social Cognitive Theory and action planning ('implementation intentions') consisting of 3 components: motivational component, action planning component, coping planning component (problem solving).	age 3 and 5m) was used to discuss general issues (parenting, sleep, etc) to monitor feeding quantity and frequency and to encourage continued participation. Both groups were given a help-line number to contact the study team about feeding issues.	sleep, maternal attitudes and feeding practices (e.g. feed on demand/routine; feed based on instructions/appetite/growth), maternal quality of life and maternal psychological factors including trait anxiety. A 4-day food diary for energy intake was completed at 8m
Sleep SAAF (Hernandez et al., 2022; Lavner et al., 2019)	RCT	212 African American mother-infant dyads, healthy full-term infants N (intervention) = 108	Mother-infant dyads were recruited from the mother/baby nursery at Augusta University Medical Centre in Augusta, Georgia, USA shortly after	Guidance on responsive parenting (drawing from the INSIGHT 2w responsive parenting curriculum (Paul et al., 2014)) regarding: 1. sleeping 2. crying	Safety control: home visits at 3 and 8w postpartum with developmentally-appropriate child safety intervention (guidance), designed to be equal in length	(Lavner et al., 2019) **Primary outcome:** between-group comparison of infant conditional weight gain scores from 3-16w. **Secondary outcomes**:

		N (safety control) = 104 In the secondary analysis (Hernandez et al., 2022): N (Intervention) = 96 N (Control) = 94	delivery (mean infant age at enrolment = 1.5 days). Study visits occurred face-to-face at participants' home.	3. **feeding (education on recognising hunger and fullness cues,** age-appropriate bottle, discussion on typical feeding frequency, etc) 4. playing All topics were discussed in detail at the first home visit at 3w postpartum (which lasted approximately 90-120 minutes on average), and was reviewed at the booster intervention visit at 8w postpartum (which lasted approximately 45-60 minutes on average). Mothers and their infants were visited at home at 1, 3, 8, and 16 weeks postpartum for intervention and data collection visits.	and intensity to the intervention group and to avoid messages that could impact responsive parenting.	1. Weight-related outcomes (differences in change in infants' weight for age over time; differences between groups in infants' weight outcomes at age 16w including BMI z-score, weight-for-age a-score, weight-for-length z-score); 2. infant sleep, 3. maternal sleep, 4. infant soothing 5. infant feeding frequency (e.g., feeding frequency, use of bottle feeding, introduction of solids), 6. infant eating behaviour, 7. maternal feeding practices and beliefs (see follow-up below), 8. maternal self-efficacy, 9. maternal depressive symptoms, 10. family routines, maternal session engagement etc. In the secondary analysis (Hernandez et al., 2022): 1. Bottle-feeding practices, introduction to other beverages and solids, and parental using food to soothe (Baby's Basic Needs Questionnaire (Stifter et al., 2011))

						2. Pressure-based feeding practices (Infant Feeding Style Questionnaire by Thompson et al. (2009))
PROBIT **(Morandi et al., 2019)**	RCT	Newborns at randomisation N (Intervention) = 299 N (Control) = 270 At infant 1y old N (Intervention) = 278 N (Control) = 251 At the second year of follow-up N (Intervention) = 252 N (Control) = 216	Veneto region (north-eastern Italy)	The 11 intervention paediatricians were trained to provide standardised oral and written educational resources on protective practices, with particular emphasis on RF practices, at 5 scheduled routine visits during the children's first two years of life (at 1, 3, 6, 12, and 24m of age). Parents were also given information about the health consequences of childhood obesity.	Control arm with usual care and follow-up at the routine visits (same number of scheduled visits).	**Primary outcome**: the rates of overweight/obesity in two arms (defined with BMI). **Secondary outcomes**: child length and weight, feeding patterns including breastfeeding or formula feeding, feeding on demand introduction of solids, use of beverage at 12m and 24m.

Appendix A2: Study characteristics of RCTs with home visits or in-person interventions.

Study ID	Aim	Was the intervention successful?	Summary of findings
The Baby's First Bites trial (van Vliet et al., 2022)	To test whether promoting the *what* and/or promoting the *how* of complementary feeding will result in **increased vegetable consumption** and liking and a better **self-regulation of energy intake** in infants and toddlers up until the age of 36 mo.	No (No effect on child vegetable intake or energy intake – main study aim)	• Interventions were not effective in increasing vegetable intake or self-regulation of energy intake (no follow-up group differences regarding child vegetable intake or self-regulatory behaviour). • More sensitive feeding behaviour (observation and using RCFCS (Hodges et al., 2013)) and less pressure to eat (using Infant Feeding Style Questionnaire (Thompson et al., 2009)) was found in the VIPP-FI and COMBI groups, compared to the RVE and AC group, mostly at t_{18} (post-test at child age of 18m, t_0 = baseline). • The proportion of children with overweight was significantly lower in the COMBI group, compared with the VIPP-FI group at t_{18} (2% compared with 16%), and with the AC group at t_{24} (7% compared with 20%). However, the number of infants with overweight was small, and nonsignificant effects on the continuous BMI z-score measure were reported. • Potential target participants: risk groups such as families who already experience problems around feeding.
INSIGHT trial (Paul et al., 2019) A **nested subsample** analysis within INSIGHT to pilot test	To evaluate a multi-components responsive parenting intervention designed for the primary	Mixed (Increased RF in terms of signing. No effect on BMI z-score or feeding	• At infant 18m old, 63.6% of intervention mothers reported teaching their infant signs in the prior year, and 61.4% of infants were using signs to communicate (median = 2 signs, range up to 34).

