Infant feeding cues, maternal feeding decisions and the development of a self-directed responsive feeding resource

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The candidate confirms that the work submitted is her own, except where work which has formed part of jointly authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

The work in Chapter 2 of the thesis include has appeared in publication as follows:

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I designed the research, undertook the literature search and drafted the review. Marion Hetherington, Siobhan Hugh-Jones, Samantha Caton, Hugo Weenen and Carel Vereijken advised on search strategy. Myself and the co-authors carried out quality ratings on reviewed papers. I developed the tables and Figure 2.1. I adapted Figure 2.2 from a diagram originally developed by Samantha Caton. I wrote the original review and re-drafted this in response to comments from other authors. Finally, I updated and amended the original publication version for inclusion in this thesis.

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Thesis Abstract

Low maternal responsiveness to infant feeding signals is a reported risk factor for childhood obesity, however, mothers may have difficulty in responding to cues. The thesis had 3 aims: to better understand infant feeding cues within complementary feeding (CF); to understand mothers' feeding decisions, perceptions and practices in the context of weaning approach (baby led or traditional weaning), and to develop a self-directed, online resource to facilitate cue recognition with a view to promoting responsive feeding.

A systematic review of the feeding cues literature was undertaken (Study 1) followed by an observational study of infant gaze, gesture and vocalisation during feeding with 20 mother-infant dyads (Study 2). 11 mothers from Study 2 then participated in qualitative, video-elicited interviews concerning choice of feeding method, and decisions and perceptions during feeding interactions (Study 3). Studies 1-3 informed the development of a self-directed, online responsive feeding resource (Study 4), which was evaluated by 23 parents and professionals for acceptability and satisfaction.

Findings suggest that low responsiveness to feeding cues may arise from poor recognition, but that attention to infant gaze, gesture and vocalisation during feeding may help mothers to recognise satiation (Study 2). However, mothers may have difficulty following cues, even when recognised, because of worries about infant intake, behaviour which deviates from maternal feeding expectations, and practical pressures (Study 3). Such issues were reported by mothers across different CF approaches. Study 4 indicated that an online, self-directed responsive feeding intervention is feasible to deliver and acceptable to parents. The thesis offers potentially new insights for understanding infant communication of hunger and satiation and responsive feeding, and identifies research directions to investigate these further. It also highlights the need for feeding interventions to address cue recognition, issues which compromise maternal responsiveness, and to be flexible to the specific needs of individual mother-infant dyads.

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Chapter 1 – Introduction

1.1 Background and thesis aims

This introduction sets out the background to the thesis and provides an overview of the different studies it comprises. The central aim of the research was to investigate infant hunger and satiation cues[1] in the context of complementary feeding[2] (CF) with the goal of developing a responsive feeding intervention for parents. The work was predicated on evidence that low maternal[3] responsiveness to infant feeding cues, particularly fullness cues, is a risk factor for the development of childhood obesity (de Lauzon-Guillain et al., 2012: Hurley, Cross, & Hughes, 2011).

1.1.1 Understanding infant hunger and satiation cues

The infant feeding cues literature is relatively small (Hodges et al., 2008). However, it is apparent that infants express hunger and satiation through a number of commonly observed cues (Hodges, Hughes, Hopkinson, & Fisher, 2008; Hodges, Wasser & Colgan, 2016; Skinner et al., 1998) (Table 1.1). Despite the reporting of such cues, a recent review suggests that mothers' ease in interpreting feeding signals may vary according to their own BMI, breastfeeding history, educational level and depressive symptomatology (McNally et al., 2016). There is also evidence that mothers may have difficulty in responding to cues appropriately, with 75% of 361 mothers of toddlers (aged 12-36 months) reporting the use of coaxing or coercion when feeding their child (Chan, 2005) and 44% reporting that they did not interpret food refusal as indicating satiation.

Mothers' ability to interpret and respond to feeding cues may also be complicated by differences in how these are expressed by individual infants. McNally et al. (2016) identified several infant characteristics which may impact on babies' communication of hunger and fullness including: temperament, feeding method, gestational age at birth, gender and individual feeding traits.

[1] Hereafter also referred to as feeding cues
[2] The transition from an exclusively milk based diet (breast or formula) to the consumption of solid foods
[3] It is acknowledged that fathers play a key role in feeding and parenting. However, most research in these areas has involved mothers, therefore the terms 'mothers' and maternal are used throughout the thesis except where studies have explicitly involved both mothers and fathers.

Table 1.1. - Commonly observed feeding cues in infants from 0-18 months of age compiled from Hodges et al., (2008), Hodges et al., (2016) and Skinner et al., (1998)

	Motor and mouth behaviours	**Vocal behaviours**	**Other**
Hunger	Mouthing, rooting, latching on Opening mouth when breast, bottle or spoon approaches Reaching for spoon or leaning in as spoon/food approaches Excitatory limb movements Bringing or showing food or feeding utensils to caregiver Hitting caregiver on the arm or chest Motioning to be placed in the highchair Fidgeting or squirming	Crying Whimpering, whining or fussing Asking for food Excitatory vocalisation Repeating consonant-vowel combinations (e.g. dah-dah-dah) to show readiness for the next spoonful	Will not settle Temper tantrum Increased alertness Postural attention Settling into feed/decrease in tension Eating readily
Satiation	Detaching from nipple Turning head or body away from breast, bottle or spoon, Closing mouth to reject food Putting hand to face Lateral head shake Spitting food out Hitting the tray or table Removing bib or trying to leave Playing with food	Crying as feeding continues Saying ‘no’ or ‘all done’	Looking distressed Losing interest in food Gaze aversion Slowed rate of eating Decreased muscle tone Taking an interest in surroundings Losing interest quickly Grimacing or frowning Falling asleep Vomiting

As discussed in Chapter 2 of the thesis, there is also evidence that issues other than hunger and satiation may influence infant feeding behaviour. For example, babies have been reported to prefer flavours to which they have been exposed previously in utero, during breast feeding or in early CF, and to consume more of food with such flavours (Cooke & Fildes, 2011; Gerrish & Menella, 2001; Mennella, Jagnow, & Beauchamp, 2001).

Processes such as sensory specific satiety (SSS), may also influence infant responses to food. That is, as a particular food is consumed, its palatability declines, while appetite is renewed with exposure to foods with different sensory qualities (Rolls, Rowe, & Sweeney, 1981). There is evidence of SSS influencing consumption patterns in children as young as two. Lipps and Deysher (1986) asked 21 two to five-year olds and 26 adults to rate their liking of a spoonful of a high or low-density chocolate or vanilla dessert before, immediately after and 20 minutes after consuming a 99-gram portion on two separate occasions. Both adults and children showed a significant decrease in liking for the desserts immediately after eating regardless of their energy density, thereby indicating that decreased liking was associated with exposure to the desserts' sensory attributes, rather than satiation.

Studies also suggest that SSS may influence feeding behaviour in infants. In an experimental study of 74 six to eleven-month-old infants, Mennella, Kennedy, and Beauchamp (2006) found mothers of babies fed on hydrolysate formula significantly more likely to report that their infants did not enjoy eating vegetables with similar flavour notes to these, i.e. broccoli or cauliflower, compared to infants fed milk formulas which did not contain such flavours. This appears contrary to the evidence regarding exposure and food preferences, however the authors suggest that, for infants, newly acquired flavour preferences may be specific to the context in which they appear (in this case milk feeds) and may take time to generalise to other contexts (i.e. CF).

Taken together, research findings suggest that interpreting and responding to infant hunger, satiation and eating behaviour are therefore, complex tasks. This has important implications for responsive feeding practices in both milk and CF contexts. Infant hunger and satiation are therefore, explored further in relation to milk and complementary feeding in Chapter 2 of the thesis, while subsequent chapters focus on feeding cues, and issues shaping mothers' feeding responses in the specific context of CF.

1.1.2 Complementary feeding and complementary feeding methods

CF covers the period from 6 to 24 months of age, (World Health Organisation, 2018) and is important for meeting infants' increasing nutritional needs. The CF period is also believed to play a key role in determining food preferences (Coulthard, Harris & Emmett, 2009) and in the development of eating behaviours (Schwartz, Chabanet, Lange, Issanchou, & Nicklaus, 2011).

Prior to 2001, the World Health Organisation's recommended age for the introduction of CF was four to six months of age. As such, traditional CF practices in developed countries have involved the introduction of spoon-fed purees and mashes with infants eventually progressing to self-feeding foods in their whole form. In 2002 the recommended age for introducing CF was revised upwards to six months. At six months, babies can pick up food and bring it to the mouth (Jones, 2016) and, in the last 10-15 years some mothers have therefore adopted 'Baby Led Weaning' (BLW) i.e. the use of whole foods and infant self-feeding from the outset of CF. In this approach, infants eat family foods provided in manageable sizes and shapes in the context of family meals. Moreover, BLW emphasises exploratory aspects of CF and the importance of infant autonomy in determining what, and how much babies consume, with milk feeds (breast or formula) continuing on demand until infants' desire for these decreases (Rapley & Murkett, 2008).

Importantly, it has been suggested that BLW provides infants with greater control over intake, represents a more 'responsive' style of feeding than TW, and facilitates the development of healthy eating habits (Rapley & Murkett, 2008). Perhaps as a result of this, the approach is growing in popularity (Caroli et al., 2012) though this is despite current evidence for BLW being mixed or lacking (Fewtrell et al., 2017).

1.1.3 Responsive parenting and responsive feeding

Regardless of which CF approach mothers use, there is evidence that 'responsive feeding' facilitates positive feeding interactions and supports the development of healthy eating habits (Harbron & Booley, 2013). The notion of responsive feeding has developed from the broader concept of responsive parenting, wherein mothers are viewed as 'responsive' if they react promptly, predictably and appropriately to infant behaviour, and avoid the use of controlling or intrusive behaviours themselves (Ainsworth, 1989). Building on such principles, Black and Aboud (2011) suggested that responsive feeding involves the use of predictable feeding schedules, the provision of healthy, developmentally appropriate food, sensitivity to children's feeding cues and appropriate responses to these. In contrast, Black and Aboud (2011) proposed that nonresponsive feeding practices may impact negatively on feeding interactions. Such practices may involve mothers pressuring infants to eat or placing undue restrictions on feeding (a controlling style), allowing the infant to control the feeding interaction (indulgence) or the infant receiving little attention during feeding (an uninvolved style) (Black & Aboud, 2011).

Hughes, Power, Fisher, Mueller, and Nicklas, (2005) also mapped notions of responsive feeding onto those of responsive parenting drawing on the dimensions of demandingness and responsiveness highlighted by Baumrind (1989). Demandingness relates to parental control, supervision and expectations of children's compliance, while responsiveness refers to emotional warmth, involvement and acceptance of the child's behaviour (Vollmer & Mobley, 2013). Using these dimensions, feeding styles may be viewed as authoritarian (high demandingness and low responsiveness); indulgent/permissive (low demandingness and high responsiveness); uninvolved (low demandingness and low responsiveness and authoritative (high demandingness and high responsiveness).

Authoritative feeding practices have been found to be associated with positive feeding outcomes. A survey of 231 caregivers (parents, grandparents and others) using the Caregiver's Feeding Styles Questionnaire (CFSQ) by Patrick, Nicklas, Hughes and Morales (2005) found authoritative feeding was significantly associated with a higher level of fruit and vegetable intake in three to five-year-olds. In contrast, non-responsive styles (indulgent, uninvolved and authoritarian feeding) have been shown to be associated with poorer outcomes. A survey of 104 mothers using the CFSQ and the Child Eating Behavior Questionnaire (CEBQ) (Birch et al., 2001) by Hankey, Williams and Dev (2016) found an uninvolved feeding style was associated with emotional overeating in three to five-year-olds, while Hughes, Shewchuk, Baskin, Nicklas and Qu (2008) found indulgent feeding was associated with excess consumption and higher BMI in a survey of 718 three to five-year-olds, again using the CFSQ. Morawska, Laws, Moretto and Daniels (2014) meanwhile, found authoritarian and coercive feeding practices were significantly associated with infant food refusal in a video interaction study of 21 mother-infant dyads. Together, such findings suggest that responsive feeding, or the lack thereof, impacts both on the development of young children's eating habits and on infant mealtime behaviours.

1.1.4 Responsive feeding and the bi-directionality of parent child feeding interactions

While maternal feeding styles appear to influence children's eating behaviour, it is likely that controlling practices also arise from the interaction of maternal and infant characteristics, with mothers adopting coercive or restrictive practices in response to concerns about intake. Gregory, Paxton and Brozovic (2010) used the Child Feeding Questionnaire (Birch et al., 2001) and the Child Eating Behavior Questionnaire (CEBQ) (Wardle, Guthrie, Sanderson, & Rapoport, 2001) to examine relationships between child eating behaviour and parental feeding practices in 183 two to four-year-olds. The authors found significant positive associations between concern about child underweight and maternal pressure to eat, and food restriction and concern about overweight. They also found that child food fussiness predicted maternal pressure to eat and while food responsiveness predicted maternal restriction.

Further evidence of the bi-directionality of feeding comes from Farrow and Blissett (2008). In a longitudinal survey study of 62 mother infant dyads they found maternal pressure to eat was negatively correlated with birth weight, indicating that mothers were more likely to pressure infants with lower birth weights or those with slow weight gain than their peers. Such findings demonstrate the complex and inherently dyadic nature of feeding interactions with important implications for responsive feeding interventions.

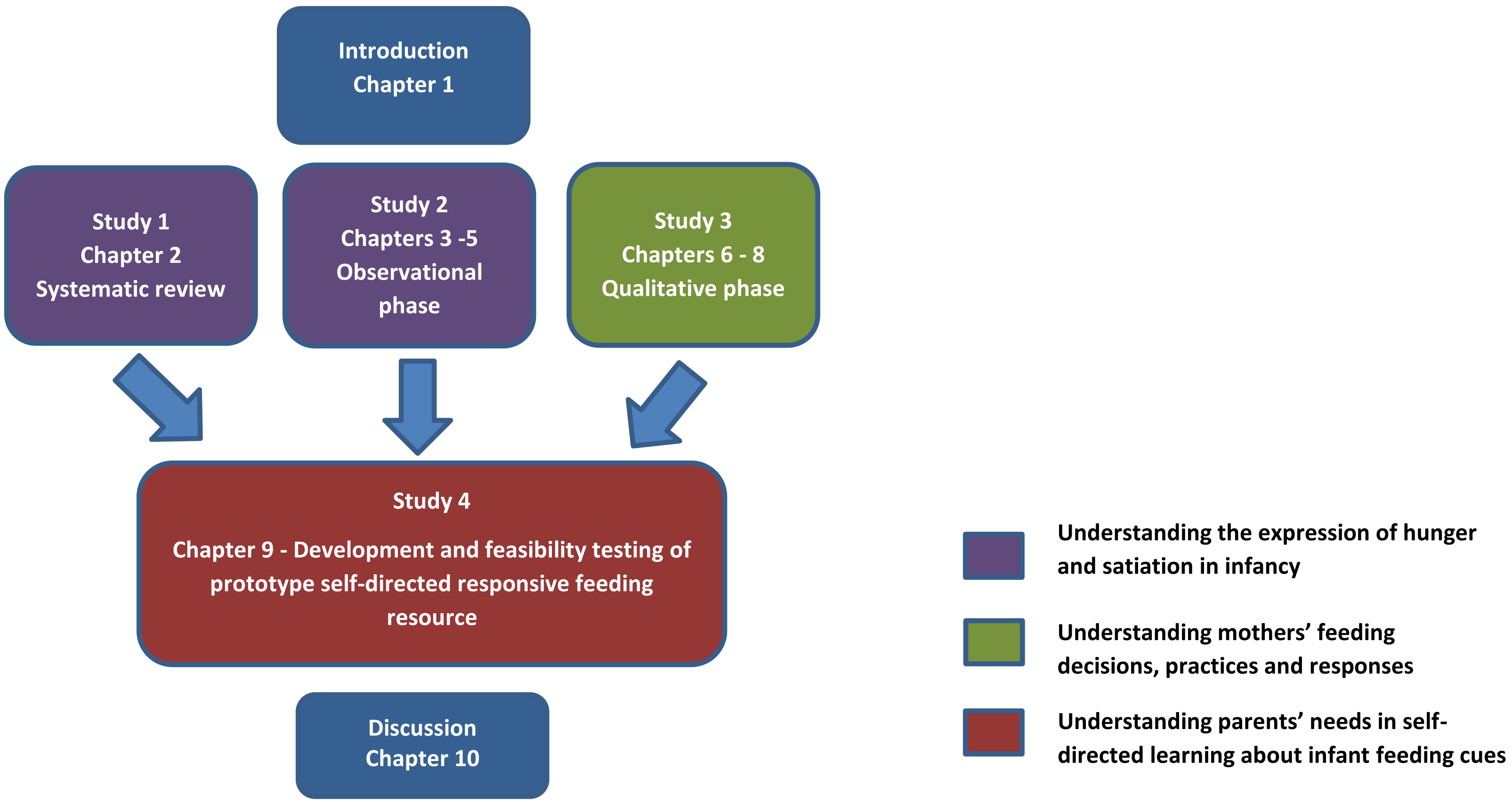
1.2 Overview of thesis chapters, methods and areas of investigation

As noted, the main aim of the thesis was to investigate infant feeding cues during CF with the goal of developing a responsive feeding intervention for parents. To achieve this, three areas of investigation were undertaken in order to develop a better understanding of:

1. The expression of infant hunger and satiation within CF
2. Mothers' feeding decisions, practices and responses
3. Parents' self-directed learning needs regarding feeding cues and babies' feeding behaviour

The relationship between these areas, thesis studies and chapters is illustrated in Figure 1.1.

Figure 1.1. Relationship between thesis studies, chapters and areas of research



1.2.1 Overview of thesis methods

A range of quantitative and qualitative methods was used in the thesis (Table 1.2). Full accounts of these are provided in each chapter, along with details of eligibility criteria, recruitment, measures and study procedures.

Table 1.2 Summary of thesis methods

Study/Chapter	Method	Measures/tools
Chapters 3, 4, 5	Video observation and micro-coding of infant behaviour during CF	- Noldus Observer XT video coding software - Bespoke behavioural coding schemes
Chapters 6, 7, 8	Video elicited semi-structured interviews	- Bespoke semi-structured interview schedule - Feeding videos from observational strand of thesis
Chapter 9	Online survey Data capture	-Articulate Presenter software and Articulate Online web-hosting - Adapted version of the User Satisfaction Questionnaire (USQ) (Kobak, Stone, Wallace, Warren, Swanson, & Robson, 2011)

1.2.2 Study 1, Chapter 2 - Systematic review

The development of responsive feeding resources ultimately depends on the availability of accurate and reputable information concerning the infant communication of hunger and satiation. Therefore, the first phase of the thesis involved a systematic review regarding feeding cues in the first two years of life, and issues that impact on how these are expressed and perceived. The review revealed a paucity of observational studies of infant feeding cues, and limitations in work conducted date i.e. a lack of attention to overall patterns of behavioural change during feeding. It also revealed a lack of validated tools for conducting systematic observations of feeding behaviour.

1.2.3 Study 2, Chapters 3, 4 and 5 – Behaviour change in infant feeding episodes

The first phase of the thesis (Study 2) attempted to address the current lack of observational studies of infant feeding cues, and the lack of observational tools for examining infant behaviour during feeding, as identified by the systematic review. Infants were observed directly in typical mealtime contexts in their own homes. Direct observation has advantages over maternal reports of infant behaviour as it enables the observation of behaviours of which participants are unaware or which they may not report (Bergmeier, Skouteris, Haycraft, Haines & Hooley, 2015). Furthermore, naturalistic observations may capture more representative interactions than those conducted in laboratories, as participants are likely to feel more comfortable in familiar settings (Gardner, 2000). Naturalistic observations also offer potential insights into issues such as food preparation practices and 'normal' eating routines (Pesch & Lumeng, 2017). Finally, the use of observations in participants' own homes allows for greater flexibility for families of young children (Gardner, 2000).

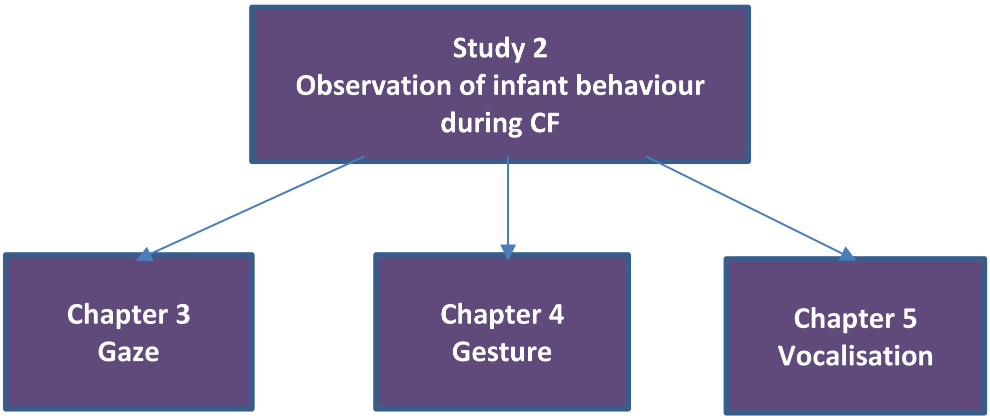
Notwithstanding the benefits of direct observations, these also have potential disadvantages. Firstly, they are time intensive in terms of coder training, conducting observations and carrying out reliability testing (Gardner, 2000). A further concern is that participants may change their behaviour in response to being observed, although the use of unobtrusive filming or familiarising participants with observation procedures may help to mitigate this (Gardner, 2000).

The use of *naturalistic* rather than laboratory-based observations, also has disadvantages such as a lack of standardisation in how meals are conducted, the type and amount of food served and potential environmental challenges e.g. background noise or unexpected interruptions. In addition, the variability of naturalistic settings necessitates a consideration of how many observations are required to achieve a representative picture of feeding interactions (Pesch & Lumeng, 2017). Despite such issues, direct, naturalistic observation of infant feeding was considered to be the most appropriate method for obtaining detailed data on relatively typical feeding interactions. It was also considered to offer the most comfortable and convenient observational context for families taking part in the study.

1.2.3.1 Gaze, gesture and vocalisation in pre-verbal communication.

In addition to determining the most appropriate method for studying infants during feeding, it was also necessary to identify *which* behaviours would be observed. A decision was taken to focus on infant gaze as an indicator of attention and as a key medium of pre-verbal communication. Gesture and vocalisation during feeding were also examined as other important channels of pre-verbal communication. All three behaviours were examined in Study 2 using the same video data across whole feeding episodes and in separate courses (to explore potential associations between behavioural change and the presentation of sweet or novel foods). Chapters 3, 4 and 5 describe the development, reliability testing and application of the coding schemes for each behaviour (Figure 1.2).

Figure 1.2 – Components of Study 2



1.2.3.1.1 Infant gaze

Gaze provides caregivers with important information regarding infant state and attention, particularly before the development of intentional communication (Coupe-O'Kane & Goldbart, 1998; Cronin & Mandich, 2015). Gaze aversion has also been used as a measure of behavioural avoidance and negative arousal in infants (Cohn & Tronick, 1983; Waters, Matas, & Sroufe, 1975), although infants may also avert their gaze during pleasurable interactions as a means of regulating arousal and processing information (Field, 1981). Alternatively, infants may shift their gaze in order to seek out other stimuli in order to maintain arousal at an optimal level (Kagan, 1971; Kaye & Fogel, 1980).

Gaze is also used by infants for interaction and communication with new-borns showing preferences in their gaze patterns for facial versus non-facial stimuli (Farroni, Csibra, Simion

& Johnson, 2002) and four-week-old infants seeking eye contact during feeding (Zeifman, Delaney, & Blass, 1996). By six weeks of age babies are able to engage in mutual gaze with their mothers (Owens, 2015) and by three months of age their gaze at their mothers can be seen to involve turn taking (Jaffe, Stern & Peery, 1973).

Between 8 and 13 months of age infants develop the ability to attend to others' focus of gaze i.e. to respond to joint attention (Mundy et al., 2007). Within this they also learn to use their own focus of gaze to direct others' attention i.e. to initiate joint attention to share experiences (Mundy et al., 2007). Importantly, infants also use joint attention for the purpose of requesting objects including food (Crais et al., 2009; Stifter & Moyer, 1991). Other aspects of infant gaze behaviour meanwhile, have been implicated in the communication of hunger and satiation. These are discussed further in Chapter 3.

1.2.3.1.2 Infant gesture

Movement is another key medium of infant communication, however, its use for the purpose of intentional communication (i.e. gesture) does not emerge until infants are around six months old (Crais, Douglas & Watson, 2004). This is about the same time that CF is introduced. As such, mothers face the challenge of interpreting rudimentary gestures while also trying to gauge infants' appetite for solid foods.

The earliest stage of infant communication is the pre-intentional behaviour phase which, typically lasts from birth to three months (Rowland, & Fried-Oken, 2004). During this time, movement is largely reflexive with infants relying on parents to infer their physical and emotional state from movement and other behaviours (Karniol, 2010). Between three- and six-months infants start to gain control over movement, although this is still not used for intentional communication.

Communication begins to assume intentionality in the 'unconventional communication' stage (6-12 months) when infants start to use movement in a more goal directed way and gesture emerges (Carpenter, Mastergeorge, & Coggins, 1983). Initially gestures are rudimentary, e.g. arching the body as a sign of protest (Blake, & Dolgoy, 1993). However, as infants approach eight or nine months, gestures become more conventional e.g. waving to say 'goodbye' or pointing to an object to request it. The final stage of communication development starts in the second year of life with the acquisition of ‘symbolic’ communication e.g. picking up a cup to signify thirst. Infants exposed to manual signing also begin to use gesture in a more abstract way for example using the ‘more’ sign to request more food (Rowland & Fried-Oken,2004)

Like other modes of infant communication, gesture can be appreciated more fully when considered in terms of its communicative ‘functions’. Importantly, the same gesture can serve a number of different purposes; in the context of a meal an infant may point to an item to request it, to request information about it, or simply to ‘comment’ on it. Consistent with this, Bruner (1981) proposed that children’s early communications can be categorised according to three main functions:

1. Behaviour Regulation - to regulate the behaviour of others (e.g. to protest or to request or reject objects)

2. Social Interaction - to initiate or respond to interaction with others (e.g. to greet or to play a game)

3. Joint attention - to draw another person’s attention to an object (e.g. showing or pointing)

Research suggests that infants acquire different communicative functions at different ages, though the sequence of acquisition may differ between children (Crais et al., 2004). In an observational study of gesture in twelve 6 – 24-month-old infants and toddlers, they found behaviour regulation to be the earliest function children acquired, with protest gestures emerging first (median age six to seven months), followed by requesting objects (median age seven to nine months). Importantly, these findings suggest that in the first weeks of CF, infants’ may only be able to use gesture for protesting, with the ability to request emerging a few weeks later. The role of gesture in the specific communication of hunger and satiation is examined in detail in Chapter 4 of the thesis.

1.2.3.1.3 The development of vocalisation in infancy

Vocalisation progresses through the same developmental stages as gesture in terms of the acquisition of intentionality, and intentional vocal communication can be seen to serve the same communicative functions as gesture.

The different vocal behaviours observed in infants emerge in a number of stages including: reflexive phonation (birth to two months), in which reflexive sounds such as coughing, sneezing, and crying predominate; cooing (one to four months), in which infants produce sounds that resemble vowels; expansion (three to eight months), characterised by the occurrence of clear vowels a range of new sounds such as yells, screams, whispers, and raspberries; canonical babbling (5 - 10 months) during which infants produce combined vowel and consonant sounds, and finally, meaningful speech (10 - 18 months) in which infants combine babble and meaningful speech to produce longer utterances (Kuhl & Meltzoff, 1996).

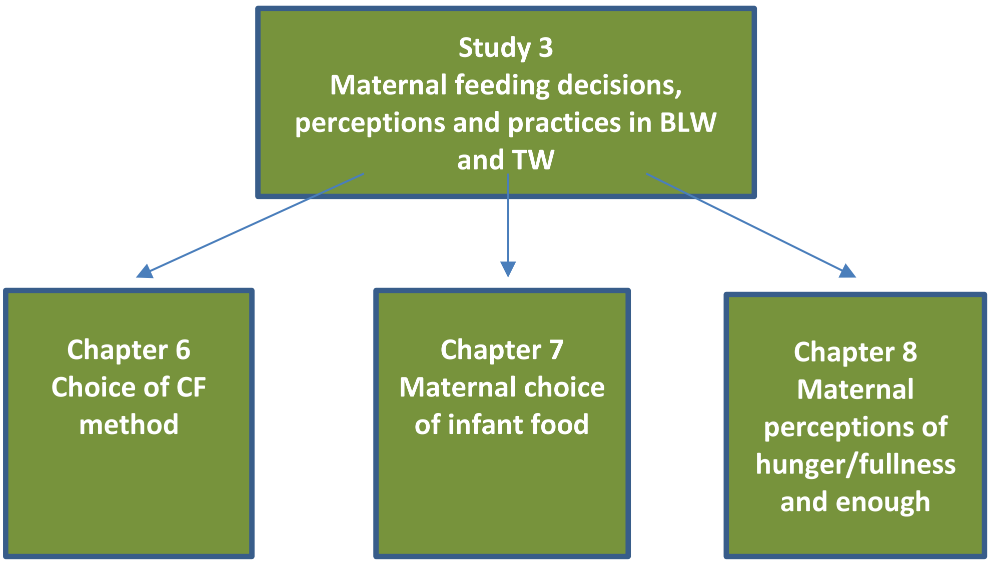
Infant vocal behaviours have also been categorised as distress or non-distress vocalisations, with the latter being further differentiated according to whether they have speech like qualities (involve vowel or consonant sounds) or not (Hsu, Fogel & Cooper, 2000). Furthermore, within the category of distress vocalisations, several different types of cry have been identified including: birth cry, cries resulting from separation, pain or the infant being startled (Lindová et al., 2015). Importantly, a number of studies have attempted to differentiate hunger cries from other forms of cries (Gustafson & Harris, 1990; Lindová et al., 2015). These, and the role of other forms of vocalisation in expressing hunger and satiation, are discussed further in Chapter 5 of the thesis.

1.2.4 Study 3, Chapters 6, 7 and 8 - Mothers' feeding decisions and perceptions

While an understanding of infant communication and feeding cues is key to responsive feeding, responsiveness also requires mothers to follow cues, to avoid controlling behaviours, and to feed in ways which meet infants' developmental needs. As such, a full understanding of the necessary conditions for responsive feeding requires an appreciation of the factors which shape maternal feeding behaviours. Study 3 therefore involved an exploration of mothers' feeding decisions and perceptions. This was conducted with reference to CF approach i.e. BLW or TW, to reflect current feeding methods and how these might relate to mothers' feeding practices and perceptions. Qualitative studies are appropriate for exploring such subjective and complex issues as well as the practical constraints and circumstances which shape people's choices. Study 3 therefore involved a semi-structured, qualitative exploration of maternal feeding decisions in which interviews were facilitated by observation and discussion of videos of mothers feeding their own infants. Such 'video-elicited' interviews have been used previously to encourage reflection on interactions between health professionals and patients (Gao, Burke, Somkin, and Pasick, 2009; Henry and Fetters, 2012), however, they have not been used before to explore feeding interactions. The method has been reported to enhance participant memory and to provide a useful means of exploring interpersonal interactions and events within these (Kwasnicka, Dombrowski, White, & Sniehotta, 2015; Paskins, McHugh & Hassell, 2014). As such, video elicitation was considered to offer a potentially valuable tool for accessing 'on-line' aspects of mothers' feeding perceptions and responses, and their views of how their CF approach influenced feeding practices.

Three separate analyses were conducted using the same data generated from the video elicited interviews, with each discussed in a different thesis chapter. Chapter 6 examines mothers' initial choice of feeding method. Chapters 7 and 8 explore choice of complementary food and maternal perceptions of hunger, satiation and 'enough' within BLW and TW respectively (Figure 1.3).

Figure 1.3 – Components of Study 3



1.2.5 Study 4, Chapter 9 - Development and testing of a self-directed online responsive feeding resource

Responsive feeding programmes to date have largely been conducted in face to face individual, or group contexts. This is costly, and despite self-directed programmes having been shown to be effective in several areas of parenting (Feil et al., 2008; Kobak et al., 2011; Sanders, Markie-Dadds, Tully, & Bor, 2000). As such, the aim of Study 4 was to develop and feasibility test an online self-directed responsive feeding programme. Evidence from the systematic review, the infant feeding literature and observational and qualitative phases of the thesis informed the development of the resource. Its acceptability to parents and nutrition and child care professionals was examined using data capture and survey methods in order to evaluate its perceived usefulness and to determine areas requiring revision. The development of the resource, its theoretical underpinnings, and findings regarding its acceptability are described in full in Chapter 9.

1.2.6 – Chapter 10 - Discussion and synthesis

The final section of the thesis discusses the implications of all findings for understanding responsive feeding, for the development of responsive feeding interventions and for new research directions.

Chapter 2 - Communicating hunger and satiation in the first two years of life: a systematic review

2.1 Introduction

Childhood obesity is prevalent in developed countries (Ogden, Carroll, Kit, & Flegal, 2012: Wang & Lobstein, 2006) and research has focussed on factors which might increase obesity risk in children. Some of the factors identified thus far include: parental body mass index (BMI); birth weight; early adiposity; weight gain during the first year of life and maternal feeding practices (Dev, McBride, Fiese, Jones & Cho, 2013: Reilly et al., 2005).

Several reviews indicate that maternal feeding practices may increase obesity risk by influencing the early entrainment of appetite control (Disantis, Hodges, Johnson, & Fisher, 2011; Hurley et al., 2012). However, the precise mechanisms linking maternal feeding practices and childhood obesity remain unclear. DiSantis et al. (2011) proposed a theoretical role for maternal feeding 'responsiveness' in infant and child overweight.

Some evidence exists to support this proposal. Worobey, Lopez, and Hoffman (2009) found lower maternal sensitivity to feeding cues at six months predicted infant weight gain between six and twelve months of age. Meanwhile, a systematic review by Hurley et al. (2011) reported that two types of low responsivity, namely, restrictive feeding and indulgent feeding were associated with a high BMI in infants and young children. In addition, DiSantis et al. (2011) identified that a third kind of discordant response, maternal pressure to eat, may also increase obesity risk.

Consistent with this, Farrow and Blissett (2006) reported that infants with high weight gain in the first six months whose mothers exhibited pressure to eat, continued on this trajectory between 6 and 12 months of age. Similarly, Lumeng et al. (2012) found assertive prompts to eat and maternal intrusiveness to be associated with higher adiposity in toddlers. Poor responsiveness to satiation through pressure to eat, may therefore also affect obesity risk.

2.1.1 Review rationale and aims

Despite reported associations between maternal responsiveness and infant adiposity, the direction of causality between these remains unclear. Overfeeding may arise from insensitivity to fullness cues or the use of food to settle fractious infants (Worobey et al., 2009; Redsell et al., 2010). Restrictive feeding practices may also play a role by increasing the desirability, and consequent consumption, of restricted foods (Dev et al. 2013). Importantly though, mothers may simply be responding to their child's appetite (Webber Cooke, Hill and Wardle, 2010a) as some infants have a more avid appetite than others (Agras, Kraemer, Berkowitz, & Hammer, 1990). In turn, mothers may restrict intake for children they perceive to over-eat or may pressure children with small appetites to eat more (Webber, Cooke, Hill, & Wardle, 2010b). There is, therefore, a need to better understand what shapes mothers' perceptions of infant feeding cues and responses to these in order to inform the development of interventions to prevent overfeeding. The aim of the current review was to evaluate, synthesise and consider the evidence regarding what infants communicate during meals, what mothers respond to and how. Specifically, the review aimed to identify:

1. How hunger and satiation are communicated in the first two years of life.
2. Factors which influence individual infants' communication of hunger and satiation.
3. Factors which shape maternal perceptions of feeding cues and responses.
4. How food preferences impact on feeding behaviour, and how far hunger and satiation cues can be differentiated from those relating to preference.

2.2 Method

2.2.1 Search strategy

An initial scoping exercise was conducted to establish whether reviews had been completed previously on infant feeding cues. The Cochrane Systematic Review Database was searched followed by Medline, CINAHL, Web of Science, PsycINFO, Science Direct and Maternity and Infant care. The scoping exercise was also used to generate search terms and synonyms, and to establish the utility of the databases for the search. Final key word search terms appear in Table 2.1.

Key word searches were initially conducted across all publication years up to January 2014 and subsequently repeated up to January 2018 to update the review. Where databases offered combined keyword and subject heading search options (Medline, Maternity and Infant Health, PsycINFO and CINAHL), search terms (infant and feeding) were mapped to subject headings. Following keyword and combined keyword and subject heading searches, results were refined by applying initial limiters: English language, full text, peer reviewed, human and child.

Table 2.1 – Final search terms

(Infan* OR baby OR babies OR toddler* OR new-born* OR neonate*)
AND
(Feed* OR eat* OR hunger OR satiety OR satiation OR fullness OR meal*)
AND
(cue* OR behavio?r or behavio?rs OR sign* OR communication)

2.3 Results

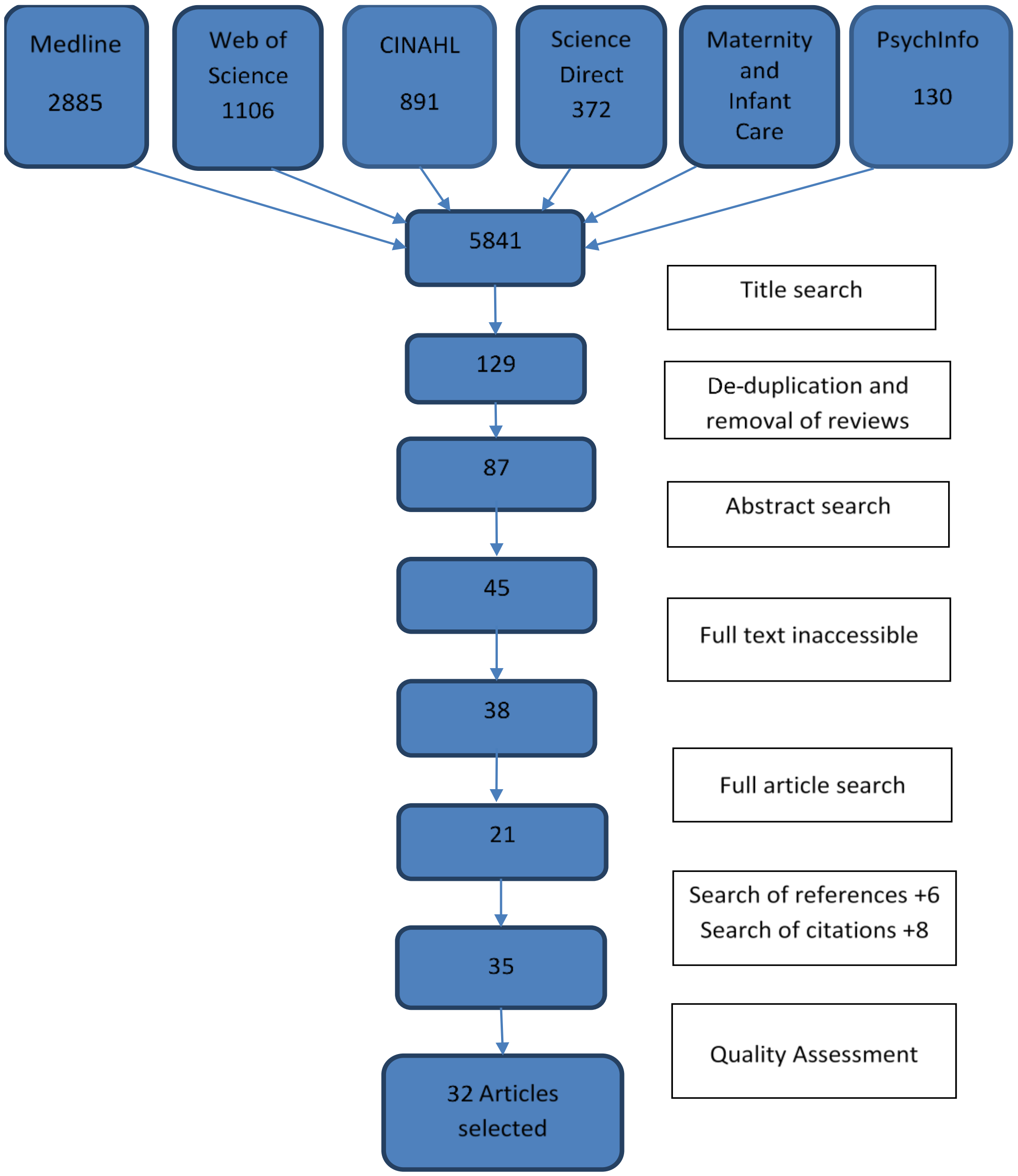
The study selection process is outlined in Figure 2.1; 5841 articles were returned in total. Their titles were screened according to the inclusion and exclusion criteria (Table 2.2) and irrelevant papers were discarded (n= 5712).