infant signing as an additional component.	prevention of obesity, compared to a home safety control among first-born infants and their parents. INSIGHT's central hypothesis was that responsive parenting and specifically RF promotes self-regulation and shared parent–child responsibility for feeding, reducing subsequent risk for overeating and overweight.	behaviours beyond sign use.)	• The most common signs were "more" (53.1%) and "all done" (51.3%), both related to feeding. • Higher use of the "all done" sign in the intervention group than control (63.9% vs 45.5%, *p*=.01). No difference for the "more" sign (56.9% vs 51.3%, *p*=.43). • The brief signing intervention was not associated with differences in BMI z-score, maternal feeding practices, or maternal ratings of child appetite at ages 2–3y.
INSIGHT trial (Paul et al., 2018) To test the intervention effect on reducing childhood overweight and obesity risk by age 3y		Mixed (Reduced BMI z-score at 3y. No effect on overweight/obesity prevalence at 3y. Effects were stronger at 2y but may diminish over time).	• At age 3y, children in the intervention group had a **lower mean BMI z-score** compared to the control group (−0.13 vs 0.15, absolute difference −0.28 [95% CI, −0.53 to −0.01], *p*=.04). • Mean **BMI percentiles** did not differ significantly. • **Overweight/Obesity prevalence at 3y**: lower prevalence in the intervention group but not significant. Overweight: 11.2% (intervention) vs 19.8% (control), OR=0.51, *p*=.07. Obesity: 2.6% (intervention) vs 7.8% (control), OR=0.32, *p*=.09. • Earlier outcomes at 2y: intervention children reported lower prevalence in overweight (11.4% vs 20.8%, *p*=.04) and obesity (0.8% vs 8.3%, *p*=.005). Intervention effects were attenuating by age 3.
INSIGHT trial (Savage et al., 2016) To test the intervention effect on reducing		Yes (Slower infant weight gain in the first 6m and lower overweight	• **Rapid weight gain** (from birth to 28w): intervention infants reported lower mean conditional weight gain than controls (-0.18 vs 0.18, *p*=.004), effect did not differ by feeding mode (breastfed vs formula-fed).

rapid infant weight gain (from birth to 28w) and overweight prevalence at age 1y.		prevalence at 1y. Consistent effects across feeding modes).	• **Weight-for-Length percentiles at 1y**: intervention infants reported lower mean score than controls (57.5% vs 64.4%, *p*=.04). • **Overweight prevalence at 1y** (⩾95th percentile): intervention infants reported significant reduction than controls (5.5% vs 12.7%, *p*=.05)
INSIGHT trial (Ruggiero et al., 2021) To test the intervention effect on child eating traits at 2.5y, and maternal feeding practices at 3y.		Yes (Reduced controlling feeding practices (pressure, food to soothe, food as reward) and promoting structure (consistent routines). Effects on child eating traits only on reduced emotional overeating.)	• Intervention children showed lower emotional overeating than controls at 2.5y (using CEBQ, mean 1.34 vs 1.48, *p*=.03). No significance in other eating traits. • At infant 3y using Structure and Control in Parent Feeding Questionnaire, compared to control groups, intervention mothers reported: - more consistent meal routines (mean 4.0 vs 3.8, *p*=.002) - less pressure (2.1 vs 2.3, *p*=.01) - less food to soothe (1.7 vs 2.0, *p*=002) - less food as reward (2.1 vs 2.2, *p*=.047) No differences in restriction or limiting exposure to unhealthy foods. • Moderation by child eating traits: - Child SR moderated the intervention effect on maternal use of limiting exposure to unhealthy foods, indicating Intervention was most effective for children at higher levels of SR. - Child FR moderated the intervention effects on maternal use of pressure, indicating that at lower levels of FR, control mothers used more pressure than intervention mothers.

			Intervention mothers maintained more RF regardless of child appetite, while control mothers adjusted in less adaptive ways.
INSIGHT trial (Paul et al., 2025) To test whether this early-life responsive parenting intervention (delivered through age 2 years) had sustained effects on child weight outcomes through age 9 years		NO (Marginally significant on the primary outcome: lower BMI across 3-9y. No effect on secondary outcomes: BMI z-score, overweight/obesity prevalence and other health outcomes)	• Intervention children had **lower mean BMI** than controls (16.59 vs 16.95; difference −0.36; ***p*=.049**). • Cross-sectional outcomes revealed **no significant differences** in **BMI z-score** or **overweight/obesity prevalence** at child age 5, 6, and 9y. • No consistent differences in blood pressure, waist circumference, body composition, or metabolic markers.
NOURISH trial (L. Daniels et al., 2012)	To evaluate the effect of a community-based intervention, consisting of anticipatory guidance, maternal education and peer support for first-time mothers of infants aged 4-7m at enrolment that will 1. foster healthy food preferences, dietary intakes	Yes (Improved RF practices and reduced controlling, non-RF practices. Reduced BMI z-score and reduced rapid weight gain by 14m of infant age).	• Intervention infants showed significantly **lower BMI-for-age z-score** (0.23±0.93 vs 0.42±0.85, *p*=.009) and **less rapid weight gain** (OR=1.5, 95%CI 1.1–2.1, *p*=014) from baseline (mean infant age 4.3m) to 14m. • Control mothers were more likely to use **non-RF** than intervention mothers: Using food as reward (15% vs 4%, *p*=.001) Games to encourage eating (67% vs 29%, *p*<.001). • Using Infant Feeding Questionnaire. Intervention mothers reported **greater awareness of satiety cues** and were more

	and eating behaviours in young children;		likely to **let the child decide how much to eat** (76% vs 44%, OR=4.1, *p*<.001).
NOURISH trial (Daniels et al., 2014) To assess intervention effect on child eating behaviours, food preferences, dietary intake, and parenting practices at age 2y	2. initiate and maintain positive maternal feeding practices in young children; 3. enhance maternal efficacy (knowledge, skills, confidence) with respect to child feeding.	Mixed (Modest but positive impact on child eating behaviours and food preferences by age 2. Mothers reported more autonomy-supportive parenting practices No effect on child BMI z-score)	• At infant 2yr using CEBQ, compared to control children, intervention children showed: - Higher SR (3.1 vs 3.0, *p*=.03). - Lower emotional overeating (1.5 vs 1.6, *p*=.009). - Lower fussiness (2.5 vs 2.6, *p*=.01). - No significant differences on FR. • Mothers of intervention children reported greater exposure to a wider variety of vegetables compared to controls (*p*=.008). Intervention child "liked" more fruits (*p*=.008), fewer "liked" (*p*=.03) and "tried" (*p*=.01) non-core beverages. • Intervention mothers reported greater autonomy encouragement compared to control mothers (4.34 vs 4.16, *p*=.002). No differences in parental warmth, irritability, or overprotective parenting. • No significant group difference in BMI z-score at child 2y old.
NOURISH trial (Daniels et al., 2015) To evaluate intervention sustained effect on maternal RF practices and child obesity risk up to child 5y old		Mixed (Sustained improvement in maternal RF practices up to 5y. No effect on child weight outcomes)	• Across child aged 2-5y, with multiple measurements, intervention mothers consistently reported less frequent use of non-RF practices (e.g. pressure, restriction, emotional feeding, food as reward) than control mothers. • At 5y, intervention mothers reported more appropriate responses to food refusal on 7 of 12 items (e.g., reoffering new foods, fewer coercive strategies) than control mothers.

			• Child BMI z-score were consistently lower in the intervention group at all follow-ups (14m, 2y, 3.5y, and 5y), but differences were not statistically significant (overall group effect *p*=.06). • At 5y: no difference in the prevalence of overweight/obesity (13.3% control vs 11.4% intervention, *p*=.66). • Waist circumference z-score at 5y did not differ between groups.
NOURISH trial (Magarey et al., 2016) To evaluate intervention sustained effect on child dietary intake, food preferences, and eating behaviours up to child 5y old (outcomes measured at child 2y, 3.7y, and 5y in this study).		Mixed (Small improvements in dietary quality indicators (higher fruit & vegetable score), greater liking of fruits, lower FR and higher SR. No effect on vegetable and fruit intake)	• Using CEBQ, at 5y of child age, compared to controls, intervention children showed: Lower FR (mean 2.3 vs 2.4, *p*=.04) Higher SR (mean 3.1 vs 3.0, *p*=.04) No group differences for emotional overeating or fussiness at later time points. • No time x group differences in child eating traits. There was a time effect for all child eating traits across age 2, 3.7, and 5yr, indicating developmental changes in eating behaviour independent of intervention. • Dietary Intake at 5y of child age using 24-h recall & Child Dietary Questionnaire No significant group or group × time effects for fruit, vegetable, discretionary food, or non-milk sweetened beverage intake. Fruit & vegetable score (using Children's Dietary Questionnaire): Intervention children scored higher than controls (15.3 vs 14.5; target ⩾18), *p*=.03. No differences for discretionary food or beverage scores.

			• Food preferences: intervention children liked a higher proportion of fruits than controls (74.6% vs 69.0%), *p*<.001. No differences for vegetables or discretionary foods.
The Baby Milk trial (Lakshman et al., 2018)	To evaluate the efficacy, cost-effectiveness and acceptability of a theory-based, multi-component intervention to reduce formula-milk intake and prevent excess weight gain during infancy, as well as to understand the psychological mediators of any effect of the intervention on formula-milk and energy intake.	Mixed (Reduced milk intake, slowed weight gain till infant 6m old in the intervention group. Nonsignificant rapid weight gain prevalence between groups.)	• Intervention group infants had reduced milk intake at 3m (14% lower), 4m (12% lower), 5m (9% lower), and 6m (7% lower) compared to the control group. • The intervention slowed weight gain from baseline to 6m (mean change 0.32 SD scores vs 0.42 SD scores in controls; adjusted difference −0.08 SD scores, statistically significant) but had no effect on weight change from birth to 12m. • Rapid weight gain prevalence: At 6m: 21.8% (intervention) vs 28.6 (control), nonsignificant. At 12m: 40.3% (intervention) vs 45.9% (control), nonsignificant. • At 8m, both groups consumed ~770 kcal/day, about 16% higher than WHO recommendations, showing persistent overfeeding despite intervention.
Sleep SAAF (Hernandez et al., 2022; Lavner et al., 2022)	To test whether a responsive parenting programme can promote infants' sleep and self-soothing and reduce rapid weight gain during the first 16 weeks of life among African American infants born in the South.	Mixed (Slower but nonsignificant weight gain in the intervention group. Reduced pressure-based feeding and using food to soothe in	• Intervention mothers reported **more responsive feeding**, **lower likelihood of using beverages other than breast milk/formula to soothe** (16.7% vs 33.0%, *p*=0.01), and **less pressure with cereal** than control mothers (though not statistically significant, *p*=0.09). Intervention mothers reported **less pressure to finish/soothe** than controls (mean 2.04 vs 2.33, *p*=0.007). Feeding mode and maternal age moderated this effect.

		intervention mothers.)	• There were no significant group differences in mothers' reports of **recognising hunger or fullness cues**, **bottle-feeding practices** (e.g., adding cereal to bottle, using an appropriate nipple/bottle size), or in context-based or emotion-based food to soothe. • Adjusting for covariates, mean **conditional weight gain** was lower among intervention infants (0.04, 95% CI [-0.33, 0.40]) than control infants (0.28, 95% CI [-0.08, 0.64]), but not statistically significant (*p*=0.15, effect size d=0.24). • Intervention infants were nearly **half as likely** to experience upward crossing of 2 major weight-for-age percentile lines (14.1%) compared to control infants (24.2%), *p* = 0.09, odds ratio=0.52 (95% CI [0.24, 1.12]). • At 16w of infant age, there were no significant group differences for infant weight-for-age percentiles or z-score, weight-for-length percentiles or z-score, or BMI-for-age percentiles or z-score, with effect size ds ranging from 0.00 to 0.10. Rapid weight gain trend toward benefit, but not statistically significant.
PROBIT trial (Morandi et al., 2019)	To evaluate whether a paediatrician-delivered educational programme promoting RF and healthy lifestyle practices from birth to 24m could 1) reduce the prevalence of overweight and	Mixed (Improved early feeding patterns (feeding on demand at 3m), but no effect on the prevalence of	• At the age of 2y, the prevalence of obesity in the intervention group was lower than controls but not statistically significant (8.7% vs 13.4%; *p*=0.10). No group difference in child BMI, overweight/obesity prevalence, or beverage consumption, or TV viewing. • At the age of 3m, a higher proportion of the intervention infants were **fed on demand** (93% vs 80%, *p*<.001).

	obesity in toddlers; 2) improve infant feeding patterns and lifestyle behaviours	obesity/overweight, or BMI at 2y)	

Appendix A3: Summary of findings of RCTs with home visits or in-person interventions.