Table 2.2 – Inclusion and exclusion criteria

Inclusion Criteria
- Qualitative or quantitative
- Peer reviewed
- Focus on feeding behaviour in typically developing children aged 0-2 years
- Focus on hunger and satiation cues in typically developing children aged 0-2 years
Exclusion Criteria
- Full text version of paper unavailable
- Non-human population
- Primary focus on children over 2 years of age, maternal (rather than infant) feeding behaviours, feeding in premature infants, infant feeding in populations with medical conditions (e.g. developmental disorder, maternal substance abuse) or infant feeding in populations with maternal disorder (e.g. depressive illness, eating disorder etc.)
- Review articles/ books or papers not written in English

Duplicate and review articles were then removed (n=42). The abstracts of the remaining articles (n=87) were screened for relevance and exclusion and inclusion criteria were applied resulting in 42 articles being discarded.

Figure 2.1: Systematic review selection process



Of the remaining 45 articles only 38 were fully accessible. These were read in full; those not fulfilling inclusion criteria were discarded (n= 17). Reference list/citation searches were conducted for the remaining articles leading to the selection of a further 14 articles (Table 3). The remaining 35 articles were subjected to quality assessment (described below). Those receiving a mean score below 14 on the 22-point scale were removed, leaving 32 articles published between 1966 and 2017.

2.4 Quality assessment of studies

In the final stage of selection, articles were rated for quality using a tool developed by Moore (2012) (Appendix A1). The measure evaluates 11 aspects of quality including: clarity of research aims, appropriateness of methods, rigour of design, data collection, adequacy of conclusions and attention to ethical considerations. Items are rated from 0 -2 with a maximum overall score of 22. The tool was selected on its suitability for assessing both qualitative and quantitative papers and non-intervention studies. Quality ratings were subjected to inter-rater reliability analysis using a non-fully crossed design; the main author rated all papers while second authors each rated a different sub-set of papers. A random sample of 14 papers (just over 40% of the selected papers) was selected for the intraclass correlation (ICC) analysis. A high level of inter-rater agreement was found (single measures ICCs by use of a one-way random effects model) $r = .82$ ($p < .001$). The ratings per paper are detailed in Table 3. Mean article ratings were fair (14 - 16) for 6 papers, good (17-19) for 12 and excellent (20-22) for 14. The mean quality rating across all raters and all papers was: 18.75 (± 2.29).

2.5 Overview of selected papers

2.5.1 Terminology

Several selected studies use the terms “satiety” and “satiation” synonymously (e.g. Hodges, Hughes, Hopkinson, & Fisher, 2008; Llewellyn, van Jaarsveld, Plomin, Fisher, & Wardle, 2012). This review distinguishes between the two with ‘satiation’ referring to the process leading to the cessation of eating, and ‘satiety’ referring to the internal state after eating which determines the interval before the next meal (Blundell & Bellisle, 2013).

2.5.2 Summary of selected studies

The main methodological features of the selected studies and their findings are reported in Table 2.3. Most were cross-sectional (n=12) or had longitudinal/repeated measures components (n=9) or were experimental/quasi-experimental (n=9). Two studies were cohort studies. These involved questionnaires and one used modelling of heritability of eating traits (Llewellyn et al. 2012). Most of the cross-sectional studies employed surveys and structured observational methods. Exceptions to this were Hodges et al. (2008) and Anderson et al. (2001) who used semi-structured interviews and focus groups respectively.

Table 2.3 – Table of returned papers (n =32) outlining study methods, findings and quality ratings

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding infant hunger and satiation	Quality ratings (first, *second* and mean ratings)
Anderson et al. (2001) 'Rattling the plate - reasons and rationales for early weaning'	N= 29 - Multiparous and primiparous mothers, mean age 27 years, of babies aged between 8 and 18 weeks, mean age 13 weeks.	**Cross-sectional** Focus group discussions exploring beliefs and attitudes re the introduction of solid food. Qualitative content analysis.	Introduction of solids was based on infant age, size, weight and a variety of perceived increased infant hunger cues.	Both infant behaviours (chewing hands, crying) and infant characteristics (age, size) are used by mothers to gauge hunger along with external cues such as time.	20/22 *19/22* **19.5**
Blossfield et al. (2007) 'Texture preferences of 12-month-old infants and the role of early experiences'	N= 70 - 39 male and 31 infants aged between 48 and 57 weeks, mean age 52.7 weeks.	**Quasi-experimental** Infants fed chopped or pureed carrots. Measures – amount consumed, maternal ratings of enjoyment, questionnaire measures e.g. CEBQ [a], FFQ [b].	Consumption of chopped carrots related to familiarity with different textures, higher dietary variety, food fussiness and the number of infant teeth.	Amount of food consumed varies according to liking as well as with infant characteristics (e.g. pickiness or number of teeth).	22/22 *22/22* **22**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Buvinger et al. (2017) 'Observed infant food cue responsivity: Associations with maternal report of infant eating behavior, breastfeeding, and infant weight gain'	N = 30 Ten full term male infants in each age category 6, 9, and 12-months.	**Experimental** Infants presented with food and visually similar non-food items in plastic containers. Video analysis of number of 10 second intervals involving touching of items during a 60 second presentation episode.	Infants showed a preference for food versus non-food items. The strongest predictors of food preference were maternal-reported infant food responsiveness, and history of exclusive formula-feeding.	Exclusive formula feeding may be associated with increased infant responsivity to food cues, with implications for eating behaviour and consumption.	18/22 *18/22* **<u>18</u>**
Coulthard et al. (2014) 'Exposure to vegetable variety in infants weaned at different ages'	N= 60 32 male and 28 female infants aged between 4.5 and 5.9 months. 29 infants were weaned before 5.5 months and 31 were weaned after 5.5. months.	**Quasi-experimental** Baseline testing, followed by 9 day exposure to single taste puree (carrot) or variety of tastes (parsnip, sweet potato, courgette). Consumption of a novel puree (pea) measured after exposure period.	An interaction effect was found between CF age and exposure on novel puree consumption; infants in the single taste group weaned at six months ate significantly less pea puree than others.	Age of exposure to vegetable flavours may impact on subsequent acceptance/ amount consumed. Findings suggest that there may be sensitive period for the acceptance of such flavours between 4 and 6 months.	19/22 *19/22* **<u>19</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Darlington and Wright (2006) 'The influence of temperament on weight gain in early infancy'	N=75 43 male and 32 female infants between 8 and 12 weeks of age, mean age 10 weeks.	**Short term longitudinal.** Infants' birth weights and weights taken at 8-12 weeks. Completion of IBQ[c] and 'Baby's Day' record by mothers.	Slow weight gain was significantly associated with fearful temperament. Fast weight gain was associated with irritable behaviour.	Infant temperament may affect appetite or the communication of hunger, though mothers may feed irritable babies more in order to soothe them	20/22 *20/22* **<u>20</u>**
Forestell and Mennella (2012) 'More than just a pretty face. The relationship between infant's temperament, food acceptance, and mothers' perceptions of their enjoyment of food'.	N=92 48 male and 44 female infants, mean age 52 weeks.	**Experimental** Infants video-recorded when fed test vegetable in laboratory conditions. Measures: facial expression coding; Infant Temperament Scale and maternal ratings of infants' enjoyment.	Infants with high scores on the approach dimension of temperament ate more of a test vegetable for longer and with fewer negative expressions	Infant temperament may play a part in food acceptance and amount consumed. Consumption is therefore not purely determined by hunger.	22/22 *21/22* **<u>21.5</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Gross et al. (2010) 'Maternal Perceptions of Infant Hunger, Satiety, and Pressuring Feeding Styles in an Urban Latina WIC Population'.	N= 368 Mothers, mean age 28 years with infants aged < 20 weeks, mean infant age 18.8 weeks.	**Cross-sectional** Secondary analysis of survey data regarding maternal perceptions of hunger, satiation and pressuring feeding style.	Hand sucking was perceived as hunger and head turning as satiation. Most mothers (72%) believed crying indicated hunger. High maternal BMI and low educational level were associated with lower sensitivity to satiation.	Common cues are used by mothers to identify hunger and satiation. Lower maternal educational level and higher BMI may be associated with lower awareness of infant satiation.	19/22 *17/22* **<u>18</u>**
Hodges et al. (2008) 'Maternal decisions about the initiation and termination of infant feeding'	N= 71 Mothers of full-term infants at 12, 26 or 52 weeks of age, 35 males and 36 females. Mean maternal age, 28.9 years.	**Cross-sectional** Structured interviewing and qualitative content analysis.	Mothers' responsiveness to feeding cues was variable with some focussing on amount consumed while others focused on infant state or oral behaviours. Specificity of cues increased with infant age.	A range of overt and subtle hunger and satiation cues are reported by mothers e.g. crying, licking the lips, spitting food out, and stopping the meal. Different mothers focused on different cues.	19/22 *17/22* **18**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and **<u>mean</u>** ratings)
Hodges et al. (2013) 'Development of the responsiveness to child feeding cues scale'	N = 144 Mothers of 28 to 104-week-old infants and toddlers, mean maternal and infant age and M:F ratio unknown.	**Cross-sectional** Development and testing of measure of caregiver responsiveness to feeding cues using structured feeding observations.	Mothers responded more to hunger than fullness. Responsiveness was associated with maternal characteristics (education, BMI, breast-feeding duration). Mothers responded more to hunger in older children.	Hunger cues may be more salient for mothers than satiation cues as may the cues of older children. Responsiveness to satiation appears to be associated maternal characteristics.	22/22 *21/22* **<u>21.5</u>**
Hodges et al. (2016) 'Development of Feeding Cues during Infancy and Toddlerhood'	N = 45 - 24 male and 21 female infants purposefully sampled from a previous study sample of 125 as those with high, middle and low BMI Z-scores	**Longitudinal** Secondary analysis - Infants videoed during feeding at 3, 6, 9, 12 and 18 months. Videos analysed for the presence of hunger and satiation cues.	'Early' feeding cues were seen less often than 'active' ones. Type and prevalence of cues varied with age.	'Early' signs of hunger and fullness may be difficult for mothers to notice. Feeding signals also vary with infant age and are more overt as infants get older.	20/22 *20/22* **<u>20</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Hwang (1978) 'Mother-infant interaction- effects of gender on infant feeding behavior'	N = 58 Primiparous mothers 23 male and 35 female new-born infants observed at < 1 week (2 and 4 days). Maternal age unknown.	**Short term longitudinal** Time sampled observation of two single breast-feeding sessions on days two and four of life in hospital setting.	On day four mean number of feeding periods was significantly higher for males than females and the first feeding period was significantly longer for females than males. Males cried more than females during feeds.	New-born male and female infants appear to show different feeding behaviours, with possible implications for maternal perceptions of hunger and satiation.	14/22 *15/22* <u>**14.5**</u>
Lew and Butterworth (1995) 'The effects of hunger on hand-mouth coordination in new-born infants'	N= 18 New-born term infants born between 38- and 42-weeks gestational age observed at 1 week or younger.	**Cross-sectional** Structured observations of infants before and after milk feeding by formula or breast. Analysis of differences between hand-face and hand-mouth contacts.	Distribution of hand-face and hand-mouth contacts did not differ pre-feed. Proportion of hand-mouth did not differ before and after feeding. Open mouth postures before hand-mouth contacts only occurred before feeding.	Open mouth postures prior to hand-mouth contacts may be an indication of hunger in new-born infants.	21/22 *20/22* <u>**21.5**</u>

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Llewellyn et al. (2011) 'Development and factor structure of the Baby Eating Behaviour Questionnaire in the Gemini birth cohort'	N = 2402 1194 male and 1208 female infants, mean age 32.8 weeks, range 16-80 weeks.	**Cohort study** BEBQ [d] for milk fed infants. Questionnaire items refined via interviews with a sample of mothers (n = 10).	Four appetite constructs were identified: food responsiveness; enjoyment of food; satiety responsiveness and slowness in eating. All constructs correlated with 'general appetite'. Group differences were observed in appetitive behaviours.	Different groups of infants have different appetites e.g. males appear to have larger appetites and to be less satiety responsive than females; premature infants have smaller appetites and higher satiety sensitivity than term infants; breastfed infants appeared to be less satiety responsive than formula fed infants.	21/22 *21/22* **<u>21</u>**
Llewellyn et al. (2012) 'Inherited behavioral susceptibility to adiposity in infancy'	N = 4634 2289 males and 2345 female infants, mean age 32.8 weeks, range 16-80 weeks.	**Cohort study** BEBQ [d] and infant weight measures taken at 12 weeks + multi-variate genetic modelling.	Infant weight was correlated with BEBQ appetite traits. Genetic influence was shown for satiety responsiveness, slowness in eating and appetite.	Eating traits of infants are heritable. Expression of appetite is therefore influenced by genotype.	21/22 *21/22* **<u>21</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and mean ratings)
McMeekin et al. (2013) 'Associations between infant temperament and early feeding practices. A cross-sectional study of Australian mother-infant dyads from the nourish RCT'	N= 698 342 male and 356 female infants between 8 and 28 weeks of primiparous mothers. Mean infant age 17.2 weeks. Mean maternal age 30.1 years.	**Cross-sectional** Maternal self-report on STSI [e] and IFQ [f]	Mothers of infants with difficult temperaments reported a lower awareness of hunger and satiation cues and were more likely to use food to soothe.	It may be difficult for mothers of infants with difficult temperaments to distinguish hunger and satiation cues from distress cues. Maternal depression also appears to be associated with lower awareness of infant feeding cues and greater use of food to calm babies.	21/22 *20/22* **20.5**
Mennella et al. (2001) 'Prenatal and postnatal flavor learning by human infants'	N= 46 28 male and 18 female infants. Mean infant age 22.6 weeks.	**Experimental -** Infants assigned to one of three groups: carrot juice or water during pregnancy and breastfeeding. Responses to cereals containing water or carrot juice measured via consumption, facial expression, and maternal ratings.	Infants exposed to carrot flavours in utero or during lactation exhibited fewer negative facial expressions to carrot-flavoured cereal than plain cereal.	Exposure to flavour leads to greater acceptance, greater enjoyment and greater consumption. Amount eaten is not purely determined by hunger. Facial expression may be one way of differentiating between cessation of eating due to dislike and that arising from satiation.	21/22 *20/22* **20.5**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Mennella et al. (2009) 'Early milk feeding influences taste acceptance and liking during infancy'	N= 97 Full term infants between 16 and 36 weeks, mean age 25 weeks, who had been spoon fed baby cereal for at least 2 weeks	**Experimental** Subgroups of breastfed and 2 types of formula fed babies observed to measure acceptance of sweet, salty, bitter, savoury, sour, and plain cereal.	Type of formula impacted on responses to different tasting cereals. Formula-fed infants showed preferences for the tastes to which they had been exposed.	Prior exposure leads to greater consumption of food with familiar taste compounds. Negative facial expression may provide a basis for distinguishing between satiation and dislike.	21/22 *21/22* **<u>21</u>**
Nisbett and Gurwitz (1970) 'Weight, gender, and the eating behavior of human new-borns'	(Experiment 1) N= 42 22 male and 20 female new-born infants.	**Experimental** Infants in 3 weight groups alternately fed sweet/standard formula of the same caloric value daily. Intake was recorded.	Heavy infants were more responsive than medium and light weight infants to sweetened formula. Female infants responded more to sweetened formula than males.	Gender and weight may impact on satiety responsiveness to sweetened milk.	18/22 *17/22* **<u>17.5</u>**

Authors and Title	**Participants and sample**	**Design and Methods**	**Main findings**	**Implications for understanding hunger and satiation in infancy**	**Quality ratings (first, *second* and <u>mean</u> ratings)**
Nisbett and Gurwitz (1970) 'Weight, gender, and the eating behavior of human new-borns'	(Experiment 2) N=34 18 male and 16 female new-born infants.	**Experimental** Infants formula fed over two days with a normal or small hole teat. Consumption and duration of feeds recorded by mothers.	Heavier and female infants consumed significantly less in the small hole condition. Medium, lighter weight and male infants' consumption was not significantly affected.	Gender and weight may impact on effort expended in feeding and consequent amount consumed.	18/22 *17/22* **<u>17.5</u>**
Parkinson and Drewett (2001) 'Feeding behaviour in the weaning period'	N = 100 Mother infant dyads. 51 male and 49 female Infants/toddlers observed between 52 and 61 weeks, mean age 55 weeks. Maternal age range ≤24 to ≥ 35 years.	**Cross-sectional** Naturalistic observation of two mealtimes analysed using all occurrence sampling. Codes developed regarding mothers' feeding of children and child self-feeding and related child behaviours.	Despite similarity in the age of the toddlers self-feeding and being fed varied highly. Intake was correlated with number of bites rather than meal duration. Self-feeding led to a longer meal time on average while longer meals were associated with lower food intake.	Number of bites may be a better indication of hunger levels than meal duration although account needs to be taken of whether the child self feeds or is fed by the mother. Self-feeding tends to lead to longer meal duration and lower intake in toddlers.	20/22 *17/22* **<u>18.5</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Paul et al. (1996) 'Infant feeding behavior: Development in patterns and motivation'	N= 20 Full term infants at 2, 10, 18, and 26 weeks. Gender unknown.	**Short term longitudinal** Structured observation prior to during and after milk feeding. Observations supported by video recording of sucking, breathing and swallowing.	Two-week-old infants were visually attentive when feeding. Motor activity and alertness shifted from pre- to post-feeding time during the first 6 months.	Motor behaviours differ with feeding state and at different points in the feeding cycle according to infant age. Differences also appear to exist in the sucking behaviours and consumption patterns of formula and milk fed babies	15/22 *13/22* **<u>14</u>**
Reau et al. (1996) 'Infant and toddler feeding patterns and problems: Normative data and a new direction'	N= 281 157 male and 124 female infants and toddlers, age range, 12 -108 weeks. Mean age unknown.	**Cross-sectional -**Survey research using self-report questionnaire. Items included infant and toddler hunger at the start of a meal, feeding behaviours, feeding problems and feeding duration.	No differences were reported between feeding time in terms of birth weight or birth order. 90% of infants and toddlers took fewer than 30 minutes to eat a meal. Reports of feeding problems were especially common in toddlers.	Feeding problems are common in infants and especially toddlers. Variability in hunger is normal. Meal durations beyond 30 minutes may indicate feeding problems.	17/22 *14/22* **<u>15.5</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Shloim et al. (2017) 'Looking for cues – infant communication of hunger and satiation during milk feeding'	N = 27 mother infant dyads. Infants aged between 3 and 22 weeks. Mean maternal age and mean infant age unknown.	**Cross sectional** Secondary analysis of feeding videos using the NCAST[g] to observe engagement and disengagement cues in the first, middle and last sections of breast and formula feeds.	More engagement and disengagement cues were observed in breast than formula fed infants.	Infant expression of hunger and satiation may vary with feeding mode, with breastfed infants appearing to communicate hunger and satiation more actively than formula fed babies.	18/22 *18/22* **<u>18</u>**
Skinner et al. (1998) 'Mealtime Communication Patterns of Infants from 2 to 24 Months of Age'	N= 98 Infant mother dyads. Typically developing infants from 8-96 weeks. Infant gender, mean infant age and mean maternal age unknown.	**Longitudinal** Structured interviews and questionnaires at 10 time points from 2 to 24 months. Participants were randomly assigned to six interviews. Data collected regarding children's mealtime communication at each time point.	Hunger signs appeared before satiation cues (4.4 – 5.7 months and 5.8 to 7.5 months respectively). Extreme variability was seen in communicative behaviours. Food likes and dislikes increased with age as did verbal communication relating to eating.	Hunger and satiation communication is highly variable. Likes/dislikes are easier to discern in older infants than younger ones, though liking was exhibited less than dislike through facial expression.	19/22 *15/22* **<u>17</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Stevenson et al. (1990) 'Rhythms in the dialogue of infant feeding: Preterm and term infants'	N = 34 Mother infant dyads with 17pre-term infants and 17 full term infants at 32 weeks (age gestationally adjusted). Maternal age and infant gender unknown.	**Cross-sectional** Solid food feeding interactions video-recorded through a one-way mirror. Coding of maternal and infant behaviours such as gaze, vocalisation, and self-feed.	Feeding outcomes were similar for both groups. Pre-term infants fussed more during feeding than term infants. Mothers of premature babies responded to vocalisations with offers of food more than those of full-term infants.	Expression of hunger may differ subtly in premature babies. Mothers of these babies offer food more in response to vocalisation than those of full-term babies.	17/22 *15/22* **<u>16</u>**
Turkewitz et al. (1966) 'Relationship between feeding condition and organization of flexor-extensor movements in the human neonate'	N= 35 New-born female infants, aged < 1 week to 1.5 weeks, mean age ≏ 1 week	**Cross-sectional** Observational study of flexion and extension movements of infants' hands during two 5-min periods prior to and post-feeding.	The proportion of hand flexion to extension movements was greater prior to feeding than post-feeding, regardless of whether infants were awake or asleep.	Hand flexion appears to be associated with hunger in new born infants.	17/22 *19/22* **<u>18</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
van Dijk et al. (2009) 'Variability in eating behavior throughout the weaning period'	N= 20 12 male and 8 female full-term infants aged between 16 and 24 weeks, mean age 22 weeks.	**Short term longitudinal.** Naturalistic observation of infants and caregivers across a 12-week period following the introduction of solids. Feeding video recorded and coded.	Amount consumed increased over time. Mealtime duration was stable over time (8 - 10 minutes). Frequency of food refusals decreased over time. Feeding behaviours varied across and within infants particularly after the introduction of solids.	Infant feeding behaviour is highly variable during the initial CF period; however, meal duration increases over time. Food refusal is also common at the introduction of CF.	19/22 *17/22* <u>**18**</u>
Ventura et al. (2012) 'Infant regulation of intake: the effect of free glutamate content in infant formulas'	N=30 14 male and 16 female infants, mean age 8.5 weeks.	**Experimental.** Infants fed one of three formulas over three days: cow's milk formula, protein hydrolysate, cow's milk formula with free glutamate. Satiety ratios were calculated for each formula.	Infants consumed significantly less cow's milk formula and showed higher satiety ratios after the enhanced cow's milk formula and the protein hydrolysate than standard cow's milk formula.	Formula composition impacts on satiation and satiety regardless of energy content.	21/22 *20/22* <u>**20.5**</u>

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Ventura et al. (2015) 'Consistency in infants' behavioral signalling of satiation during bottle-feeding'	**N= 41** Infant mother dyads infants ≤4 months of exclusively or predominantly formula fed. 23 female and 28 male infants, mean age 2.2 months. Mean maternal age 27.5	**Experimental** Infants videotaped feeding to satiation with cow's milk formula (CMF) and CMF fortified with free glutamate. Videos analysed for frequency and timing of satiation. Mothers completed the IFSQ[h.]	Satiation cues appeared earlier with fortified cow's milk than standard formula. Less consistent infant signalling and signs of overfeeding were associated with mothers with lower responsiveness scores on the IFSQ.	The expression of satiation and the regulation of consumption appear to be associated with formula composition and maternal feeding style.	22/22 *21/22* **<u>21.5</u>**
Wasser et al. (2011) 'Infants Perceived as "Fussy" Are More Likely to Receive Complementary Foods Before 4 Months'	N= 217 Infant mother dyads visited at 12,24,36,48 and 72 weeks of infant age. 101 males and 116 females. Mean maternal age 22.7 years	**Cross-sectional** Infant feeding patterns assessed through dietary history and 24 hour dietary recall. Infant temperament traits measured by the Infant Behaviour Questionnaire	Infants with high distress to limitations were more likely to receive CF early. Maternal obesity was associated with early introduction of CF and maternal depression with the early introduction of juice.	Infants with difficult temperaments may be perceived as hungrier or fed to soothe them or as a coping response by depressed mothers. Obese mothers may misinterpret difficult temperament for hunger or may have larger, hungrier babies.	22/22 *22/22* **<u>22</u>**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and mean ratings)
Wright et al. (1980) 'Do breast-feeding mothers know how hungry their babies are?'	N= 190 132 formula fed and 58 breastfed infants in the first 8 weeks of life. Infant gender unknown.	**Short term longitudinal** Video recording of feeding sessions at monthly intervals from just after birth for formula (FF) and breastfed (BF) infants. Mothers also kept diaries of infants' feeds.	Long intervals between feeds led to breastfed infants consuming larger meals than formula fed infants. Sucking patterns differed by group. Diurnal differences appeared in feed sizes of breast but not formula-fed infants.	Breast and formula fed babies show different patterns of feeding behaviour in terms of sucking behaviour and variability of consumption.	15/22 *15/22* **15**
Wright (1986) 'The development of differences in the feeding behaviour of formula and breastfed human infants from birth to 2 months'	N=30 Mothers of 14 male and 16 female breastfed infants, mean infant age 4 weeks, mean maternal age unknown.	**Short term longitudinal** Mothers asked three questions regarding infant hunger. 14 mothers also kept a 4-day diary of feeds, provided hunger ratings and weighed infants before and after feeds.	77% of mothers reported infant hunger varied across the day - more so for boys. Milk consumption did not vary significantly across the day or by gender.	Most mothers could assess accurately their infant's hunger. However, gender may influence mothers' interpretation of hunger cues. Mothers of boys may misinterpret high activity and arousal levels as hunger.	15/22 *16/22* **15.5**

Authors and Title	Participants and sample	Design and Methods	Main findings	Implications for understanding hunger and satiation in infancy	Quality ratings (first, *second* and <u>mean</u> ratings)
Young and Drewett (2000) **'Eating behaviour and its variability in 1-year-old children'**	N= 30 13 female and 17 male infants aged 50 - 57 weeks old, mean age unknown.	**Short term longitudinal** Video recorded observations of meals in the home over two consecutive days coded with a scheme developed from two other studies	Median meal duration was 17 min. There was high variability between infants in feeding behaviours and across meals. Refusal was a common but highly variable behaviour – median 11, range 0-101	At 52 weeks of age toddlers' eating behaviour is variable across meals. Food refusal is common in this age group. Toddlers also consume desserts faster and with fewer refusals than main courses.	19/22 *18/22* **<u>18.5</u>**

a – Child Eating Behaviour Questionnaire
b – Food Frequency Questionnaire
c – Infant Behavior Questionnaire
d - Baby Eating Behaviour Questionnaire
e - Short Temperament Scale for Infants
f - Infant Feeding Questionnaire
g - Nursing Child Assessment Satellite Training
h – Infant Feeding Styles Questionnaire

2.6 Review of returned papers

2.6.1 Areas of investigation

Six main research areas with implications for understanding the communication of infant hunger and satiation were identified. Findings from the papers are summarised in Table 2.3 and discussed here.

1) Maternal perceptions of infant communication of hunger and satiation.
2) Observational studies of infant behaviours associated with hunger and satiation conducted under controlled conditions.
3) The impact of infant characteristics on the expression and perception of hunger and satiation.
4) Feeding behaviour norms in infancy.
5) The impact of feeding method and milk composition on infant feeding behaviour, hunger and satiation
6) The impact of food preferences on infant feeding behaviour.

2.6.2 Maternal reports of feeding cues

Several studies investigated mothers' perceptions of infants' feeding cues. Anderson et al. (2001) used focus groups to examine maternal beliefs regarding readiness for CF. Perceptions of hunger related both to babies' characteristics (e.g. age, weight) and their behaviour (e.g. increased rate of milk consumption, agitation, and changed sleeping patterns). Mothers also reported being able to identify a 'hungry cry'; this was differentiated from other cries by time of day rather than the characteristics of the cry itself. Reported satiation cues included the baby seeming more 'content' and them wanting to eat less often.

Gross et al. (2010) also examined mothers' perceptions of infant hunger and satiation. In a survey relating to general feeding rather than the introduction of CF, they found most mothers believed infants could sense their own satiation and were attentive to three hunger and satiation behaviours: hand sucking, head turning and crying. The list of cues was generated by the authors, though participants agreed they used them to identify hunger and satiation. Gross et al. (2010) also found that obese mothers were less likely to agree that babies could sense their own satiation, and that maternal obesity and longer breastfeeding history were associated with perceiving hand sucking as indicating hunger.

In a study involving semi-structured interviews Hodges et al. (2008) investigated cues which prompted mothers to initiate and end feeding. Like Anderson et al. (2001) the authors found mothers used both infant behaviours and external cues (e.g. time) to identify hunger. Commonly identified hunger cues in this study were crying, fussing and licking the lips and these were reported across several infant age groups (3, 6 and 12 months). Commonly reported satiation cues included pulling away, spitting food out and stopping feeding. The authors also found that the prominence, intensity and specificity of infant cues guided decisions about initiating and ending feeds and that mothers found cues easier to interpret with increasing infant age.

The only longitudinal maternal report study retrieved in the search was conducted by Skinner et al. (1998). They examined mealtime communication behaviours in children up to 22 months of age using structured interviews with mothers. The authors found that hunger behaviours (e.g. opening the mouth for the spoon) appeared at a younger age than satiation behaviours (e.g. closing the mouth to reject food) (4.4 to 5.7 months versus 5.8 to 7.5 respectively). In addition, they noted that, overall, hunger and satiation behaviours were highly variable across infants. The study also examined the communication of food preferences with behaviours such as opening the mouth readily as the spoon approached, and consuming a large amount, being reported as indicating liking, while negative facial expression and body movements (throwing food, head turning) were identified as indicating dislike.

Wright (1986) also examined the expression of hunger in infants though this time with particular reference to infant gender. Mothers of breastfed babies were asked when their infants were most hungry, how they identified hunger and about the variability of their breastmilk supply. All mothers of male babies agreed hunger varied across the day but only around half the mothers of females reported this. Mothers identified increased frequency of feeding as a hunger cue for males whereas agitation was cited for females. Late afternoon/early evening were identified as hungry times for males while mothers of females associated hungry times with feeling they had less breastmilk, rather than time of day. Despite such differences, recordings of infant weight taken from before and after feeding indicated that relatively constant volumes of milk were consumed by girls and boys across the day. It appears then that mothers of male and female infants may interpret different behaviours as hunger depending on the gender of their child (Wright, 1986).

In summary, maternal report studies indicate that mothers respond to a range of infant hunger and satiation cues and that perceptions of cues are shaped in part by infant and maternal characteristics. Studies in this area also suggest that it may be possible to differentiate cues associated with dislike of food (e.g. negative facial expression) from those associated with satiation. However, it may be more difficult to differentiate between hunger and liking, as reported liking cues appeared similar to reported hunger cues e.g. opening the mouth readily and avid consumption.

2.6.3 Observational studies of infant feeding behaviour and feeding cues

Two studies have involved observations of infant behaviour under controlled conditions before and after feeds. Lew and Butterworth (1995) observed hand to mouth contacts in new-borns pre- and post-prandially. They found that hunger did not affect where hand contacts were made on the face, and there was no difference between the proportion of hand-mouth contacts before and after feeding. However, hand-mouth contacts preceded by open mouth postures were only observed before feeding. This coordination of open mouth postures with hand-mouth contacts may therefore be associated with hunger in new-borns.

Similarly, Turkewitz, Fleische, Moreau, Birch, and Levy (1966) examined hand movements before and after feeding. The researchers observed the flexion and extension movements of new-borns' hands and found that, regardless of whether infants were awake or asleep, the proportion of flexion movements was significantly greater before feeding than after. Flexed hand postures may therefore be another behavioural indication of hunger in young infants.

While Turkewitz et al. (1966) and Lew and Butterworth (1995) specifically investigated infant hand movements before and after feeding, Paul et al. (1996) examined several aspects of behaviour before, after and during feeding in infants between 2 and 26 weeks of age at 8-week intervals. The researchers found sucking behaviours increased in rate with infant age, while the number and length of pauses in sucking decreased. Breast and formula feeding behaviour were compared at two weeks of age but not beyond this; breastfed infants consumed milk at less than a third of the rate of formula-fed babies and breast feeds took around four times longer than formula-feeds. The authors also examined motor activity during feeding; this was low for all age groups. Following feeding, motor activity and muscle tone decreased in two-week-old infants. However, post-feeding motor activity increased in older infants. The study therefore indicated that infant sucking and motor activity varied with hunger and satiation, though the precise pattern of behaviour differed by age and feeding method.

Hodges et al. (2013) also conducted structured observations of infants during feeding though with a more explicit focus on 'feeding cues' rather than isolated behaviours such as motor activity or sucking behaviour. They identified 20 types of hunger cue and 28 types of satiation cue as part of the development of the Responsiveness to Child Feeding Cues Scale (RCFCS). Hunger ('receptiveness to being fed') and satiation cues (fullness) were further categorised as 'early' (e.g. increased alertness), 'active' (e.g. excitatory movements) and 'late' (e.g. fussing and crying) to reflect changes in cue intensity. The scale was tested via observations of mothers' responses to cues during milk and solid feeds video recorded in a university department. Neither hunger nor satiation cues were described in detail, however, the authors found mothers to be more responsive to hunger, than satiation cues. They also noted that responsiveness to satiation was predicted by lower maternal BMI, longer breastfeeding duration, and higher educational level.

In a later study, Hodges, Wasser and Colgan (2016) used the RCFCS to conduct observations of infant feeding cues during milk feeds and CF in infants between three and eighteen months of age. Cues were examined from videos of milk and complementary feeds taken in the home to a systematic protocol. The most prevalent early receptiveness cue observed in younger infants was sucking. However, the authors found early receptiveness cues overall (e.g. sucking, opening and closing the mouth repeatedly, lip smacking) were observed less frequently than active receptiveness cues (e.g. rooting, excitatory vocalisations, approaching food, excitatory limb movements). Hodges et al. (2016) also noted changing patterns of cues with age. Reduced tension associated with 'settling into' feeds decreased in frequency by 45% between the ages of 3-6 months and 18 months, while behaviours such as reaching for food and postural attention increased in infants at 6 months and remained largely stable to 18 months. Excitatory limb movements peaked at 6 months, but were infrequently observed subsequently, while other active receptiveness cues (e.g. fidgeting and excitatory vocal behaviours) were infrequently viewed as a whole. Regarding late receptiveness cues, crying was infrequently observed and tantrums and frantic moving of the head from side to side were not observed at all in the study sample.

Like maternal report studies, observational studies therefore indicate that infants use numerous cues to signal hunger and fullness, that maternal characteristics may impact on perceptions of/responses to cues, and that the signalling of hunger and fullness varies with infant age. In addition, this group of studies suggests that cues vary according to level of hunger and satiation and that some cues are more commonly observed than others.

2.6.4 Effect of infant characteristics on hunger, satiation, and feeding behaviour

Several studies have examined associations between infant characteristics and feeding behaviour. Using the Infant Temperament Scale (Carey & McDevitt, 1978), Forestell and Mennella (2012) investigated associations between temperament and liking of a novel vegetable. They found that infants with higher ratings on 'approach' traits (those more willing to approach novel situations) ate more green beans, and for longer, and showed fewer negative facial expressions (assessed by mothers) than those with lower approach ratings.

Darlington and Wright (2006) also investigated the impact of temperament on feeding though in relation to weight gain in the first two months of life. Using the Infant Behavior Questionnaire (IBQ) (Rothbart, 1981), they found that infants with high fearfulness scores exhibited slow weight gain, whilst those with high scores on 'distress to limitations' showed faster weight gain. The IBQ was also used to investigate infant temperament and the early introduction of CF by low-income mothers by Wasser et al. (2011). They noted that both 'distress to limitations' and infant 'activity level' were significantly associated with the introduction of solids before four months of age. In addition, Wasser et al. (2011) found maternal obesity to be significantly associated with the early introduction of solids suggesting again that maternal characteristics may influence perceptions of infant hunger.

Research by McMeekin et al. (2013) further supports the contention that both infant and maternal characteristics influence perceptions of feeding cues. In a study using the Short Temperament Scale for infants (STSI) (Sanson, Prior, Garino, Oberklaid, & Sewell, 1987), they found that mothers of babies with 'difficult temperaments' were significantly more likely to feed their babies to calm them. Meanwhile, regarding maternal characteristics, mothers with higher scores on the Edinburgh Post Natal Depression Scale (Cox, Holden, & Sagovsky, 1987) were found to be significantly less aware of infant feeding cues and more likely to feed their babies to calm them.

Llewellyn, van Jaarsveld, Johnson, Carnell, and Wardle (2011) also explored the impact of infant characteristics on feeding behaviour. In developing the Baby Eating Behaviour Questionnaire (BEBQ), they examined associations between individual characteristics and feeding traits. Male babies were found to have larger appetites, to respond more to food cues and to be less satiety responsive (sensitive to feeling full and fullness between meals) than females. Premature infants were reported to have smaller appetites, lower enjoyment of food, slower feeding and higher satiety responsiveness than full term infants. Breastfed babies had larger overall appetites, were more responsive to food cues and less sensitive to satiety cues than mixed fed or formula fed babies. Finally, infants with higher birth weights had larger appetites, fed more quickly, enjoyed food more and were less responsive to satiety than lower birth weight babies. Thus gender, birth weight and gestational age at birth may all influence infant appetite and feeding cues.

The BEBQ was also used by Llewellyn et al. (2012) to investigate relationships between genotype and eating traits. In this large-scale twin study, details of zygosity, infant age, gestational age and gender were collected alongside appetite data at the age of three months. Significant shared genetic effects were found in twins regarding: weight, slowness in eating traits, satiety responsiveness and appetite size. The findings therefore suggest that appetite and behaviours associated with this are shaped in part by genetic make-up.

Additional evidence that gestational age at birth influences feeding behaviour comes from research by Stevenson, Roach, Ver Hoeve, and Leavitt (1990). They observed feeding behaviour in term and pre-term infants. No significant differences were found between groups regarding amount eaten, infant vocalisations or infants' gaze at mothers during feeding. However, pre-term infants were significantly fussier during feeding than term infants and mothers of pre-term infants responded to vocalisations with offers of food, while mothers of term infants did not.

In relation to gender and feeding cues, an observational study of new-borns by Hwang (1978) found that on the fourth day of life, boys suckled significantly more frequently and for shorter periods than girls. In addition, Hwang noted that, during feeding, males were significantly more likely to fuss than females, both on the second and fourth days after birth. Nisbett and Gurwitz (1970) also reported gender differences in feeding behaviour though within the context of formula feeding. They increased the sweetness of formula fed to new-borns and found female and heavier infants consumed significantly more sweetened formula than male or lighter infants. In a second experiment, the researchers manipulated the size of the hole in the bottle teat, alternating feeds of standard formula with a regular and a small hole. Consumption by boys was not affected by the small hole, though that of female and heavier babies was reduced. The findings suggest that female and heavier infants may be more responsive to sweetness, or possibly, are more able to detect this. Female and heavier infants may also be less willing to expend energy on feeding when this is made more difficult.

Overall, studies relating to the impact of individual differences on feeding behaviour suggested that several physical attributes influenced the amount infants consumed and how cues were expressed. Appetitive traits, in particular, appear to be heritable. Meanwhile, temperament affects several aspects of feeding behaviour, with implications for how mothers perceive and respond to these, particularly for mothers with depressive symptoms.

2.6.5 Infant feeding behaviour norms

Four studies have examined normative aspects of infant feeding such as intake and duration of feeding. These provide contextual information which is helpful in understanding feeding behaviour and the expression of feeding cues in infancy. In an observational study of toddlers, Parkinson and Drewett (2001) found mean meal duration across 2 observed meals was approximately 19 minutes with a mean intake of 165 grams. However, within these parameters the authors found a high degree of variability across individuals and meals. They found meal duration and intake were not significantly correlated but instead, intake increased significantly with number of bites. Number of bites therefore may be a better indicator of level of hunger in toddlers than meal duration.

Infant and toddler feeding norms were also investigated by Reau, Senturia, Lebailly, and Christoffel (1996). They asked mothers about duration and enjoyment of eating, food refusal and eating speed. Mean reported feeding duration did not differ significantly across age, birth weight or birth order; 90% of infants and toddlers were reported to finish a meal in less than 30 minutes. Food refusal, however, was commonly reported in toddlers, indicating that this is not necessarily a satiation cue but rather a developmentally typical eating behaviour in toddlers.

Young and Drewett (2000) conducted observational research into toddlers' eating behaviour. Their work provides particular insights into feeding behaviour in the contexts of savoury and sweet courses. Median intakes for dessert and main meals were similar (71 and 82 grams respectively) though median durations were five and ten minutes respectively. Furthermore, median number of food refusals for sweet courses was around half that for the main course, indicating that the children consumed desserts more quickly and with fewer refusals than in main courses despite already being partly satiated.

Other observational research into infant eating patterns was carried out by Van Dijk et al. (2009), in this case in the context of the introduction of CF. They found considerable variability within individuals in terms of food refusal, intake and meal duration. As might be expected, this variability was greatest in the earliest spoon-feeding sessions. The average duration of meals was relatively constant (eight to ten minutes across the three-month period observed). Consumption, however, increased during the first 12 weeks of CF while refusal decreased.

Studies regarding feeding norms therefore suggest that hunger (as expressed by amount consumed) can vary considerably both across and within individuals. Consumptive behaviours also appear to vary in infants according to developmental stage, and in response to savoury and sweet foods.

2.6.6 The impact of feeding method on infant feeding behaviour.

While some studies have reported incidental differences in feeding behaviour according to feeding method (e.g. Llewellyn et al., 2011), three have examined relationships between feeding method, feeding cues and infant hunger more directly. Wright, Fawcett and Crow (1980) video-recorded three feeding sessions at monthly intervals from birth to two months in formula and breastfed infants. Mothers also kept feeding diaries. Breastfed babies exhibited pauses in sucking while feeding whereas formula fed infants fed almost continuously. The authors also identified diurnal variations in the size of feed consumed by breastfed infants, with early morning feeds being the largest of the day. This may represent a diurnal variation in breastmilk composition, or in the hunger or thirst of breastfed babies; however, it was not observed in formula fed babies. Feeding method (breastfeeding or formula) therefore appears to impact both on feeding behaviours and patterns of hunger.