Study ID, trial name and study aim (based on the study protocol)	Design	Participants	Settings	Intervention	Comparison	Outcome measures
ProASK (Redsell et al., 2017) To test the feasibility and acceptability of using a digital tool (ProAsk) with UK health visitors (HV) and parents.	Multicentre, pre- and post-intervention feasibility study, with process evaluation (interview)	N = 66 parents of infants aged 6-8w, and N = 22 health visitors.	Rural and urban deprived settings, UK community care	Delivered on a tablet device at routine HV visits The programme comprised a validated risk prediction tool to quantify overweight risk status and a therapeutic wheel detailing motivational strategies for preventive parental behaviour. Parents were encouraged to agree goals for behaviour change with health visitors who received motivational interviewing training.	N/A	**Primary outcome**: weight-for-age z-score Secondary outcomes: parenting self-efficacy; maternal feeding style (by Infant Feeding Questionnaire); infant diet; exposure to physical activity and sedentary behaviour. Qualitative interviews ascertained the acceptability of study processes and intervention fidelity.
The Growing Healthy study (Denney-Wilson et al., 2015) To prevent excess weight gain in infancy by	non-randomised quasi experimental feasibility trial	646 participants at baseline N (Intervention) = 301 N (Control) = 345 Mothers in the intervention group	Australia	A new app, website and online forum with a 'one-stop shop' for evidence-based advice for parents, consistent with national guidelines on infant feeding in the first 9m of life.	Usual care	Both intervention and comparison participants completed surveys at baseline (infant under 6m of age), and when infants were 6&9m; Breastfeeding practices;

supporting parents especially from socioeconomically disadvantaged families with healthy feeding practices through a scalable, low-cost mobile health (mHealth) intervention		were slightly older on average (31.3 v 30.4 years, *p*<0.001) and more likely to be breastfeeding (70.7 v 64.8% *p*=0.017) than control mothers. Intervention mothers were more likely to be first time parents (57.8% v 38.5%, *p*<.001) than control mothers		Parents received 3 push notifications in the app for each week on infant feeding topics relevant to the age of their infant. Messages were tailored to mode of feeding (breast, formula or mixed) with links to more information on the app/website. Parents could connect with other parents on the *Growing Healthy* Facebook group. Each week 3 messages were posted here to reinforce programme content and to encourage interaction and engagement.		Formula feeding practices (7 items from the Baby Milk Study); Solids and dietary exposure to fruit, vegetables, non-core snacks and drinks; Parental feeding behaviours and beliefs, and infant satiety (by Infant Feeding Questionnaire, BEBQ-SR); Anthropometrics
The Positive Parent **Suárez et al. (2018)** To test the effectiveness of the "Educar en Positivo" ("The Positive Parent") programme in promoting positive	Quasi-experimental study, feasibility trial	148 parents in the programme group (self-assigned to the module of "The Positive Parenting") Gender - mothers: 85.14% Parental age in years (M ± SD): 32.6 ± 7.9 Children age in years (M ± SD): 5.2 ± 4.1	Spain	The programme had 5 Modules: (1) The Internet: a resource for the whole family; (2) Helping our family get along better; (3) Understanding and guiding my young child's behaviour; (4) Our child is different, let's help him/her grow; (5) Healthy eating habits: a challenge for the whole family.	Visitor group: complementary multimedia material related to the programme topics. Complementary materials involve 25 educational videos and	Internet experience and use (Suárez et al. 2016); Daily parenting mood (designed for this study) Online parental support scale (Escala de Apoyo Parental Online, EAPO; Suárez et al. 2016);

parenting, and to identify factors influencing program satisfaction.		164 parents in the visitor group Gender - mothers: 78.10% Parental age in years (M ± SD): 34.4 ± 9.1 Children age in years (M ± SD): 5.0 ± 4.8		Each had 4 types of activities in each: Introduction, Observation of other parents' views, Reflection on their own practices and consequences, and Remembering the main lessons learned. The programme offered parents the possibility of joining online discussion forums in each module moderated by the content manager to promote the exchange of experience. It also included a personal diary that parents can use throughout the learning process where they can make a commitment to transfer the knowledge acquired to real-life situations.	podcast of experts.	Implementation measures (6 measures recorded); Programme satisfaction scale (14 items elaborated for this study)
Taki, Russell, Wen, et al. (2019) To explore pregnant women's and	Study 1: a cross-sectional survey conducted with	Study 1: N = 107 (pregnant women) Study 2: N = 29 (mothers of infants aged <1 year)	Australia	Survey questions in Study 1 included basic demographics and app usage (such as app download, and its purpose) as well as	N/A	Study 1: Multiple logistic regression analyses were conducted to examine demographic factors associated with their app usage.

mothers' perceptions, interest, and experiences with mobile apps/websites about infant feeding practices, as part of early childhood obesity prevention.	pregnant women in their third trimester. Study 2: qualitative study with mothers of infants aged <1 year.			likelihood of using an app for promoting infant feeding practices. The qualitative study was adopted to inform the development of a mHealth intervention on healthy infant feeding practices (the *Growing Healthy* feasibility trial). Aim: to investigate mothers' interest in the development of a website and smartphone app that provided infant feeding information; explore maternal infant feeding beliefs and behaviours.		Study 2: Thematic network analysis was used to explore the themes generated from the interview, such as "technology usage" and "interest in a mHealth programme".
Baby Byte (Mobley et al., 2023) To explore parental preferences for mobile health app content and features aimed at improving RF practices for	Semi-structured interviews, guided by app prototype ("BabyByte") showing sample screens (goal setting, growth tracking,	40 parents (20/20 mothers/fathers) of children aged 0-2y	USA	Framework: guided by the Technology Acceptance Model and Theory of Planned Behaviour. One-on-one interviews (45–60 min), guided by app prototype ("BabyByte") showing sample screens (goal setting, growth tracking, discussion boards, expert	N/A	Thematic analysis: Parental attitude towards using a child feeding app; Likelihood of use; Valued features; Potential benefits

children aged 0–2y	discussion boards, expert Q&A, videos, quizzes, recipes)			Q&A, videos, quizzes, recipes).		

Appendix A4: Study characteristics of Group 3: studies that included digital based interventions but are not RCT.