Further evidence of differences in feeding behaviour between breast and formula fed infants is provided by Shloim, Vereijken, Blundell and Hetherington (2017). They used the Nursing Child Assessment Satellite Training (NCAST) Feeding Scale (Sumner & Spitz, 1994) to observe engagement and disengagement cues in videotapes of breast and formula fed infants. Frequencies of cues were observed in each third of the meal (beginning, middle and end). The authors noted a significantly higher frequency of disengagement, than engagement cues, in all infants and significantly more engagement cues at the beginning than the end of feeding. Importantly, breastfeeding infants were observed to exhibit both more engagement and disengagement cues overall than formula fed infants. Breastfed infants were also perceived as showing significantly higher frequencies of specific engagement cues (sucking sounds and mouth opening) at the start of feeds than formula fed feeds. In addition, breastfed infants showed a significant reduction in immobility between the middle and last parts of feeds where no similar reduction was observed in formula fed infants. The authors concluded that the observed differences between breast and formula fed infants arose from the requirement for breast feeding babies to engage more actively in feeding, thereby leading them to communicate more actively also.

In addition to evidence of differences in the behaviour of breast and formula fed infants during milk feeds, studies suggest that feeding mode may impact differentially on responsiveness to solid food cues. Buvinger et al. (2017) tested interest in food and non-food items in infants by videoing their responses to pairs of food and visually similar toys (e.g. a round biscuit and a yo-yo) presented in clear plastic containers for 60 seconds. Videos were coded to examine how many ten second intervals involved infants touching items. Infants' mothers also completed the BEBQ as a measure of feeding behaviour. Babies were found to have an overall preference for food over toy items in terms of number of intervals involving touching. Buvinger at al. (2017) also found infants who had never been breastfed (n=7) touched food significantly more than non-food stimuli. Infants who had never been breastfed also had significantly higher BEBQ food responsivity scores. Infant rate of weight gain since birth (but not birth weight or maternal BMI) was also significantly associated with touching of food items, though this effect was attenuated when breastfeeding history was included in analyses. Findings therefore suggest that a history of exclusive formula feeding is associated with higher responsiveness to food cues in infants.

In summary, studies relating to milk feeding method suggest that breast and formula fed infants show different feeding patterns and behaviours, and importantly, that formula fed infants may show fewer feeding cues than breastfed babies during milk feeds. There are also preliminary indications that feeding method may influence infants' responsiveness to solid foods.

2.6.7 Formula milk composition and feeding behaviour

It has been proposed that differences between breastfed and formula fed infants in growth velocity and in the experience of hunger and satiation may be attributable in part to milk composition (Heinig, Nommsen, Peerson, Lonnerdal, & Dewey, 1993). Breastmilk differs from formula in the amount and form of amino acid content, and this may play a role in the faster weight gain recorded in infants fed cow's milk formula compared to breastmilk. There is also evidence, however, that different types of formula milk may impact differentially on infant hunger and satiation. As free amino acids such as glutamate are implicated in satiation in both animal and human studies, Ventura, Beauchamp, and Mennella (2012) manipulated formula milk composition to examine its effects on intake and satiety. They fed infants a standard cow's milk formula, a high free glutamate formula or a cow's milk formula fortified with free glutamate. Infants consumed significantly less of the high free glutamate formula and the fortified cow's milk formula than the regular cow's milk formula. The authors also examined the effect of formula composition on satiety (determined by the effect of the first meal on later consumption). They found significantly higher levels of satiety after consumption of the high free glutamate formula and the fortified cow's milk formula than standard cow's milk formula.

Further evidence that formula milk composition may affect regulation of intake is provided by Ventura, Inamdar and Mennella (2015). They video-taped infants up to four months of age feeding to satiation with a cow's milk formula one day and a free glutamate enriched cow's milk formula another day in counterbalanced order. Videos were analysed frame-by-frame for the timing and frequency of satiation behaviours (e.g. arm waving, negative facial expression, leaning away, arching the back, gagging or coughing). Infants were found to consume less of the fortified cow's milk formula and to feed on this for a shorter duration. Mothers in the study also completed the Infant Feeding Styles Questionnaire (IFSQ) (Thompson et al., 2009) as a measure of feeding responsivity. All infants showed at least three satiation behaviours in the second half of the feed and the authors found no differences in the frequency or type of behaviours observed. However, infants were observed to display first and final satiation cues earlier during the enhanced cow's milk formula feed than the standard formula feed indicating that formula type affected the timing of infant satiation signalling. Ventura et al. (2015) also found that infant satiation signalling varied with maternal responsiveness; infants of mothers with lower IFSQ responsiveness scores signalled their satiation less consistently across the two feeds and also spat milk up more (an indication of overfeeding).

Taken together, findings from formula milk studies suggest that formula composition affects the expression of hunger and satiation in terms of the length of time infants take to become satiated, the timing of the appearance of satiation cues and the duration of satiation (satiety). Importantly, there is also evidence from this area of interactions between maternal feeding responses and infant expression of cues.

2.6.8 Food preferences and the impact of exposure on infant feeding behaviour

Several studies suggest hunger and satiation are not the only drivers for infant consumption but that food preferences also play a role. Such findings are important in understanding feeding cues as we need to be able to differentiate eating arising from liking from that arising from hunger, likewise the cessation of eating due to dislike rather than fullness.

There is evidence that hedonic responses to food are shaped in part by early exposure to different food characteristics. Mennella, Forestell, Morgan, and Beauchamp (2009) investigated acceptance of cereal flavoured with breast milk, cow's milk formula and hydrolysed casein formulas (HCFs) in four to nine-month-old infants. HCFs have stronger savoury, bitter and sour tastes than breastmilk or cow's milk formula and the investigators found that infants previously fed on these ate significantly more savoury, sour and bitter tasting cereals than those breastfed or fed cow's milk formula. Mennella et al. (2009) also assessed liking of the cereals via the Facial Action Coding System (Ekman & Friesen, 2002). Infants in this study showed fewer negative facial expressions (e.g. brow lowering, nose wrinkling, squinting) than the other groups. Thus, enjoyment of taste (shown through facial expression) was significantly associated with amount consumed.

Research on food preferences has examined flavour as well as taste preference. Mennella, Jagnow, and Beauchamp (2001) examined liking of carrot flavour in breastfed infants of mothers who drank carrot juice or water during pregnancy and lactation. Infants with previous exposure to carrot flavour in utero or through breastfeeding showed fewer negative facial expressions and greater enjoyment of carrot juice flavoured cereal (rated by mothers) than those without prior exposure. Amount consumed and meal duration showed a similar trend but these were not significant. In terms of food flavour (rather than taste), infants may therefore communicate liking or dislike through facial expression more than intake or eating duration.

While several studies have examined taste and flavour preferences in infancy, the impact of texture preference on eating has been reported by Blossfield, Collins, Kiely, and Delahunty (2007). They used mothers' ratings to assess enjoyment of chopped or pureed carrots in toddlers. Previous experience with different textures was the strongest predictor of enjoyment of the chopped carrots and was also associated with amount consumed. This again suggests that amount consumed and eating duration are driven by enjoyment as well as hunger.

Alongside evidence that exposure to different food attributes influences infant eating behaviour, there are indications that the *timing* of exposure also plays a role. Coulthard, Harris and Fogel (2014) examined the impact of exposure to a variety of vegetable purees (parsnip, sweet potato and courgette) versus exposure to a single puree (carrot) over a nine day period on acceptance of a novel puree (pea) in infants weaned between four and five and five and a half and six months. No difference was found between groups on a baseline measure of carrot acceptance prior to the exposure period, and no effect was found for age or exposure group to pea consumption. However, the authors found a significant interaction between CF age and exposure to vegetable variety, with single flavour infants weaned at 6 months or older eating significantly less of the novel puree than the variety group, thereby indicating that there may be a sensitive period for the acceptance of vegetable flavours between four and six months.

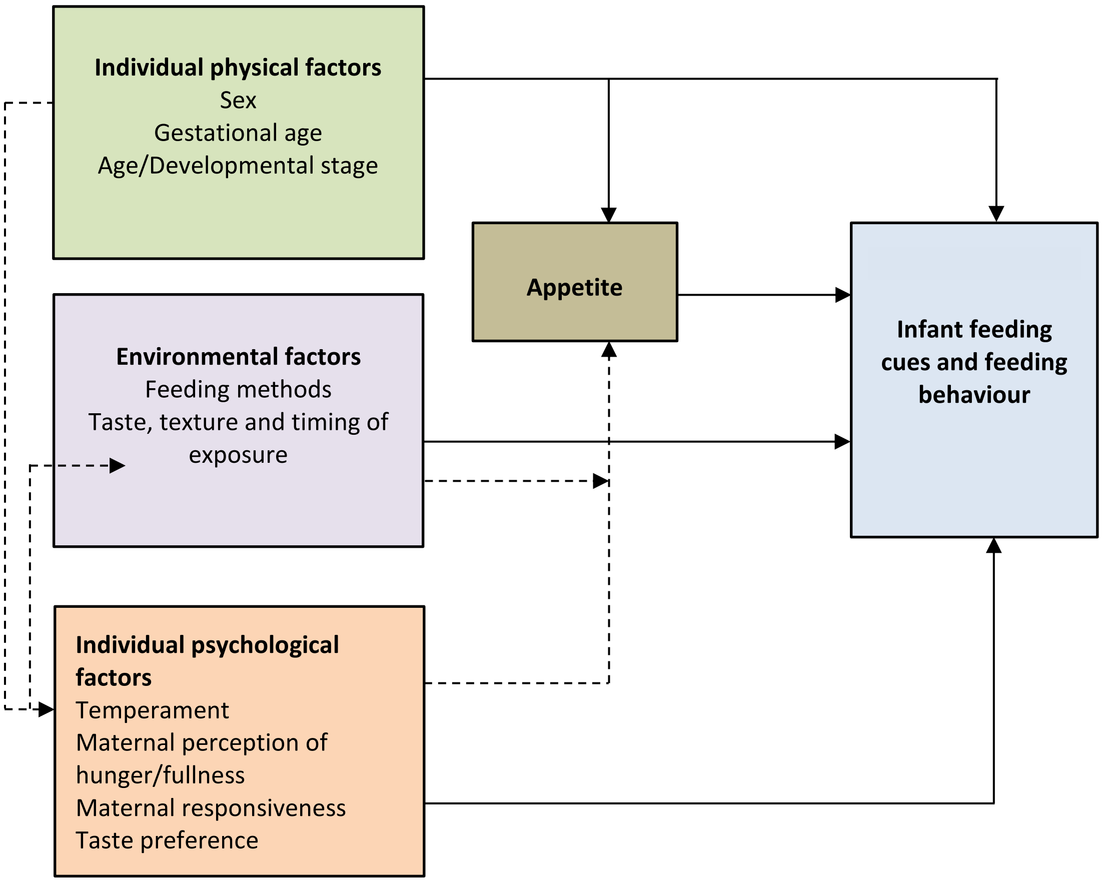
In summary, evidence from food preference and exposure studies indicates that the amount of a given food that infants consume is determined by preference. Furthermore, this appears to be the case across a range of food attributes. Therefore, infant eating, and the cessation of eating, are not only driven by hunger but also by familiarity with, and enjoyment of food.

2.7 Discussion

The purpose of this review was to evaluate the evidence regarding how infants communicate hunger and satiation, factors that impact on the expression of these states, factors which shape maternal perceptions of feeding cues, and how far infant hunger and satiation can be differentiated from behaviours driven by the hedonic features of food.

The review suggested that feeding cues and how these are expressed are shaped by numerous issues (Figure 2.2). These can be conceptualised as, individual psychological factors, infants' physical attributes and environmental factors. Many factors influencing feeding cues and behaviours are inter-connected, e.g. food preference (individual psychological factor) influences consumption but it is itself influenced by exposure (environmental factor) (Blossfield et al., 2007: Mennella et al., 2001) and temperament (individual psychological factor) (Forestell & Mennella, 2012).

Figure 2.2 - Main influencing factors on feeding cues in the first two years of life (established connection in solid lines, impact of individual factors on appetite, and interactions between factors, in broken lines)



2.7.1 Infant feeding cues and feeding behaviour – weighing the evidence

Maternal self-report studies provide important evidence regarding the cues which are salient to mothers in assessing hunger and satiation in infants of different ages, and in relation to decisions about when to terminate feeds (Anderson et al, 2001; Hodges et al., 2008: Skinner et al., 1998). Both Skinner et al. (1998) and Hodges et al. (2008) provided a good level of detail regarding feeding cues while Skinner et al. (1998) also provided insights into cues which may be associated with food preference rather than hunger and fullness. In addition, mean quality ratings for these maternal report studies were good. Nonetheless, it is important to note that this literature is relatively small, and reliant on recall, rather than the direct and systematic observation of infant behaviours.

Studies involving direct, structured observations of infants in controlled conditions offer a higher resolution on specific aspects of hunger and satiation signalling in infancy. These suggest that different motor, vocal and sucking behaviours are indicative of hunger and satiation (Lew & Butterworth, 1995; Paul et al., 1996: Turkewitz et al., 1966), and that hunger and satiation behaviours vary with infant age (Paul et al., 1996) with primarily reflexive feeding cues being observed in the earliest stages of development. However, again, this body of work is small. In addition, the observations conducted by Lew and Butterworth (1995) and Paul et al. (1996), were conducted in relatively artificial conditions i.e. infants were observed on a hospital table in the former and mothers were asked to refrain from talking to their infants during feeding in the latter. Furthermore, Turkewitz et al. 1966; Lew and Butterworth 1995 failed to report issues which may have biased results (e.g. observer blindness to experimental condition). Only Paul et al. (1996) conducted longitudinal observations over an extended period (i.e. months rather than days) and only Paul et al. (1996) compared behaviours before and after feeding with those during feeding. Despite this, the quality rating for this paper was relatively low as the reporting of some study details was inadequate. Furthermore, Paul et al. did not examine how feeding behaviour developed *within* feeding episodes. Evidence from such studies could therefore be more robust.

The two Hodges et al. papers (2013, 2016) received high quality ratings and importantly, were the only studies involving a validated tool for observing feeding interactions/feeding cues (the RCFCS). They also involved the observation of largely naturalistic feeding interactions, provided important details of temporal changes in feeding cues within feeding episodes and, in the case of Hodges et al. (2016), provided details of developmental changes in cues. However, it is important to note that the RCFCS was developed primarily to examine feeding responsiveness rather than feeding cues per se. Furthermore, RCFCS procedures do not enable a detailed examination of all types of cues across entire feeding episodes; hunger cues are only coded ten minutes prior to feeding up to 1 minute after the first bite. In addition, the timing of hunger and fullness cues across feeding is not recorded and so the precise balance of hunger and satiation cues across feeding cannot be discerned. This is important since it cannot be assumed that hunger and fullness behaviours are always temporally separated. Rather, there is evidence that infants may display hunger cues late in feeding, causing mothers confusion about terminating feeds (Price et al., 2012).

Alongside the observational studies of feeding cues and behavioural changes associated with hunger and satiation, Parkinson and Drewett (2001), Van Dijk et al. (2009) and Young and Drewett (2000) conducted observations of normative infant eating behaviour in naturalistic settings and Reau et al. (1996) investigated normative feeding behaviour using survey methods. It is a relative strength that the feeding norms literature includes both observational and longitudinal enquiry. Furthermore, evidence from most of these studies appears to be robust as most received good quality ratings. In addition, findings from these studies were generally consistent regarding 'gross' aspects of feeding behaviour, such as meal duration, intake and the impact of developmental changes on feeding. These studies also indicate that behaviours such as food refusal (which might be perceived as satiation) are common, particularly at transition points such as the introduction of CF, highlighting the contextual parameters of feeding cues in infants. They also provide insights into the impact of different kinds of food (savoury versus sweet) on eating behaviour.

2.7.2 Individual psychological factors

As noted in Figure 2.2, individual psychological factors in both mothers and infants appear to influence maternal feeding methods (environmental factors) which in turn may impact on how infants signal hunger and satiation. In turn, individual environmental factors such as exposure to different foods may impact on taste preferences, the cues that infants exhibit in relation to different foods, and how cues are interpreted by mothers. An important indication from several studies is the key role mothers play in managing feeding in response to feeding cues and the fact that mothers' interpretation of cues may not be based solely on infant behaviour but also infant characteristics, such as gender, temperament etc. Other important findings in relation to psychological issues were that hunger cues may be more salient to mothers than satiation cues (Hodges et al., 2013), that maternal characteristics (such as obesity) were associated with lower responsiveness to infant fullness (Gross et al., 2010; Hodges et al., 2013). Meanwhile, Ventura et al.'s (2015) finding that infants of less responsive mothers signalled satiation less consistently raises the possibility that mothers may be less 'responsive' because their infants signal less clearly *or* that infants of less responsive mothers signal less consistently because their cues do not meet with appropriate responses. Studies by Gross et al. (2010), Hodges et al. (2013), and Ventura et al. (2015)

therefore highlight the highly dyadic nature of feeding interactions. This appears to be a robust finding given that quality ratings for these studies ranged from good to excellent.

In relation to other psychological issues, evidence suggests that infant temperament may influence feeding behaviour in terms of enjoyment of novel foods or intake of food (Darlington & Wright, 2006; Forestell & Mennella, 2012; McMeekin et al., 2013; Wasser et al., 2011). Most studies in this area have identified associations between temperament and weight gain or temperament and maternal feeding practices. While these studies received excellent ratings, several explanations may account for their findings, making it difficult to draw conclusions about the role of temperament in the expression of infant hunger and fullness. Darlington and Wright's (2006) finding that infants with high distress to limitations gained weight quickly may be explained in relation to maternal responses to these babies. Infants with high distress to limitations were reported to sleep less and to fuss more and may have received additional feeds to comfort them. This is supported by McMeekin et al.'s (2013) finding that mothers of "difficult" infants were more likely to feed them as a soothing strategy. Alternatively, mothers in Darlington et al.'s (2006) study may have fed demanding babies more as a result of misinterpreting fractiousness as hunger. A further possibility is that this group of infants may simply have been hungrier and more demanding because of rapid growth (Darlington & Wright, 2006).

Darlington and Wright's (2006) finding that infants with high fearfulness scores showed slower weight gain is harder to explain. The authors suggest such infants may have difficulty expressing their needs, though no evidence is provided for this. The precise mechanisms behind associations between temperament and infant weight therefore remain unclear. The picture is further complicated by findings that maternal characteristics may shape responses to infants with demanding temperaments (Darlington & Wright, 2006; Wasser et al., 2011). While these findings confound attempts to identify causal relationships between infant feeding and infant temperament, they again highlight the bi-directional nature of feeding interactions.

A further difficulty in interpreting the infant temperament and feeding behaviour literature arises from differences in study characteristics, as noted by Bergmeier et al. (2013). Different temperament measures were used by McMeekin et al. (2013) from those used by Darlington and Wright (2006) and Wasser et al. (2011) (the STSI and the IBQ respectively). Furthermore, infants in Darlington's study were younger than those in McMeekin et al.'s (2013) and Wasser et al.'s (2011) research, (8-12 weeks and 8-72 weeks). In addition, the cross-sectional nature of much research to date limits how far causal conclusions can be drawn regarding infant temperament and weight gain.

2.7.3 The impact of physical characteristics

As illustrated in Figure 2.2, infants' individual physical characteristics may affect how feeding cues are expressed and/or, how they are perceived by mothers (individual psychological factors). Thus, individual physical factors may impact on individual psychological factors.

In relation to physical factors, Llewellyn et al.'s (2012) twin study provides high quality evidence that appetitive behaviours are determined in part by genotype. Llewellyn et al.'s (2011) study of infant appetite also lends credibility to the proposition that characteristics such as gender, birth weight etc. influence appetite, and therefore, the expression of hunger and satiation. There is additional evidence that characteristics such as gender, birth weight or prematurity influence feeding behaviours, and potentially how feeding cues are expressed (Hwang, 1978; Nisbett & Gurwitz, 1970; Stevenson et al., 1990; Wright, 1986). Such studies involved direct observation with appropriate procedures taken in relation to this (inter-rater reliability, and observer blindness). This is a relative strength. However, findings from some studies have been brought into question by more recent research. Wright's (1986) conclusion that reported differences in hunger between male and female infants arose from maternal perceptions, rather than infant behaviour, is undermined by evidence from Powe et al. (2010). They found that the breastmilk of mothers of boys is higher in energy than that of mothers of girls, thereby casting doubt on assumptions that the breastmilk to which males and females are exposed is necessarily the same. This finding though provides some basis for concluding that infant gender might (indirectly) influence the expression of hunger. Furthermore, studies by Hwang (1978) and Nisbett and Gurwitz (1970) suggest that gender may shape other aspects of feeding behaviour (e.g. response to taste), although the quality rating for former was low, and overall, the lack of homogeneity of studies of gender and feeding hampers attempts to draw simple conclusions. Additional, and more robust research in this area would therefore be beneficial.

While Wright's (1986) conclusions regarding gender have been challenged by recent research, the same cannot be said of studies of prematurity and later feeding behaviour. The literature search generated very little research on the impact of prematurity on feeding cues in infancy beyond the first days and weeks of life. However, findings from Llewellyn et al. (2011) and Stevenson et al. (1990) suggest that, compared to term babies, premature babies may exhibit different feeding cues or different appetitive behaviours at 8 months of age and beyond. While the Stevenson et al. (1990) paper received a relatively low quality rating, the indication that premature infants may exhibit different eating traits and feeding cues to term infants merits further investigation, given that such issues may impact on mothers' feeding responses.

2.7.4 Environmental factors

As discussed, environmental factors may have bi-directional relationships with individual psychological factors (Figure 2.2). Here there are preliminary indications that infants fed exclusively on formula milk may be more responsive to food cues (Buvinger et al., 2017). There is also high quality evidence from Ventura et al. (2012; 2015) that formula milk composition affects speed of satiation and length of satiety with implications for the frequency with which hunger cues are observed, the speed with which they abate and the likely timing of satiation cues. Wright et al.'s (1980) finding of differences in consumption and feeding patterns between breast and formula fed infants may also have implications for interpreting infant hunger and satiation; the authors suggest a lack of variation in the parameters of formula feeds compared to breast feeds may make it harder for formula feeding mothers to interpret hunger and satiation. This paper received a relatively low quality rating, however, the proposition that interpreting hunger and fullness may be more challenging in formula feeding is supported by Shloim et al.'s (2016) findings regarding differences in the signalling of engagement and disengagement between formula and breastfed babies.

As noted, environmental factors such as exposure to different food characteristics and the timing of such exposure give rise to individual psychological factors by influencing food preferences. More importantly for this review, however, the literature indicates that consumption and the duration of feeding are both associated with liking, while cessation of feeding is associated with dislike. This has been reported across several food characteristics - taste, flavour and texture (Blossfield et al., 2007; Mennella et al., 2001; Mennella et al., 2009). Such findings arose from good quality studies and are significant for understanding feeding cues as intake and continued feeding are perceived as hunger in mothers' reports

(Anderson et al., 2001). Similarly, cessation of eating is perceived to indicate satiation (Gross et al., 2010; Hodges at al., 2008). The question is therefore whether cues associated with liking and dislike can be differentiated from those associated with hunger/satiation. This has implications for mothers deciding when a child has eaten enough.

Facial expression appears to provide some basis for differentiating between dislike and satiation as negative expressions appear to indicate dislike (Blossfield et al., 2007; Forestell & Mennella, 2012; Skinner et al., 1998; Mennella et al., 2001). Distinguishing between eating driven by pleasure rather than hunger, however, is more challenging. Studies provide few clues regarding liking cues beyond facial relaxation and smiling (Mennella et al., 2009; Skinner et al., 1998). Furthermore, what is not known is the relative contribution made by hunger and hedonic aspects of eating to issues such as consumption and duration of eating. More good quality research is therefore needed in this area.

2.8 Review evaluation

While the review has explored a large amount of research regarding the communication of hunger and satiation in infancy, it has limitations. Only published papers were considered and a search of the grey literature was not performed; important findings may therefore have been omitted.

A second limitation lies in the heterogeneity of the studies discussed. While the diverse nature of the papers reviewed might be considered a strength, this presents challenges when synthesising findings and drawing conclusions. The varying topics and methods of investigation involved in the reviewed papers makes comparison difficult, even for studies within the same area of enquiry.

Finally, while papers with the lowest ratings were excluded from the review, and the majority of retained papers were of a good quality, the quality of a few remaining studies was relatively low. There were also discrepancies between raters on quality for a small number of papers. However, as inter-rater agreement over all was high, no further action was taken. As such the strength of conclusions drawn in the review should be considered in relation to the quality of the individual papers to which they relate.

2.9 Review implications

This review has identified several gaps in the literature regarding infant feeding cues. The development of validated observational tools to examine patterns of hunger and satiation behaviours throughout complete feeding episodes would help to address some of these. Such tools would produce a fuller record of infant communication of hunger and satiation during meals and a more representative picture of the challenges mothers face in deciphering cues. In addition, they would enable more accurate 'tracking' of maternal responses to infant cues than is currently possible, thereby, facilitating the examination of the respective impacts of infant and maternal characteristics on feeding interactions.

In relation to the impact of infant attributes on feeding interactions, the review has identified gaps in the research regarding associations between infant temperament and the expression of hunger and satiation. Here research using consistent measures of temperament is needed to facilitate comparisons across studies. Furthermore, the lack of observational research regarding temperament and infant feeding behaviour is problematic. Addressing this would elucidate the precise contributions of infant and maternal characteristics to reported associations between infant temperament and weight. There is also a need to investigate further the reported associations between inconsistent infant signalling of satiation and lower maternal responsiveness. Such research could inform responsive feeding interventions, should it confirm that infants with difficult temperaments, or those who express satiation less clearly, are at risk of being over-fed.

Regarding broad conclusions that can be drawn about infants' physical attributes and feeding cues, it seems that a range of characteristics (gestational age at birth, birth weight, gender) may shape feeding behaviour. However, the relative impact of different characteristics is difficult to judge as a disparate range of behaviours has been studied (e.g. response to taste, sucking behaviour, and fussiness during meals). A more coherent programme of research is indicated to investigate the impact of different infant characteristics on the same aspects of feeding.

A final area for further enquiry indicated by the review concerns the need to understand the contributions that signals indicating hunger/satiation and liking/dislike make to infant intake of food. Additional studies to examine feeding behaviour in the contexts of main and sweet courses are needed. Likewise, research to determine how infants communicate liking of food is needed given that studies so far provide relatively few insights into this. This has implications for healthy eating initiatives given evidence that infant consumption is not only driven by hunger.

In summary, the existing literature provides insights into many aspects of hunger and satiation in infancy; however, there are significant gaps in our knowledge. Addressing these would make a valuable contribution to our understanding of infant feeding cues and what infants bring to feeding interactions with parents. This is particularly important given the implication of maternal feeding practices in the development of infant obesity risk.

Chapter 3 - The eyes have it: infant gaze as an indicator of hunger and satiation.

3.1 Introduction

This chapter describes the first of three separate analyses conducted for Study 2 of the thesis, i.e. the observational phase of the research. The aim of this analysis was to examine gaze change during CF. Chapters 4 and 5 detail the other analyses conducted for Study 2, i.e. the examination of infant gesture and vocalisation respectively. The current chapter describes the main procedures involved in all three analyses.

3.1.1 Gaze as an indicator of hunger and satiation

Studies have shown that gaze and visual attention to food vary with hunger and satiation, and between individuals of different weights. Nijs et al. (2010) used eye tracking and a visual probe task to examine attention to pictures of food during hunger and satiation in 26 overweight and 40 normal weight adult females. They found no differences between groups or conditions in the eye-tracking data. However, the visual probe task showed greater automatic orientation by participants towards food cues in hungry versus satiated states, and by overweight versus normal-weight participants.

Research also suggests that gaze provides a measure of interest in food on the part of children. In a study which controlled for hunger, Folkvord et al. (2015) investigated the impact of food advertising on intake of snacks in 92 seven to ten-year-old children. They found that children who showed a longer gaze duration for food cues in a digital advertising game, ate more of an advertised snack than those who were not attentive to the cues.

Despite evidence that gaze may differ by hunger status in adults and children, it has received little attention as a marker of infant feeding state. However, evidence from a handful of studies suggests that gaze may provide an indication of infant interest in feeding. Anderson et al. (2001) found infants' visual interest in others' food was one signal used by mothers to determine their babies' readiness for the introduction of solids, while mothers Hodges et al.'s (2008) feeding cues study identified 'staring' as a hunger cue.

Two observational studies also suggest that infant gaze may provide insights into interest in feeding. Paul et al. (1996) found significantly higher eye movement frequencies and longer durations of visual exploration of objects before, and after, milk feeds in infants of 18 weeks of age and older, compared with during feeding. The authors did not find significant differences between pre and post prandial gaze, though evidence from Gerrish and Menella (2000) suggests that gaze behaviour may also differ with hunger and satiation. They examined the responsiveness of 13 four to six-month-old infants to a rotating, musical mobile before and after breastfeeds by examining frequency of limb movements and duration of gaze at the mobile when switched on and off at one-minute intervals on two separate days. They found no significant differences in limb activity in pre and post prandial states. However, infants looked at the mobile significantly longer after, than before breastfeeding, suggesting a shift in attention towards the mobile during the fed state.

3.1.2 Rationale, aims and hypotheses

Given indications that gaze differs with feeding state in adults, children and babies, and the key role that it plays in infant communication, a systematic examination of this behaviour may provide new insights into the signalling of infant hunger and satiation. The current lack of studies in the area, however, means there are no tools for investigating gaze change during infant feeding. There are brief references to infant gaze in some responsive feeding measures. For example, gaze aversion is identified as a potent disengagement cue in the NCAST Feeding Scale (Sumner & Spitz, 1994) and visual attentiveness to the caregiver is regarded as an indicator of infant feeding responsiveness in the RCFCS, (Hodges et al., 2013). However, these scales serve primarily as measures of caregiver feeding responsiveness, and do not offer a means of following or measuring infant gaze across meal episodes. The analysis described in this chapter therefore had three aims:

1. to develop a reliable coding scheme to track infant gaze across mealtimes
2. to test the feasibility of applying the coding scheme to mealtime gaze behaviours
3. to use the scheme to examine gaze change across infant feeding episodes.

A decision was taken to develop and test the scheme within solid, rather than milk feeds, given that gaze is easier to observe during CF as a consequence of infants' upright posture and, because the limited work which already exists regarding gaze and feeding state has only been conducted in milk fed infants.

The development of a reliable measure of gaze during CF would facilitate the investigation of this behaviour as an index of attention to food and may highlight which, if any, aspects of gaze are associated with infant hunger and fullness. Results from such work may help to extend our understanding of infant feeding cues and may therefore assist with the development of responsive feeding interventions. In pursuing the development of the gaze coding scheme, it was hypothesised that:

1. Gaze behaviour would change across the meal away from gazing at food to non-feeding related gaze in common with patterns of post-ingestive behaviour in animals (i.e. the behavioural satiety sequence (Rodgers, Holch, & Tallett, 2010).

2. Higher frequencies of gazing at food would be seen in main than dessert courses (if offered) i.e. before infants were partly satiated by the main course.

3. Gaze would follow similar patterns of change in mains *and* desserts. High frequencies of gazing at food would be observed at the start of both, rather than declining steadily across meals, as the introduction of food with different sensory qualities (dessert) would be expected to prompt a renewed interest in eating, consistent with SSS principles.

4. Gaze aversion from food, as a form of rejection, would increase in frequency as the meal progressed.

3.2 Method

3.2.1 Ethics

Ethical approval for the research was granted by the School of Psychology Ethics Committee at the University of Leeds, ethical approval reference: 14-0010 date approved: 15-Jan-2014. Mothers gave consent for themselves and their infants to participate in the study following receipt of study information and the opportunity to discuss questions with the researcher (Appendices B1, B2).

3.2.2 Participants

Flyers containing study information were sent to day nurseries and mother and baby groups in Leeds, England and surrounding areas (Appendix B3). Families were eligible to take part if they had started or were about to start complementary feeding, and they had an infant between 6 and of 18 months of age with no developmental or feeding difficulties. Twenty mother-infant dyads were recruited. Infants were eight males and twelve females between six and eighteen months of age at the time of entry into the study (mean age 11.7 months ± 3.40). Seven infants had been fed using BLW (as defined by their mothers). One BLW mother reported the occasional use of a spoon to feed yoghurt and to start meals. The remaining four BLW mothers reported using only independent feeding or the use of a loaded spoon for infants to self-feed. Thirteen infants had been fed using TW followed by more independent feeding with increasing age. All infants had been breastfed at birth for at least a few days. Mean breastfeeding duration was 24.89 weeks (± 15.96). Six mothers continued to breastfeed at the time of the study. Mean age for the introduction of CF was 22.2 weeks (± 1.85). Mothers were aged between 30 and 43 years of age (mean age 34.6 ± 3.23). Nine were first time mothers and all but two had a higher educational qualification. Participants were from a predominantly white UK background with one non-UK South Asian family also taking part.

3.2.3 Design

This first strand of Study 2 comprised four phases; phase 1 involved filming two separate feeding episodes between mothers and their infants; phase 2 involved development, piloting and revisions to the coding framework along with piloting of the coding method (continuous or instantaneous coding). This phase used video recordings taken in phase 1 and video recordings taken from an earlier research study. Phase 3 involved formal reliability testing using a sample of 20 percent of the footage of videos from phase 1 along with final revisions of the coding scheme itself. Phase 4 involved the coding of the entire video data set and related analyses.

3.2.3.1 Phase 1 - Data collection

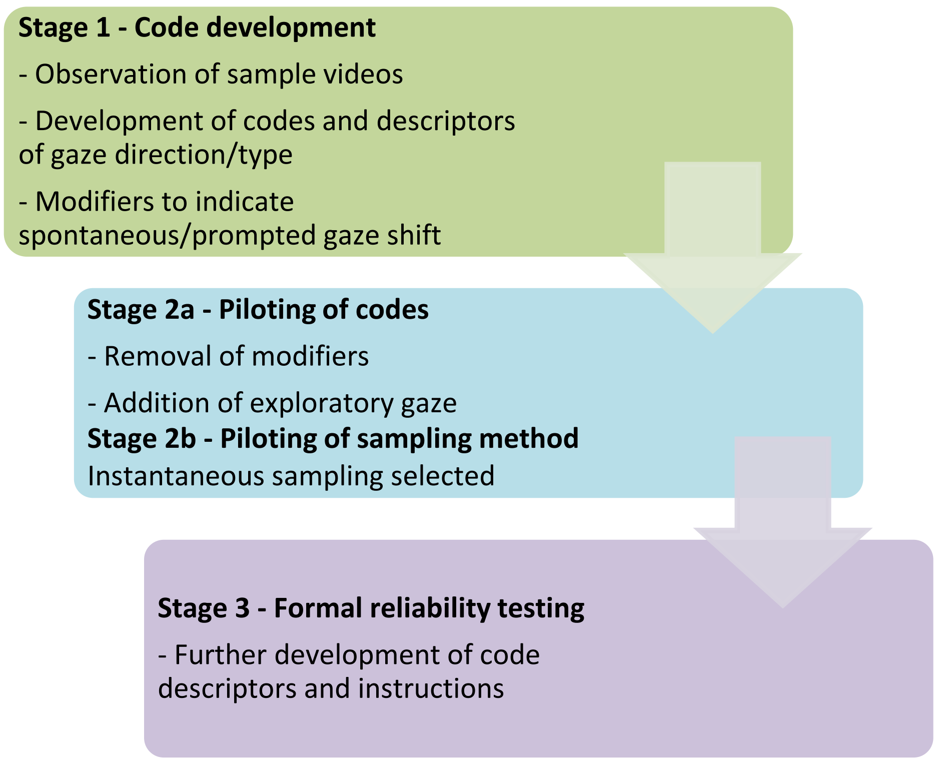
Participants were visited three times at home. At the first visit, demographic details and a feeding history were taken. At visits two and three, infants were video recorded eating a familiar meal at their usual lunchtime. The mean time between filming visits was sixteen days (±12.80). Mothers were asked to not feed their babies before filming to ensure that infants were hungry before the meal. During filming mothers were asked to serve a familiar and liked meal in line with normal feeding practice and to ignore the presence of the researcher. Most infants (n = 16) were offered and ate dessert as well as a main course at both filming visits and both courses of the meal were filmed accordingly. Where possible, filming took place in the absence of siblings to minimise interruptions to the meal. An older sibling was present during filming with one family.

Meals were filmed using a hand-held Panasonic SDR-H90 video camera and filming commenced with the seating of the infant in the high chair or at the table. Filming took place at a distance of approximately 2 metres to ensure that both mothers and infants were in shot. The camera's zoom facility was used to capture finer details of infant behaviour where these could not be observed satisfactorily from a distance. The researcher was in sight of both mothers and infants during filming though there was no interaction between the researcher and participants when filming was taking place. The majority of mothers sat opposite their infants during filming, with short periods of time away for food preparation and clearing up activities. One mother did not sit with her baby during the meal but interacted with the infant between bouts of food preparation. Filming ended when mothers indicated that the meal was finished.

3.2.3.2 Phase 2 - Development of codes

The development of the Infant Gaze at Mealtime (IGM) coding scheme involved a number of stages (Figure 3.1) (full details of the final scheme appear in Appendix B4).

Figure 3.1 – Development of gaze coding scheme



The initial coding scheme was informed by observations of a random sample of videos for five different study infants, and five other infant feeding videos from an earlier project for which consent had been gained and which were available to the first author. Observational codes were developed largely as descriptions of gaze direction during feeding e.g. ‘gazes at food’, ’gazes at drink etc.’ (Table 3.1). The code ‘gazes at other’ was used to describe instances of the infant gazing at non-feeding related items and the infant gazing at the camera. Infants were also observed to gaze at the caregiver during feeding. The code ‘gazes at caregiver’ was therefore also included to describe gaze direction and on the basis that visual attentiveness to the caregiver appears as an indication of feeding responsiveness in the RCFCS (Hodges et al., 2013). Two further descriptions of infant gaze were included in the initial coding scheme: ‘watches caregiver’ where the infant’s gaze followed the caregiver’s movements for example around the kitchen (rather than gazing directly at the caregiver’s face); and ‘active gaze aversion’ where infants were observed to avert their gaze in direct response to offers of food. The inclusion of this code was also informed by its identification as a disengagement cue in the NCAST feeding scales (Sumner & Spitz, 1994).

Table 3.1 - Initial gaze coding scheme

Behaviour	Modifier	
Unobservable	n/a	
Watches caregiver	n/a	
Gazes at caregiver	i) spontaneously	ii) prompted
Gazes at drink	i) spontaneously	ii) prompted
Gazes at food	i) spontaneously	ii) prompted
Gazes at other	i) spontaneously	ii) prompted
Active gaze aversion	n/a	

Finally, an ‘unobservable’ code was included for instances where the infant’s eyes were obscured. Modifiers were included in the initial coding scheme for gazing at the caregiver, gazing at food and gazing at other objects, to identify whether gaze was directed to these spontaneously, or whether it was prompted, for example by the caregiver drawing the infant’s attention to an item or to herself. Descriptors were developed alongside all behaviour codes to provide additional details for coders.

3.2.3.2.1 Piloting of codes

The usability of the initial IGM was assessed by piloting codes with entire videos from the first filming visit for five of the participants (89.23 minutes of footage in total). Following this pilot, a number of changes were made to the first version of the scheme (Table 3.2). First, the IGM was simplified by removing the ‘spontaneous or prompted’ modifiers for ‘gazes at caregiver’, ‘gazes at drink’, ‘gazes at food’ and ‘gazes at other’. During piloting, the vast majority of gaze shifts were observed to be infant initiated, and the inclusion of modifiers therefore made coding unnecessarily time-consuming. Furthermore, there were also occasions where the categories proved unworkable; for example, it was difficult to categorise gaze shifts to the caregiver as being unequivocally spontaneous or prompted if they were part of an ongoing social exchange.

Table 3.2 – Revised gaze coding scheme

Behaviour
Unobservable
Watches caregiver
Gazes at caregiver
Gazes at drink
Gazes at food
Gazes at other
Exploratory gaze
Active gaze aversion

The second change to the scheme involved the addition of a new code. Infants were observed to engage in a type of gaze behaviour which was not yet captured by any code, whereby they would gaze intently at objects and food while actively manipulating them (e.g. turning, squeezing, etc.). The developmental psychology literature indicates that such visual examination is associated with exploratory play (Ruff & Salterelli, 1993) and a new code of ‘exploratory gaze’ was therefore added.