Appendices B: Chapter 4

		Appetite (interest/disinterest in eating)	Appetite intensity	Agitation
Previous feeding experience	Yes (n=134)	1.19 ± 0.63	6.89 ± 1.65	2.52 ± 1.67
	No (n=64)	1.52 ± 1.04	5.95 ± 1.41	3.36 ± 1.83
		p = .006	*p* < .001	*p* = .002
Have children in the household or not	1 or more children at home (n=92)	1.15 ± 0.55	7.09 ± 1.63	2.17 ± 1.40
	No children at home (n=106)	1.42 ± 0.95	6.15 ± 1.52	3.33 ± 1.87
		p = .020	*p* < .001	*p* <.001

Appendix B1: Group comparison between parenting status on infant interest/disinterest in eating, appetite intensity, and agitation of the baby displayed in Video10 (N=198).

Measures		Min	Max	Mean ± SEM	Internal reliability (Cronbach 's alpha)
AEBQ - Satiety Responsiveness		1	5	2.65 ± 0.06	.75
RISE-Q15	Decreased Food Appeal	1	7	3.13 ± 0.08	.79
	Physical Satisfaction	1.7	7	4.96 ± 0.08	.76
	Planned Amount	1.7	7	4.60 ± 0.08	.67
	Self-Consciousness	1	6.3	2.28 ± 0.08	.85
	Decreased Priority of Eating	1	6	2.51 ± 0.07	.67
IES-2 - Reliance on Hunger and Satiety Cues		1	5	3.27 ± 0.06	.86
TAS20	Difficulty Describing Feelings	5	25	13.57 ± 0.33	.87
	Difficulty Identifying Feelings	7	35	16.74 ± 0.51	.92
STAI - Trait anxiety		20	75	47.82 ± 0.90	.95
ST-DEP	Dysthymia	5	20	9.86 ± 0.24	.92
	Euthymia	5	20	12.56 ± 0.26	.73
AQ-S	Social Skills	0	8	4.06 ± 0.17	.79
	Routine	0	4	2.51 ± 0.09	.57

Appendix B2: Descriptive statistics of individual's appetite traits and wellbeing, in addition to internal reliability check (Cronbach's alpha) of measures (N = 198).

Appendices C: Chapter 5

Measures		Min	Max	Mean ± SEM	Internal reliability (Cronbach's alpha)
IFQ	Concern About Infant Undereating or Becoming Underweight	0	4	1.23 ± 0.04	.75
	Concern About Infant's Hunger	0	3.3	0.28 ± 0.02	.54[a]
	Awareness of Infant's Hunger and Satiety Cues	1.3	4	3.16 ± 0.03	.69
	Concern About Infant Overeating or Becoming Overweight	0	3.33	1.69 ± 0.03	.65
	Feeding Infant on a Schedule	0	4	2.17 ± 0.04	.68
	Using Food to Calm Infant's Fussiness	0	4	2.30 ± 0.04	.71
	Social Interaction with the Infant During Feeding	0	4	2.78 ± 0.04	.06[b]
MEM-P	Anxiety	1	7	1.79 ± 0.05	.87
	Stress and Anger	1	6.4	2.69 ± 0.05	.82
	Efficacy	1.8	7	5.06 ± 0.05	.80
ABEQ	Food Responsiveness	1.3	5	3.47 ± 0.04	.74
	Satiety Responsiveness	1	4.8	2.53 ± 0.04	.74
	Enjoyment of Food	1.7	5	4.24 ± 0.03	.85
	Slowness in Eating	1	5	2.57 ± 0.05	.84
	Food Fussiness	1	5	2.08 ± 0.04	.91
IES-2-Reliance on Hunger and Satiety Cues		1	5	3.73 ± 0.03	.85
RISE-Q15	Decreased Food Appeal	1	6.7	2.73 ± 0.06	.79
	Physical Satisfaction	1	7	5.14 ± 0.05	.79
	Planned Amount	1	7	4.30 ± 0.06	.61

	Self-Consciousness	1	6	2.00 ± 0.05	.84
	Decreased Priority of Eating	1	6	2.18 ± 0.05	.67
TAS-20	Difficulty Identifying Feelings	7	35	15.77 ± 0.28	.87
	Difficulty Describing Feelings	5	25	13.07 ± 0.21	.84
	Externally Oriented Thinking	9	30	19.80 ± 0.18	.47[c]
CEBQ-T	Food Responsiveness	1	5	2.94 ± 0.04	.79
	Satiety Responsiveness	1	5	2.82 ± 0.04	.80
	Enjoyment of Food	1	5	4.11 ± 0.03	.87
	Slowness in Eating	1	5	2.84 ± 0.04	.74
	Food Fussiness	1	5	2.27 ± 0.04	.91

Appendix C1. Descriptive statistics of parental responsive feeding practices, mealtime emotions, individual's appetite traits and wellbeing, in addition to internal consistency reliability (Cronbach's alpha) of measures (N = 445).

[a] This measure was not included in the following analysis.

[b] Low Cronbach's alpha value due to poor inter-item correlation (.031; number of items = 2). This measure was not included in the following analysis in the present study.

[c] According to a review of the literature and a psychometric study of the TAS-20, Cronbach's alpha of EOT ranged from .45 to .76 in most studies (Kooiman et al., 2002). In the present study, total scores of TAS-20 were used to identify participants with alexithymia and were entered into the following analysis.

	1. AEBQ-Satiety Responsiveness	2. IES-2-Reliance on Hunger and Satiety Cues	3. RISEQ-15-Physical Satisfaction	4. RISEQ-15-Decreased Food Appeal	5. TAS-20 sum
1	-	.122**	.255***	.344***	-.031
2		-	.349***	-.057	-.200***
3			-	.138**	-.177***
4				-	.209***

Appendix C2: Correlation analyses between individual’s appetite traits and Alexithymia status. ***p* < 0.01, ****p* < 0.001. N = 445.