3.2.3.2.2 Piloting of coding method

Following revision of the IGM, a second round of piloting was conducted to establish the most feasible method for coding, i.e. continuous coding or instantaneous sampling. The main observer and a second observer coded footage from the main courses of five selected films from phase one on a continuous basis. The first, middle and last twenty percent of main course footage was used. Fifteen video sections of between 1.53- and 4.74-minutes length were coded with a total of 46 minutes of film coded. The same observers then coded the same films using an instantaneous sampling frame of three seconds, i.e. frozen images were coded every three seconds. Subsequent discussions indicated that instantaneous sampling enabled coders to observe and interpret behaviours from relatively clear, frozen images every three seconds. In contrast, coders encountered difficulty coding gaze shifts continuously, as these were often subtle and fleeting. A decision was therefore taken to use instantaneous sampling. The test interval of three seconds was retained; this allowed for frequent observation of infant gaze whilst reducing the risk of missing behaviours and minimising burden on coders.

3.2.3.3 Phase 3 - Formal reliability testing

Filmed meal episodes were divided into main and dessert courses in order to facilitate a comparison of behaviours between these. The mean length of main course videos was 14.46 minutes and the mean length of dessert course videos was 7.31 minutes. As for the testing of coding methods, each course was divided into the first, middle and last twenty percent of course footage as a sampling strategy to enable comparisons of behaviour early, late and at the mid-point in feeding episodes. This resulted in between 6 and 12 video sections per infant across the two filmed feeding episodes, depending on whether infants had eaten a dessert and a main course on both filming visits (n =16). A stratified random sample of videos was selected for reliability testing which included only infants who had consumed both a main and dessert course at each filming visit, and equal numbers of spoon fed and baby led weaned infants. The sample contained the video sections for four participants (20 percent of the participant group) and comprised 48 video clips out of a possible 225. These varied between 2.33 and 17.83 minutes in length.

Videos were coded using Noldus Observer XT video analysis software using a fully crossed design and two under-graduate second coders. Video clips were coded in random order to minimise any impact that order effects (i.e. expectations of behaviour at different time points) may have on coding. The order in which clips were presented was determined using a random number generator. Second coders received training, practice and feedback sessions before carrying out independent coding on half of the sample videos (n = 24). Initial inter-rater reliability calculations were carried out on the raw data from this subset of the reliability sample using the Observer XT's reliability calculation facility. This was used to identify instances of poor inter-rater agreement on individual coding using a Pearson' correlation of .70 as an acceptable threshold for inter-rater reliability (Stemler & Tsai, 2008). Videos for individual observations with correlation coefficients lower than .70 were therefore reviewed by all three coders and areas of disagreement were discussed. Second coders then re-coded videos clips for which agreement was below the required threshold until a correlation of at least .70 was attained with the main coder. This process was repeated for the second half of the reliability film clips.

While Pearson's correlations are useful for coder training and feedback, they are not considered the best option for final reliability analyses (Bakeman & Quera, 2011). These were therefore conducted using two-way mixed effects, single measure ICCs for absolute agreement across all behaviour codes on all observations, and absolute agreement on individual codes across all observations. ICCs were carried out using square root transformed data, as observational coding data were not normally distributed (Hallgren, 2012).

Test-retest reliability analyses were also performed to assess the reliability of the IGM over time. The same sample of 48 film clips was re-coded by the main coder 20 weeks after the initial coding session. Again, two-way mixed effects ICCs were conducted with transformed data for absolute agreement. Analyses were carried out to examine total agreement across all observations in the reliability sample at the first and second coding, and for each of the individual gaze behaviour codes at the first and second coding.

3.2.3.4 Phase 4 - Treatment of data

A total of 225 video sections of between 26 and 355 seconds in length were coded. As with phase 3, videos were presented for coding in random order to minimise order effects. Following coding of the complete data set, data for 'unobservable' instances of gaze were removed. Mean frequency scores were calculated between meals 1 and 2 for remaining gaze behaviours at the three time points of the main and dessert courses. This produced one set of figures for each course section. Mean frequencies, ranges and standard deviations were calculated for each type of gaze behaviour across whole meals and for the three time points of mains and dessert courses.

Inferential analyses for main and dessert course data began with the square root transformation of frequency data to address the issue of the differing video lengths across different infants, meals and courses. Transformed data were normality tested using Shapiro

Wilks analyses to determine the appropriateness of subsequent parametric and non-parametric analyses. Assumptions tests were also conducted to determine appropriate non-parametric tests. Analyses of change were conducted between what were assumed to be the hungriest and most satiated parts of the meal (the first 20% of main courses and the last 20% of dessert courses) using repeated measures ANOVAs, Wilcoxon's signed rank or Sign tests as appropriate. Three-way factorial repeated measures ANOVAs with Bonferroni corrections were conducted to assess main effects for gaze, time and course for the transformed whole meal data as no non-parametric equivalent exists for such analyses. Two-way repeated measures ANOVAs were conducted to examine the effect of gaze behaviour and time within main and dessert courses. One-way ANOVAs and Friedman's tests were subsequently used to examine individual behaviours at course level. Finally, significant results from these analyses were subjected to pairwise and Wilcoxon Signed Ranks tests as appropriate. All non-parametric tests were conducted using raw data and exact significances. Critical values were adjusted using Bonferroni corrections for multiple Wilcoxon comparisons to control familywise error rate. Post-hoc power analyses were conducted using G-Power to assess the adequacy of sample size for main and simple main effects ANOVAs using $\alpha = 0.05$, the relevant sample size (n= 16 for all whole meal and dessert analyses and n=20 for main course analyses) and the relevant ηp^2 value.

3.3 Results

3.3.1 Inter-rater reliability

ICCs across all 48 observations were in the excellent range, ICC= .95 with a 95% confidence interval from .94 to .96 (F (383,766) = 58.69 $p < .001$) (Cicchetti, 1994). ICCs for individual gaze codes were good to excellent (Appendix B5).

3.3.2 Test-retest reliability

Test-retest ICCs across all 48 observations were in the excellent range, ICC= .98, with a 95% confidence interval from .97 to .98 (F (383,383) = 95.31 $p < .001$). Test-re-test ICCs for individual gaze codes were all in the excellent range (Appendix B5).

3.3.3 Whole meal descriptive statistics

Gazing at other showed the highest mean frequency across the six time points of the whole meal (Table 3.3). This was also the most variable behaviour. Gazing at food showed the second highest mean frequency whilst the lowest mean frequency was seen in active gaze aversion.

Table 3.3 – Mean gaze frequencies across whole meals

Behaviour	N (Time points)	Range	Mean	Std. Deviation
Active gaze aversion	6	0 - 1	0.11	0.13
Exploratory gaze	6	1 - 8	4.26	2.62
Gazes at caregiver	6	3 - 10	6.51	2.64
Gazes at drink	6	0 - 5	2.27	1.75
Gazes at food	6	4 - 13	9.05	3.24
Gazes at other	6	9 - 21	15.32	5.67
Watches caregiver	6	1 - 7	2.89	2.31

3.3.4 Main course descriptive statistics

Mean frequencies of exploratory gaze and gazing at the caregiver increased at all three time points during the main courses while those of gazing at food, and watching the caregiver decreased (Appendix B6). There were no discernible patterns of change for other gaze behaviours across time in the main courses.

3.3.5 Dessert course descriptive statistics

Mean frequencies of gaze aversion from food, gazing at the caregiver, and gazing at other increased over time in the dessert courses and gazing at food and watching the caregiver decreased (Appendix B7). No other patterns of gaze change were observed.

3.3.6 Post hoc power analyses

Post hoc power calculations revealed that most main and simple effects ANOVAS were under-powered with the exception of: the main effect of gaze behaviour in the whole meal and main courses ($1-\beta = .99$ in both cases) and the main effect of time in the dessert course ($1-\beta = .95$).

3.3.7 Analyses of changes in gaze between the hungriest and most satiated sections of the meal

Repeated measures ANOVAs of gaze change between the hungriest and most satiated parts of the meal (the first 20% of the main courses and last 20% of the dessert courses) revealed highly significant decreases over time in the frequency of gazing at food, $F(1,15) = 23.14$, *p*

$< .001$, $\eta p^2 = .61$ and gazing at other, $F(1,15) = 10.22$, $p = .006$, $\eta p^2 = .41$ and a significant increase in time in the frequency of exploratory gaze, $F(1,15) = 5.14$, $p = .039$, $\eta p^2 = .26$. Wilcoxon's signed ranks tests also revealed a highly significant median decrease in watching the caregiver, $Z = -3.02$, $p = .001$. No other significant changes in gaze behaviour were observed between Times 1 and 6.

3.3.8 Whole meal ANOVAs

Three-way repeated measures ANOVAs revealed a highly significant main effect for course, $F(1,15) = 26.42$, $p < .001$, $\eta p^2 = .64$, indicating that gaze behaviours as a whole differed between main and dessert courses. A highly significant main effect was also shown for behaviour, $F(6,90) = 59.43$, $p < .001$, $\eta p^2 = .80$ thereby indicating that different types of gaze behaved differently during meals, i.e. the independence of different behaviours. Highly significant interactions were also found for course by behaviour, $F(6,90) = 3.62$, $p = .003$, $\eta p^2 = .19$ and behaviour by time (after the application of the Greenhouse Geisser correction), $F(6.13,91.98) = 12.19$, $p < .001$, $\eta p^2 = .45$. As such, overall gaze behaviour was seen to vary both by course and by time across feeding episodes.

Whole meal ANOVAs of individual types of gaze by course found significantly higher frequencies of a number of gaze behaviours in main than dessert courses, i.e. gazing at food: $F(1,15) = 5.41$, $p = .034$, $\eta p^2 = .27$; gazing at the caregiver: $F(1,15) = 10.22$, $p = .006$, $\eta p^2 = .41$; gazing at other: $F(1,15) = 22.31$, $p < .001$, $\eta p^2 = .60$ and watching the caregiver: $F(1,15) = 5.14$, $p = .039$, $\eta p^2 = .26$.

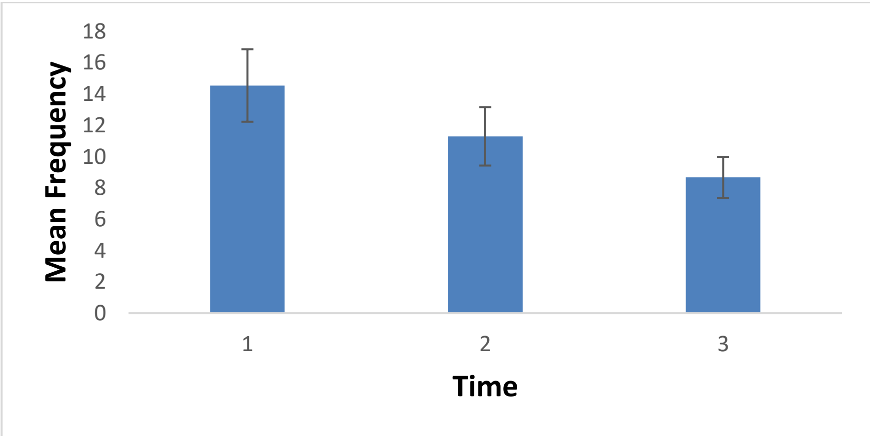
3.3.9 Main course ANOVAs and Friedman's analyses

A significant main effect for gaze was found $F(6, 114) = 49.45$, $p < .001$, $\eta p^2 = .72$ indicating that different forms of gaze behaved differently during the main courses of meal. Mauchly's test was significant for the interaction between gaze and time. This was found to be

significant on the application of the Greenhouse-Geisser correction, $F(5.29, 100.60) = 8.31$, $p < .001$, $\eta p^2 = .30$ showing that gaze frequency changed with time for some types of gaze behaviour.

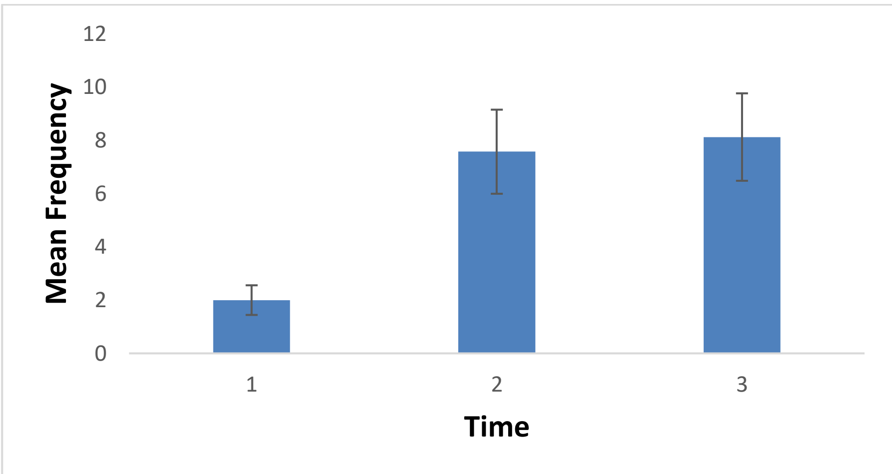
Repeated measures ANOVAs for changes in individual behaviours over time in main courses did not show significant results for gazes at caregiver and gazes at other. However, a highly significant result was found for gazes at food $F(2,38) = 8.57$, $p = .001$, $\eta p^2 = .31$, with a significant decrease in the frequency of this behaviour over time (Figure 3.2). Pairwise comparisons indicated that significant differences in gazing at food occurred between time 1 and time 2 (p = .029) and time 1 and time 3 (p = .002). No significant difference was observed between times 2 and 3.

Figure 3.2 – Main course gazing at food mean frequencies and standard errors



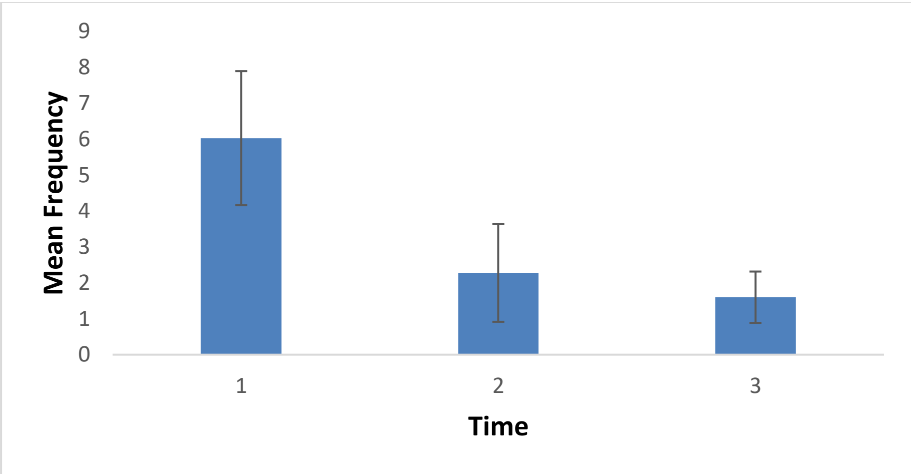
Friedman's tests revealed a significant increase in the frequency of exploratory gaze over time, X^2 (2) = 18.47, $p < .001$ (Figure 3.3). Post hoc Wilcoxon signed-rank tests found a significant increase over time for exploratory gaze behaviour between times 1 and 2, Z = -3.53, $p < .001$ and times 1 and 3, Z = -3.38, $p < .001$, but not between time 2 and time 3. Therefore, infants' interest in exploring increased by the second half of the meal and remained high relative to the beginning of the course.

Figure 3.3 – Main course exploratory gaze mean frequencies and standard errors



A highly significant median decrease was also observed in the frequency of watching the caregiver over time, X^2 (2) = 9.51, p .007 (Figure 3.4). Wilcoxon signed-rank tests showed significant decreases in the frequency of this behaviour between times 1 and 2 (Z = -2.36, p = .008) and 1 and 3, Z = -2.63, p = .003**.** Thus, infants' gaze shifted from watching their mothers as main courses progressed. Friedman's analyses did not reveal any significant changes over time in active gaze aversion or gazing at other.

Figure 3.4 – Main course watching the caregiver mean frequencies and standard errors



3.3.10 Dessert course ANOVAs and Friedman's analyses

A significant main effect for gaze was found F (6, 90) = 5.74, p < .001, ηp^2 = .28. There was also a significant main effect of time, F (2,30) = 48.46, p < .001, ηp^2 = .76 and a significant interaction between gaze and time following application of the Greenhouse-Geisser correction, F (12, 80.77) = 33.50, p < .001, ηp^2 = .69.

In contrast to the main courses, repeated measures ANOVAs for individual behaviours during desserts showed a significant increase in the frequency of gazing at the caregiver, F (2,30) = 8.27, p =.001, ηp^2 = .36 (Figure 3.5). Pairwise comparisons revealed that significant changes in the frequency of gazing at the caregiver occurred between times 1 and 3 (p =.005) and 2 and 3 (p = .049). Significant decreases were also observed in the frequency of gazing at food F (2,30) = 16.84, p < .001 ηp^2 = .53 (Figure 3.6) with pairwise analyses identifying that these occurred between times 1 and 3, and 2 and 3 (p < .001 and p = .011).

Figure 3.5 – Dessert course gazing at the caregiver mean frequencies and standard errors

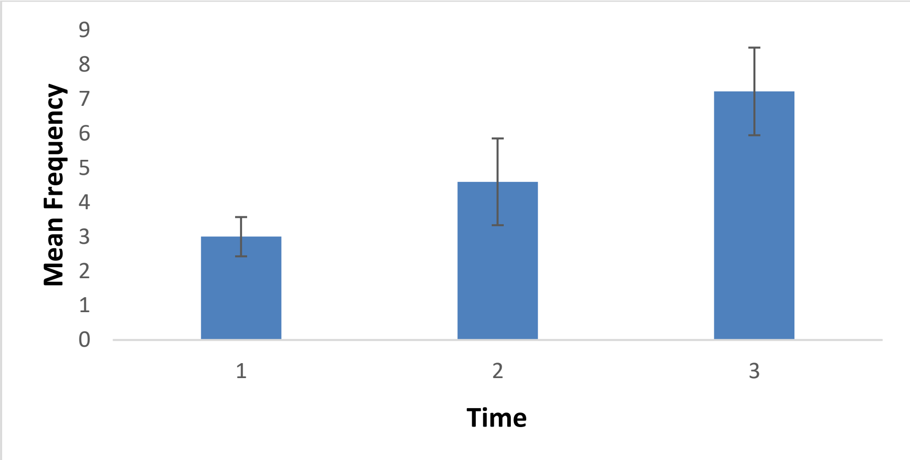
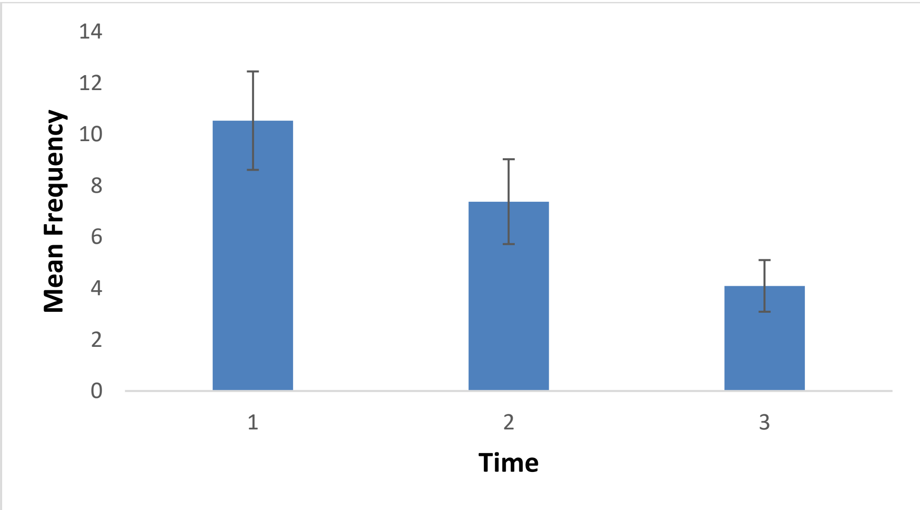
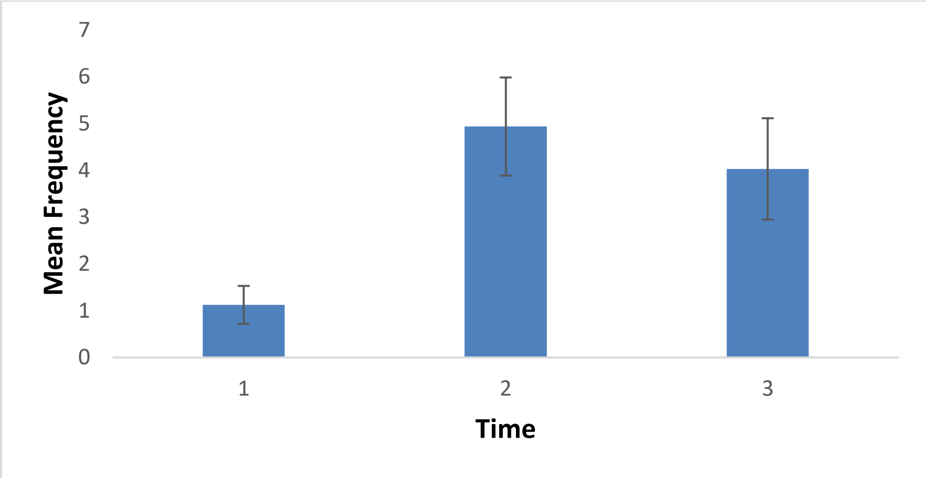


Figure 3.6 – Dessert course gazing at food mean frequencies and standard errors



Friedman's analyses showed a significant increase in exploratory gaze behaviour over time X^2 (2) = 8.54, p = .012 (Figure 3.7). Post hoc Wilcoxon signed-rank tests revealed significant changes in exploratory gaze behaviour between time 1 and time 2 (Z = - 2.81 p = 0.003) and time 1 and time 3 (Z = - 2.66, < 0.005).

Figure 3.7 – Dessert course exploratory gaze mean frequencies and standard errors



3.4 Discussion

This analysis aimed to develop and test a reliable coding system to examine infant gaze during CF. Results indicate that the IGM is a reliable measure and that observation of gaze during meals may offer a tool for examining infant hunger and satiation levels subject to further testing.

3.4.1 Reliability of the IGM

High inter- and intra-rater reliabilities were found for the IGM. These can be attributed to its comprehensiveness and relative simplicity in describing infant gaze. Results are consistent with findings from earlier studies indicating gaze can be coded with high levels of reliability (Harrigan, Rosenthal & Scherer, 2008; Ruff, Capozzoli & Saltarelli, 1996). The high reliability of the coding scheme is likely to arise to some degree from the conditions in which it was tested. First, the use of video coding software and instantaneous sampling facilitated the observation of relatively clear, 'frozen' images, thereby increasing coding accuracy. Second, the use of video software enabled the slowing down and repeated viewing of behaviours. Furthermore, the practice of reviewing inter-rater agreement half way through reliability coding is likely to have reduced coder drift (Martin, Bateson & Bateson, 2007).

Despite high levels of inter-rater reliability for individual behaviours, the ICC for 'unobservable' gaze was low relative to other behaviours (in the good rather than the excellent range). The descriptor for this code may therefore benefit from refinement. Coders were instructed to use this code if both of the infant's eyes were obscured, or the direction of gaze could not be discerned. Images of infants' eyes were sometimes indistinct in video stills however, leading to coder disagreement.

Testing and subsequent revisions of the IGM generated a scheme which described all gaze behaviours during feeding adequately. It is likely therefore, that it has good content validity, while its development from naturalistic observations is also likely to ensure good external validity (Knapp et al., 2013). Despite this, there are potential threats to validity of the scheme, e.g. the removal of the 'spontaneous' and 'prompted' gaze modifiers during scheme development means it will have inevitably captured gaze shifts prompted by mothers rather than entirely infant initiated ones. The context in which videos were recorded may also have affected coding accuracy, e.g. there were times when the direction of infant gaze could not be ascertained as this was directed at items which were out of shot. Participant reactivity to the presence of the camera (i.e. infant curiosity about this or the presence of the researcher) may also mean the frequency of some behaviours was over or under-estimated. The former is particularly likely gazing at other. This point made, infants appeared to be more accustomed to the camera at the second filming visit. This may have helped to mitigate reactivity.

Additional limitations to the scheme arise from the use of instantaneous rather than continuous coding. This may have limited the IGM's accuracy in assessing the frequency of gaze behaviours meaning the rates and durations of different gaze behaviours could not be calculated (Martin et al., 2007) and data could not be used for sequential analysis (Bakeman & Gottman, 1997).

3.4.2 Gaze change across eating episodes

Significant decreases were observed between the times at which we assumed the infant was hungriest and most satiated (the first 20% of main courses and the last 20% of desserts) for gazing at other, watching the caregiver and gazing at food, while a significant increase was noted for exploratory gaze. Such changes in gaze may therefore be indicative of infant hunger and satiation.

A number of gaze behaviours showed significantly higher frequencies in main, compared to dessert courses (gazing at other, watching the caregiver and gazing at food). These may be associated with higher levels of infant hunger, as infants would be assumed to be partly satiated by the time of their second course. However, only gazing at food and exploratory gaze showed consistent changes over time at course as well as meal level. Watching the caregiver showed a significant reduction over time during main courses but not desserts. This might be explained by higher levels of hunger in main courses leading infants to attend more to mothers preparing food at the start of the meal. This appears to provide support for hypothesis 1 as it suggests a decrease in visual attention to food (preparation) over time. It seems more likely though that this observation reflects meal set up issues, i.e. mothers were observed to spend more time preparing food at the start of mains than desserts, with the latter largely involving pre-prepared/quickly prepared foods such as fruit or yoghurt. Furthermore, decreases in the frequency of watching the caregiver were not independent of mothers' actions; mothers tended to stop food preparation early in the meal/main course and then sat down, meaning there was less for infants to 'watch' as time progressed. In addition, it is unclear whether infants watched their mothers early in the main course because they were preparing food or out of general curiosity.

The significant reduction in gazing at other from Time 1 to Time 6 and the significantly lower frequency of this behaviour during dessert than main courses should also be interpreted cautiously. This behaviour may be indicative of hunger as, during filming, infants appeared to engage in 'looking around' early in the meal while absorbed in eating. However, no significant reduction was observed over time in this behaviour within main or dessert courses. Furthermore, as looks to the camera were coded as gazes at other, decreases in the behaviour may have occurred as a result of infants becoming less interested in the camera over time.

Findings for gazing at food in entire meals and during separate courses however, provide stronger support for hypothesis 1 that infants would look less at food and would engage more in non-food gazing over time. Frequencies of gazing at food decreased significantly from the start to the end of meals in both main and dessert courses. Findings also provide support for hypothesis 2, that more food related gazing would be observed in main than dessert courses. In addition, they provide support for hypothesis 3 as, rather than frequencies of gazing at food declining steadily from the start of mains to the end of desserts, they were observed to decline during main courses, increase at the start of desserts and then to resume a downward trend as desserts progressed. This pattern *may* be associated with the effects of SSS as it suggests a renewed (visual) interest in food with the presentation of a different food, i.e. dessert.

Findings regarding exploratory gaze also provide support for hypothesis 1. Furthermore, the increase in this behaviour as main and dessert courses progressed, is consistent with the principle of the behavioural satiety sequence (Rodgers et al., 2010), Gerrish and Menella's (2000) finding that infants showed greater visual attention to a mobile after, rather than before, breastfeeding, and with reports of infants playing with their food as a satiation sign (Hodges et al., 2008, Hodges et al., 2016; Skinner et al., 1998).

Like gazing at food, frequencies of exploratory gaze showed similar patterns of change in main and dessert courses, although the former decreased significantly during these while the latter increased. This finding may also be understood in relation to SSS as, frequencies of exploratory gaze decreased between the end of main courses and the start of desserts before resuming an upward trend, suggesting a shift from exploratory gaze back to gazing at food on the presentation of dessert. Patterns of exploratory gaze may therefore also provide an indication of infant interest in eating.

Findings regarding the *timing* of changes to the frequency of gazing at food and exploratory gaze also have implications for understanding infant satiation. In both main and dessert courses a significant increase was observed in the frequency of exploratory gaze by the middle 20% of the course, suggesting changes in this behaviour may be associated with developing (rather than complete) satiation. Similarly, a significant decrease in the frequency of gazing at food was observed by the middle 20% of main courses. The same pattern was not observed for decreases in gazing at food during desserts. In these, the significant decrease occurred between the middle point of the courses and the end. The later change in the frequency of gazing at foods between main and dessert courses may reflect an infant interest in dessert (sweet foods) which persists for longer than for savoury foods. Previous studies have not examined differences in infant gaze (or other cues) between sweet and savoury courses. However, evidence from Young and Drewett (2000) of more rapid eating of desserts by toddlers suggests the hedonic qualities of food, as well as hunger, may impact on infant responses.

Overall, patterns of gazing at food, exploratory gaze and the timing of these across courses and meals are interesting. They appear to support study hypotheses and therefore may offer insights into the expression of infant hunger and satiation. It is important to note however, that alternative explanations may account for these findings. In the first instance, the decrease in gazing at food over time and the increase in exploratory gazing may be interpreted in terms of changing infant interest in response to the presentation of new stimuli or as a result of boredom with eating over time. Furthermore, observed differences in gazing at food between main and dessert courses may arise from differences in feeding practices between courses; many mothers in the study offered fruit as dessert, giving a few berries at a time, rather than providing a 'full dessert' in one go. This may account for the later decrease in gazing at food during desserts. Alternatively, observed differences in behaviour between courses may be related to the order of course presentation. It would therefore be beneficial to examine infant gaze change during feeding and in relation to sweet and savoury foods under more controlled conditions. The implications of these points are explored further below

Findings for gazing at the caregiver were mixed. The higher frequency of this behaviour during main than dessert courses might suggest that it is associated with hunger. This would be consistent with infants using eye contact to indicate readiness for the next spoonful or helping of food (Crais et al., 2009; Stifter & Moyer, 1991), thereby supporting hypothesis 2. However, a significant *increase* over time was observed in the frequency of gazing at the caregiver during desserts but not main courses. This would suggest this behaviour is associated with satiation and a move away from feeding related to social gaze during desserts thereby contradicting hypothesis 2. The most likely explanation for these contradictory findings is that infants use dyadic gaze for different communicative aims (requesting and social interaction) and so this behaviour may be used to signal both hunger and satiation.

Hypothesis 4 was not supported by this analysis as no significant reductions were observed in active gaze aversion either between Times 1 and 6 of the whole meal, or in separate main or dessert courses. This is unexpected given that gaze aversion has been identified as a potent indication of satiation (Hodges, 2008: Sumner & Spietz, 1994). However, the likelihood of observing gaze aversion is dependent on maternal responsiveness. It may be that mothers in this sample were relatively responsive to infant fullness thereby obviating the need for infants to display this 'strong' satiation cue. This is supported by sample characteristics – most mothers were well educated with relatively long histories of breastfeeding. Such characteristics are known to be associated with greater feeding responsiveness (Hodges et al. 2013). Furthermore, a third of infants in the sample were fed using BLW, while another third were feeding with some degree of independence, again decreasing the likelihood of observing gaze aversion. Finally, mothers may have fed more responsively as a consequence of being filmed and observed during feeding.

3.5 Evaluation

As noted, while findings suggest that gazing at food and exploratory gaze may have utility as indicators of infant hunger and satiation, observed changes in these over time may also be explained by changing infant interest and/or responses to novel stimuli. This is countered to some extent by the fact that the code exploratory gaze included gazing at food where this was accompanied by exploratory behaviour (e.g. manipulation). As such, increases in the frequency of this behaviour did not represent an absolute switch of visual attention from food to non-food stimuli. Rather, infants also gazed at food in the later stages of eating but in an exploratory way. Furthermore, findings for gazing at food and exploratory gaze are consistent with those of Folkvord et al. (2015) and Gerrish and Mennella (2000) regarding gaze in fed and hungry children. Despite these points, it would be beneficial to examine findings further under experimental conditions using methods appropriate to the assessment of hunger. Such measures may involve observing gaze with and without the use of a pre-load, or using a counterbalanced design for the presentation of mains and desserts to facilitate more rigorous comparisons between these. The use of additional measures, such as a bite count as an index of consumption, would also be helpful to corroborate assumed relationships between gaze, hunger and satiation. Approximate bite counts were attempted in the present study, however, these proved difficult to establish as BLW and younger infants in particular frequently mouthed food rather than taking clear bites.

Another important issue in the use of the IGM is its development from a small sample of videos and its testing on the same sample. In addition, power calculations showed most parametric analyses for analyses described here to be under-powered, thereby compromising their ability to detect smaller effect sizes. However, those significant results that were found are likely to be trustworthy given the greater risk of a type 2 than a type 1 error with underpowered samples (Banerjee et al., 2009).

Lack of maternal diversity in the study sample also represents a limitation as mothers from different backgrounds may interact differently with infants at mealtimes and this may impact on infant gaze. Further testing of the scheme is indicated therefore with a larger, more diverse sample, to ensure that it adequately captures the gaze behaviours of a wider range of infants along with changes in these, over time. These points made, it is a strength that the IGM was tested in infants from a range of different ages and across different feeding practices (TW and BLW). Furthermore, the scheme was subjected to rigorous reliability testing and the random order of video coding is likely to have minimised potential effects of researcher expectations on the coding of gaze at different time points during courses. As such, it provides a useful starting point for investigating infant gaze behaviour during meals and provides preliminary indications of gaze behaviours which may be indicative of hunger and satiation.

3.6 Conclusion

Findings from this analysis suggest that gaze may provide an indication of infant feeding state in the context of CF. Both gazing at food and exploratory gaze changed consistently across main and dessert courses, in line with expected changes from feeding to non-feeding related behaviour and were consistent with expectations of a renewed interest in food at the start of dessert courses. Within this, changes in exploratory gaze may offer the most promising indicator of hunger and satiation. Unlike other gaze types, this appears to be most likely to function independently of course set up or caregiver behaviour.

Importantly, findings from the present analysis also indicate that observations of gaze in *separate* main and dessert courses may provide a higher resolution on the shape and timing of cues, thereby facilitating a more refined understanding of hunger and satiation behaviour. This may have implications for the development of responsive feeding interventions. Further work is now needed however, to test the validity of gaze as an index of infant hunger and to exclude alternative explanations for the findings of this analysis.

Chapter 4 - Infant gesture as an indicator of hunger and satiation: insights from a functional perspective on communication

4.1 Introduction

This chapter outlines the second of three analyses conducted for Study 2 regarding the observation of infant gesture during CF meals and findings arising from this.

4.1.1 Gesture and the communication of infant hunger and satiation

Some gestures[4] have been reported in the feeding cues literature. In infants of six months of age, Skinner et al. (1998) and Hodges et al. (2016) observed gestures likely to indicate satiation, such as reaching for the spoon, turning the head away and closing the mouth to reject food, while Hodges et al. (2106) also observed shaking the head, taking the bib off, trying to leave and pushing food away the caregiver's hand. Gestures likely to indicate hunger were also reported in the two studies i.e. infants grabbing food (Skinner et al., 1998) and pointing at food (Hodges et al., 2016).

Notwithstanding Skinner et al. (1998) and Hodges et al.'s (2016) observations, these studies examined movements associated with hunger and fullness in the context of general feeding cues, rather than attempting a systematic study of gesture during feeding. As such, they may have overlooked subtle forms of gesture, or the use of the *same* gesture to communicate *different* messages.

Studies to date have also provided few details of temporal changes in gesture and other cues during feeding, despite the likelihood that behaviour will change with need state (moving from hunger to satiation and satiation), and the implications this has for alerting mothers to developing satiation. Hodges et al.'s (2016) study provided some indications of temporal changes in feeding cues, including gesture, using the RCFCS, as cues were categorised as 'early' or 'late' indications of feeding state. However, as noted in Chapter 2, the authors did not record hunger cues after the first minute of feeding or the timing of fullness cues within feeds. Therefore, the precise pattern of gestures and other cues across meals was unknown. This is a limitation since it cannot be assumed that hunger and fullness signals appear at different times during feeding. Rather, mothers may be presented with a mixture of feeding

[4] Movements of the arms, head and body for the purpose of intentional communication

cues as satiation develops and an awareness of the relative presence/absence of hunger and fullness signals may help them to gauge hunger levels and feeding responses accordingly.

4.1.2 Rationale, aims and hypotheses

In light of the need to develop a better understanding of infant feeding cues and the coincident timing of gesture development and CF, a focused investigation of gesture during solid food meals is merited. This would provide information regarding not just what gestures are seen, but when they happen, how they change over time and whether their meanings are unequivocal. This analysis therefore aimed to develop and test a coding scheme to describe infant gesture and its functions during CF and to explore its utility for assessing infant hunger and satiation.

In pursuing these aims it was hypothesised that:

1. The function of infant gesture would change across the meal with a decrease in rates of request gesture and an increase in rates of non-feeding related gesture over time, consistent with the behavioural satiety sequence (Rodgers et al., 2010).

2. The rate of request gestures would decrease as meals and courses progressed and the rate of rejection gestures would increase.

3. Infant gesture would follow similar patterns of change in main and dessert courses. High rates of request gestures would be observed at the start of both, rather than these declining steadily across meals, as the introduction of a different food type (dessert) would be expected to prompt renewed interest in feeding, consistent with SSS principles.

4.2 Method

As with the development of the gaze coding scheme (Chapter 3), this analysis involved four phases (described below).

4.2.1 Design

4.2.1.1 Phase 1 - Data collection

The same video data described in Chapter 3 were used to examine gesture change during feeding episodes.

4.2.1.2 Phase 2 - Development of codes

The development of the Infant Gestures During Feeding coding scheme (IGF) was informed by a random sample of study videos for five different infants and the same five videos from a previous study used for developing the IGM. Gestures were defined as intentionally communicative movements using the head, arms and body (Crais, 2004). Infants may use gaze shifts gesturally from 12 months of age to establish joint attention for the purposes of 'commenting' or requesting (Bruinsma, Koegel, & Koegel, 2004). However, gestural gaze was excluded from the IGF as 'general' gaze had been investigated in the first stage of Study 2, and, as gaze shifts for establishing joint attention are difficult to observe. Keeping the mouth closed to reject food may also be used gesturally by infant. This too, was excluded from the coding scheme given the difficulty of assessing the intentionality of this behaviour and because of the difficulty of discerning a clear onset point for keeping the mouth closed. Following initial observations, the IGF was developed to reflect developmental change in infant gestures as well as their communicative functions (behavioural regulation, social interaction or joint attention) (Table 4.1).

Table 4.1 - Initial gesture coding scheme

Behaviour	Modifier	Descriptor
Unobservable	N/A	Movement cannot be observed. View obscured
No gesture	N/A	Infant does not engage in gesture
Reject with the body	Food/ Drink/Other	Pulling or turning away from offer
Reject by pushing	Food/ Drink/Other	Infant pushes away food/ other item when offered
Reject with head shake	Food/ Drink/Other	Lateral headshake observed
Reject with hand halt	Food/ Drink/Other	Hand held up with palm facing outwards
Requests to out of high chair	N/A	Infant raises hands, squirms in high chair, or tugs at bib
Reaching to request	Food/ Drink/Other	Infant reaches for food etc.
Pointing to request	Food/ Drink/Other	Use of point or sign as request gesture
Social gesture	N/A	Wave, clap, declarative/ interrogative point, showing or offering to initiate interaction, 'showing off', social response to caregiver

Attention was also given to the different areas of the body that infants use to communicate, e.g. communication with the body as a whole, such as turning away, or communication with the arms.

Gestures which appeared to be associated with behavioural regulation were sub-classified according to whether they involved a request or rejection and 'modifiers' were added to determine what the infant was requesting or rejecting, i.e. 'food, 'drink' or 'other' as appropriate. The 'other' category of modifier was used where infants requested or rejected a non-food or non-drink item, or where the infant's target was not visible or discernible from the caregiver's response. Indications that infants wished to leave the highchair were classed as 'requests' by their communicative function, i.e. requests to be taken out of the chair. However, in terms of hunger and satiation cues, such gestures would be understood as indicating satiation.

Gestures associated with social interaction and joint attention e.g. declarative pointing, 'showing, etc. were classed as social gestures with no further sub-classification. Gestural responses to caregivers' social interactions were also coded as social gesture. Codes were also included in the scheme to record times when no gesture occurred (no gesture) and when the view of the infant was obscured (unobservable).

A key issue in coding infant gesture is distinguishing communicative movements from those without communicative intent (Golinkoff, 1985). Movements were deemed to involve intentional communication in the following circumstances:

1. They were accompanied by gazing at the mother or coordinated with vocalisation (Bates et al., 1979; Desrochers, Morissette, Ricard, 1995; Harding & Golinkoff, 1979).

2. Rejection gestures were made in response to caregiver action/vocalisation, or, in the case of rejecting by giving, were initiated by the infant rather than items being given at the mother's request.

3. Movements were repeated by the infant until the infant's (communicative) goal had been met (Golinkoff, 1986; Hoff, 2013).

Where descriptors failed to assist in discriminating between intentionally communicative movements and other movements, no code was entered. i.e. in cases of uncertainty, movements were not classed as gestures.

4.2.1.2.1 Piloting of codes

Pilot testing of the IGF was carried out by the main researcher to assess its usability and ability to capture infant gestures during mealtimes adequately. The initial coding scheme was tested using entire videos from the first filming visit for five of the participants. Continuous coding was found to be feasible for gestures; these occurred relatively infrequently and so could be observed easily. Piloting indicated that the initial scheme failed to capture a number of infant gestures. These were noted and added to the IGF (Table 4.2) before videos were reviewed to re-check the scheme's comprehensiveness and usability.

New codes included 'request body', where infants were observed to lean in or to adopt an open mouth posture in response at the sight of the caregiver holding a spoonful or food or drink cup; 'request outburst', where infants were observed to flail their arms in protest at the withdrawal of a food, drink or other item by the caregiver; 'request grab', where infants were observed to grab a spoon or cup and pull it to the mouth when offered by the caregiver; 'reject outburst', where infants were observed to flail their arms in response to the offer of food, drink or another item; 'reject grab', where infants were observed to grab a spoon or drink when offered as though to stop the item being brought to the mouth, and 'reject give', where infants were observed to give the caregiver an item such as a plate , spoon or cup as though asking for it to be taken away (Table 4.2). During piloting, it was also noted that it was difficult to determine the communicative function of some gestures, i.e. the message behind them was unclear. In view of this, an additional code – 'ambiguous' was added to the scheme.

A second stage of pilot testing was carried out as part of training a second coder for reliability testing. At this stage, a final additional code 'request give' was added where infants were seen to give a spoon or cup to the caregiver to request that it be filled. The full version of the gesture coding scheme and instructions for its use appear in Appendix B8.

Table 4.2 – Revised gesture coding scheme

Behaviour	Modifier	Descriptors
Ambiguous	N/A	Communicative movement but unclear message
Unobservable	N/A	Movement cannot be observed. View obscured
No Gesture	N/A	Infant does not engage in gesture
Reject with body	Food/drink/other	Pulling or turning away from offer
Reject by pushing	Food/drink/other	Infant pushes away food/ other when offered
Reject head shake	Food/drink/other	Lateral headshake observed
Reject hand halt	Food/drink/other	Hand held up with palm facing outwards
Reject with grab	Food/drink/other	Infant grabs item to resist caregiver action
Reject with outburst	Food/drink/other	Arm flail in response to caregiver offer
Reject by giving	Food/drink/other	Infant spontaneously gives mother items to remove
Request with outburst	Food/drink/other	Arm flail to request item or in response to caregiver attempting to remove item
Request by grabbing	Food/drink/other	Infant grabs item caregiver is holding e.g. to hurry feed
Request out of highchair	N/A	Infant raises hands, squirms in high chair, or tugs bib
Request give	Food/drink/other	Infant offers spoon/cup for caregiver to re-fill
Request reach	Food/drink/other	Infant reaches for food etc.
Request with point/sign	Food/drink/other	Use of point or sign as request gesture
Social gesture	N/A	Wave, clap, declarative/ interrogative point, showing or offering to initiate interaction, 'showing off', social response to caregiver

4.2.1.3 Phase 3 - Formal reliability testing

Mean percentages were calculated for periods of no gesture during the three sampled time sections of the main and dessert courses. Mean rates were also calculated for gestures relating to all items (i.e. food, drink and 'other'). Both inter-rater and test-re-test analyses were conducted with the same sample of video clips used to test gaze coding reliability. Videos were presented in random order for coding using a fully crossed design.

The second coder coded the reliability sample in three tranches of video clips: the first being 15 clips, the second, 18, and the final tranche, 15. Inter-rater reliability tests followed the same procedures as for gaze coding (Chapter 3) (Pearson's analyses followed by ICCs), except rate (frequency per minute) rather than transformed frequency data were used. In addition, inter-rater analyses for 'no gesture' were conducted separately from those for overall agreement on the 48 observations as these were processed in percentage form.

Test-retest reliability analyses were performed by re-coding of the reliability sample by the main coder 20 weeks after the initial coding in order for this to coincide with inter-rater testing.

4.2.1.4 Phase 4 - Treatment of data

The same procedures were used for sampling and coding video data as outlined for the IGM (Chapter 3) with videos coded in random order and with rate, rather than frequency data used for analyses of behaviour change over time. Mean rates, ranges and standard deviations were calculated for each gesture type across whole meals and during the three time points of mains and dessert courses.

Data for unobservable and ambiguous gestures were excluded from analyses of change over time as were request/rejection gestures relating to non-food items. Data for gesture types with ICCs below .60 (i.e. good, Cicchetti, 1994) were also excluded ('reject grab', 'reject headshake', 'reject outburst', 'request outburst' and 'request out'). Exceptions were 'reject with the body' and 'reject give' which showed good test-retest *or* inter-rater reliability respectively. Data relating to periods of no gesture were also excluded from analyses of change over time.

Shapiro Wilks normality tests revealed that gesture data were non-normally distributed. They were also not amenable to log transformation because of the large number of zero scores. Therefore, inferential analyses involved non-parametric tests of raw data where possible, with the exception of the use of factorial repeated measures ANOVAs where no non-parametric equivalent exists. These were used to examine: the effects of course, gesture and time across whole meals, the effects of gesture type and course for whole meals, and the effects of gesture and time for main and dessert courses. Inferential analyses for gesture rates followed the same procedures as those for gaze data (Chapter 3). Post hoc power analyses were also conducted for main and simple effects ANOVAs.

4.3 Results

4.3.1 Inter-rater reliability

Overall inter-rater reliability for gesture by rate was in the good range, ICC .67, with a 95% confidence interval from .62 –.70, F (767,767) = 4.71, $p < .001$ (Cicchetti, 1994) as was that for the percentage of time in which infants did not gesture ICC .90, with a 95% confidence interval from .83 – .94, F (47,47) = 18.51, $p < .001$. Inter-rater reliabilities were moderate, good, or excellent for most gesture types (Appendix B9).

4.3.2 Test re-test reliability

Test re-test reliabilities for all gesture and periods of no gesture were good: ICC .68, with a 95% confidence interval from .64 –.72, F (767,767) = 5.18, $p < .001$ and ICC .87 with a 95% confidence interval from .77 –.93, F (47,47) = 15.74 $p < .001$. Test re-test reliability was good to excellent for most gestures (Appendix B10).

There was a moderate level of agreement for the rate of ambiguous gestures, reject give and reject headshake. As with inter-rater reliability testing, zero ICCs were obtained again for rejecting by grabbing, reject and request outbursts and requests to be taken out of the highchair.

4.3.3. Whole meal descriptive statistics

The highest mean rate of gesture across whole meals was for social gesture (Table 4.3). This was also the most variable type of gesture across whole meals 1 and 2. Requesting by giving showed the lowest mean rate for all gestures and for all request gestures.

The highest mean rate for request gestures was seen in requesting by pointing while the highest mean rate of rejection gestures was seen in rejecting with the body and the lowest in rejecting by pushing. Rates of request gestures were generally higher than those of rejections across meals as a whole.

Table 4.3 - Mean gesture rates across whole meals

	N (Time points)	Range	Mean	Standard Deviation
Reject body	6	0.17	0.14	0.07
Reject give	6	0.09	0.03	0.04
Reject push	6	0.05	0.02	0.02
Request body	6	0.26	0.09	0.09
Request give	6	0.07	0.01	0.03
Request grab	6	0.16	0.11	0.05
Request point	6	0.20	0.15	0.08
Request reach	6	0.37	0.14	0.14
Social gesture	6	1.13	0.85	0.46

4.3.4 Main course descriptive statistics

There was an overall increase in rate across all types of rejection gesture from time 1 to time 3 of the main course, though this was not consistent across all time points for all behaviours (Appendix B11). As with whole meals, the highest rates of rejection were seen in rejecting with the body at all three time points of the main course. The lowest rate of rejection gestures involved giving to reject, again, at all three time points.

Rates of most request behaviours decreased from time 1 to time 3 of the main courses though again this was not consistent for all behaviours across all three time points. However, rates of requesting by reaching increased consistently across all three time points. Requesting by grabbing generally showed the highest mean rate across the three time points, while requesting by giving was not observed at all during main courses. Finally, for the main courses, average rates of social gesture increased steadily across all time sections.

4.3.5 Dessert course descriptive statistics

Rejecting with the body and rejecting by pushing both increased in rate between times 1 and 3 in the dessert courses, though the increase was only consistent over time for the former (Appendix B12). Rates of requesting by reaching, pointing and requesting with the body all decreased between times 1 and 3 though again, the pattern of decrease was not consistent across all time sections. Increases were observed over time in rates of requesting by grabbing and requesting by giving between times 1 and 3, though these were not consistent across time points for both behaviours. Finally, in the dessert courses, mean rates of social gesture increased steadily and consistently across the beginning, middle and final sections of desserts in meals 1 and 2.

4.3.6 Post hoc power analyses

Post hoc power calculations show that most main and simple effects ANOVAS were under-powered with the exception of the main effect of gesture in the main courses (1-β = 0.89).

4.3.7 Analyses of changes in gesture between the hungriest and most satiated sections of the meal

Wilcoxon tests for gesture rates between the first 20% of the main courses and the last 20% of the dessert courses showed a significant median increase in the rate of social gesture between the two time points, Z = - 2.70, p = .005. No other significant changes were found in gesture rates between the first and last sections of the meal.

4.3.8 Whole meal ANOVAs

The repeated measures ANOVA to examine the main effects of rate of gesture, time and course across meals 1 and 2 showed a significant main effect for course, F (1,15) = 5.12, p = .039, ηp^2 = .56, arising from a higher mean rate of gesture as a whole in dessert than main courses. A significant main effect was also observed for time, F (2,30) = 9.54, p = .001, ηp^2 = .40, Mauchly's test indicated that sphericity had been violated for gesture, gesture by course, gesture by time, course by time and gesture by course by time. Following the application of the Greenhouse-Geisser correction a highly significant result was found for the main effect of gesture F (2.26, 33.98) = 11.38, $p < .001$, ηp^2 = .43 with an increase in the total use of gesture over time, and gesture by time F (3.10, 46.53) = 8.10, $p < .001$, ηp^2= .35 showing that the different kinds of gesture behaved differently in this analysis and that types of gesture also varied with time. No significant results were found for the interaction of course and time or course, gesture and time.

The repeated measures ANOVA of course by individual gesture type found a significantly higher rate of requesting by reaching in dessert courses than mains, F (1,15) = 18.27, p= .001, ηp^2= .55. No other significant differences were identified between rates of different gestures between main and dessert courses.

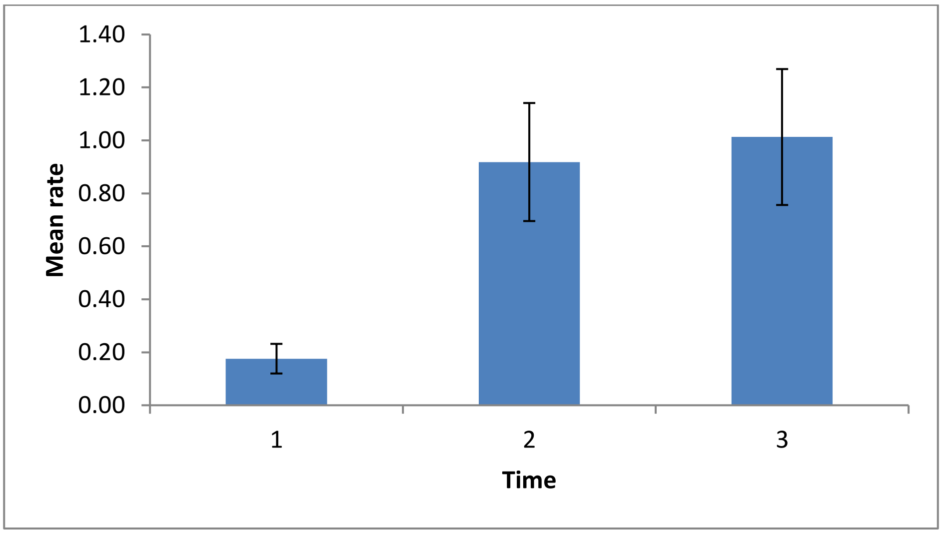
4.3.9 Main course ANOVAs

Mauchly's test indicated that the assumption of sphericity had been violated for the main effects of gesture and gesture and time and the Greenhouse-Geisser correction was applied. Significant results were subsequently found for the main effects of gesture, F (2.11, 38.22) = 10.01, $p < .001$, $\eta p^{2} = .36$ and gesture and time F (2.48, 44.65) = 6. 77, $p = .001$, $\eta p^{2} = .27$, thereby showing that different gestures behaved differently within the main courses and also varied at the different time points of the course. A significant result was also found for time, F (2, 36) = 7.83, $p = 0.02$, $\eta p^{2} = .30$, with mean rates of gesture increasing as time progressed within main courses.

4.3.10 Main course Friedman's analyses

Friedman's tests revealed a significant increase over time in the rate of social gesture $X^2(2) = 12.47$, $p = .001$ (Figure 4.1). Wilcoxon signed ranks tests showed significant increases in rates of this behaviour occurred between times 1 and 2 and 1 and 3, Z = -2.97 $p = .001$ and Z= -2.98 $p = .001$ respectively. No significant changes were observed in rates of other gesture types across the three time points of the main courses.

Figure 4.1 – Main course social gesture mean rates and standard errors



4.3.11 Dessert course ANOVAs

Mauchly's test indicated that the assumption of sphericity had been violated for the main effect of gesture and the Greenhouse-Geisser correction was applied revealing a highly significant result: F (2.60, 38.93) = 7.32, p= < .001, ηp^2 = .33. A highly significant result was also found for gesture by time: F (16, 240) = 3.15, p = .001, ηp^2 = .17

4.3.12 Dessert course Friedman's analyses

Following the main effects ANOVA, Shapiro Wilks analyses indicated gesture data were not normally distributed. Subsequent explorations of change in gesture type over time were therefore conducted using Friedman's tests. Friedman's tests showed a significant increase over time in the rate of social gesture, $X^2(2) = 6.76$, p = .035 (Figure 4.2) and a significant change over time in requesting with the body $X^2(2) = 7.68$, p = .012 (Figure 4.3). Post-hoc Wilcoxon's analyses of these behaviours did not return any significant results.

Figure 4.2 – Dessert course social gesture and standard errors

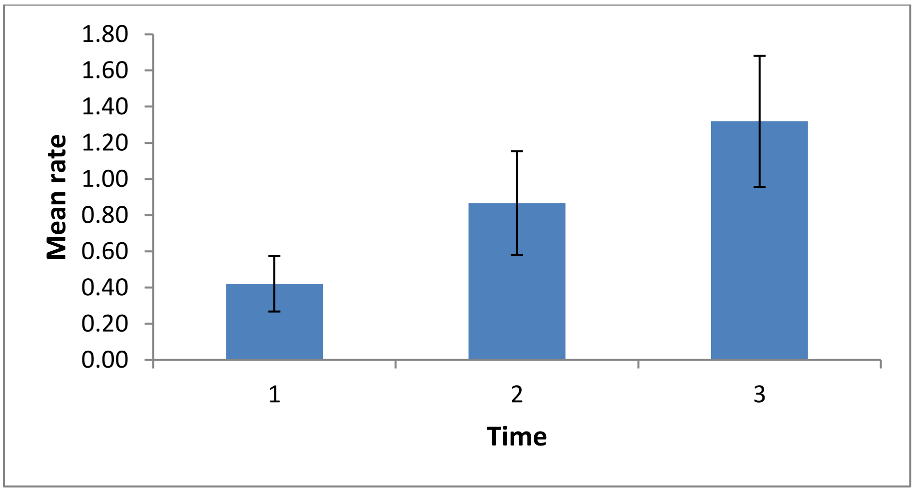
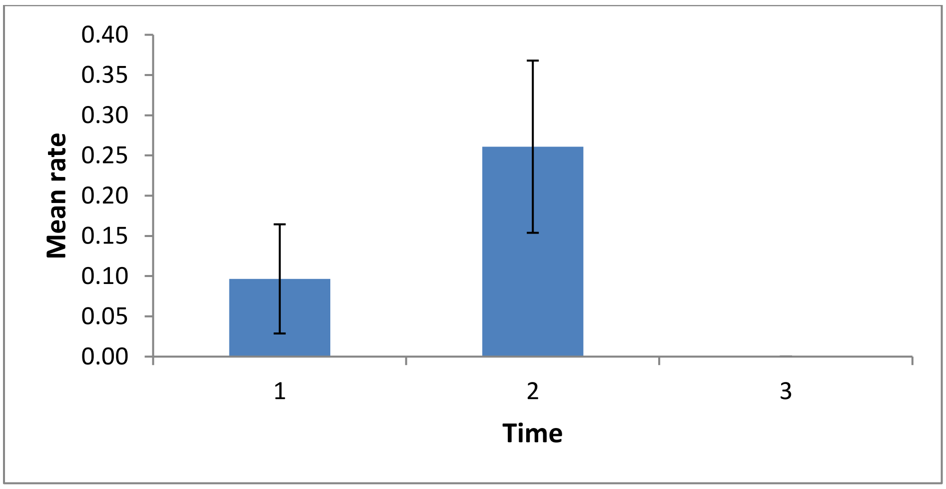


Figure 4.3 – Dessert course request with the body mean rates and standard errors



4.4 Discussion

This analysis aimed to develop and test a coding scheme of infant gesture use during solid food meals and to explore its utility for assessing feeding state. Findings indicate that it is feasible to categorise and track a range of gestures during CF episodes and, importantly, to code these reliably. Findings also suggest that focussing specifically on infant gesture offers the potential to identify discrete behaviours not previously described, and to highlight ambiguities that mothers may face in interpreting feeding cues i.e. where the same gesture (e.g. grabbing) may be used to communicate different messages. Results also provide preliminary indications that attention to the communicative function of gestures may provide insights into behavioural change associated with developing satiation. However, further investigations of observed associations between gesture use and the progression of feeding are required in order to exclude alternative explanations, as discussed below.

4.4.1 Reliability of the IGF

Both inter- and intra-rater reliability scores for the coding of infant gesture were good or excellent for the majority of behaviours identified in the IGF. This is likely to have arisen from the ongoing development of codes and descriptors during piloting and reliability testing. As with gaze coding, the practice of regularly reviewing inter-rater agreement is also likely to have minimised coder 'drift' (Martin et al., 2007), while the practice of coding just 20% of film footage at a time may have helped to limit coder fatigue.

Observations of infant behaviour were consistent with gestures reported by Hodges et al. (2008), Hodges et al. (2016) and Skinner et al. (1998), regarding the communication of hunger and satiation, namely: reaching, grabbing and pointing to request food as hunger cues and turning or shaking the head, removing the bib, trying to leave and pushing away the caregiver's hand as satiation cues. The observation that infants used rejecting with the body at a higher rate than other rejection gestures is also consistent with Hodges et al. (2016) who reported pulling away as the most prevalent active disinterest cue.

Beyond similarities in findings between this research and others, the specific attention given to gesture, rather than general feeding cues, in this analysis facilitated the identification of cues not described previously. Specifically, infants were observed to use both giving and grabbing gestures for the purposes of requesting and rejecting food. While Hodges et al. (2016) identified the giving of utensils to caregivers as a satiation cue, infants in the present analysis were observed to also use the same gesture to request more food. Similarly, grabbing the spoon during feeding appeared to be used both to request a faster pace of feeding, and as a means of slowing or resisting feeding. This use of the same gesture for different purposes highlights potential ambiguities which mothers may face in interpreting their infants' feeding signals.

For the most part it was possible to code such giving and grabbing gestures reliably, though this was not the case for grabbing for the purposes of rejection. The reason why it was possible to code grabbing to request reliably, but not grabbing to reject, is unclear. However, this may be attributable to the latter occurring infrequently in the reliability sample.

4.4.2 Analyses of gesture change over time

Findings regarding hypothesis 1, the expectation of a change from feeding related (request) gestures to non-feeding related gesture over time, were mixed. While mean rates of most request gestures decreased over time in both main and dessert courses, no significant results were obtained for these. The only exception to this was for requesting with the body, which *increased* rather than decreased significantly during dessert courses. Despite this there is some support for hypothesis 1 regarding findings for the use of ocial gesture over time. Rates of this behaviour increased significantly from the first to the last sections of meals thereby demonstrating the expected shift towards non-feeding related gesture consistent with the behavioural satiety sequence.

Separate analyses of main and dessert courses also showed significant increases in rates of social gesture across both courses, while post hoc analyses of main courses showed such increases were significant by middle of the course. Increases in the use of social gesture may therefore be associated with developing, rather than complete satiation. No significant changes were observed between specific time points during desserts, suggesting that change in rates of this behaviour were more gradual in second courses.

Mean figures indicate a general increase in the rate of most rejection gestures during main and dessert courses. However, significant increases in these were not observed. This runs contrary to hypothesis 2 and may be explained by several factors. In the first instance, overall rates of most gesture types (excluding social gesture) were low and post hoc power analyses indicate that the sample was too small to detect small effect sizes (changes in infrequently occurring behaviours). Secondly, the nature, as well as the size of the sample may have compromised its ability to detect changes in rejection behaviours. The inclusion of quite a large proportion of BLW infants may explain the observation of fewer rejection gestures than expected, given that BLW infants feed relatively independently, and therefore have less scope to reject food. Furthermore, nearly half of the infants were over the age of 12 months and using at least some degree of independent feeding, again decreasing opportunities for rejections of food. Finally, as with the coding of gaze behaviours (Chapter 3) the relative homogeneity, and likely responsiveness of mothers in the study, may also have impacted on observed rates of certain behaviours. Specifically, mothers may have been largely responsive to satiation signals, thereby negating the need for infants to show high rates of rejection behaviours.

The lack of a significant reduction over time for most request behaviours also runs contrary to hypothesis 2. In addition, though mean rates of most request gestures decreased in main and dessert courses, the significant increase in requesting with the body during the dessert courses counters hypothesis 3 (the expectation that gesture would follow similar patterns in main and dessert courses and that high rates of request would be observed at the start of both in response to the provision of novel food). These findings may be explained by meal set up issues. For example, many mothers were observed to provide infants with finger foods or snacks to keep them occupied while preparing the main meal, thereby reducing hunger at the start of the meal, and potentially reducing the need for infants to use request gestures at the start of meals. During desserts, mothers were observed to present small amounts of fruit or yoghurt, and then to wait for the infant to request more, thereby elevating rates of request gestures across desserts and decreasing the likelihood of observing significant change over time. This, may also account for the observation of a significantly higher rate of requesting by reaching in dessert, than main courses again contradicting hypothesis 2, which would predict lower levels of request behaviours during dessert than main courses, as a result of higher satiation. However, the finding might be interpreted as reflecting a higher motivation in infants to consume sweet than savoury foods. Furthermore, only reaches representing clear requests (gestures), rather than responses to offers of food (actions) were coded. Therefore, reaching behaviour was infant driven, though likely to be shaped in part by course environment. As with gaze (Chapter 3), this point highlights the need to further examine the impact of course set up, versus food characteristics, on infant feeding responses.

While findings for request gestures contradict hypothesis 3, analyses of social gesture use provide some support for the expectation of higher infant interest in feeding at the start of both main and dessert courses. Rates of social gesture behaved similarly in both courses, increasing significantly over time. Furthermore, they declined between the end of main courses and the start of desserts. This may represent a shift in infant attention back to feeding with the presentation of dessert and might, therefore, be associated with the effects of SSS. It is important to note however that findings regarding social gesture use might also be explained in terms of changing infant interest in response to the presentation of novel stimuli and/or boredom with performing the same activity over time. Furthermore, social gesture data should also be interpreted cautiously as the lack of differentiation in coding between social gestures initiated by infants and those made in response to mothers means that rates of this behaviour may have been inflated. For the most part, infants were observed to initiate social gestures, however at least some of the social gestures recorded will have been made in response to maternal behaviour.

4.5 Evaluation

Despite the insights that may arise from focussing on gesture and its functions during feeding, the analysis has the same limitations in terms of the nature and size of the sample as described in Chapter 3. These issues will have impacted on observed and observable behaviour change to some degree. As noted, observed increases in rates of social gesture over time may be attributable to issues other than satiation. Despite this, observed changes in this behaviour appear consistent with the behavioural satiety sequence and possibly, with the effects of sensory specific satiety. Nonetheless, observed associations between increases in social gesture and the progression of feeding require further investigation. As with the analysis of gaze, it would be informative to conduct further work in controlled conditions using appropriate manipulations and measures of hunger and satiation against which findings may be validated. It may also be instructive to compare infant gesture in feeding and non-feeding situations to identify how far novelty and boredom may precipitate a general move towards more socially oriented behaviour in other contexts. Furthermore, the lack of differentiation between infant initiated social gestures and those made in response to mothers in the coding scheme means that a re-examination of the data coding infant initiated social gesture only, would be helpful.

4.6 Conclusion

Findings from this analysis indicate that examining gesture during infant feeding interactions may facilitate the observation of previously undescribed cues. They also highlight some of the challenges of interpreting cues given that infants may use the same gesture for different communicative aims. Furthermore, adopting an explicitly 'functional' perspective on gesture may provide insights into behaviour change associated with hunger and satiation. In particular, findings suggest that a move to socially orientated communication may be associated with developing infant satiation. Meanwhile, as with the observation of gaze, the observation of gesture in separate main and dessert may illuminate differences in infant behaviour in response to sweet and savoury foods. Findings are however, preliminary. Further research is required to investigate associations between feeding episode progression and changes in infant gesture, and to determine more precisely how far these may be indicative of hunger and satiation.

Chapter 5 - Listening to hunger and fullness – infant vocalisation during complementary feeding

5.1 Introduction

This chapter describes the final analysis for Study 2, i.e. the examination of infant vocalisation during CF and findings relating to this.

5.1.1 Infant vocalisation and the communication of hunger

Like gaze and movement, vocalisation is a key medium for infants to express their state and needs. Vocalisation in the form of crying has been identified as one of the earliest infant hunger cues, and one that persists into toddlerhood (Hodges et al., 2008). Other types of vocalisation such as babble have also been reported in the communication of hunger and fullness (Skinner at al., 1998), though no studies have examined these in detail, or described vocal behaviour as a whole during feeding episodes. This represents a gap in the literature, given the centrality of vocalisation to preverbal communication, its potential to provide a more detailed understanding of infant feeding cues and, the contribution that such knowledge could make to the development of responsive feeding interventions.

5.1.2 Crying and infant hunger

While crying is one of the most salient infant hunger cues, studies suggest that adults cannot distinguish hunger cries from other cries reliably. Lindová et al. (2015) played 30 twenty second clips of positive (play, post prandial and reunion vocalisations) and negative (pain, isolation and hunger) vocalisations of 19 infants aged 5-10 months to 333 adult listeners and asked them to identify the eliciting situation in a forced choice task. Participants differentiated vocalisations as positive or negative almost perfectly; however, their ability to identify the specific situations which provoked both positive and negative vocalisations was much poorer. Here hunger vocalisations were not recognised at a statistically significant level and were often misidentified as cries resulting from isolation.

Gustafson and Harris (1990) also investigated participants' ability to discriminate directly between hunger and other types of cry. Participants were played sixteen randomly presented segments of hunger and pain cries from infants of four months of age, each of fifteen seconds duration. Of the eight hunger and pain cries, four were from the first minute of crying and four from the third, in order to reflect different distress levels in 'early' and 'late' cries. Participants were asked to identify whether the cry originated from hunger, tiredness, the need for a nappy change, pain, anger or fear, as well as the level of distress. Options for the 'cause' of each cry were intended to reflect categories of distress, with the expectation that participants would attribute early hunger cries to less urgent stimuli and pain cries to those involving higher distress (pain, anger, or fear). The authors found participants to be significantly better at identifying the cause of early cries (hunger or pain) than late ones. Late hunger and pain cries were not accurately discriminated, although mothers rather than non-mothers were somewhat better at discriminating between late hunger and pain cries and significantly better overall in attributing cries to the correct causes. Gustafson and Harris (1990) concluded that beyond the very early segments of cries (the first minute), mothers were unable to differentiate between hunger and pain cries and that the observed differences in distinguishing between hunger and pain cries from the first minute of crying were likely to have arisen from their differing levels of urgency rather than them having more specific perceptual characteristics.

Overall, research suggests that adults may be able to differentiate between hunger cries and other distress vocalisations to a limited extent i.e. very early in the crying episode, and that experience with infants is helpful in this respect. However, findings also indicate that adults cannot discriminate hunger cries from other cries reliably, particularly where they have limited experience of infants.

5.1.3 Other forms of vocalisation in the communication of hunger and satiation

While crying has received much attention as a hunger cue, it is important to note that it has also been cited as a *satiation* cue in infants of six and twelve months (Hodges et al. 2008; Hodges et al., 2016; Skinner et al., 1998). This raises the potential difficulty of determining whether crying late in feeding represents continued hunger or satiation, although, no studies have examined whether perceptual differences exist between hunger and satiation cries.

Other types of vocalisation have been reported as representing hunger and satiation in the infant feeding literature, though these have received limited levels of description. Skinner et al. (1998) reported that some (but not most), infants between 8 and 24 months used vocalisations such as 'dah dah' to show their readiness for the next spoonful of food during solid food meals. This behaviour was noted to peak at around 12 months of age but then to decrease as verbal skills developed. Beyond this, Skinner et al. (1998) reported that toddlers with a mean age of 16 months used single words to 'guide' the meal. However, they did not elaborate further on this.

Hodges et al. (2008) similarly noted the use of 'food specific vocalisations' to indicate hunger in infants of 12 months of age, though again did not provide further details. In addition, they noted the use of simple language ('no more') as a satiation cue in infants of the same age. In a later study, Hodges et al. (2016) also reported the use of excitatory sounds as a hunger signal in infants of six months of age and the use of the word 'no' as a satiation cue in older infants, though the age at which this behaviour appeared was not reported.

Despite the insights into vocal behaviour and feeding state provided by Skinner et al. (1998), Hodges et al. (2008) and Hodges et al. (2016), such studies did not focus specifically on vocal behaviours across feeding episodes. Rather they examined 'feeding cues' in general. Furthermore, descriptions of hunger and satiation vocalisations from Hodges et al. (2008) and Skinner et al. (1998), were gathered from maternal reports outside of the feeding situations in which they occurred. In addition, as described in relation to gesture (Chapter 4), Hodges et al. (2016) did not record the occurrence of hunger cues (including vocalisations) after the first minute of eating. Neither did they record the timing of fullness cues within feeds, meaning the precise pattern of these, including vocal satiation cues, was unknown. Therefore, it is possible that important, but subtle, changes in vocal behaviour associated with hunger, satiation and developing satiation may have been overlooked in such studies.

5.1.4 Rationale, aims and hypotheses

Gaps in the infant feeding cues literature regarding vocalisation, suggest that closer examination of this behaviour across feeding may provide insights into infant hunger and satiation. This analysis therefore aimed to develop and test a coding scheme to describe infant vocalisation and its communicative functions in CF, and to explore its utility for assessing infant feeding state. In pursuing these aims it was hypothesised that:

1. The function of infant vocalisations would change across the meal with a decrease in rates of request vocalisations and an increase in rates of non-feeding related vocal behaviour over time, consistent with the behavioural satiety sequence (Rodgers et al., 2010).

1. The rate of request vocalisations would decrease, and the rate of rejection vocalisations would increase, as courses and meals progressed.

2. Infant vocalisation would follow similar patterns of change in main and dessert courses. High rates of request vocalisations would be observed at the start of both, rather than these declining steadily across meals, as the introduction of a different food type (dessert) would be expected to prompt renewed interest in feeding, consistent with SSS principles.

5.2 Method

The analysis of vocalisation followed the same four phases as the gaze and gesture analyses described in Chapters 3 and 4 (data collection; development and piloting of the coding scheme; formal reliability testing and finally, coding of the entire video data set and related analyses).

5.2.1 Design

5.2.1.1. Phase 1 - Data collection

The same video data collected for the Chapters 3 and 4 were used to examine vocalisation during infant feeding.

5.2.1.2 Phase 2 - Development of codes

The initial coding scheme is shown in Table 5.1 (full details of the final coding scheme, code descriptors and instructions for use appear in Appendix B13). The initial development of the infant vocalisation at mealtimes coding scheme (IVM) was informed by a random sample of videos from five different study infants and the five videos from a previous study used to inform the development of the gaze and gesture coding schemes. The IVM was also developed with reference to literature regarding infant feeding, developmental psychology and the development of vocal communication in infancy. Videos were initially observed with a view to establishing the feasibility of developing a scheme to code all infant vocalisations during a mealtime episode, as well as how vocalisations might be categorised. Following initial viewings, vocal behaviours were noted and videos reviewed to assess whether codes reflected observed behaviours.

Only vocal behaviours deemed to have communicative value in expressing infant state were included in the coding scheme, i.e. vegetative sounds (coughs, hiccups, burps) were excluded from the scheme in common with other studies of infant vocalisation (Bloom, Russell & Wassenberg, 1987). Vocalisations with communicative value were categorised according to whether they were directed (intentionally communicative) or undirected (not used for intentional communication).

Table 5.1 – Initial vocalisation coding scheme

Behaviour	Modifier	Descriptor
No Vocalisation	N/A	Infant is silent
Directed **Social interaction**	N/A	Proto-conversation/vocal play with care giver, social laughter, declarative or interrogative vocalisation
Rejection	Food, drink, other	Vocalisation associated with rejection made while gazing at caregiver's face or in direct response to offer of food etc.
Request	Food, drink, other	Vocalisation associated with imperative 'eye point', manual point, reach or other indication of request.
Undirected **Agitation**	N/A	Infant cries or fusses spontaneously without direct reference to caregiver behaviour
Vocal play	N/A	Infant vocalises to self – (gaze is not directed towards care-giver) incudes squeals/grunts/babble, laughter to self
Feeding related	N/A	'Mmmm' or verbal comment (yum) if not directed to caregiver

Vocalisations were deemed to involve intentional communication if:

1. They were accompanied by gazing at the mother or coordinated with gesture (Desrochers et al., 1995; Harding & Golinkoff, 1979).
2. They were repeated by the infant until an apparent communicative goal had been met (Golinkoff, 1986; Hoff, 2013).

Directed vocalisations were developed to reflect their communicative function (request, reject or social interaction) and where behaviours were associated with requests or rejections, 'modifiers' were added to the coding scheme to identify the item being requested or rejected, i.e. 'food, 'drink' or 'other'. As with gesture coding, the 'other' category of modifier applied to non-food or non-drink items, or where target of the vocalisation could not be discerned. Social vocalisations were classed as those initiated by the infant for purposes of commenting, seeking information (e.g. requesting the name of an object), those made to initiate play or interaction, and those made in response to caregiver social interaction.

Undirected vocalisations were sub-classified according to whether they involved distress/agitation, vocal play/babble, or feeding related vocalisations e.g. 'mmm' or 'num, num' sounds when the infant was engaged in eating. A code of no vocalisation was included in the coding scheme to record times when the infant was silent. Unlike the gesture coding scheme, no 'unobservable' code was required as, even if the infant was not observable on camera their vocalisations could still be heard.

5.2.1.2.1 Piloting

Pilot testing of the IVM was carried out by the main researcher to assess its usability and ability to capture infant vocal behaviour during mealtimes comprehensively. The initial scheme was applied to the same full videos used for pilot testing the IGM and the IGF. Notes were made during piloting to record any difficulties with the scheme and any vocal behaviours which the scheme did not reflect.

Piloting revealed that it was difficult at times to identify a cause for some instances of distress. As such, distress vocalisations were sub-classified according to whether they involved crying or fussing for which the cause was unknown, or agitation for which the cause was apparent, e.g. fussing at the sight of food which ended once eating commenced or agitation at the end of a meal when infants appeared to be satiated and wanting to stop eating.

Other vocal behaviours were observed during piloting in the form of excited vocalisations (gasps, pants and shrieks) and undirected raspberry blowing (the infant blowing raspberries to themselves). Raspberry blowing as part of social interaction was added to the category of social vocalisation (Table 5.2).

Table 5.2 Revised vocalisation coding scheme

Code	Modifier	Descriptor
No vocalisation	N/A	Infant is silent
<u>Undirected</u> Agitation	N/A	Undirected negative vocalisation (whine, fuss, cry). Settles in response to event or caregiver action
Unknown distress	N/A	Infant is distressed, appears to involve discomfort. Does not settle readily.
Self-vocalisation	N/A	Infant vocalises to self. Includes squeals/grunts/ babble, undirected laughter
Eat vocalisation	N/A	Vocalisations associated - 'mmm', 'amm' 'yum' while eating (not directed towards care-giver)
Excited	N/A	Infant expresses excitement through vocalisation, gasp, shriek etc.
Raspberry blowing	N/A	Infant blows raspberries to self
<u>Directed</u> Ambiguous	N/A	Vocalisation appears to be intentionally communicative but unclear communicative function
Non-speech reject	Food, Drink Other	Cries, whines, fusses, grunts while gazing at caregiver or in response to offer of food etc.
Speech reject	Food, Drink Other	Consonant/vowel sounds alone/combined, words to reject items
Non-speech request	Food, Drink Other	Cries, whines, fusses, grunts while gazing at caregiver to request items or in conjunction with imperative 'eye point' or other request gesture.
Speech request	Food, Drink Other	Consonant or vowel sounds alone/combined, words to request items.
Social	N/A	Grunt, squeal, babble, words, laughter directed at/ in response to caregiver, declarative/ interrogative comment, social raspberry blowing

5.2.1.3 Phase 3 – Formal reliability testing

No second coder was available for inter rater- reliability testing of the IVM. Test re-test analyses were conducted for all behaviour codes one month after first the coding, using the same sample and procedures as for gaze and gesture coding. As with analyses for 'no gesture', 'no vocalisation' reliability tests were conducted separately from those for overall agreement, as the former were processed by percentage rather than rate.

5.2.1.4 Phase 4 - Treatment of data

The same procedures were used for sampling and coding video data as outlined for the gaze and gesture data (Chapters 3 and 4) with videos coded in random order. As with reliability testing rate and the analyses of gesture, rate rather than frequency data were used for analyses of behaviour change over time. (Chapters 3 and 4). Rejection and request vocalisations relating to non-food items or drinks were removed from the data for analysis as they were not considered relevant to the investigation of vocalisation in the context of hunger and satiation. Only individual behaviours with a good to high level of test-re-test reliability (.60 or above, Cicchetti, 1994) were retained for analyses of vocalisation change across meals. As such, 'non-speech reject' and 'non-speech request' were excluded from the analyses. Data for ambiguous vocalisations and distress vocalisations where the cause of the distress was unknown were also excluded from analyses of behaviour change as the meaning of these vocalisations was impossible to determine. Data relating to periods of no vocalisation were excluded from analyses of change over time, as the aim of the analysis was to examine changes over time in the form and function of vocalisation rather than the absence of these.

As for the analysis of gesture, rate, rather than frequency data, were used to analyse vocalisation. Shapiro Wilks tests indicated that vocalisation data were non-normally distributed. They were also not amenable to log transformation because of the large number of zero scores. Therefore, as for gesture, inferential analyses involved non-parametric tests, with the exception of the use of factorial repeated measures ANOVAs (detailed below). Inferential analyses and post hoc power analyses for vocalisation involved the same steps as those for gaze and gesture (Chapter 3).

5.3 Results

5.3.1 Test re-test reliability

Overall agreement for vocalisation codes (excluding instances of no vocalisation) was in the excellent range – ICC .88, with a 95% confidence interval from .87 - .90, F (575,575) = 16.20,

$p < .001$. Test-re-test reliability was also in the excellent range for no vocalisation, ICC .96 with a confidence interval from .92 - .98, F (47,47) = 48.62, $p < .001$. ICCs were in the good to excellent range for other vocal behaviours except for vocalisations involving non-speech sounds (Appendix B14).

5.3.2 Whole meal descriptive statistics

The highest average rate of vocalisation across meals as a whole was for social vocalisation (Table 5.3). This was also the most variable type of vocalisation across whole meals 1 and 2. The lowest average rate of behaviour was seen in raspberry blowing which was also the least variable behaviour across whole meals. Rates of request vocalisations were more than 5 times higher than those for rejections.

Table 5. 3 – Mean vocalisation rates across whole meals

Behaviour	N (Time Points)	Range	Mean	Std. Deviation
Agitation	6	0.71	0.39	0.26
Eating vocalisation	6	0.43	0.28	0.16
Excited vocalisation	6	0.33	0.08	0.13
Raspberry blowing	6	0.06	0.02	0.02
Self-vocalisation	6	0.62	1.15	0.24
Social vocalisation	6	1.46	1.74	0.52
Speech reject	6	0.10	0.03	0.04
Speech request	6	0.54	0.26	0.20

5.3.3 Main course descriptive statistics

Descriptive analyses revealed that the highest rates of behaviour across the three time points of main courses 1 and 2 were in the form of social vocalisations (Appendix B15). Mean rates of speech requests for food were higher at each time point than mean rates of speech rejections and the latter showed the lowest rates of any type of vocalisation across the three time points. Mean rates of request vocalisations, raspberry blowing and self-vocalisations all increased consistently across main courses. Rates of rejection vocalisations also increased from the start to the end of main courses though the increase was not consistent across all time points. Rates of agitated vocalisations showed U-shaped pattern, with higher rates of this behaviour at the beginning and end of the main courses than the middle.

5.3.4 Dessert course descriptive statistics

Descriptive analyses revealed that the highest mean rates of behaviour across the three time points of dessert courses 1 and 2 involved social vocalisations with a consistent increase in rates of this behaviour across the three sections of the dessert courses (Appendix B16). Rates of excited vocalisation showed a consistent decrease over the three time points of the dessert courses while agitated vocalisations showed a similar pattern to that of the main course, i.e. a U-shaped pattern, with higher rates of this behaviour at the beginning and end of the dessert courses. As with the main courses, mean rates of speech requests for food were higher at each time point than those for rejections. Mean rates of rejection vocalisation increased consistently across dessert courses. Mean rates of request vocalisations decreased from the start to the end of desserts but not consistently over all time points. The lowest rates of vocalisation across the three time points of the dessert courses involved speech rejections and raspberry blowing. No clear pattern of change was observed for raspberry blowing during the dessert courses.