	MEM-P-Efficacy	1	2	3	4	5	6	7
TAS20-sum	-.357***	-.301***	.110*	.120*	.080	.051	.075	-.043
MEM-P-Efficacy	-	.341***	-.245***	-.180***	-.093*	-.040	-.095*	.083

Appendix C3: Correlation analyses between individual’s Alexithymia status, RF practices and positive mealtime emotions. 1: IFQ-Awareness of Infant’s Hunger and Satiety Cues; 2: IFQ-Concern about Infant Undereating or Becoming Underweight; 3: IFQ-Concern About Infant Overeating or Becoming Overweight; 4: IFQ-Concern About Infant's Hunger; 5: IFQ-Feeding Infant on a Schedule; 6: IFQ-Using Food to Calm Infant's Fussiness; 7: IFQ-Social Interaction with the Infant During Feeding. **p* <0.05, ***p* < 0.01, ****p* < 0.001. N = 445.

	1	2	3	4	5	6	7
CEBQ-T-Food Responsiveness	-.105*	-.291***	.319***	.129**	.036	.175***	-.038
CEBQ-T-Satiety Responsiveness	-.040	.422***	-.208***	-.091	-.070	.007	.038
CEBQ-T-Food Fussiness	-.224***	.387***	-.058	-.037	-.045	.027	.012
CEBQ-T-Slowness in Eating	-.082	.297***	-.085	.003	.020	-.049	.036
CEBQ-T-Enjoyment of Food	.250***	-.405***	.099*	.026	.079	.029	.024

Appendix C4: Correlation analyses between caregiver's RF practices and caregiver reported child appetite traits. 1: IFQ-Awareness of Infant's Hunger And Satiety Cues; 2: IFQ-Concern about Infant Undereating or Becoming Underweight; 3: IFQ-Concern About Infant Overeating or Becoming Overweight; 4: IFQ-Concern About Infant's Hunger; 5: IFQ-Feeding Infant on a Schedule; 6: IFQ-Using Food to Calm Infant's Fussiness; 7: IFQ-Social Interaction with the Infant During Feeding. *p <0.05, **p < 0.01, ***p < 0.001. N = 445.

Type of correlation	Variables	IFQ-Awareness of Infant's Hunger and Satiety Cues	MEM-P-Efficacy
Eta correlation[a]	Caregiver's education	.113	.112
	Feeding method in the first 3m	.051	.045
	Complementary feeding method	.037	.055
Point Biserial correlation[b]	Caregiver gender	.079	-.025
	Infant gender	.052	.052
Pearson Correlation	Caregiver age	-.028	.000
	Infant age	.050	.012

Appendix C5: Correlation analyses based on study hypotheses between caregivers' gender, age, education background, feeding method in the first 3m, complementary feeding approach, infant gender, and infant age as covariates for caregivers' awareness of infant cues during feeding (measured by IFQ-Awareness of Infant's Hunger and Satiety Cues), and mealtime emotions (measured by MEM-P-Efficacy).

[a] For correlations between nominal variables (with three or more groups) and continuous variables. Eta correlation value interpretation: 0.00–0.19: No or negligible association; 0.20–0.39: Weak association; 0.40–0.69: Medium association; 0.70–1.00: Strong association.

[b] For correlations between nominal variables (binary) and continuous variables, ranging from -1 to 1. Point Biserial correlation value interpretation: ±0.00 to ±0.10: negligible/no relationship; ±0.10 to ±0.30: small/low relationship; ±0.30 to ±0.50: medium/moderate relationship; ±0.50 to ±1.00: large/high relationship.

	Model 1		Model 2	
Variable	B [SE]	β	B [SE]	β
Constant	4.97 [0.12]		4.82 [0.32]	
Caregiver’s alexithymia	-0.02 [0.00]	-0.33***	-0.02 [0.00]	-0.35***
Caregiver’s gender			0.10 [0.06]	0.08
Caregiver’s age			-0.00 [0.01]	-0.03
Caregiver’s education			-0.04 [0.02]	-0.09
Infant gender			0.04 [0.05]	0.03
Infant age			0.01 [0.00]	0.05
Feeding method in the first 3m			0.06 [0.06]	0.05
Complementary feeding approach			0.04 [0.04]	0.06
R^2	0.10		0.12	
F	48.40***		7.65***	
ΔR^2			0.03	
ΔF			1.74	

Note: N = 408. SE = Standard Error

**p*<.05; ***p*<.01; ****p*<.001

Appendix C6: Hierarchical Linear Regression reporting predictors of caregiver’s Awareness of Infant Hunger and Satiety Cues.

	Model 1		Model 2	
Variable	B [SE]	β	B [SE]	β
Constant	6.71 [0.23]		6.48 [0.61]	
Caregiver's alexithymia	-0.03 [0.01]	-0.35***	-0.04 [0.01]	-0.35***
Caregiver's gender			-0.14 [0.11]	-0.06
Caregiver's age			-0.01 [0.01]	-0.02
Caregiver's education			0.01 [0.04]	0.01
Infant gender			0.12 [0.10]	0.06
Infant age			0.00 [0.01]	0.02
Feeding method in the first 3m			0.18 [0.11]	0.08
Complementary feeding approach			0.08 [0.07]	0.05
R^2	0.12		0.12	
F	55.23***		7.72***	
ΔR^2			0.01	
ΔF			0.94	

Note: N = 408. SE = Standard Error

*p<.05; **p<.01; ***p<.001

Appendix C7: Hierarchical Linear Regression reporting predictors of caregiver's positive emotions during mealtimes.

Variables	IFQ – Using Food to Calm Infant's Fussiness	
	β (SE)	*p*
Caregiver's gender	0.10 (0.09)	.29
Caregiver's age	0.01 (0.01)	.47
Caregiver's education	0.02 (0.03)	.60
Infant's gender	-0.07 (0.08)	.39
Infant's age	-0.01 (0.01)	.17
Feeding method in the first 3m	-0.41 (0.09)	< .001
Complementary feeding approach	0.12 (0.06)	.037
CEBQ – Food Responsiveness	0.33 (0.06)	< .001
CEBQ – Satiety Responsiveness	0.26 (0.07)	< .001
CEBQ – Food Fussiness	-0.01 (0.05)	.84

Note: N = 408. SE = Standard Error

Appendix C8: Multivariate regression reporting predictors of caregiver's Using Food to Calm Infant's Fussiness.

Appendices D: Chapter 6

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Filming guideline

The general aim of this study is mealtime interaction including how babies indicate hunger and full cues. We would like to invite you to film one typical feeding interaction at home and participate in an online interview. The filming and interview data will only be analysed for the purpose of our research in compliance with GDPR. If you have any concerns regarding your privacy, you are free to withdraw from the filming task but you will still be eligible to participate in the interview.