5.3.5 Post hoc power analyses

Post hoc power analyses revealed that most main and simple effects ANOVAS were under-powered with the exception of the main effect of vocalisation in the whole meal and in main and dessert courses (1-β = 0.92, 1-β = 0.90 and 1-β = 0.89 respectively).

5.3.6 Analyses of changes in vocalisation between the hungriest and most satiated sections of the meal

Wilcoxon tests between rates of vocalisation between the first 20% of the main courses and the last 20% of the dessert courses showed a significant median increase in the rate of self-vocalisation between the two time points, $Z = -2.95$, $p = .002$, while Sign tests showed a significant median increase in the rate of social vocalisation in the last 20% of the dessert course, $p = .001$. No significant differences were found between rates of either rejection or request vocalisations between the hungriest and most satiated sections of the meal.

5.3.7 Whole meal ANOVAs

The repeated measures ANOVA to determine the main effects of rate of vocalisation, time and course across meals 1 and 2 showed a highly significant main effect for course, $F(1,15) = 12.05$, $p = .003$, $\eta p^2 = .45$, arising from a higher mean rate of vocalisation in desserts than main courses. Mauchly's test indicated that sphericity had been violated for behaviour, course by vocalisation, vocalisation by time and course by vocalisation by time. Following the application of the Greenhouse-Geisser correction a highly significant result was found for the main effect of vocalisation F (1.66, 24.90) = 10.93, p = .001, ηp^2 = .45 and vocalisation by time, F (4.23, 63.46) = 3.88, p = .006, ηp^2 = .21 showing that the different kinds of vocalisation behaved differently in this analysis and that types of vocalisation also varied with time. No significant results were found for time or the interaction of course and behaviour by time.

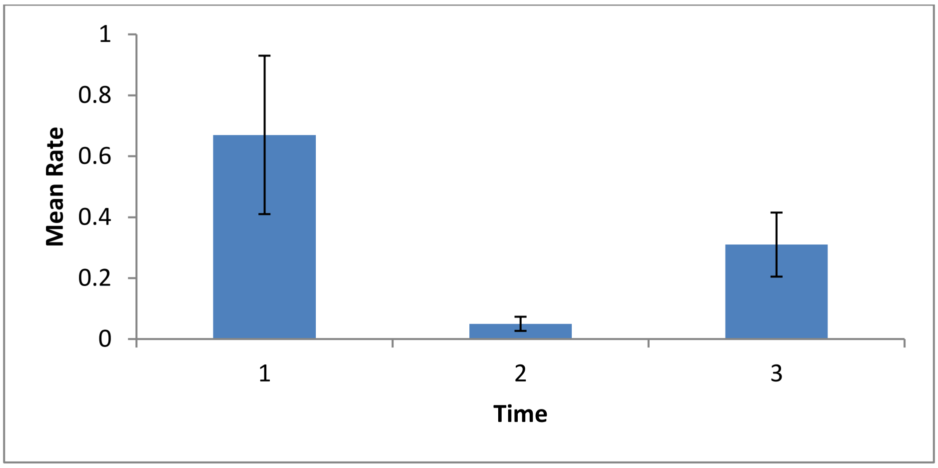
Whole meal ANOVAs of individual types of vocalisation over time found significant differences between rates of excited vocalisations by course, F (1,15) = 5.78, p = .03, ηp^2 = .28 with higher mean rates of this behaviour during dessert than main courses. Whole meal ANOVAs also showed a significantly higher rate of request vocalisations in dessert than main courses, F (1,15) = 8.21, p = .012, ηp^2 = .35.

5.3.8 Main course ANOVAs and Friedman's analyses

Repeated measures ANOVAs for the main effects of time and vocalisation revealed a significant effect for time F (2, 38) = 3.31, p = .047, ηp^2 = .15, i.e. different rates of vocalisation as a whole at different points in the main course. Mauchly's test indicated that sphericity had been violated for vocalisation and the interaction between vocalisation by time. The Greenhouse-Geisser correction was applied and a highly significant result was found for the main effect of vocalisation F (1.17, 33.47) = 11.68, p < .001, ηp^2 = .38 and for vocalisation by time (F 4.52, 85.83) = 4.23, p = .002, ηp^2 = .18. As with the whole meal analyses, these results indicate that different types of vocalisation behaved differently in this analysis and that rates of different forms of vocalisation varied over time.

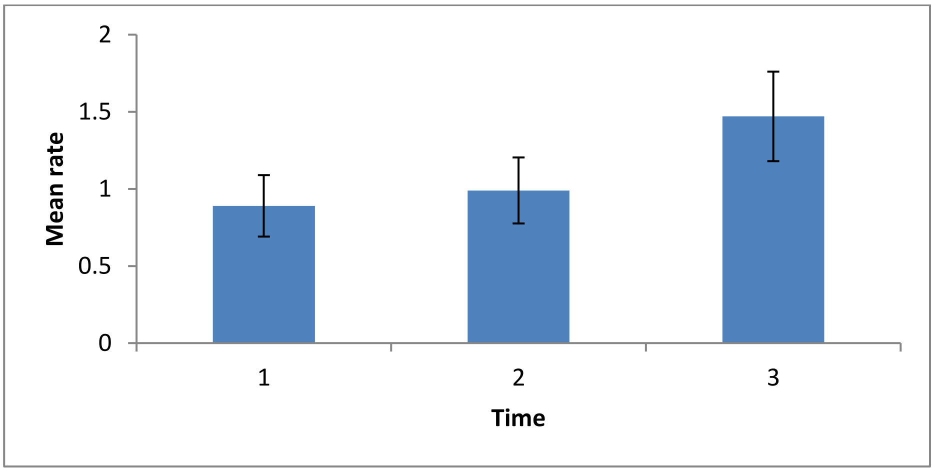
Friedman's tests showed a significant change in median rates of agitated vocalisations over time $X^2(2)$ = 8.04, p = .016. Rates of this behaviour showed a U-shaped pattern (Figure 5.1) with further Wilcoxon signed rank analyses revealing a significant median reduction in this behaviour between time 1 and 2 of the main course Z = -2.67 p = .005.

Figure 5.1 – Main course agitated vocalisations mean rates and standard errors



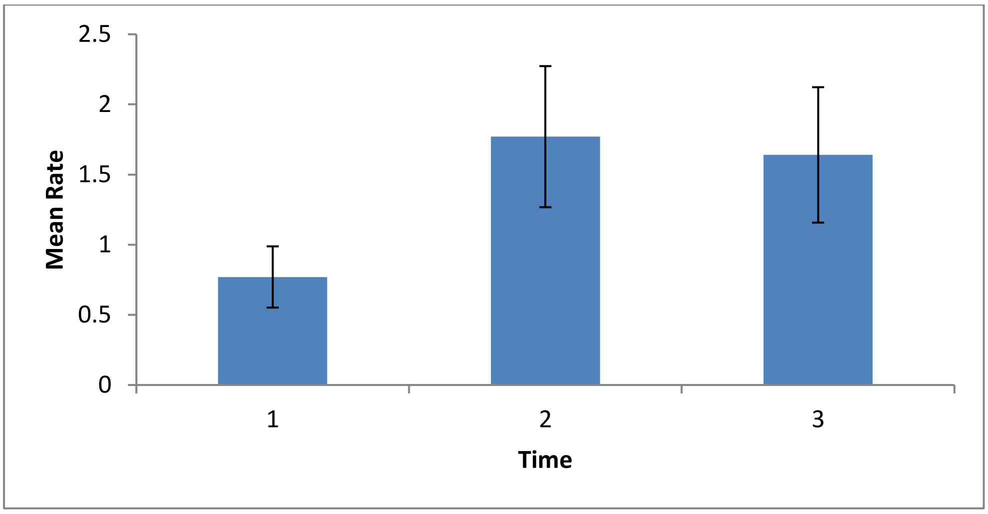
Friedman's analyses also a showed significant median increase in rates of self-vocalisation over time $X^2(2) = 6.30$, $p = .044$ (Figure 5.2) with Wilcoxon's Signed Ranks tests showing a significant increase between times 1 and 3, Z = -2.43 $p = .014$.

Figure 5.2: Main course self-vocalisation mean rates and standard errors



Rates of social vocalisation also showed a significant median increase in Friedman's analyses of main courses, $X^2(2) = 15.47$, $p < .001$ (Figure 5.3) with Wilcoxon's analyses identifying significant changes between times 1 and 2, and 1 and 3 (Z = -2.81 $p = .003$, Z = -2.77 $p = .004$). Friedman's analyses of main course data showed no significant changes over time in rates of speech request or speech rejection vocalisations.

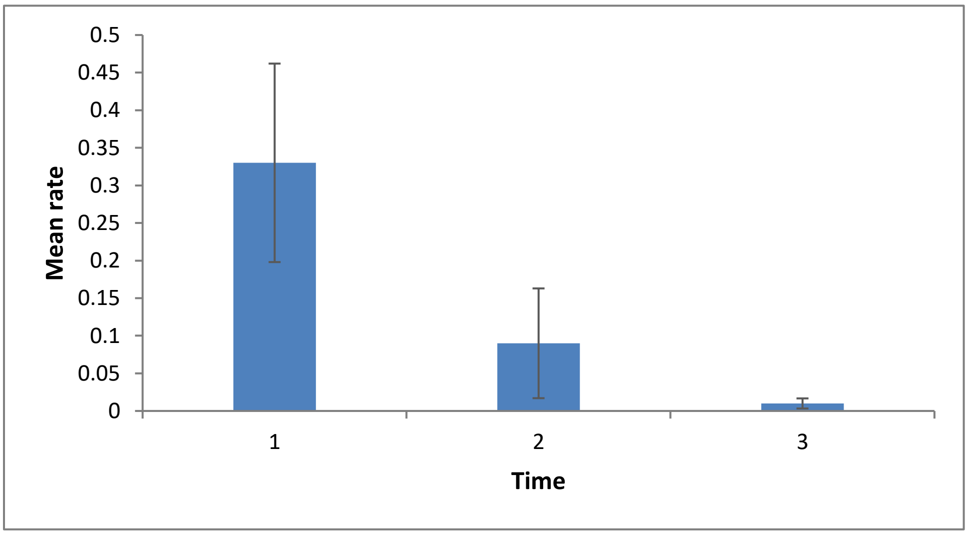
Figure 5.3 Main course social vocalisation mean rates and standard errors



5.3.9 Dessert course ANOVAs and Friedman's analyses

Mauchly's tests showed that sphericity had been violated for vocalisation and vocalisation by time. Greenhouse Geisser corrections were applied and a highly significant result was found for vocalisation, F (1.93, 28.98) = 11.13, *$p < .001$*, $\eta p^2 = .43$ showing that different types of vocalisation behaved differently during dessert courses. Friedman's tests showed a significant median reduction in rates of excited vocalisation over time $X^2(2) = 8.40$, $p = .008$ (Figure 5.4). Post hoc Wilcoxon signed rank analyses did not show a significant reduction in this behaviour between specific time points. Friedman's analyses did not show any significant changes in rates of speech requests or speech rejections or other forms of vocalisation over time during the dessert courses.

Figure 5.4 Dessert course excited vocalisations mean rates and standard errors



5.4 Discussion

This analysis aimed to develop and test a coding scheme of infant vocalisation during solid food meals and to examine its utility for assessing infant feeding state. Results indicate that infants use a wide range of vocalisations during feeding and that it is possible both to categorise these and code the majority of them reliably. Preliminary findings suggest that focusing specifically on vocalisation across meals and within different courses may elucidate behavioural changes associated with hunger and satiation, as well as revealing previously undescribed behaviours during feeding. Such an approach may also provide insights into differential infant responses to savoury and sweet foods.

5.4.1 Reliability of the IVM

The lack of a second coder and inter-rater reliability tests for the vocalisation coding scheme means that the reliability of the IVM has not been fully established. However, test-retest reliability scores were high for the majority of vocalisation codes. An exception to this was in the coding of non-speech request and reject vocalisations, i.e. requests and rejections expressed through crying or fussing. The reason why it was not possible to code these behaviours with a good level of reliability is unclear. This may have arisen because of difficulty discriminating requests and rejections involving crying from other distress vocalisations. However, the coding of other types of distress vocalisation (unknown distress and agitation) showed a good level of reliability. It seems more likely therefore that difficulties arose in assessing the intentionality of requests and rejections involving non-speech sounds, given that the coding scheme required the attribution of intentionality to request or rejection cries to differentiate them from 'undirected' distress vocalisations. As such, it may have been more difficult to recognise intentionality in non-speech rejection and request vocalisations than those involving speech sounds and lower levels of distress. This is an important observation as mothers may also have greater difficulty in decoding such vocalisations.

Notwithstanding the difficulty of coding non-speech request and rejection vocalisations, the reliable coding of *undirected* or reflexive distress vocalisations (agitation/apparent discomfort) is consistent with evidence from Gustafson and Harris (1990) that it is possible to differentiate hunger from other types of cry (e.g. pain). The U-shaped pattern of change observed in agitated vocalisation during feeding episodes indicates that this was associated with hunger at the beginning of a feeding episode and satiation at the end. Reliability testing also showed this type of vocalisation could be differentiated from vocalisations appearing to involve discomfort, and vice versa. Mothers may therefore also be able to distinguish between hunger and pain cries in mealtime settings. The finding also highlights the utility of identifying distress vocalisations representing discomfort as these can be removed from examinations of distress vocalisations associated with hunger and satiation.

Several of the different types of vocalisation identified in the coding scheme are consistent with reports of vocal behaviours associated with hunger and fullness from other studies, e.g. excitatory sounds, crying and fussing (agitation) and the use of verbal requests and rejections are consistent with reports by Hodges et al. (2008 and 2016) and Skinner et al. (1998). Infants in this analysis were also observed to make 'mmm' sounds during meals, a behaviour previously identified by Skinner et al. (1998) as an enjoyment cue. Importantly, however, infants were also noted to use a number of vocal behaviours which have not been reported by studies of hunger and satiation cues, notably, social vocalisations and self-vocalisations. As discussed below these may have utility for recognising infant satiation.

5.4.2 Changes in infant vocalisation over time

Findings regarding hypothesis 1, the expectation of a change from feeding related (request) vocalisations to non-feeding related vocal behaviours over time, were mixed. No significant decrease was noted in rates of request vocalisation from the start to the end of meals or during separate courses. Furthermore, while mean rates of request vocalisation decreased during dessert courses, they increased during main courses. As such, results for patterns of request vocalisation over time run contrary to hypothesis 1. Despite this, findings regarding increased rates of social and self-vocalisations from the first to the last section of the meal were consistent with hypothesis 1. They illustrate the anticipated change over time to non-feeding related vocalisations i.e. socially orientated vocalisation and vocal play or exploratory vocalisation suggesting that these behaviours may be associated with infant satiation. Separate analyses of main and dessert courses also showed significant increases in rates of self and social vocalisations from the beginning to the end of main courses with significant changes occurring in social vocalisations by the mid-point of these. This suggests that this behaviour may be indicative of developing, rather than complete satiation.

Anticipated increases in rates of rejection vocalisations and decreases in rates of request vocalisations (involving speech sounds) were not observed between the hungriest and most satiated sections of the meal, or across main and dessert courses. This runs contrary to hypothesis 2. The reasons for this are unclear, however, several possible explanations exist. As with findings for gaze and gesture, mothers in Study 2 may have been feeding their infants in a highly responsive way, thereby negating the need for infants to reject feeding advances vocally. Descriptive findings provide some support for this view, as rates of rejections were lower than those for requests at all three time points in both main and dessert courses. This suggests mothers may have been sensitive to signs of disinterest while also allowing infants the opportunity to initiate requests. Such practices would be consistent with a responsive feeding style.

The non-homogeneous nature of feeding situations in Study 2 (the involvement of both spoon-fed and self-feeding infants) is also likely to have impacted on findings for request and rejection vocalisations with fewer opportunities for requesting and rejection behaviours in the case of self-feeding infants. Finally, as was the case for gesture, meal set up is likely to have affected the rate and timing of request vocalisations. Practices such as providing finger foods alongside spoon-feeding, and providing dessert foods in stages, may have affected rates of requests and rejections. This is supported by the observation that rates of request gestures were significantly higher in dessert than main courses.

Patterns as well as rates of request vocalisations also differed between courses. Mean rates of these increased across main courses and decreased across dessert, thereby contradicting hypothesis 3. This may be explained in terms of meal set up and sample issues discussed above. However, analyses of social vocalisation provide some indication of higher infant interest in feeding at the start of both main and dessert courses. Rates of this behaviour increased from the start to the end of both courses (although not significantly during dessert courses). Furthermore, they declined between the end of main courses and the start of desserts before resuming an upward trend in the latter. As with patterns for social gesture (Chapter 4) this might be interpreted as representing a shift in infant attention back to feeding with the presentation of dessert. It may, therefore, be associated with the effects of SSS.

Despite the indications that increased use of social vocalisation may be associated with developing infant satiation, as with gesture and gaze (Chapters 3 and 4), it is important to note alternative explanations for the changes in vocal behaviour identified in this analysis.

That is, the significant increases in rates of social and self-vocalisation over time may reflect changes in infant interest, rather than hunger and satiation per se. Furthermore, like the gesture coding scheme, the lack of differentiation between infant initiated social vocalisations and those made in response to mothers, raises the possibility that recorded rates of social vocalisation may have been inflated in this analysis. As such, the view that changes in social and self-vocalisation may indicative of infant feeding state requires further investigation as discussed below.

Importantly, the observed pattern for agitated vocalisation is consistent with reports of fussing and crying as *both* a hunger and a satiation cue (Hodges et al., 2008; Hodges et al., 2016). Beyond the repeated patterns of social and agitated vocalisations in main and dessert courses, other findings do not support hypothesis 3, for example, the significantly higher rate of request vocalisations in dessert courses. As discussed, this may be attributable to meal set up. It may also be explained in part, however, by infants being more motivated to consume sweet rather than savoury food, thereby continuing to request this at a relatively high rate in desserts. This is supported by the observation that rates of excited vocalisations were also significantly higher in dessert, than main courses, despite infants being partially satiated by that time. Furthermore, it is likely that rates of excited vocalisations, would be relatively independent of course set up. This lends support to the idea that observed differences between main and dessert courses may arise from infants' differing responses to the hedonic characteristics of foods. This is also an important observation as excited vocalisations have previously been identified as a hunger signal (Hodges, 2016), when in fact, findings from the present analysis indicate that they may also reflect food preference. Further research to examine this would be beneficial subject to appropriate measures and manipulations to eliminate the potential impact of order effects in the presentation of main and dessert courses.

5.5 Evaluation

While the analysis offers useful insights into infants' vocal expression of hunger and satiation during CF, it is subject to similar limitations as described in Chapters 3 and 4. In particular, there is a need to develop further evidence regarding observed associations between social and self-vocalisations and feeding progression. There is also a need to further investigate assumed associations between SSS and social vocalisation during main and dessert courses. As with the analyses of gaze and gesture, additional research in this area would be best conducted under experimental conditions and using supplementary measures (e.g. bite counts) to corroborate assumed relationships between hunger and changes in vocal behaviour over time. This would assist in addressing alternative explanations for study findings.

The analysis of vocalisation during feeding is also subject to limitations in terms of sample size and power, sample make-up and the potential of course set up to impact on findings. As such, further investigations of infant mealtime vocalisations would also benefit from being conducted with a larger, more diverse sample. Furthermore, unlike the gaze and gesture coding schemes, it was not possible to conduct inter-rater reliability tests with the vocalisation coding scheme. Therefore, the IVM requires additional testing to establish its reliability more fully.

5.6 Conclusion

Findings from this analysis indicate that a specific examination of vocalisation across feeding episodes may offer insights into changes associated with developing satiation. In particular, they suggest that increased rates of social and self-vocalisation may be indicative of developing satiation/infant interest in eating. Findings also indicate that higher rates of request and excited vocalisations may be associated with differential responses to sweet and savoury foods, as well as hunger. These may have implications both for researchers attempting to classify feeding cues and mothers trying to decode them.

While study findings are interesting, they are preliminary at present and further investigations are required to examine potential associations between feeding progress, satiation and changes in in infant vocal behaviour. As for gaze and gesture findings (Chapters 3 and 4), it would be especially productive to conduct further research under controlled conditions in order to develop more robust findings and in order to examine alternative explanations for study findings

Chapter 6 - "Make sure that you do it right" - Infant feeding decisions: choosing between baby led and traditional weaning

6.1 Introduction

This chapter is the first of the three qualitative analyses conducted as part of Study 3 exploring different aspects of maternal feeding decisions. The aim of this analysis was to explore mothers' choice of CF method (BLW or TW) and the issues which shaped this. Chapters 7 and 8 examine maternal decisions regarding choice of infant food and assessments of hunger and fullness in relation to BLW and TW. This chapter describes the methods and analytical approach taken across all three analyses.

6.1.1 Baby led weaning and the current CF landscape

While most mothers continue to use TW, BLW is gaining in popularity as an alternative CF approach (Brown, 2016). This may arise from its positioning as a 'responsive' feeding method wherein infants, rather than mothers, determine (from a given choice) the items and volume they consume (Brown, Jones and Rowan, 2017). In contrast, proponents of BLW have asserted that TW infants have less control over intake and mothers may be more inclined to feed beyond infant satiation (Rapley & Murkett, 2008).

6.1.2 Reported benefits of BLW

As discussed in Chapter 1, responsive feeding appears to influence infant weight gain (Farrow & Blissett, 2006), later eating patterns and obesity risk (Black & Aboud, 2011). Compared to TW, BLW has been proposed to confer better infant appetite regulation (Brown & Lee, 2015) and a range of additional benefits including: greater infant involvement in family meals, more enjoyable mealtimes, fewer 'battles' between parents and infants, and infant meals which are easier and cheaper to prepare (Rapley & Murkett, 2008). BLW has also been argued to lower choking risk, food fussiness and to improve nutritional intake (Rapley & Murkett, 2008).

These claimed benefits are likely attracting many mothers to BLW, although it is important to note that distinctions between feeding approaches are not always clear cut, with some mothers who self-identify as using BLW employing spoon-feeding alongside this (Cameron, Taylor & Heath, 2013). Furthermore, evidence behind claims for BLW requires development. In relation to feeding responsivity, a questionnaire-based study of 702 mothers of infants aged 6-12ms, participants using BLW reported being significantly less likely to pressure their child to eat than TW mothers (Brown & Lee, 2011a). The study however, did not take account of potential biases arising from infant factors such as temperament and eating traits. These are known to influence mothers' feeding behaviour, including the degree to which they feed responsively (McMeekin et al., 2013; Wasser et al., 2011), meaning mothers may be less inclined to choose BLW if their infants are temperamentally less settled (Brown, Jones & Rowan, 2017). Furthermore, self-report measures may be limited by social desirability bias and may not always provide an accurate reflection of feeding practices (Bergmeier, Skouteris, Haycraft, Haines & Hooley, 2015).

Evidence regarding the relationship between BLW and infant appetite regulation is also mixed. In a questionnaire study of parents of 155 children between 32-42 months of age, Townsend and Pitchford (2012) found an increased prevalence of obesity (12.7% versus 0%) in TW compared to BLW children. However, there was also a greater prevalence of underweight (4.7% versus 0%) and overweight (14.3% versus 3.2%) in BLW infants. Meanwhile, results from the BLISS study (Baby-Led Introduction to Solids) a randomised controlled trial of an adapted version of BLW (Taylor et al., 2017) provides robust evidence to contradict claims that the approach confers better appetite regulation than TW. They found no difference in BMIs between 166 BLW and TW infants at 12 and 24 months of age. BLW mothers in the study also reported their infants to be *less* satiety responsive on CEBQ scores than control group infants at 24 months. The study provided some support for the claim that BLW may be protective against food fussiness, as BLW infants were reported to be significantly less food fussy at 12 months than the control group; however, no difference was found in food fussiness between groups at 24 months.

In relation to nutrition, a recent diary-based study of 51 infants from 6 – 8 months of age found that, compared to TW infants, BLW infants had a significantly higher intake of fat and saturated fat (Morison et al., 2016). Furthermore, while the authors found no significant difference in energy consumption for complementary foods between BLW and TW infants, work by Brown and Lee (2011b) indicated that BLW infants may depend more on milk feeds than TW babies. In a survey of 655 mothers of infants between 6 and 12 months of age, they found BLW infants received significantly more milk feeds during the day and the night than TW infants. It is not clear whether these feeds involved breastmilk or formula; however, such findings have raised concerns about iron intake in BLW infants given that breastmilk is a poor source of iron, and infants have a need for iron rich food from 6 months of age (Cicehro, 2016). There is good quality evidence from the BLISS study, however, that higher iron consumption can be achieved via BLW if appropriate foods are offered (Cameron, Taylor & Heath, 2015).

Findings regarding the benefits of BLW for families and infants are similarly unclear. Twenty BLW mothers in an interview study by Cameron, Heath and Taylor (2012) reported finding BLW a more convenient and less stressful feeding approach than TW. In contrast however, some participants in Arden and Abbott’s (2015) online interview study of 15 BLW mothers, reported stressful experiences whilst introducing solids to their infants in this way. While both studies involved small samples, together they suggest that mothers may have both positive and negative experiences of using BLW.

An important issue requiring further evidence is BLW and choking risk. While BLW proponents suggest it involves a lower risk than TW, evidence is inconsistent. In Cameron et al.’s (2012) interview study of 31 BLW mothers of infants between 8 and 24 months, 30% reported at least one choking episode. However, the BLISS study found no difference in choking risk when the adapted BLW approach (with low risk foods) was compared to a control group (Fangupo et al., 2016).

Although little is known about the extent to which decisions to adopt BLW are shaped by the claims made for the approach, there is evidence that it is associated with a particular maternal demographic characterised by: high levels of maternal education and professional occupations (Cichero, 2016); longer breast-feeding duration (Brown & Lee, 2017) and a lower likelihood of mothers returning to work before their infants are 12 months old (Brown & Lee, 2011b). Mothers using BLW also appear to differ from TW mothers in their own eating behaviours, wellbeing symptoms and personality traits. In a questionnaire study with 604 mothers with infants aged 6-12 months, BLW mothers reported lower levels of restrained eating, anxiety, obsessive compulsive symptoms and introversion than TW mothers (Brown & Lee, 2016). Furthermore, Brown and Lee (2011b) found BLW mothers sought less support from health professionals about feeding, expressed higher levels of confidence, and worried less about mess and intake than TW mothers. The Brown and Lee (2011b and 2016) studies however, are subject to the limitations of self-report methods described above.

6.1.3 Rationale and aims

BLW has been positioned as a more responsive feeding approach than TW. However, evidence for the approach is currently both mixed and limited. This is important given the key role of early feeding in forming eating habits. Therefore, it would be helpful to understand what is driving parental choice of CF. This is particularly true regarding assumptions about infants' ability to regulate their intake, the capacity of BLW to meet infants' nutritional and social needs, and issues such as choking risk. Such information would assist health professionals in supporting mothers to make well-informed, evidence-based CF choices with potential benefits for infant health. It would also help orient support to any misconceptions, or strongly held values that parents may have about BLW. In view of these points, the aim of this analysis was to explore, via qualitative methods, mothers' reasons for choice of CF approach.

6.2 Method

This method section describes the procedures involved in this analysis and the analyses discussed in Chapters 7 and 8.

6.2.1 Ethics

Ethical approval for the study was given by the University of Leeds School of Psychology Research Ethics Committee reference number: 14-0116; date approved: 16-Jun-2014. Participants received information about the study and completed consent forms following discussions with the lead researcher (Appendices C1, C2).

6.2.2 Participants

Mothers were eligible to take part if they had participated in Study 2 – the observational study of infant feeding cues. Twenty mothers who had taken part in Study 2 were invited by email to participate in an interview study of feeding decisions (Appendix C3). Eleven mothers consented; five reported using BLW and six reported using TW. One of the BLW mothers reported some use of spoon feeding for example, to feed yoghurt. The remaining four BLW mothers reported using only independent feeding or use of loaded spoons for infants to self-feed. Of the TW mothers, one had commenced feeding using BLW but had abandoned it and adopted TW a few weeks into CF. Participants received a £10 voucher for participation. Mean participant age was 33 years (± 2.86) and mean infant age was 14.81 months (± 3.82). Nine mothers had an undergraduate degree or higher. Mean age at which infants were introduced to solids was 23.36 weeks (± 1.96). Four mothers (two from each group) were still breastfeeding at the time of the study. Mean breastfeeding duration was 29.40 weeks (± 16.88). All mothers were from a white UK background. The characteristics of BLW and TW mothers are shown in Table 6.1.

Table 6.1 – Maternal characteristics of participants (n=11) by feeding method

	BLW (n=5)	TW (n=6)
Mean maternal age (years)	31.80 (± 1.78)	34 (± 3.35)
Mean infant age (months)	12.40 (± 3.78)	16.83 (± 2.64)
Primiparous	100%	50%
Multiparous	0%	50%
Breastfeeding duration at interview (weeks)	29.80 (± 14.10)	29.07 (± 0.26)
Infant age at CF (weeks)	22.80 (± 1.95)	22.00 (± 2.52)
Educational level (degree equivalent or higher)	80%	83%

6.2.3 Data collection

Data were collected through semi-structured interviews, including a video elicited element, in which the researcher and participant viewed a video of the mother feeding her infant a solid food meal at home. Videos had been filmed previously as part of Study 2. Interviews took place a mean of 13.78 (± 6.93) weeks after filming. Mothers were informed that the purpose of the interviews was to better understand CF choices and decisions made during infant feeding. Ten participants were interviewed in their own home and one was interviewed outside the home. Participants were asked a number of questions which formed the basis for the three analyses described in this chapter, Chapter 7 and Chapter 8 (Figure 6.1).

Figure 6.1 – Overview of interview questions

Choice of CF method (Chapter 6)	Maternal choice of infant food (Chapter 7)	Perceptions of hunger, fullness and 'enough' (Chapter 8)
1. Why did you choose to feed this way?	**1.How did you decide what to give your baby day to day?**	**1. How did you know if your baby was hungry or full?**
2. What influenced your decision?	**2.How did you decide what to give for dessert?**	**2. How did you decide how much to offer?**
3. What was your experience of feeding this way?		**3. How did you decide your baby had had enough/when to end the meal?**

Interview topic

Opening questions (prior to viewing video)

Video elicited section of interview

At the start of the interview mothers were asked to reflect on the time that they introduced CF and the issues which shaped their choice of CF method. Further questions were asked regarding choice of infant food, and perceptions of infant hunger and fullness while mothers watched the video of them feeding their infant with the researcher. Participants were free to determine the content and direction of discussions beyond the main interview questions.

6.2.4 Data preparation and analysis

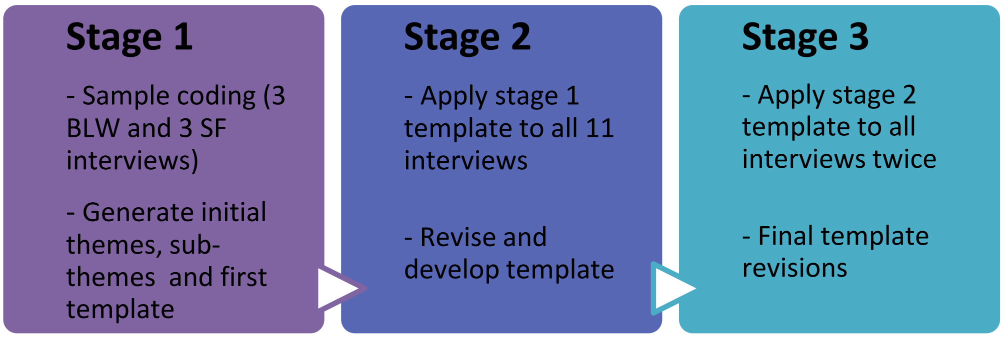
The aim of the current analysis was to explore mothers' choice of CF method and factors which influenced this. The mean length of interviews was 52.23 minutes, equating to a mean of 15.1 (± 3.01) pages of interview transcripts per interviewee.

The chosen method of analysis was template analysis. This is a form of thematic analysis which, like the standard approach described by Braun and Clarke (2006), involves the hierarchical coding of data, with similar codes drawn together to produce higher-order codes (King, 2004). Unlike other qualitative approaches such as grounded theory or interpretative phenomenological analysis (IPA), template analysis usually commences with the use of apriori themes (Waring & Wainwright, 2008). This enables the researcher to capture issues which address study aims from the outset, rather than taking an entirely inductive approach

(Brooks, McCluskey, Turley & King, 2015). Template analysis was also considered suitable for meeting the aims of Study 3 as it facilitates the comparison of data across groups (Waring & Wainwright, 2008) in this case, the CF choices of TW and BLW mothers.

The analysis progressed in stages (Figure 6.2). In stage one, a subset of interviews was randomly sampled (three BLW and three TW). Sample transcripts were read and re-read for familiarisation purposes and then coded using interview questions as apriori themes (Why did you choose to feed this way? What influenced your decision? What was your experience of feeding this way?). While most of the discussion regarding CF approach occurred at the beginning of interviews, whole transcripts were examined for comments relating to interview questions to develop an initial coding template. Coding of the sample transcripts led to the development of a stage 1 template.

Figure 6.2 – Stages of template development



In stage two, all 11 interviews were coded using the stage one coding template, i.e. scrutinising each interview for the presence or absence of the stage one themes and sub-themes and refining or generating themes/sub-themes when new data were encountered or where codes could not easily be applied. This process of refinement and development gave rise to a stage two template. The analysis was repeated for the entire data set for a further two cycles using the stage two template; additions and revisions were made to the template at each stage. Coding and template development stopped after the initial template had been applied to the full data set three times; at this point no further significant themes or subthemes could be identified in the data. Figure 6.3 illustrates the development of two themes (‘Right for me/the family’ and ‘Right for the baby’) across the different stages of template development.

Figure 6.3 – Example of code development

First stage

How I felt about it:

"It made sense to me" (BLW mum)

"It just seemed like the way to go" (BLW mum)

"I went with what I felt was right" (TW mum)

Second stage

Right for me:

"It made sense to me" (BLW mum)

"It just seemed like the way to go" (BLW mum)

"I went with what felt was right" (TW mum)

Right for the family

“We’re going to put it on a plate and give her a spoon and that’s how we eat” (TW mum)

"We like to cook our food ourselves, we try and avoid processed foods" (BLW mum)

Third stage

Right for me/the family:

"It made sense to me" (BLW mum)

"It just seemed like the way to go" (BLW mum)

"I went with what I felt was right" (TW mum)

“We’re going to put it on a plate and give her a spoon and that’s how we eat” (TW mum)

"We like to cook our food ourselves, we try and avoid processed foods" (BLW mum)

Right for the baby

"It goes back to that philosophy of them [...] making the choice themselves" (BLW mum)

"My child infleunced my decision, [...] where she was developmentally” (TW mum)

In developing these themes, quotes from the sample data produced the initial theme, 'How I felt about it'. Scrutiny of the full data set led to the amendment of this theme to 'Right for me' and the development of an additional theme, 'Right for the family', while further reading of the dataset led to these themes being collapsed together and the generation of a new theme i.e. 'Right for the baby'. This was developed as a separate theme from 'Right for me/the family' as mothers' comments focussed a great deal on how their chosen CF approach met their infant's needs, though the notion of 'rightness' was evident in both themes.

6.2.5 Template testing

Two interviews (one BLW interview and one TW) were randomly selected and coded by a second researcher using the final template. Cohen's Kappa was used to check inter-rater agreement. Agreements between coders were identified on the use of the same theme/s in the same paragraph of text (Appendix C4). Disagreements were identified where the researchers had coded different themes or where one had identified an appropriate theme and the other had omitted to do so. Cohen's Kappa indicated substantial agreement between coders, $\kappa = .636$ (95% CI, .420 to .852), $p < .001$ (Landis & Koch, 1997).

6.3 Findings

Mothers explained several factors which they felt influenced their choice of weaning method (Table 6.2). Five themes were generated to represent their reasons, and these spanned both BLW and TW groups, namely: 'knowledge and influence'; 'beliefs and perceptions'; 'experience and continuity'; 'right for the baby' and 'right for me'. The nature of the themes and similarities and difference between groups are discussed below, with extracts and assigned pseudonyms

6.3.1 Theme 1 - Knowledge and Influence

Both groups talked about different kinds and sources of information that influenced their choice of CF approach. These included formal, semi-formal and informal influences. In terms of formal influences, health visitors were perceived to advocate BLW: *'That was advocated as kind of <u>the</u> choice"* (Katie, BLW); *"I just kind of got the impression when you mentioned BLW that that was the route that the health visitors were trying to recommend these days"* (Lily, BLW). Thus, mothers were alert to the subtle promotion of BLW from perceived experts.

Table 6.2 – Final template: Themes and sub-themes for choice of CF method and numbers of participants contributing to each theme (in brackets)

Mothers using BLW (n=5)	Mothers using TW (n=6)
1.Knowledge and influence (5) - Formal/ semi-formal influences (4[5]) - Informal influences (2) - BLW book (4)	**1. Knowledge and influence (3)** - Formal/ semi-formal influences (0) - Informal influences (3)
2. Beliefs and perceptions (5) - There is a 'right' way to feed (1) - Beliefs about BLW (5) - Beliefs about TW (4)	**2. Beliefs and perceptions (4)** - There is a 'right' way to feed (1) - Beliefs about BLW (3) - Beliefs about TW (4)
3. Experience and continuity (2) - Professional background (1) - Previous feeding experiences (1)	**3. Experience and continuity (3)** - Professional background (1) - Previous feeding experiences (2)
4. Right for me/us as a family (3) - Made sense/seemed right, fitted (2) - How we eat (1)	**4. Right for me/us as a family (3)** - Made sense/fitted with my outlook (1) - My choice (2) - How we eat (2)
5. Right for the baby (5) - Developmental stage/ milestones (1) - Infant autonomy and control (5) - Infant choice (4) - Empathy for infant, trusting infant choices (5)	**5. Right for the baby (6)** - Developmental stage (2) - Infant attributes (4)

Mothers also reported actively seeking information on BLW either because of a lack of information from their health visitor (*"you got a leaflet […] and so there was a lot of going away and your first port of call's Google")* (Laura, BLW) or because online information searching is natural when one is in a not-knowing position: *"Just a lot on the Internet really, just places like Mumsnet, other people's experiences, bits on websites"* (Rebecca, BLW).This participant reported synthesising information from a range of sources and reflects how BLW mothers were keen to be informed and ready. Four of the five BLW mothers referred to BLW

[5] **Includes participant who started weaning using BLW but subsequently changed to TW**

books by Rapley and Murkett (2008; 2010). Investing time in researching BLW appeared important to these mothers, who were not necessarily convinced at the outset that they would use BLW, but the texts *"made me realise that that was the road I wanted to go down"* (Laura, BLW*); "it just seemed like the best way to go really! Yeah, and I found the book really helpful and yeah, gave it a try"* (Lily, BLW). In these ways, the texts appeared to have been highly influential in convincing mothers that BLW was do-able, sensible and in line with their values.

In contrast to BLW mothers' use of professional expertise or information from the internet and books, TW mothers prioritised lay and local forms of knowledge from family and friends: "*I suppose I didn't do much external research really, it's not really my thing, I'm a lot happier talking to people and seeing what other people have done"* (Maggie, TW). Another spoke of choosing TW because of its strong tradition, and therefore likely support, in their local networks: "*I had more people I could talk to that had done it pureed, like with my mum and things I suppose and other relatives, it was more traditional […] it was the way everyone did it"* (Suzie, TW).

Thus, different forms of knowledge appeared to have different values for mothers choosing BLW or TW, with BLW mothers feeling the need to actively build their knowledge about that method in order to feel legitimised and practically prepared to adopt it.

6.3.2 Theme 2 - Feeding beliefs and perceptions

6.3.2.1 BLW Mothers' beliefs about BLW and TW

Mothers from both groups expressed particular beliefs about their chosen method. Several BLW mothers' accounts indicated that beliefs about infant self-regulation were influential. Mothers' talk suggested that allowing the infant to determine their own intake involved trust: *"It was like you've got trust their instincts still so you're giving them food and then they'll stop eating when they're full"* (Laura, BLW). Talk about infant control over intake also involved parallels being drawn between BLW, breastfeeding, and confidence in infants' ability to regulate their own appetites: *"You can't over-feed a breastfed baby cos they just won't latch on […] they won't take it if they don't want it […] why would you go from letting the baby feed themselves to then you spoon feeding them"* (Lily, BLW). Some contradiction arose here though, with both the belief that infants can self-regulate, and the belief that they cannot, influencing the decision to use BLW. One participant perceived BLW as being more protective against over-feeding than TW because she viewed infants as *not* being able to sense their own fullness, and therefore was at risk of being over fed in the context of spoon feeding.

Accounts of reasons for choosing BLW also reflected ideas about the relative nutritional importance of solid foods compared to breastmilk before the age of 12 months ("*food is for fun until they are one"* (Rebecca, BLW)). Some BLW mothers expressed the view that breastmilk met all of the infant's nutritional needs in the first year of life, so CF was primarily concerned with infants learning about food and becoming accustomed to solids. Within this, limited intake of solids was not seen as a cause for worry as long as the infant was consuming plenty of milk: "*because he was having his milk I was fine, I was okay'* (Laura, BLW).

The notion of CF as a learning experience was also evident in BLW mothers' proposition that BLW presents a lower choking risk than TW. Here, mothers suggested that BLW provided greater opportunities than TW for infants to learn to manage safe swallowing: *"It's actually safer because children can learn while their gag reflex is still much further forward they can learn about what size chunks to bite off and how much food to put in their mouth"* (Lily, BLW). Like accounts of infant self-regulation, talk about choking risk was also framed in terms of infant control: "*They're in control of how much they put in their mouth"* (Lily, BLW) and again, the need to trust the infant: "*They'll put it in so far and then it will hit and then and it's about them, you trusting them that they know what they're doing"* (Katie, BLW).

Despite perceived lower choking risk being part BLW's appeal, three of the five mothers choosing this approach reported having done baby first aid training. This seemed to also play a role in the decision to use BLW by providing a sense of preparedness for identifying and managing choking episodes: *"I went to a first aid course to understand the difference between gagging and choking"* (Laura, BLW); *"I did baby first aid so I knew what to do"* (Katie, BLW). The Rapley and Murkett (2008) Baby Led Weaning book was also identified as imbuing a sense of confidence in relation to choking risk: *"But the book that I read really made me feel confident with it"* (Lily, BLW).

Claims that BLW offers a less stressful approach to infant feeding were also evident in talk about the decision to use this approach. Here again the need to relinquish control to the infant was expressed: *"It's recognising the bit that you have control over and the bit which is about your little person and that felt good to me that actually I'll do what I can and then I'll* *not get stressed out"* (Katie, BLW). Meanwhile, the perceived lower food preparation demands also influenced the decision to use BLW: *"I was finding it hard to actually cook meals for us as adults, never mind cook meals for her and puree them and do all that sort of stuff at the same time, so it was more for just the whole ease"* (Rebecca, BLW). Thus, both relinquishing control to the infant and the practicality of BLW were seen as factors in reducing the 'stress' of infant feeding for these mothers.

Mothers in the BLW group also talked about their CF choices in terms of social aspects, especially including the infant in family meals: *"I never really wanted […] just to feed Samuel and then he went to bed and then we ate […] I liked the idea of that family, like all being round the table together"* (Laura, BLW). Another mother commented that her infant's independent feeding freed up her and her partner to eat their own meals, *"If you're spoon feeding […] one of us would be having to spoon feed Eliza while our meals went cold".* The same participant added," *but with the baby-led it's more, she's more included in the meal somehow"* (Lily, BLW). This view then established the infant as having no unique needs and being able to accommodate any approach to feeding as well as underlining the perceived practicality of the approach again.

In contrast to BLW, TW was perceived by BLW mothers as involving the investment of significant time and energy in preparing different meals for the infant from the rest of the family: *"I was listening to my friend saying "Oh, I spent two hours on Sunday boiling and pureeing and freezing" and you'd be thinking, oh gosh, you know, it's great, I just, I make something for myself and we give Esther a bit"* (Katie, BLW). As such, for BLW mothers, the benefits of the approach were seen as extending beyond the infant to parents also.

Accounts of choosing BLW also reflected beliefs about the importance of eating being *"a really nice experience"* (Katie, BLW) for the baby and about mealtimes being fun characterised by exploration and experimentation: *"I liked that, that Esther […] could experiment with the food and it was supposed to be fun, really […] it was just about her trying different textures* (Eleanor, BLW). The importance of infant control featured again in such accounts: *"You know, kind of exploratory play with food and making their own choices […] it just all fitted"* (Katie, BLW). In contrast, TW was characterised as involving parental, and not infant, control: *"The idea of baby-led weaning is that they're eating when they want to rather* *than you thinking 'I'm gonna put the spoon in your mouth now"* (Lily, BLW) or even forceful and insensitive feeding practices such as *"pushing it down her throat"* (Rebecca, BLW).

BLW mothers' emphasis on the importance of infants' exploration of food was informed by beliefs about the role of exposure in promoting acceptance of a wide range of foods. Here mothers identified BLW as providing greater opportunities for exposure to taste and texture than TW, and as protecting against fussy eating: *"it can encourage children to be less fussy with food because they learn that that's a piece of broccoli and it's green and it looks like that […] they'll learn what the different foods are and how they look and how they taste"* (Lily, BLW). Two mothers also expressed the belief that the use of purees was an added complication or a barrier to infants accepting whole foods as: *"They don't have that recognition of what that food is"* (Laura, BLW). In talking about purees, some BLW mothers also assumed comparability between their and their infant's taste preferences: *"Would I really want to eat pureed broccoli? Would I really want to eat pureed chicken? So […] why would I make her eat it?"* (Rebecca, BLW). This was linked to the negative perception of pureed food as: "*one big pile of mush"* (Lily, BLW) and of spoon-feeding as necessarily involving the provision of processed foods *"If I did traditional […] I'm glad he's never really had any processed, packaged food"* (Laura, BLW). Commercially available baby foods meanwhile, were seen as being inherently suspect or bad: *" I can't stand, you know like baby jars because I don't know what's in them"* (Katie, BLW). Decisions to use BLW rather than TW therefore, can be seen to reflect not just beliefs and perceptions, but mothers' own values and emotional responses to food.

As well as BLW being seen as protective against fussy eating, BLW mothers viewed it as protecting against obesity. Again, this was contrasted with TW: *"Because a lot of babies in the seventies and eighties were spoon fed we don't know when they're full"* (Laura, BLW). One mother also believed that BLW would prevent more general unhealthy eating patterns: *"I don't want her to [...]end up with any sort of food issues, you know, where she comfort eats or any of that sort of stuff"* (Rebecca, BLW). Overall then, BLW mothers' accounts of the approach positioned it as a prophylactic to a range of eating difficulties such as obesity, fussy eating and broader, unhealthy relationships with food.

6.3.2.2 TW mothers' beliefs about BLW and TW

In contrast to the BLW group, the decision to use TW was guided by the perception that the best approach to feeding was a 'mixed' one, i.e. the use of spoon feeding combined with finger foods. Mothers in the TW group did not perceive themselves as 'just spoon feeding' but doing both 'BLW' and spoon feeding*: "So I thought actually I'll do a little bit of both"* (Christina, TW), reflecting a 'best of both worlds' perception of TW as well as a tendency to regard BLW as essentially being little more than the use of finger foods without any spoon feeding. Moreover, the view that 'doing both' was best, was underpinned by the belief that spoon feeding was necessary to ensure adequate nutrition: *"You don't know what, if they're actually eating it, so I just did both really, gave them bits of stuff to eat themselves and spoon fed them at the same time so I knew they were getting something"* (Keira, TW). Within this, one TW mother identified that she recognised that BLW was informed by a different set of principles than TW, but that her main priority remained ensuring adequate intake: *"Yeah, but a baby led person would say that's not the point of the meal, so yeah, yeah, I suppose, but for me that feels good because I'd much rather he felt full at the end of the meal and then had you know, enough energy to do everything"* (Maggie, TW). TW mothers' approach to feeding then showed a willingness to 'borrow' from different approaches in order to meet personal preferences and priorities, rather than feeling the need to follow set principles or rules.

TW mothers regarded their approach as providing the greatest exposure (whole *<u>and</u>* pureed foods): *"it seemed to work quite well and she had exposure to both then as well"* (Emily, TW). Both BLW and TW mothers aspired to expose their infants to a range of flavours and textures, demonstrating a view that mealtimes are not just about reaching satiation, although the same aspirations led to different CF choices.

Aspirations to limit choking risk were also shared between TW and BLW mothers. Choking risk was a key factor in choice of CF approach for one first time TW mother in particular: *"I was scared of the lumps and bumps […] based around me being a first-time mum and nervous of the choking as well […] I wanted to do it the way with the least risk"* (Suzie, TW). However, another TW mother offered finger foods alongside spoon feeding, as she was confident about the ability to respond to a potential choking incident: *"I wasn't scared of giving them whole food because I do like the first-aid course and stuff and they say that they've got a good gag reflex and it's unlikely they're going to choke but I know how to deal with it if they* *do choke doing the first-aid, so felt quite confident really"* (Keira, TW). As for some BLW mothers then, confidence in coping with choking was a factor in this mother's feeding practices (i.e. use of finger foods) if not in terms of method (BLW or TW).

6.3.3 Theme 3 - Experience and continuity

Mothers' own backgrounds and past experiences also influenced CF choices. Professional background was a factor in choice of feeding method for two mothers, both qualified nutritionists, but who nonetheless chose different approaches. One identified that she had chosen BLW having reviewed the evidence regarding different types of CF in her professional role, while a TW mother commented*: "I'd always assumed that I would be doing a combination […] maybe because of what I teach. I hadn't kind of seen any particular evidence to say that […] that baby-led weaning was beneficial"* (Emily, TW). The different choices these mothers made shows how, even with specialist knowledge, they interpreted the evidence on TW and BLW differently. However, the emphasis that both placed on evidence-based CF demonstrates a common desire to make well informed choices using 'expert' evidence.

Inevitably multiparous mothers' experiences of feeding older siblings during infancy influenced CF decisions: *"I kind of took into consideration what I did with the boys"* (Keira, TW). All participants with previous CF experience were TW mothers and there was a sense that if an approach had worked previously there was no reason to change it. One TW mother however, opted to try BLW again with her third child *despite* having had difficulties with it with her second. This was in deference to heath visitor advice: *"I thought we'd do the pureed route […] but […] they said, 'Oh no, she'll be fine'"* and messages about the inter-connectedness of BLW and breastfeeding: "*Apparently if they breastfeed […], they're meant to be equipped to eat the solid food*" (Jess, TW). As with ideas about appetite regulation, there was a sense of continuity or complementarity between breastfeeding and BLW as expressed by other BLW mothers: *"The idea of the baby-led weaning is that it follows on from breastfeeding quite well" (BLW); "Breastfeeding had been so difficult but we got there and […] it was natural continuation of that"* (Katie, BLW). TW in contrast was perceived by one BLW mother as discontinuous to breastfeeding and disruptive to the progression of feeding: *"Why would you go from letting the baby feed themselves to then you spoon feeding them and then eventually you'll […] want them to go back to feeding themselves"* (Lily, BLW).

The experience of observing other people's feeding practices also influenced the appeal or otherwise of BLW. One BLW mother reported that experiences with family members' use of TW had not been positive: *"I felt that it would probably help with the anxieties that I'd seen my sisters have around what their kids were and weren't eating*" (Katie, BLW). The same participant stated that seeing BLW work for others was a positive influence on her choice: *"Those groups are really good because you're obviously seeing children at different developmental stages so actually you're seeing kids that are doing the BLW [...] you're seeing how they're doing it as well".* A TW mother, however, commented that seeing babies fed using BLW discouraged her from using the approach: *"All the babies that are just given whole things [...] all look a bit like scrawny"* (Keira, TW). In making this evaluation of BLW, this participant was attuned to perceptions of what a healthy weight infant should look like, whereas the BLW mother appeared to be influenced by seeing that the approach was feasible with infants at different developmental stages. The accounts of both mothers, however, demonstrate how they built on personal and localised knowledge to bolster the rationality of their CF choices.

6.3.4 Theme 4 - Right for me/right for the family

A number of BLW and TW mothers identified that choices about CF revolved around what made sense to them: *"It just seemed like the way to go"* (Lily, BLW); *"I looked a little bit into it and read up on it and I thought, yeah, that made sense"* (Katie, BLW). Similarly, a TW mother reflected that she: *"Went with what was easiest at the time and what felt right, and what made sense"* (Maggie, TW). In these ways, mothers appear to have combined what they described as an intuitive form of knowledge with evidence and practical preferences. Mothers in both groups also identified that their chosen approach aligned with food and eating related values important in their family: *"We're going to put it on a plate and give her a spoon and that's how we eat"* (Jess, TW); *"We like to eat whole foods, we like to eat natural foods, we like to cook our food ourselves, we try and avoid processed foods"* (Katie, BLW). Such accounts highlight how CF choice, for some mothers, is part of a broader set of values and ways of living, and that the choice can emerge from a feeling of 'what's right'.

6.3.5 Theme 5 - Right for the baby

BLW and TW mothers' accounts of their choice of CF method also emphasised the importance of it being 'right' for the infant. However, 'rightness' was conceptualised differently by the two groups. BLW mothers privileged issues such as infant autonomy, infant choice and empathy for the baby: *"It does all go back to that philosophy of them […] making the choice themselves"* (Eleanor, BLW). One BLW mother also identified that she liked the idea of the approach fitting with babies' developmental stage: *"I liked whenever they were talking about how it related to developmental milestones" (Katie, BLW).* However, for the most part it was TW mothers that identified their infant's developmental needs or physical attributes as shaping their CF approach: *"I like to think that my child influenced my decision, that kind of where she was developmentally and the signs that she was giving me meant that I did what was best for her"* (Emily, TW); *"They've got no teeth, […] so I just did both really"* (Rebecca, TW). One mother explained how feeding could be a forum for a broader parenting agenda *"I was very conscious he was a boy and I thought they have a […] tendency to let you do everything for them so I thought […] I'll do a little bit of both"* (Christina, TW).

Responsiveness to the infant's perceived needs and abilities led to the decision to abandon BLW for one mother. This infant had significant difficulty coping with whole food leading to vomiting episodes and eventually, the decision to abandon BLW, both for the baby and because of the stress for the rest of the family. Notwithstanding the desire to do what worked for her baby, this mother persevered for some time with BLW before abandoning it, both with this child and an older sibling. The latter ultimately lost weight while trying to get him onto solid food. The experience of persevering with BLW despite problems was expressed by another participant also: *"She spent months not eating the food, chewing it and spitting it out again […] I just wonder sometimes whether she'd have been onto solid food and been a lot better eater now if we'd gone down the route of traditional weaning* "(Rebecca, BLW). This participant however chose to continue with BLW despite worries about the infant's intake. Thus, while attention to the needs of the infant was an important factor in CF choice, mothers also showed a willingness to persevere with BLW despite difficulties or concerns that it may not suit the infant.

6.4 Discussion

This analysis explored mothers' motivations for choosing BLW or TW. This discussion will focus on the influence of mothers' CF aspirations, their CF priorities and their beliefs about CF roles and functions.

6.4.1 CF Aspirations

A key aspiration for both BLW and TW mothers was to make well-informed CF decisions. BLW mothers regularly cited the benefits of the approach as proposed by Rapley and Murkett (2008) as well as the promotion of the approach by health visitors. This counters Brown and Lee's (2011b) finding that TW rather than BLW mothers were more likely to have sought CF advice from health professionals. This may be indicative of BLW gaining traction amongst health professionals, as well as mothers, especially given recent UK health visitor guidelines' focus on infants self-feeding from the age of six months (Institute of Health Visiting, 2015).

Primiparous and multiparous mothers from both groups also aspired to feed in a way that was right for their infant. BLW mothers emphasised infant control, autonomy and choice, consistent with findings from Brown and Lee (2013) and Abbott and Arden (2014). TW mothers' talk also focussed on their infant's needs; however, their accounts focused on physical and developmental needs, reflecting different values and priorities for CF compared to the BLW mothers.

Despite the aspiration to provide the right approach for their infants, an important finding is that two participants persevered with BLW for some time despite encountering significant difficulties and concerns about their infants' intake. This raises concerns about the experience of the baby, stress on mothers and BLW as a 'responsive' approach for all infants. While studies have questioned the suitability of the approach for babies with developmental delays (Wright, Cameron, Tsiaka & Parkinson, 2010), findings here indicate that infants with less avid appetites and those who are sensitive to gagging, may also encounter difficulties, thereby countering the characterisation of BLW as a stress-free feeding approach for all families.

Mothers from both groups inevitably aspired to safe CF practices and both groups perceived their approach to involve the lowest choking risk. However, this was particularly evident in BLW mothers who spontaneously expressed confidence around identifying, and coping with choking, thereby resonating with reports of greater 'feeding confidence' in BLW mothers from Brown and Lee (2016). Notably though, in the present analysis, several BLW mothers reported taking infant first aid training prior to CF, thereby raising confidence in dealing with choking. Furthermore, the act of undertaking first aid training suggests BLW mothers may not have taken claims about BLW and lower choking risk entirely at face value.

6.4.2 CF roles, priorities and functions

A key priority for BLW mothers was allowing infant control over intake and the promotion of self-regulation of appetite. Within this were implicit assumptions about BLW as the solid food analogue of breastfeeding. As noted by Arden and Abbott (2015), this assumes an equivalence between the skills involved in breastfeeding and those implied in BLW, along with the ability of a self-feeding infant to be able to select and consume a nutritionally balanced meal. Importantly, some BLW mothers here also privileged the nutritional role of breastmilk over solid food during the first months of CF. This is consistent with reports from earlier studies of breastmilk being seen by some BLW proponents as the mainstay of infant nutrition before the age of 12 months (Arden & Abbott, 2015; Brown & Lee, 2013). In contrast, several BLW mothers in the present analysis characterised the introduction of solid food primarily as providing learning and exploratory function for infants, rather than a nutritional one.

Previous studies have indicated that BLW mothers are more likely to have breastfed their infants (and to have done so for longer) than TW mothers (Brown & Lee, 2017). However, all TW mothers in this study had also breastfed their infants and for a similar duration to BLW mothers. With the exception of the mother who tried then abandoned BLW, none of the TW mothers referred to their breastfeeding background as influencing their choice of CF method. It may be therefore that the idea of a connectedness between breastfeeding and BLW is part of its appeal for those choosing this approach. This may stem in part from the high social value that is placed on breastfeeding, as identified by Locke (2015). It also highlights a difference in perceptions or priorities between BLW and TW mothers. Notions of continuity between breast and solid feeding were absent from the talk of TW mothers, suggesting they may have perceived milk and CF as separate and distinct stages.

In terms of perceptions of their own roles in feeding, BLW mothers regarded themselves as facilitators of exploration and providers of healthy food and positive eating experiences. In contrast, TW mothers viewed their role as ensuring sufficient intake and meeting nutritional needs. Underpinning this was the notion that they as mothers ‘knew’ how much the baby needed to meet energy needs or to be full. This is consistent with reports from other authors (Brown & Lee, 2011b).

Enjoyment for the infant and infant involvement in family meals were posited as key reasons for choosing BLW, suggesting that these mothers had a sense of how mealtimes *should* be for the infant and the family in general. The alignment of BLW with positive family mealtimes has also been by reported by Cameron et al. (2012) who found both health professionals and mothers regarded it as beneficial to family mealtimes. In contrast, TW mothers in the present analysis did not intimate that infant involvement in family meals influenced their chosen method. This is not to say that they did not aspire to mealtimes being sociable or enjoyable for the infant, however, this issue was not prioritised in the interviews.

6.5 Evaluation

This analysis has a number of limitations and strengths which also apply to the analyses described in Chapters 7 and 8. The study as a whole involved a small group of participants from a relatively homogeneous demographic background. Furthermore, it is important to note that qualitative data is co-produced in a given context and shaped by the interests of the researcher and participants. Most people, when interviewed are motivated to give a coherent account of themselves, in which they are both rational and successful; findings here will therefore, inevitably reflect the ‘invested’ nature of mothers’ CF choices. There are also potential limitations to the specific use of template analysis. This tends to focus on comparisons across, rather than within groups, thereby paying less attention to individual accounts and experiences (Brooks et al., 2015).

An additional limitation to the analysis, meanwhile, relates to the use of retrospective reports of past decisions. The use of video elicited interviews may have helped to mitigate this to some extent, though discussions of chosen CF approach largely took place prior to watching the videos. Furthermore, it should be noted that the video elicited section of the interview may have caused some discomfort for mothers in observing and commenting on their own behaviour. This may have compromised discussions to some degree. Despite these issues, however, the analysis offers a detailed and systematic analysis of mothers’ CF decisions. Moreover, this is the only known analysis involving the direct comparison of TW and BLW mothers’ accounts of feeding choices. As such, it provides important insights regarding the complex and multiple factors which influenced these.

6.6 Conclusion

BLW and TW mothers' CF decisions were shaped by similar aspirations such as using an approach that was well informed, minimised choking risks, exposed infants to a wide range of tastes and textures and one which was right for the infant. Interestingly though, the *same* motivations led to *different* CF choices. Furthermore, the accounts of BLW and TW mothers reflected different priorities for CF, differing ideas about the functions of CF, differences regarding the relative roles of breastfeeding and CF, and differing perspectives on mothers' and infants' roles in feeding interactions.

The emphasis that BLW mothers placed on trusting their infants to determine their own intake is consistent with responsive feeding principles. However, mothers who chose BLW in this analysis were influenced to do so by claims of its association with a number of health outcomes, and, its promotion by health professionals, despite evidence for these claims being limited. Such claims and promotion may also have played a role in two mothers persevering with BLW despite them or their infants experiencing significant difficulties. Moreover, the finding that two mothers from only a small sample experienced significant challenges with BLW suggests that difficulties with the approach may be currently under-reported. Such findings have important implications for professionals supporting mothers in making and implementing CF decisions. In particular, they highlight the need for flexible, evidence-based approaches to CF which are responsive to the needs of individual infants and mothers.

Chapter 7 - "A good balance of everything" – Mothers' choice of infant food in Baby led and Traditional Weaning: a qualitative study

7.1 Introduction

This chapter describes the second analysis conducted as part of Study 3 – the examination of mothers' choice of infant foods in the context of different CF approaches and findings relating to this.

7.1.1 The need to develop our knowledge of mothers' food choices in CF

There is well-developed evidence regarding factors associated with mothers' first feeding choices (whether to breast or formula feed) (Brown, Raynor, & Lee, 2011), and those affecting the timing of the introduction of complementary foods (Wijndaele, Lakshman, Landsbaugh, Ong, & Ogilvie, 2009). Less is known about how mothers choose complementary foods for their infants (Boak et al., 2016; May & Dietz, 2010). A greater understanding of this would develop our knowledge of maternal behaviours which may influence overweight. It would also have implications for our understanding of feeding responsiveness, as relationships have been reported between responsive feeding practices and infant diet (Fangupo, et al., 2016; Hohman, Paul, Birch, & Savage, 2017). Furthermore, it would be beneficial to develop knowledge of infant food choices across different CF approaches as there are preliminary indications that CF may influence infant diet and nutrition (Brown & Lee, 2011b; Cichero, 2016; Morison, 2016). Doing so would inform the development of feeding interventions which reflect current infant feeding practices and are therefore likely to be effective in promoting healthy infant feeding.

7.1.2 Maternal characteristics, maternal diet and infant diet

A number of studies have investigated associations between maternal characteristics, maternal diet and infant diet. Longitudinal surveys by Robinson et al. (2007) (n = 1434 infants at 6 and 12 months) and Smithers et al. (2012) (n = 7052 infants at 6 and 15 months) found high consumption of savoury snacks, biscuits and crisps by infants to be associated with lower maternal education, age and higher maternal BMI. Smithers et al. (2012) also noted that the same associations between maternal characteristics, and infant intake of crisps, sweets and biscuits at 6 months remained at 15 months.

Notwithstanding associations between maternal demographic characteristics and reported infant diet, evidence from two smaller scale studies suggests that maternal (self-reported) diet is a stronger predictor of what infants eat. In a survey of 98 mothers of infants between 6 and 18 months, Hart, Raynor, Jelalian and Drotar (2010) failed to find a significant association between maternal education or family income and reported infant intake of fruit. Rather, infant fruit consumption was significantly predicted by mothers' self-reported fruit consumption. Hart et al. (2010) also found that maternal self-reported intake of snacks (crisps, cakes, biscuits, sweets and high sugar drinks) significantly predicted infant intake of snacks at 12 and 18 months of age. Lioret et al. (2013) similarly identified links between maternal and infant diets from dietary recall data from mothers of 421 nine-month-old infants. They found maternal diets characterised by fruit and vegetable intake significantly predicted reports of 'balanced' infant diets (involving vegetables, fruit, fish, pasta and rice); however, no significant relationship was found between maternal education and infant diet.

Taken together, evidence suggests that maternal characteristics predict infant food choices, with maternal diet being identified as a key factor in infant diet. Moreover, this appears to be the case for both healthy and unhealthy infant food choices. Mothers' CF practices (TW or BLW) however were not reported in these studies. Therefore, it is unclear how far such findings apply across different CF practices, and whether CF approach has any relationship with quality of infant diet.

7.1.3 Complementary feeding and infant diet

While no research has examined CF and infant food choices directly, two studies have provided insights in this area. Brown & Lee (2011b) found BLW infants were significantly more likely to be offered a fruit or vegetable as a first food than TW infants. They were also less likely to receive baby rice as a first food and more likely to receive home prepared food. Cameron et al. (2013) also found BLW infants were more likely than TW infants to be fed home prepared family foods rather than commercially prepared infant foods, while Rowan and Harris (2012) found 57% of foods offered to BLW infants were also consumed by their parents at the same time. As discussed in Chapter 6 however, similarities between the diets of BLW infants and their parents have raised concerns of infants being offered foods significantly higher in fat, saturated fat and sodium, and lower in iron, than their TW counterparts (Cichero, 2016; Morison et al., 2016).

7.1.4 Mothers' accounts of first food choices

While large scale surveys have been effective in describing infant diets and associations between these and other factors, they do not explain the *reasons* behind mothers' food choices. Qualitative studies offer the opportunity to access mothers' own accounts of their feeding choices, though only a handful of studies have taken such an approach to investigating the foods mothers choose for their infants. Boak et al. (2016) interviewed 32 mothers of infants between 4 and 15 months of age regarding factors affecting food choices. Participants reported the following influential factors: beliefs, values, norms and knowledge; a desire to foster good eating habits; food cost and availability; time; the influence of family and friends and infant preferences. In particular, mothers' childhood food experiences (either positive or negative) were reported to have influenced choices for infants. Mothers also highlighted the importance, to them, of providing balanced diets for their infants along with concerns about intake of salt, sugar and preservatives. However, mothers also reported being willing to be more flexible about less healthy food in different settings, e.g. when eating out.

Infant food choices were also examined by Schwartz et al. (2013) in qualitative interviews regarding the CF practices, attitudes and experiences of 18 French mothers. As with Boak et al.'s (2016) findings, participants expressed concern about limiting intake of salty, sugary and processed foods. Here worries regarding the 'addictive' nature of such foods were particularly apparent. Mothers also expressed concern regarding the risk of allergy associated with some foods (e.g. nuts) and identified these as foods to avoid. In contrast, mothers emphasised the importance of providing plenty of vegetables and of the need for variety in the food they gave their infants. Within this, feeding was seen as involving more than nutrition, rather, it was seen as serving a role in initiating infants to flavour and developing the palette. In addition, introduction of new tastes and flavours was regarded as enjoyable for mothers and a means of interacting with their babies.

The feeding approach used by Boak et al.'s (2016) and Schwartz et al.'s (2013) participants was not reported. However, two studies have examined the rationale for food choices in the specific context of BLW to some degree. Brown and Lee (2013) interviewed 36 BLW mothers and found that family foods played an important role in infant diets, though constituents of family meals were also adapted as a result of concerns about infant exposure to salt, sugar and high levels of fat. Participants also expressed the need to provide high levels of fruit and vegetables, and for infants to be exposed to a variety of foods as a prophylactic against fussy eating. Finally, mothers in Brown and Lee's (2013) study emphasised the ongoing importance of breastmilk. Here breastmilk was seen to provide insurance against poor intake of solids, while infants were reported to be at liberty to determine both the balance and form (solids or milk) they consumed. Brown and Lee's findings therefore suggest BLW mothers' food choices were driven by family diet and concerns about healthy eating. However, within this, infants could exercise autonomy over what and how they consumed.

Arden and Abbott (2015) also conducted an interview study regarding the experiences of 15 BLW mothers. Like Brown and Lee (2013), mothers in this study expressed concerns about infant salt and sugar intake. Participants also identified that they withheld or restricted access to sugary foods and again emphasised the need for balanced nutrition. Consistent with Brown and Lee (2103), Arden and Abbott's (2015) participants emphasised the continuing nutritional role of breastfeeding and expressed trust in the infant to select appropriately nutritious foods from what was provided. However, some mothers also reported exerting control over food choices, e.g. not allowing the infant to fill up on fruit if they had not consumed a satisfactory amount in the main course.

While relatively small-scale studies, Arden and Abbott's (2015) and Brown and Lee's (2013) findings suggest that choice of infant foods in BLW is influenced by similar issues to those described by Boak et al. (2016) in the general infant feeding context, i.e. concerns about healthy eating, nutritional balance and the need to limit exposure to salty and sugary food. However, Arden and Abbott's (2015) and Brown and Lee's (2013) findings also indicate that BLW mothers may place particular emphasis on the ongoing importance of breast milk and the infant's role in selecting foods to meet their own needs. Furthermore, participants in Boak et al.'s (2016) study identified a wider range of influences on food choices than those identified in the BLW studies. Such differences may arise from different aims between studies, with Arden and Abbott (2015) and Brown and Lee (2013) focussing more on feeding experiences, and Boak et al. (2016) focussing on food choices. Nonetheless, they merit further investigation with a view to understanding if, and how, food choices differ with CF approach.

7.1.5 Rationale and aims

Developing knowledge of mothers' food choices in the context of current CF approaches would generate insights for professionals tasked with encouraging healthy feeding practices. Such insights are important given that concerns that have been raised about the diets of BLW infants (Cichero, 2016: Morison et al., 2016). As such, a greater understanding of maternal food choices across CF approaches would help to identify which issues are priorities for mothers, and where there is scope for change, with implications for intervention. This analysis therefore aimed to explore the reasons for mothers' infant food choices, their subjective accounts of factors which shaped food choices, and to examine the degree to which these differed or were similar in different CF contexts.

7.2 Method

Template development and testing for choice of infant food were conducted in parallel to those for choice of weaning method, using the same procedures outlined in Chapter 6. Questions relevant to the specific analysis of infant food choices were:

1. How mothers decided what to give their baby on a day to day basis
2. How mothers decided what to offer for dessert

7.2.1 Template testing

As described in Chapter 6, two interviews (one BLW interview and one TW) were randomly selected and coded by a second researcher using the final template. Cohen's Kappa analyses for the coding of infant food choices indicated substantial agreement, $\kappa = .565$ (95% CI, .391 to .739), $p < .001$. (Landis & Koch, 1997).

7.3 Findings

Seven themes were generated from the combined interview data from BLW and TW mothers (Table 7.1). Themes reflected a range of drivers behind infant food choices including safety, nutrition and healthy eating concerns and practical considerations. Themes also reflected more implicit aims, feeding beliefs, family norms and mothers' values. Themes and sub-themes were shared between groups, though within these, different food choices were made, and differences in BLW and TW mothers' priorities were also evident.

7.3.1 Theme 1 - Keeping the infant safe

The safety of first foods was a key issue for both BLW and TW mothers. As described regarding choice of CF approach, mothers were especially alert to the risks of choking and this shaped both food choices and food preparation practices.

Table 7.1 – Final template: Themes and sub-themes for choice of infant food and numbers of participants contributing to each theme (in brackets)

Mothers using BLW (n= 5)	Mothers using TW (n = 6)
1.Keeping the infant safe (3) - Managing choking risk (2) - Managing salt (2)	**1.Keeping the infant safe (4)** - Managing choking risk (2) - Managing salt (2)
2. Nourishing the infant (5) - Balance (3) - Healthy Eating/healthy habits (4)	**2. Nourishing the infant (6)** - Balance (5) - Healthy Eating/healthy habits (6)
3. Eating rules (4) - Implicit rules (1) - Norms (4) - Proper food (4)	**3. Eating rules (6)** - Implicit rules (6) - Norms (5) - Proper food (2)
4. Liked foods (5) - What the infant likes and accepts (5) - Liked foods as strategy (2)	**4. Liked foods (6)** - What the infant likes and accepts (6) - Liked foods as strategy (3)
5. Family food (5) - Availability (5) - Not restricting by family foods (2)	**5. Family food (6)** - Availability (6) - Family food as restriction (3)
6. Variety (4) - Variety as exposure (3) - Variety as choice (2) - Variety as strategy (1)	**6. Variety (4)** - Variety as exposure (1) - Variety to combat boredom (2) - Variety as strategy (1)
7. Being Practical (2) - Location (1) - Infant attributes (2)	**7. Being Practical (4)** - Location (3) - Infant attributes (4) - Managing the meal (3)

Mothers reported actively addressing choking risks in a number of ways: firstly, *type* of food was seen as important: “*I just started at toast really and […] I gave him like the crusty bits because I didn’t want him to choke”* (Laura, BLW). Another BLW mother similarly managed choking risk through choice of food: “*Going with things like softer meats”* but also through food preparation: “*Vegetables that had been cooked that bit longer*” and through the order in which milk and solid feeds were presented: "*I would give her milk […] because I thought that, again, that might mean that if she was really hungry she might be stuffing it in and then that would obviously increase the likelihood (of choking)*" (Eleanor, BLW).

Management of choking risk through food choices also appeared in TW mothers' accounts as did food preparation as a means of reducing risk: *"I didn't really give her meat whole […] I was always a bit dodgy about that. I still pureed the meat […] and then just mashed the vegetables so that the lumps were still soft and (there was) no need to chew"* (Keira, TW); *"I was worried about her choking […] she did have lumps and things, but it was just melty lumps really"* (Suzie, TW). Thus, food preparation was a key means of reducing choking risk for mothers in both CF approaches.

Salt, particularly hidden salt content, was another safety concern affecting choice of infant foods in both groups, with mothers from both groups managing this in similar ways. The use of family foods was identified as a particular challenge by one BLW mother. This issue was addressed by rotating staple foods between higher and lower salt options (bread and pasta) with a view to managing salt intake. Another BLW mother identified the exclusion of high salt foods as a strategy for limiting salt consumption: *"I don't know what kind of sausage it is actually, but it's quite salty so I've not given that to Eliza"* (Lily, BLW). Exclusion was also used by TW mothers with salty ingredients being omitted from infant versions of family meals: "*Mine (food) appears to have a lot of soy sauce on, so I wouldn't give her the soy sauce"* (Emily, TW). The same mother, also emphasised food preparation as a means of limiting infant salt intake: "*Obviously for her portions I wouldn't cook with salt or anything […] I wouldn't salt the water for her food"* (Emily, TW). Concerns about salt intake, however, diminished for this mother as her baby got older: *"I'm less concerned about salt now so she'd have the majority of her salt, […] in her first year from things like cheese and bread […], I didn't give her processed meats until she was that little bit older"* (Emily, TW).

Taken together, both BLW and TW mothers' accounts reflected shared concerns that infant food should be safe. For the most part, mothers from both groups used similar strategies to address safety concerns, with exclusion, limited exposure and food preparation practices being key means of limiting risks of choking and high salt intake.

7.3.2 Theme 2- Nourishing the infant

Unsurprisingly, the issue of nutrition appeared frequently in mothers' responses regarding infant food choices, with both TW and BLW participants particularly emphasising nutritional balance: *"Give him one of each group, so a protein, a carb and a veg, so that's the way I try and work it each mealtime"* (Laura, BLW); *"It was really important that I was, you know, making sure that I was meeting all of her kind of nutritional needs"* (Katie, BLW); *"A good balance of everything […] she will […] want to just eat all the broccoli, all the peas, all the sweet corn, carrots, so then you have to entice her into eating the meat and some of the carbohydrate as well so it's getting the full balance in"* (Suzie, TW). As such, both BLW and TW mothers' ideas of nutritional balance involved an awareness of different food groups. Despite similar concerns about nutritional balance, however, a subtle difference was expressed by BLW and TW mothers around their role as food providers, with the TW participant identifying herself as playing an active role in encouraging *consumption* rather than just provision of a balance of nutrients during the meal itself. This contrasts with the talk of BLW participants which privileged the idea of the infant autonomy to select what he or she wanted from what was provided: "*He gets to choose what he's eating"* (Laura, BLW). Within this BLW mothers offered a balanced 'buffet' but it was up to the infant to choose 'wisely' from this.

Ideas about balance and nutritional needs were also expressed by mothers from both groups in terms of balancing the meal (or course) according to previous intake. Here food choices served a complementary or compensatory function: *"If he's had a lighter first course I might think oh I'll give like a rice pudding, […] it's based on what I think he's had over the day, so if I think, if he hasn't had any milk that day I might do rice pudding because that's like a healthy thing to have, or if he hasn't had much fruit that day I think I'd give some fruit then"* (Maggie, TW); *"We went out […] for lunch, so she had like a chicken breast and tomatoes while we were out at the meal, so I just gave her some fruit for tea when we got home"* (Laura, BLW). Thus, mothers consciously surveyed the daily balance of foods in terms of what was offered between dessert and main courses and what was eaten later in the day in relation to what had been eaten earlier. The idea of the 'heaviness' of courses and meals was apparent within this, with mothers also describing the balancing of lighter and healthier foods with heavier, more energy dense ones. As such, mothers expressed some lay sense of the need for balance in their infants' diets, a sense of what this should look like, and of their infant's likely need for larger or smaller meals.

Notions of compensation were also evident in both groups' comments about the role of milk (whether breast or formula) in compensating for potential deficits in the consumption of solids. This was particularly evident as infants consumed less milk as they entered their second year, and was a cause of anxiety for some mothers in terms of meeting nutritional needs: *"It's now that I worry more that he's not eating enough than I did back then because I kept thinking, no, he's having his milk, he's having plenty of milk"* (Laura, BLW); *" Cos you always have a back-up don't you with formula that it's got, they've lived off it for six months so they've got to be, gonna be fine, but with, when I took her off […] it is all […] worrying I suppose"* (Suzie, TW). In both cases, milk was seen to provide an important 'insurance' function in relation to nutrition, with mothers' responses to decreased milk consumption suggesting a lack of confidence in solid food to meet nutritional needs and worries about the infant not getting 'enough'.

Both TW and BLW mothers' talk about nutrition and food choices also showed their alertness to the role of early food choices in fostering healthy eating habits. Two aspects were evident here; firstly, mothers chose foods they felt would encourage healthy eating as infants got older: *"The old fruit 'incentive' plan "*(Katie, BLW), *"Give them like sticks of broccoli and things […] give them things that you want them to eat later on in life"* (Keira, TW). Secondly, as may be expected, mothers from both groups spontaneously talked about restricting the intake of unhealthy foods: *"She doesn't really have any chocolate or anything like that, any sweet things like that still, no"* (Suzie, TW); "*So I'm trying my hardest, and I know I can't do it forever, but certainly to avoid chocolate and very sugary things"* (BLW). Thus, both BLW and TW mothers were attuned to messages about healthy eating and their role as parents in shaping their infants' eating habits.

7.3.3 Theme 3- Eating rules

As interviews progressed it became apparent that decisions about infant foods were shaped by a number of implicit rules, values and beliefs. This was especially the case in relation to TW mothers' accounts of the use of sugary foods. Some mothers considered it appropriate to allow access to sugary food if the family was 'out' but not in the home context: "*She doesn't have ice cream here, she'll have it if we're out"* (Suzie, TW); *"If we're out for dinner and somebody has ice cream or something then I'm more than happy, she has ice cream"* (Emily, TW) or if the sugary food was being consumed by the parent: *"Like a KitKat or something […] I give her some of mine then, but I don't offer it her […] she just has some when*

I'm eating it really" (Suzie, TW). Infant age and time of year also shaped judgements about the acceptability of sugary foods: *"She's that bit older and it's just been the summer so she'll have Mini Milks and things"* (Emily, TW). The same mother also commented that she was happy for her baby to have puddings (i.e. desserts other than fruit and yoghurt) at nursery even though she did not have them at home: "*I would have been able to request that she didn't have puddings but I thought if she was sat in an environment with other children that it was better that she had what they were having"* (Emily, TW). As such, rules around access to sugary foods appeared to be influenced by a number of social customs such as having 'treats' when out, the drive to share treats, the 'norm' of eating ice cream in the summer, and importantly, the need for the infant to be included in social eating experiences.

On the whole, reference to the provision of sugary foods and occasions when these were permissible featured more in TW mothers' interviews than those of BLW mothers. One BLW mother though indicated that 'rules' around consuming sweet foods operated outside the home, as well as within it. This mother requested that her infant not be offered sweet desserts at nursery: "*At nursery I've asked them, because they have things like crumbles and custard […] I'd rather her just continue to have fruit and yogurt for pudding"* (Eleanor, BLW). However, the same mother also indicated that she did not want her daughter to feel different to other children at nursery and so the request to avoid puddings at nursery should only stand: "*Until she knows that she's having something different to the person next to her".* This desire for 'parity' for her infant with what others were eating, also extended to her own food choices, as Eleanor commented that she had changed her own eating habits in relation to sugary foods. She felt it unfair that she should have these and her daughter should not: "*If we're having a chocolate biscuit and she's having a rice cake, we can't do it anymore"* (Eleanor, BLW), thereby conveying the importance of 'equality' between infant and parent for this mother. This contrasts with a delineation between what was considered appropriate for adult and children's consumption of sugary foods in some TW mothers' accounts: *"She's never really offered chocolate […] we eat chocolate but it tends to be when she's in bed"* (Suzie, TW); *"He wants everything that everyone else has got. If somebody's drinking a can of Coke, I'm like 'No you can't have that"* (Christina, TW). in this instance though Eleanor, the BLW participant, also commented that a chocolate biscuit would be acceptable if restricted to 'snack time', again suggesting that the use of sweetened foods was acceptable in specific situations, even where mothers had a strong intention to avoid such foods for health reasons. These comments reflect the need to be pragmatic and to "belong" within a social setting, despite stated intentions to restrict sugar

Norms and rules about sweet foods were also evident in relation to the specific issue of dessert. In some families this was offered routinely: *"I always offer some fruit or fruit and yogurt after a meal"* (Eleanor, BLW); *"I'd always give her the option of a dessert*" (Emily, TW) whereas in others it was not: "*I tend to just give her vegetables or fruit (during the main course) […] because we don't really eat desserts*" (Lily, BLW). For the latter mother then, the provision of a (healthy) sweet food in the form of fruit was acceptable, despite the absence of a specific dessert course.