Filming procedure:

1. Seat your child properly, set up your smart phone or camera so that both you and your child are in the screen. Please make sure that you as the primary caregiver and your child are clearly in view.

This would be an **inappropriate** example: the baby is clear in the video clip; however, the camera is too close to include the caregiver during feeding. We would kindly ask both the caregiver and the child to be included in the film.

You may wish to set your camera around 2 meters away with a stand (this is just a guide!).

Please see good examples below:

2. Please film one typical mealtime at home. Please feel free to choose breakfast, lunch, or dinner – any typical eating episode at your convenience. Let us know which meal you choose to film, and which foods and drinks are offered. There is no limit to the filming length, just whatever is best for you.

3. It is lovely to know that you share meals with your little one as well as other family members. Please try to ignore the camera and other family members when they pop up in the screen. This will make the film easier to see with minimum distraction during mealtime. This is for us to view the feeding interaction that is the closest to your natural mealtime environment.

Appendix D1: Filming guidelines for participants (1/2).

(continued)

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4. After the completion of filming, please kindly upload your film via the exclusive link that you receive from the research team. Once we receive your film, we will email you with the £10 voucher to thank you for your time in filming your mealtime. Please upload the film using by 16/08/2024.

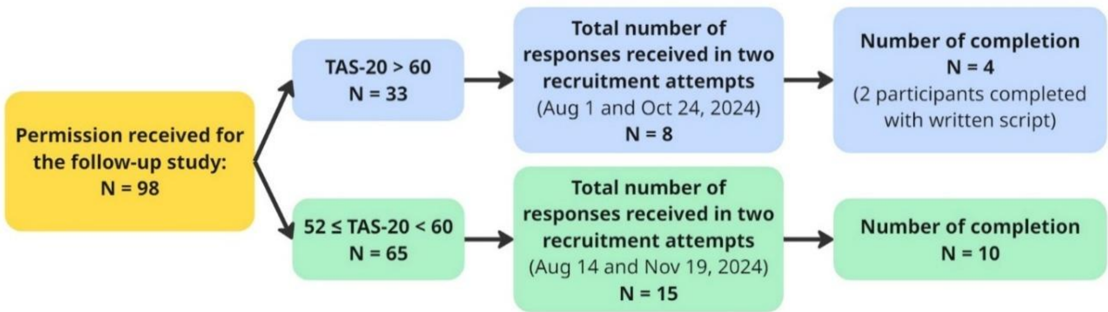
5. If you have any other questions, please email Professor Marion Hetherington, m.hetherington@leeds.ac.uk. If you encounter any problems in uploading the film, do not hesitate to contact Shihui Yu, ps19s2y@leeds.ac.uk. We will try our best to solve it so that we receive your film.

Your contribution is very important to our research project. Thank you and your beloved little one for taking part in this study. We value your support and input very much!

Appendix D1: Filming guidelines for participants (2/2).

No.	Interview question
1	How would you generally describe mealtimes with your child?
2	What is a typical family mealtime like for you?
3	When deciding how to feed your child, what would you say were the biggest influences?
4	We know that some parents follow NHS guidelines, health visitor advice. Have you used any guidance for feeding in this way? if yes, how did you feel and were they helpful?
5	Some parents also follow social media influencers for feeding guidance, and/or they may use a digital app for tracking feeds and then meals. Have you tried any apps or followed anyone on social media? If so, which ones? How did you feel?
6	Did you experience any challenges or concerns when feeding your child? Would you be able to share some details?
7	If you have experienced any challenges or concerns (when feeding your child), how did you feel? have you sought help and if so, what or who has helped in particular?
8	In our previous study, you shared a mealtime experience with us. [Present the quote] How do you feel about it now? Does this still feel true today?
9	Looking back over the last year, have you changed or adapted your feeding practices or strategies?
10	Looking back over the last year, what do you think is the most difficult experience during mealtimes, and what has been the easiest?
11	Next we have a short video clip we would like to watch with you. It is the mealtime that you shared with us. Won't be long and we would like to hear your opinions on this, for example, what do you notice and a few more small questions. [Present the videoclip] a. What did you notice when watching this video clip? b. What was the food that you were giving, and why did you choose this?

Appendix D2. Interview questions.



Appendix D3. Recruitment process based on TAS-20 scoring criteria.

Participant characteristics	N (%)
Gender	
Male	2 (14.3%))
Female	12 (85.7%)
Caregiver mean age in years (SD)	33.7 (4.7)
Education	
High School Diploma or equivalent (GED), or some college education	4 (28.5%)
Bachelor's degree (BA, BS)	9 (64.3%)
Graduate or professional degree (MA, MSc, PhD, MD, JD)	1 (7.1%)
Household income	
< £25,000	2 (14.3%)
£25,000 to £49,999	7 (50%)
£50,000 to £74,999	4 (28.6%)
> £75,000	1 (7.1%)
Marital status	
Single parent	2 (14.3%)
Co-habiting	4 (28.6%)
Married	8 (57.1%)
Ethnicity	
White	14 (100%)
Feeding method in the first 3 months	
Mostly breast feeding	11 (78.6%)
Mostly formula feeding	3 (21.4%)
Return to work before the baby was 6m	
Yes	1 (7.1%)
No	12 (85.7)
Prefer not to say	1 (7.1%)
Infant mean age in months (SD)	26.2 (6.7)
Infant gender	
Male	7 (50%)
Female	7 (50%)

Appendix D4. Participant characteristics (N = 14).

Appendices E: Chapter 7

Study ID	"Soft" outcomes	"Hard" outcomes	
	Parental self-reported RF practices[2]	**Child weight change**	**Child eating patterns**
Group 1 (RCT with digital-based interventions)			
multicomponent eHealth programme **(Lee et al., 2023)**	Intervention parents reported improved RF (greater use of responsive strategies, less use food to soothe/reward, greater modelling etc), and improved self-efficacy. No significant changes in nutrition knowledge or attitudes.	N/A	Intervention child reported increased child vegetable and fruit intake. No effect on child physical activity.
Early Food for Future Health **(Helle et al., 2019a, 2019b)**	No significant group differences in maternal feeding practices.	No significant differences on child anthropometry outcomes between groups at 12 or 24m of child age.	Intervention children reported improved fruit and vegetable intake, mealtime structures, less screen time at 12m of child age. No sustained effect on dietary patterns and mealtime routines at 24m of child age.

[2] Baby First Bites trial included both parental self-reported RF practices (using The Infant Feeding Style Questionnaire) and observed maternal feeding interactions (coded with RCFCS)

Pair Feeding Content with Nutrition Education study **(Hughes et al., 2023)**	Parents in both the in-class and online conditions showed significant improvements in feeding knowledge and practices (encouraging new foods, family meals, responsiveness to fullness cues) compared to controls. In the second analysis, improvements in feeding practices were only seen among parents who accessed at least half of the online videos. Those with low engagement showed little/no change.	N/A	N/A
Group 2 (RCT with face-to-face interventions)			
Baby First Bites trial **(van Vliet et al., 2022)**	More sensitive feeding behaviours, less pressure to eat in the VIPP-FI and COMBI groups, compared to AVE and AC group at child age of 18m.	Significant lower proportion of children with overweight in the COMBI group but the number was small. Nonsignificant effects on the continuous child BMI z-scores.	No group differences in increasing vegetable intake of self-regulation of energy
Baby Milk trial **(Lakshman et al., 2018)**	N/A	Intervention children showed slower weight gain from birth to 6m, but group differences were not significant at 12m of child age.	Intervention children reported reduced milk intake at 3, 4, 5, and 6m of child age.

		No group differences in the rapid weight gain prevalence.	
INSIGHT trial **(Paul et al., 2019)**	Intervention mothers in the subsample showed increased RF in using sign language. No effect on other maternal feeding practices.	No effect on child BMI z-score.	N/A
INSIGHT trial **(Paul et al., 2018)**	N/A	Intervention children reported lower mean BMI z-score, but BMI percentiles did not differ between groups. Intervention children showed lower overweight/obesity prevalence at child 2y, but the significant difference between groups were attenuating by child 3y.	N/A
INSIGHT trial **(Savage et al., 2016)**	N/A	Intervention children showed slower infant weight gain in the first 6m, lower weight-for-length percentiles at 1y, and lower overweight prevalence at 1y.	N/A

		Consistent effects across breastfeeding and formula feeding	
INSIGHT trial (Ruggiero et al., 2021)	Intervention mothers reported reduced controlling feeding behaviours, improved mealtime routines.	N/A	Lower emotional overeating in intervention children at 2.5y
INSIGHT trial (Paul et al., 2025)	N/A	Lower BMI in the intervention group across 3-9y of child age (*p* = .049) No significant differences in BMI z-score or overweight/obesity prevalence at child age 5, 6, and 9y. No consistent differences in other child anthropometry outcomes.	N/A
NOURISH trial (L. Daniels et al., 2012)	Intervention mothers reported improved maternal RF (greater awareness of child satiety cues, less using food as reward)	Lower BMI-for-age z-score and less rapid weight gain in intervention children by child age 14m	N/A
NOURISH trial (Daniels et al., 2014)	Intervention mothers reported more autonomy-supportive parenting behaviours	No significant group differences in BMI z-score at child 2y.	Modest but positive impact on child eating behaviours at 2y (higher SR, lower emotional overeating, lower fussiness,

			greater exposure to vegetables) in the intervention group.
NOURISH trial **(Daniels et al., 2015)**	Sustained improvement in maternal RF practices up to 5y	No group differences in child BMI z-score, overweight/obesity prevalence, and waist circumference z-score	N/A
NOURISH trial **(Magarey et al., 2016)**	N/A	N/A	Intervention children reported lower FR and higher SR at 5y No effect on vegetable and fruit intake. Small improvements in dietary quality (e.g., greater liking of fruits and vegetables)
Sleep SAAF **(Lavner et al., 2022)**	Intervention mothers reported improved RF practices, less using food to soothe, less pressure in feeding. No group differences in infant cue recognition, bottle-feeding practices.	Slower but nonsignificant weight gain in the intervention group. No group differences weight-for-age percentiles or z-score, weight-for-length percentiles or z-score, or BMI-for-age percentiles or z-score at 16w of child age.	N/A

PROBIT trial (Morandi et al., 2019)	Intervention mothers reported more feeding on demand at 3m of child age.	No group differences in child BMI, overweight/obesity prevalence.	No group differences in beverage consumption or TV viewing
Group 3 (feasibility trials, or qualitative studies for programme development)			
Baby Byte study (Mobley et al., 2023)	Parents across demographics expressed strong interest in an app to support responsive feeding. Content priorities differ by gender and income, suggesting tailoring is important. Features that combine practical guidance (recipes, tips), monitoring (growth tracking), and support (discussion boards, expert Q&A) are most valued.	N/A	N/A
ProASK (Redsell et al., 2017)	Maternal feeding style was assessed using the Infant Feeding Questionnaire, but the study mainly demonstrated feasibility of collecting these data rather than showing clear behavioural change.	At follow-up (child 6m), data collection was incomplete, only about half of parents returned usable questionnaires. No robust conclusions about changes in z-score could be drawn.	N/A
Taki 2019 (Taki, Russell, Wen, et al., 2019)	Both pregnant women and mothers found apps acceptable and potentially useful for promoting healthy infant feeding practices.	N/A	N/A

	Mothers wanted balanced, non-judgmental, practical, and personalized content, delivered in manageable frequency (e.g., weekly). Apps should integrate videos, recipes, peer support, and tailored messaging to maximize engagement. Highlights the potential of mHealth to bridge gaps in support and reduce health disparities in early obesity prevention.		
The Growing Healthy study **(Denney-Wilson et al., 2016)**	No significant differences between groups in breastfeeding, formula practices, solids timing, parental feeding practices.	No group differences in child growth trajectories.	N/A
Web-based parenting programme **(Suárez et al., 2018)**	Programme group showed sustained improvements in daily parenting mood (role satisfaction, confidence).	N/A	N/A

Appendix E1: Overview of intervention effectiveness on the improvement of parental RF practices, infant weight change, and infant eating patterns (eating traits, dietary intake), presented by groups based on Chapter 2.