For some mothers, *access* to dessert, or certain kinds of dessert depended on eating 'rules', rather than hunger or nutrition driving food choices, e.g. the provision of dessert being contingent on the main course having been eaten. Again, this notion was more prevalent in the talk of TW mothers: "*Having your pudding's the reward for eating all your dinner isn't it? You know, or the majority of your dinner*" (Christina, TW); "*The children know […] if they don't eat that there's no pudding. It's just fruit"* (Jess, TW). However, one mother expressed the opposite view and some discomfort with the idea of using dessert coercively: "*I try not to use dessert as a treat […] I don't do that at all really, it doesn't really sit right"* (Maggie, TW). Another participant commented that she was happy for her baby to have sugary desserts as long as this did not happen frequently, i.e. everything in moderation: "*It's not that I've got a problem with her having them but I don't want her to have them really frequently*" (Emily, TW).

Across both groups, mothers' accounts reflected a common notion of healthy and unhealthy desserts. Fruit and yoghurt were regarded as healthy, and to some extent, not 'real' desserts or "*Pudding, puddings"* (Emily, TW). Yoghurts were used by almost all participants, and most mothers did not express concerns about, or sometimes acknowledge, the relatively high sugar content of these : *"She wouldn't necessarily have a sugared pudding, it would be yoghurt, yeah"* (Jess, TW) although one mother commented that sugar in yoghurt was acceptable given its other nutritional attributes : "*If she's having the yoghurt and if that's where the sugar is I'm quite happy […] it's a healthy dessert isn't it, even though it does have a lot of sugar […] it's full-fat, it's got calcium in it"* (Emily, TW). For another mother, the calcium content of yoghurt was also seen as compensating for her infant not drinking much milk: *"Even now we have lots of yoghurts because she's not a milk drinker really so I need to get a bit of calcium in her"* (Jess, TW).

Another issue which shaped choice of infant foods was the notion of ‘proper food’. Two key ideas were expressed here: processed food as not ‘real food’ and the need for infants to eat a ‘proper meal’ rather than being provided with snacks. Both BLW and TW mothers valued home cooking over convenience foods for themselves and their infants: “*We like to eat whole foods, we like to eat natural foods, we like to cook our food ourselves, we try and avoid processed foods where possible”* (Katie, BLW); *“I wouldn’t give her anything, even now, like ready meals or I try to, I do the majority of my cooking from scratch”* (Suzie, TW). To some degree, this preference appeared to arise from a distrust of processed foods and suspicions about what they contained: “*I don’t know what’s in them that’s necessarily bad for her […] I don’t understand half the ingredients, it can be called all sorts of weird things […] I don’t know if that’s any good for her”* (Suzie, TW).

Ideas about ‘proper meals’ tended to revolve around consumption of the main course. Like access to desserts/ sweet foods, decisions about providing snacks were sometimes shaped by infants’ performance on the main course. Here both poor and good consumption were offered as reasons for not providing snacks by BLW mothers. One mother commented that she did not provide snacks because her daughter generally did not eat her main meal: “*When she got down she went straight to that cupboard where all her like raisins and stuff like that are and kept bringing me different packets of stuff […] - no you’re not having it, you’re just throwing all your dinner on the floor, it’s not happening”* (Rebecca, BLW). Another mother commented that she did not give snacks because her daughter was a ‘good’ eater and therefore did not ‘need’ additional snack food: “*I think well actually Ella’s eaten a brilliant breakfast, you know, she actually doesn’t need (a snack)”* (Katie, BLW). For this mother, the provision of main meals was seen as sufficient to meet the infant’s energy requirements. However, she also expressed general concerns about her baby’s intake and doubts about the infant’s appetite regulation. As such, the decision to limit snacks was part of a broader decision to limit intake: “*I started thinking is she self-regulating because she ate that much that day that you know”* and *“I think we have to maybe think a little bit more about her portions. So, it is something that we put more thought into now”.*

For another participant, the reason for avoiding snacks related to her desire to discourage ‘grazing’ (eating snacks, rather than meals) which she viewed as impractical, and not the ‘correct’ way to eat: “*Joshua was much happier grazing all day than he would be to have three meals a day, but it’s just not practical”* (Christina, TW). This view was also based on ideas about normative eating patterns: “*Rather than sitting having a meal like we do, you* *know, breakfast lunch and dinner […] you try and get them in that routine"* (Christina, TW). Another mother similarly identified the importance of 'proper eating' in relation to the division of meals into mains and desserts: "*I don't really do this thing of giving all the food at once, because I don't feel like that doesn't really happen in life, like culturally you get your first course and then you get your pudding"* (Maggie, TW). Here then, mothers' ideas reflected beliefs about *when* different types of food should be given as well as *what* types of food should be given.

Taken together, comments about infant food choices revealed that a wide range of explicit and implicit beliefs, values, norms and rules influenced decisions about the provision of different foods, when these were consumed, and how often. Within this, decisions about the provision of sugared foods and desserts and type of dessert were especially rule bound and subject to differing values and beliefs. In this area, CF approach seemed to be a factor. TW mothers expressed a diversity of views on when sugary foods were and were not acceptable, while BLW mothers generally did not refer to the use of such foods at all. Meanwhile, for the one BLW mother who did discuss this, sugary foods were seen as something to avoid as much as possible.

7.3.4 Theme 4 - Liked foods

In addition to concerns about nutrition and healthy eating, infant preferences were key determinants of the foods that mothers provided. Both BLW and TW mothers emphasised this *"She's very meat and veg, or pasta and anything meat and pasta-based, she absolutely loves it so we do a lot of, we do different minces […] and things like that* "(Suzie, TW). Mothers were also alert to foods that their infants appeared interested in and used this interest as a mechanism to drive their provision of foods: *"If it's been on our plate and she's shown an interest, we've given it to her "(*Eleanor, BLW). Infant interest was also a determinant of the amount of a certain food given: *"Sometimes he'll like just be all about the carrots, carrot-carrot-carrot and so you like keep putting more and more carrot on his tray"* (Laura, BLW); "*I guess the more she takes of it* (red pepper) *the more I'm just gonna keep putting back on her plate"* (Lily, BLW). As with the giving of desserts, sometimes less healthy food options were also provided to infants on the basis of them enjoying them: "*She has sausages occasionally and baked beans and yeah, she really, really likes those but then it tastes nice, doesn't it?"* (Emily, TW).

While infant enjoyment was a key factor in mothers' use of liked foods, food preferences were also used more consciously to meet other feeding aims. For Rebecca, whose infant was a poor eater, liked foods were given as a means of boosting intake: "*I do give her different stuff but there's the old favourites that you sort of like, you know, she's going to eat"* and, *"It's another way of getting more food into her rather than sort of just stopping the meal there"* (Rebecca, BLW). Meanwhile, other mothers identified that they used liked foods as a platform for introducing new foods i.e. liked foods were given in combination with new foods to increase the infant's eating repertoire: *"Ella really liked carrots so then I'd add carrots with other things because I knew she'd like that"* (TW); *"So she loves peas and she loves pasta so often times at meals I'll try and mix in maybe something that she's oh, you know, kind of take it or leave it with things that she really, really enjoys as well and maybe there'll be a bit of an association there"* (Katie, BLW).

Thus, for both BLW and TW mothers, food preferences were an additional factor determining the foods that infants were offered. Importantly, mothers in both groups also reported using such preferences as a means to extend the infant's acceptability of other foods.

7.3.5 Theme 5 -Family food

Family context also impacted on the foods mothers chose for their babies. To a large degree, this determined what was available to infants, with both BLW and TW mothers identifying that their infants ate what they ate: *"It was always just generally what we're having, yeah"* (Lily, BLW). Often this was because the infant ate with the family: *"Hannah is always included in the family meal. So, I kind of guess that we never really introduced things one at a time, she just had everything that we all eat"* (Jess, TW), although the same principle of family foods also applied when infants ate separately from their parents. This was as a consequence of the need for infants to fit in with other family member's routines: "*If I made a shepherd's pie for tea for us, then I made a big shepherd's pie for him and froze it all* (for the baby's lunches)"(Suzie, TW); *"She usually had whatever we got left over from tea"* (Keira, TW); "*It's also got to be something that Jason (partner) can have later so I do a lot of casseroles and things in the slow cooker and lamb hotpot […] we'll have ours and then he can warm his up later"* (Suzie, TW). Choice of infant food therefore depended on meals that could be eaten by others, or food that could be easily re-heated.

In discussing family foods, mothers were also alert to the role that these could play in restricting infant eating habits. For some mothers though this awareness arose 'after the fact': "*He'll eat some fish but not all the time, and he doesn't eat pieces of chicken, sausage or whatever, […] but it's not stuff that we eat a lot anyway so it's not stuff that I typically sort of have in the house […], so then I think maybe I've limited him in the past"* (Maggie, TW); "*The child-minder says she doesn't like eating sandwiches and I think it's not something we have in our diet and I think that might be why*" (Jess, TW). For others though, worries about restricting infant diet by parental preferences led them to the deliberate provision of foods they themselves did not like. This was particularly the case with BLW mothers: *"I gave her some avocado and I thought I'd try a little bit 'cos I'd never eaten it before and it was the most repulsive thing I've ever tasted […] but she loved it"* (Lily, BLW). Another BLW participant who disliked fish, and did not want to have to prepare it, commented that she used tinned fish to get around this problem: "*I just wanted to offer her something that didn't involve me having to prepare fish but that I could give her quite easily and so* (tinned) *mackerel became the option"* (Katie, BLW). In the latter case, nutrition seemed to be a key driver for the provision of fish: "*I just wanted to give her another oily fish*" (Katie, BLW), though in the case of the former mother the motivation appeared to be the desire for her infant to be exposed to different food experiences despite her own and her partner's preferences: *"I try to give her things, not just rule it out because we don't like it"* (Lily, BLW).

Thus, across the groups, the mothers reported working hard and thoughtfully to broaden their infants' palate (sometimes more so than their own) whilst also providing meals that would work for the whole family.

7.3.6 Theme 6 - Variety and exposure

Many mothers emphasised the need for variety in their infants' diets. A number of reasons were given for this. One mother commented on giving her baby the opportunity to try different things: *"Different types of fish so that she could try different textures and tastes of fish"* (Eleanor, BLW). To a large degree though, variety was seen as a means of preventing food fussiness. For mothers from both groups infancy was viewed as a window of opportunity for exposure: "*Exposing her to lots of different tastes which, […] will hopefully mean that, as she gets older, she will be more accepting of lots of different tastes and textures"* (Eleanor, BLW); *"I thought it was really important to expose her to as many tastes and textures when they're willing to try new things in the hope that as she gets older we'll* *have less of an issue with fussy eating"* (Emily, TW). In discussing exposure, mothers were also alert to the importance of repeated exposure and they identified that they would repeatedly offer foods which infants initially would not accept: "*Bananas are something that she wouldn't eat for months and I kept on buying them and giving them to her but she didn't eat them and then... and I don't like bananas and so but now Ella would quite happily eat bananas all day long"* (Katie, BLW); *" I think it would just keep coming back out 'cos I think they have to taste it so many times don't they before they do officially not like it"* (Jess, TW). Within this then, mothers expressed their awareness that infant taste preferences were malleable to some degree and described being motivated to do what they could to avoid current or later food refusals.

As well as expressing shared ideas about the importance of variety for exposure, BLW and TW mothers' accounts indicated that variety also served different functions for the two groups. For BLW mothers, the perceived need to provide variety was also linked to notions of infant choice: *"He gets to choose what he's eating and it's not an overwhelming choice, it's just, oh yeah, I'll eat that now"* (Laura, BLW); "*I don't know why but I try and give her three things at each meal just so she's got a bit of choice"* (Lily, BLW); *"I've done everything that I could to give Ella a varied diet and then she'll make her own choices"* (Katie, BLW). BLW mothers then, emphasised the importance of variety within meals as a vehicle for providing infant choice. The comments of some TW participants meanwhile, emphasised the need for variety between meals with previous meals shaping foods that were offered on subsequent days: *"I had a variety of different things going on in the freezer. I just took them out every morning and thought, […] you had shepherd's pie yesterday oh well I did him spaghetti bolognaise for dinner today' or I'd give him fish pie for tea"* (Christina, TW); "*I try and think what he's had recently [...] like last night I thought well he hasn't had any meat for a while so I gave him some mince that I had in the freezer "*(Maggie, TW). Choice and variety therefore were seen as a means of maintaining interest for the infant and reducing boredom rather than only being concerned with meeting nutritional needs: *"I think she's just bored of Cheerios and I was gonna try her on some different cereal, so I'm trying to mix it up a bit, give her something different every day"* (Suzie, TW).

Two TW participants also commented that they used variety strategically as a means of 're-booting' infant appetite or to encourage continued eating: *"I'll try her on something new to set her off"* (Lily, TW); "*I'd sort of have like the main bit of the dish and then give him a few other bits, and then I might give him a bit of biscuit or a bit of yoghurt, a bit of this, just to* *see, and sometimes he'd have more of one, […] sometimes then he'd have like a good helping of something else"* (Maggie, TW). This notion of using variety to 're-boot' appetite was also evident to some degree in BLW mothers' accounts with one mother commenting: "*I was giving him some sandwich back because he'd like really had quite a lot of fruit and I just thought, well now he's in the eating mode see if he'll go back to his sandwiches again*" (Laura, BLW).

7.3.7 Theme 7 - Being practical

A number of practical considerations shaped what food was given and how this was provided. Physical location was a consideration for mothers in terms of the practicality of consuming certain types of foods. Portability was important when families were out and about. Here one mother talked about her preference for individually wrapped portions of cheese: "*It was picking foods that were easy to just shove in a bag and go"* although she also noted that part of the appeal of these was their marketing: *"If I bought […], a block of Edam and chopped it, it would be cheaper, but you get wrapped up in the whole, it's just the marketing […] they're little, they're kids' sizes and they're easy"* (Suzie, TW).

Another key factor in determining mothers' food choices was their babies' individual attributes. Issues such as food allergies placed significant constraints on what one mother could feed her infant: "*He had a milk allergy […] so at the time, it used to lower choices down massively"* (Christina, TW), while infant age/development affected food choices more broadly. BLW mothers in particular were mindful of issues such as infants' manual dexterity in the foods they offered: *"I need to try and pick something that's healthy but something that she can pick up easily"* (Lily, BLW) while TW mothers' food choices related more to their infants' ability to chew and manage lumps: "*I'm giving her apples and she tries to bite into satsumas now […] and I gave her chicken drumsticks to gnaw on"* (Suzie, TW).

Management of the meal was another practical issue which shaped some mothers' food choices. Many mothers, whether using BLW or TW, were in the habit of providing infants with small quantities of finger foods while they prepared the main food for the meal. This practice was primarily concerned with keeping infants occupied and settled to free up mothers to prepare the rest of the meal: *"Bits of cheese and banana and stuff like that, just to keep them occupied as well whilst you're doing stuff, getting it ready and that"* (Keira, TW). For another TW mother, finger foods were provided more as a means of keeping the infant occupied: *"It stopped him from getting a bit sort of, I don't know, bored while you were sat* *spoon feeding him".* This also served the purpose of keeping the infant 'on board' with eating: *"'Otherwise they just turn their heads away and around"* (Christina, TW). Another TW mother, however, offered her infant finger foods alongside the main meal from the outset of CF in order to expose the infant to food in a different form as well as a means of gauging when her baby may be ready to start self-feeding: "*I also thought […] it would give me a better indication of when she was ready to start feeding herself because I'd be able to see when she was being more successful picking it up and putting it into her mouth […] so I suppose that's the main reason I did that"* (Emily, TW).

Thus, finger foods were given for a number of reasons beyond the basic function of feeding. This applied largely to TW mothers, but it was also evident to some extent in BLW mothers who used finger foods at the beginning of a meal to keep infants occupied while they prepared other foods.

7.4 Discussion

This analysis explored factors which shaped mothers' choice of infant foods and mothers' reasons for food choices in both BLW and TW contexts. Participants talked about a wide range of issues influencing food choices, several of which went beyond the need to meet energy requirements and nutritional needs. There were many similarities in food choices and reasons for these between BLW and TW mothers, but also, apparent differences between the two groups. This discussion will consider the influence of the feeding context on food choices and the strategic use of food to meet feeding aims. It will also consider findings in relation to those of other studies and implications of these for understanding mothers' food choices.

7.4.1 The feeding context

The feeding context was an important feature of mothers' accounts with a range of contextual issues shaping infant food choices including: location, social context and the context of what the infant had consumed on a particular day or within a particular meal. Feeding context was also 'infant specific' with several mothers referring to their infants' attributes (e.g. infant feeding traits and preferences) as shaping food choices. Such attributes also contributed to decisions to restrict access to snacks in the case of two BLW participants as a result of concerns about infants' under or over-eating. This is consistent with previous evidence of BLW mothers ‘renegotiating’ the principle of being ‘baby-led’ to exert control over infant intake (Arden & Abbott, 2015).

Infants’ developmental abilities also shaped food choices for both BLW and TW participants. Mothers made less explicit reference to infant age, although two mothers’ accounts (one BLW and one TW) indicated that rules around the consumption of sugary foods could be loosened more in the context of feeding an older rather than a younger infant, particularly where the infant was old enough to be aware of differences between what they and others were eating. This resonates with Schwartz et al. (2013) who found French mothers were willing to allow their infants to taste less healthy foods but tried to delay this until infants were older.

Location also appeared to be influential in the ‘loosening’ of rules around the consumption of sugary foods. This was especially the case for TW mothers concerning the consumption of sugary foods, though mothers from both groups also referred to the impact of location on salt consumption and access to snacks. Consistent with Boak et al. (2016), mothers in the present analysis showed greater flexibility around the consumption of less healthy food in outside of the home, with social context particularly impacting on mothers’ willingness for their children to consume sugary foods.

Social and cultural context also shaped both TW and BLW mothers’ feelings about what constituted proper meals and feelings about deviating from cultural norms, for example, regarding the inclusion of fruit or sweet foods in main courses. Arguably, social context was also apparent in the beliefs and principles underlying mothers’ chosen feeding approaches. This is discussed further below.

7.4.2 Food choice as strategy

An unexpected finding from the analysis was mothers’ use of food attributes to achieve aims beyond those of nutrition, for example liked foods being used as a platform to introduce new foods and variety being used to encourage intake. Such strategies were used by mothers from both groups. Importantly, this finding regarding strategic uses of food is novel for infant feeding studies, although the use of liked foods has been reported as a means of increasing consumption in young children perceived to be picky eaters (Johnson, Goodell, Williams, Power, and Hughes, 2015).

Mothers from both groups also used finger foods strategically as a means of managing aspects of the meal e.g. infant boredom, or again, to keep the infant eating. This offering of foods with different sensory attributes to encourage continued eating, is consistent with the principle of SSS, with some mothers in the current analysis apparently using this 'unknowingly' to promote eating. This finding has not been reported previously in relation to either infant feeding or the feeding of older children.

For the most part, it was TW mothers that reported using specific foods to encourage eating or to increase intake. This is consistent with Brown and Lee's finding (2011b) of higher levels of concern about intake in TW, than BLW mothers. However, the present analysis indicated that BLW mothers also used liked foods and variety to encourage intake, though less coercively than some TW participants. That is, variety and liked foods were offered, but it was up to the infant to choose to consume them.

Like TW mothers, BLW mothers in the current analysis offered variety for the purpose of exposure and to prevent food fussiness, but, also to promote infant choice. BLW mothers also appeared to be more inclined to offer their babies foods that they themselves did not eat, thereby reflecting an implicit idea in BLW; i.e. that mothers' role is to provide infants with wide ranging feeding experiences to promote exploration and infant autonomy (Cameron, Heath & Taylor, 2012). The desire to provide wide ranging feeding experiences for reasons other than exposure was also apparent in the accounts of TW mothers' as it was given by one TW mother as a reason for the relaxation of eating 'rules' in different eating contexts. However, the emphasis here was on inclusion in social aspects of eating rather than exploration as such. Thus, infants' eating 'experience' was generally less of a feature of TW mothers' reports of food choices than those of BLW participants.

Food choices were also used strategically by mothers in this analysis to achieve balance between different meals or courses with participants adapting meals and courses according to previous intake. This has not been reported previously but it is reminiscent of reports of BLW mothers providing flexibility around infant intake of breast milk and solid feeds so that these complemented one another (Arden & Abbott, 2015; Brown & Lee, 2013). Importantly, both BLW and TW mothers in the present analysis also expressed the idea of milk (whether formula or breast) as having an important compensatory or insurance function. Furthermore, where milk intake was low, other foods such as yoghurt were used to ensure calcium intake, again demonstrating the role of ideas about compensation in shaping food choices and of mothers' sensitivity to certain nutritional ideals.

7.4.3 Infant food choices in this and other studies

Compared to many existing studies, participants in this analysis were largely older, and highly educated and the foods that they reported using were consistent with those reported for mothers of the same demographic background, with a particular emphasis on healthy eating and the provision of fresh fruits and vegetables (Robinson et al., 2007; Smithers at el., 2012). Mothers' accounts of food choices from the analysis also support reported associations between maternal and infant diets, with many mothers identifying that their infants ate what they themselves ate. In addition, infant food choices reported by BLW mothers again reflect reported associations between BLW and the provision of home cooked, family meals (Brown & Lee, 2011a; Cameron et al., 2013). TW mothers' accounts were not consistent, however, with reported associations between TW and commercially produced infant foods (Brown & Lee, 2011b) as TW mothers made almost no reference to using these. This is likely to arise from the relatively homogeneous nature of the sample, with TW and BLW mothers coming from relatively highly educated backgrounds, and therefore, being less likely to use pre-prepared infant foods (Smithers et al., 2012). As such, it may be that reported associations between BLW and certain infant diets are more reflective of BLW mothers' demographic characteristics, than being directly associated with the approach. Findings from this analysis though indicate that attitudes towards the use of sugared foods and sugary desserts may differ between BLW and TW mothers. While both groups aspired to limiting the use of such foods, TW mothers appeared more comfortable and pragmatic than BLW mothers about their occasional consumption. The reason for this apparent difference is unclear, although it may be related to more idealised aspirations for infant feeding on the part of some BLW mothers (Arden & Abott, 2015). Regardless, this is an important observation, as we know that the restriction of sweet foods may increase their appeal to children (Deve et al., 2009; Hurley et al. 2011; Jansen, Mulkens, Emond, & Jansen, 2008) and therefore may not be productive for encouraging healthy eating habits.

7.5 Evaluation

Despite the insights generated from this analysis, it has a number of limitations. These are largely as reported in Chapter 6, i.e. sample size and sample homogeneity. Food choices, and reasons given for these here, are likely to reflect the sociodemographic and cultural characteristics of the sample, and therefore, may not be applicable to other groups. However, many findings are consistent with those of previous studies. In addition, this analysis has produced insights into factors affecting food choices which have not been reported before. This is likely to have resulted from the use of video elicited interviewing which enabled mothers to reflect on food choices proximally, rather than distally to feeding, as would have been the case in a 'standard' interview. Within this, mothers were especially able to comment on highly dynamic food choices made in the context of the specific feeding interaction, for example the practice of offering of a different type of food to 're-boot' appetite and to prolong eating. This highlights the utility of video elicited interviews for accessing 'unseen' and previously unreported processes.

7.6 Conclusion

BLW and TW mothers in the analysis reported similar concerns in their choice of infant foods and many common themes emerged between the two, for example, in relation to providing a variety of healthy, nutritious foods and the use of exposure to prevent fussy eating. Some differences were identified in food choices and feeding practices. These appear to reflect differing ideas and priorities about infant autonomy, maternal role in relation to feeding and the experience of feeding for the infant. BLW mothers in particular emphasised the importance of food choices in promoting learning and exploration. Within this, they saw themselves as facilitators of feeding experiences with infants having the autonomy to make their own food choices. In contrast, the accounts of some TW mothers placed greater emphasis on their role in ensuring consumption (rather than just provision) of a balanced intake.

The finding that mothers used food for purposes other than meeting basic feeding needs is an interesting one which has implications for the development of responsive feeding interventions. In particular, it reveals how some mothers from both groups used food attributes and preferences to encourage intake and that this could operate either positively or negatively. For example, while the use of variety may be helpful for encouraging intake in poor or fussy eaters, its use to cajole infants into eating more than they otherwise would, contradicts responsive feeding principles and the development of healthy eating habits. The latter practice appeared more in the accounts of TW, than BLW mothers. However, BLW mothers' accounts referred more to the use of restriction. This is important as both coercion and restriction can be seen to contradict responsive feeding principles and may impact negatively on the development of children's feeding habits. As such, the relative use of coercion and restriction by TW and BLW mothers merits further investigation to establish if it reflects a broader pattern of difference between groups.

In summary, findings provide important insights into the way that BLW and TW mothers make decisions about what to feed their infants and point to subtle relationships between CF practices, food choices, food uses and responsive feeding.

Chapter 8 - "An invisible map" - maternal perceptions of hunger, satiation and 'enough' in the context of baby led weaning and traditional spoon feeding.

8.1 Introduction

This chapter describes the final analysis for Study 3 and findings from this - the qualitative exploration of maternal perceptions of hunger, fullness and 'enough' in BLW and TW feeding episodes.

8.1.1 The need to understand maternal perceptions of hunger and satiation in different CF contexts.

Responsive feeding depends first on a mother's ability to recognise hunger and satiation signals and second on receptiveness to following these. It has been proposed that BLW mothers feed more responsively, worry less about infant intake and are less controlling in their feeding practices than TW mothers (Brown, Jones & Rowan, 2017; Brown & Lee, 2011a). However, the evidence for such claims is limited, as is our understanding of how mothers in general interpret cues and use them to determine their feeding practices. A fuller appreciation of any differences or similarities in how TW or BLW mothers perceive and use infant feeding cues would enhance our understanding of responsive feeding and possible obstacles to this.

8.1.2 Perceiving and responding to infant hunger and satiation

There is evidence that mothers can identify a wide range of feeding cues in infants of different ages (Hodges et al., 2008; Skinner et al., 1998). However, studies also suggest that the interpretation of cues is not straight forward, with infant characteristics such as birthweight, temperament and sex affecting how cues are perceived (McNally et al., 2016) and associations having been reported between mothers' own characteristics and responses to their infants (Gross et al., 2010). Despite this, little is known about *how* mothers make sense of feeding cues and what determines responses to these, particularly within CF. Studies in milk feeding and early CF contexts provide some insights into influences on feeding perceptions and responses. Price, et al. (2012) analysed telephone discussions concerning obesity prevention between health professionals and 60 mothers of infants aged 0-6 months. Mothers identified two main challenges in deciphering infant feeding state: firstly, contradictions between expectations and observations of infant behaviour e.g. the observation of ongoing hunger cues despite infants having just been fed. Secondly, the short duration of some breastfeeds: even where infants were growing appropriately, meant mothers viewed short feeds as inadequate. This led them to offer formula after breastfeeds. Participants also reported the use of night feeds in the absence of infant hunger, to settle the baby. This was especially true when mother themselves were tired. Such findings highlight the complexities of interpreting hunger and satiation cues and the role of drivers other than infant hunger in shaping mothers' feeding responses.

Research into the introduction of CF has also demonstrated the impact of infant night time waking on mothers' feeding perceptions and responses. Heinig et al. (2006) conducted focus group interviews with 65 low income mothers of infants aged 4-12 months old regarding infant feeding practice beliefs. Again, participants identified both night time waking and infant crying as indications of hunger, and, expressed the view that these could be remedied if babies were full. This in turn led to the early introduction of solids. The authors also found the idea of infant satiation was highly valued by participants, while perceptions that babies were not getting 'enough' led to anxiety and the replacement of breastfeeding with formula feeds. Mothers also reported practices such as giving additional food to infants if they felt they would not be full for long enough and adding food from baby jars to night time bottles if infants had not consumed all the contents of a jar during the day. Consistent with Price et al. (2012) then, perceptions of infant hunger in this study were influenced by beliefs that infants *should* be full and that satiation would lead to a settled infant who would sleep well.

Bentley, Gavin, Black and Tedi (1999) also explored feeding practices and beliefs in interviews with 19 African American mothers aged 13-20 with infants between 0 and 24 months. They found decisions about early CF to be heavily influenced by cultural beliefs about infant hunger; for example, infants who were considered small for their age were perceived as needing to be 'fed up' while some infants were perceived as 'greedy' and 'needing' more food. Consistent with the findings of Heinig et al. (2006) and Price et al. (2012), they also found behaviours such as crying and night time waking were viewed as hunger cues. Importantly, the young age of mothers in this study was another key factor in shaping feeding perceptions and responses, as mothers invariably relied on their own mothers' and grandmothers' for feeding advice. Thus, interpretations of infant hunger and responses to this were shaped by the high value placed on satiation, the need to keep infants settled and cultural understandings of infant hunger and satiation.

Work by Jain et al. (2001) further highlights the role of factors other than child hunger in shaping maternal' feeding responses, though in a pre-schooler context rather than in infancy.

Focus group discussions of barriers to obesity prevention with 18 low income mothers of 2-4-year olds with BMIs ≥ the 85th centile, indicated that mothers fed their children for several reasons other than perceived hunger. In particular, participants reported experiencing difficulty in restricting the provision of food to children with avid appetites, even if they had just eaten. Mothers also identified the emotionally rewarding nature of feeding as leading to a reluctance to constrain their children's eating. Jain et al. (2001) also noted that this reluctance may have arisen in part from mothers' use of food to manage or reward behaviour. Importantly, such findings highlight the fact that feeding may occur for numerous reasons and despite an absence of perceived hunger cues.

8.1.3 Maternal perceptions of 'enough'

Evidence to date suggests that mothers' perceptions of what is 'enough' for their infants, like perceptions of feeding cues, are likely to be shaped by a range of issues. However, the specific question of what mothers of infants consider to be enough has not been examined. It has received some attention in the context of preschool children. Here the emphasis has been on how mothers determine how much to provide, rather than how they decide when their children have consumed enough. Johnson, Goodell, Williams, Power and Hughes (2015) conducted interviews with 30 low income mothers of children between two and five years of age as they prepared a typical meal for their child in a laboratory setting. Maternal assessments of how much was enough tended to be based on whether children were perceived as 'good' or 'picky' eaters. Where children were perceived to be 'good' eaters, judgements of enough were based on what else children had eaten in the day, as well as nutritional balance. Mothers of picky eaters, however, determined what was "enough" by estimating what they believed their child would accept. In both cases, mothers reported knowing the 'right' amount for their child according to their experience of them. Decisions about how much to provide were also made on the basis of preventing children from becoming hungry again a short time later.

Few other studies have addressed the question of how parents determine what is enough for their child, either in terms of how much to provide, or how they judge adequate intake. However, evidence from a study of feeding practices by Jacquier, Gatrell and Bingley (2016) is consistent with that of Johnson et al. (2015). They interviewed 19 male and female mixed income caregivers of children aged between one and five years. Participants found it hard to articulate how they determined what was enough. However, issues such as experience of their child and what they anticipated their child could eat appeared to influence what was provided. Another interview study with 26 mothers of two-year olds by Spence, Hesketh, Crawford and Campbell (2016) also provided insights into mothers' assessments of enough. Issues such as perceived 'poor' eating and child age (younger rather than older) were reported to cause concern about the sufficiency of intake and led mothers to encourage children to eat more.

Taken together, the evidence suggests caregivers' interpretation of feeding cues, their feeding responses and perceptions of what is 'enough' are shaped by beliefs, experience, and child characteristics. However, findings to date regarding judgements of what is enough are limited to older children rather than infants. Furthermore, studies of interpretations of cues and feeding responses have been generated in research with largely low-income mothers and in apparently traditional (rather than BLW) CF contexts. As such, it is unclear if the issues identified apply to mothers with different demographic characteristics or across CF practices. The question of maternal perceptions and responses in non-traditional CF contexts is therefore explored further below.

8.1.4 Perceiving and responding to feeding cues in BLW

No studies have specifically examined maternal perceptions of hunger, satiation and what constitutes enough in the context of BLW although there is preliminary evidence of different feeding responses (lower levels of maternal restriction and maternal pressure to eat) in BLW than TW mothers (Brown, & Lee, 2011a; Brown & Lee 2015). Such evidence is limited to two self-report studies, however, findings from these raise questions about how, and why, feeding interactions in BLW may differ from those in TW. The proposed higher responsiveness of BLW may arise from BLW mothers being more attuned to their infants' signals and/or being more disposed to following these than TW mothers. Alternatively, or additionally, BLW may be a more responsive approach as a direct consequence of the greater infant control it affords (Brown, Jones, & Rowan, 2017). However, if this is the case, it raises questions as to how BLW mothers determine issues such as how much to offer, when to end meals and how they assess the adequacy of their infants' intake. While central tenets of BLW are infant led feeding and trusting infant intake, there are reports of a higher prevalence of both underweight and overweight in BLW children (Townsend & Pitchford, 2012). In addition, there is evidence that BLW mothers may adapt the principles of the approach where concerns about intake arise (Arden & Abbott, 2015). However, little is known about on what basis this happens. The issue of how BLW mothers interpret and act on their infants' communication of satiation cues, and how this differs from TW mothers therefore merits attention. Developing knowledge in this area would enhance our understanding of current feeding practices and how mothers manage these, with potential insights for professionals tasked with supporting mothers' feeding practices and for encouraging responsive feeding.

8.1.5 Rationale and aims

Notwithstanding research insights to date, there is scope to develop our understanding of maternal perceptions and responses to feeding cues in a wider range of contexts. Moreover, given that interviews into feeding perceptions and responses have largely been conducted away from the interactions to which they apply, there is scope to develop a greater understanding of the dynamic 'online' assessments that mothers make *during* feeding. As such, this analysis used video-elicited interviewing to explore maternal perceptions of hunger and satiation during a typical, realistic mealtime interaction. The analysis reported here aimed to explore perceptions of 'enough' and decisions about when to end meals in the context of different weaning practices.

8.2 Method

The same procedures detailed in Chapter 6 were used in this analysis. Interview questions relevant to mothers' perceptions of hunger and satiation were:

1. How mothers determined whether their baby was hungry or full

2. How they decided what was enough and when to end the meal.

8.2.1 Template testing

Two interviews (one BLW interview and one TW) were randomly selected and coded by a second researcher using the final template. Cohen's Kappa indicated moderate agreement between coders, κ =.427 (95% CI, .406 to .448), $p < .001$ (Landis & Koch, 1997) for the coding of text relating to infant food choices.

8.3 Findings

8.3.1 Reporting of feeding cues

BLW and TW mothers reported noticing many similar hunger and satiation cues (Tables 8.1 and 8.2). Differences were observed however in the range of satiation cues reported by the two groups, with TW mothers reporting a wider and more extensive range of these than BLW mothers.

Table 8.1 – Hunger cues reported by BLW and TW mothers

Mothers using BLW (n = 5)	Mothers using TW (n = 6)
Eagerness to eat	Eagerness to eat
Rapid eating	Rapid eating
Vocalisation	Vocalisation
Fractiousness/tantrum	Fractiousness/tantrum
Infant goes to get food him/herself	Infant goes to get food him/herself
Infant settled with food/absorbed in eating	Infant absorbed in eating
Continued eating	Tries to get into highchair
Agitation - food has run out	Will eat dessert if still hungry after main
Saying “Yum yum”	Infant grabs the bowl
Infant tries to latch on	Needs night feeds/ more day time breastfeeds

Table 8.2 – Satiation Cues reported by BLW and TW mothers

Mothers using BLW (n = 5)	Mothers using TW (n = 6)	
Drops/throws food	Drops/throws food	Fidgets, doesn’t want to stay put
Stops eating	Stops eating	Back arching
Messes about with plate or food	Messes about with plate or food	Climbs out of high chair
Gives food	Gives food	Spits food out
Agitation/fussiness	Agitation/fussiness	Refuses food/closes mouth
Boredom	Boredom	Shakes head/turns away
Says ‘all done’	Says ‘all done’	Pushes food away
Not ‘interested’	Not ‘interested’	Feeding becomes a struggle
Slowed eating	Slowed eating	Will not even eat liked foods
Decreased intake	Decreased intake	Kicks self away from table
Infant doesn’t seek food out	Infant doesn’t seek food out	
Stops part way though eating	Stops part way though eating	

8.3.2 Template themes

Three main themes were generated to capture maternal perceptions of infant hunger and satiation and how mothers determined when to end the meal. These were: 'deciphering'' 'enough' and 'strategies', each with a number of sub-themes (Table 8.3). The majority of themes and sub-themes were shared, though some differences were observed between groups in both.

Table 8.3 – Final Template – Themes and sub-themes for how mothers identify hunger, satiation and enough in t TW and BLW and numbers of participants contributing to each theme (in brackets)

Mothers using BLW (n = 5)	Mothers using TW (n = 6)
1. Deciphering (4) - Difficulty and guesswork (3) - Infant attributes – age, temperament, appetite (2) - Food preferences (1) - Continued eating (3) - Infant state – boredom (2) - Ambiguity/ need for certainty (1)	**1.Deciphering (5)** - Difficulty and guesswork (5) - Infant attributes – age (2) - Food preferences (1) - Continued eating (1) - Infant state – boredom/tiredness/ hunger (3) - Ambiguity/need for certainty (1)
2. Enough (3) - Offering enough (3) - Enough as sufficient (1) - Enough as not too much (2) - Infant decides enough (2) - Enough from a distance (1)	**2.Enough (6)** - Enough as sufficient (6) - Enough as not too much (1) - Infant decides enough (2) - Enough from a distance (3)
3.Strategies (5) - Gauging enough (5) - Infant reading (3) - Time and routine (3) - Overview (4) - Portions and measures (2) - Ensuring enough (1)	**3.Strategies (6)** - Gauging enough (5) - Infant reading (2) - Time and routine (4) - Portions and measures (3) - Ensuring enough (4)

8.3.3 Theme 1 Deciphering

Mothers from both groups reported numerous feeding cues exhibited by their infants, but also some difficulty in interpreting both hunger and satiation: "*Yeah, I mean it's all guesswork as well*" (Katie, BLW); "*It's just guesswork […] I don't think there's any way to know really, I can't ask him how hungry he is"* (Maggie, TW); *"I think you guess more at that age […] it wasn't an exact science"* (Christina, TW). This point reflected a common experience for both BLW and TW mothers, i.e. the specific difficulty of interpreting younger infants' cues: "*You always had to look a little bit harder I think to get her signals"* (Katie, BLW); "*At the time he couldn't (communicate hunger clearly). Well if he could, he was doing it very invisibly"* (Christina, TW); "*Really early it was quite difficult to know if they were full or not"* (Emily, TW). In contrast, two mothers reported finding it easier to understand cues as their babies got older. This arose partly from mothers' developing familiarity with their infant, "*And then you just get to know what they're wanting"* (Keira, TW), although the same mother noted that developing familiarity with her infant's eating still involved: "*Trial and error over time*" (Keira, TW). Generally, though, mothers found the cues of older infants easier to interpret because of their developing communication skills: *"It's probably become a bit clearer now that he'll eat and then he'll say I'm done, yeah, I think, (I'm) a bit more clear on that"* (Maggie, TW); "*It's pretty easy now to know because he's developed communication skills*" (Christina, TW). The same mother also identified that her son's increasing assertiveness also helped to get his message across: "*Whereas now, he dictates what he wants and when he wants it"* (Christina, TW).

While infant age featured in several accounts, other infant characteristics also impacted on the clarity of infants' signals and the ease of interpreting these. Individual eating or temperament traits appeared in the accounts of two BLW mothers. One participant found her baby's hunger hard to gauge because she showed little interest in eating: "*I'm constantly trying to tell myself she'll eat if she's hungry*" (Rebecca, BLW) while another encountered difficulty in gauging her daughter's satiation because of the baby's avid appetite: "*I think she would probably, because she loves it so much, would quite happily just eat until she pops*" (Katie, BLW). In both cases mothers were attuned to their individual babies' eating traits, though working with these presented challenges. While expert advice suggests that babies will express hunger through appetite, such examples demonstrate that in mothers' experience, infants may not follow the "rules" and that appetite regulation may not be an obvious, process or one that is equally apparent in all infants. Meanwhile, Katie identified her daughter's perceived placidity as a younger baby as a barrier to gauging her hunger. This meant there were few cues from which to be ‘baby led’ and so this mother had to play a more active role in prompting the infant: “*I don’t know whether that’s her temperament or what, but she was much more passive about, it was me saying - oh do you want to try some more*?” (Katie, BLW).

Beyond infant characteristics, mothers from both groups reported that infant behaviour could also complicate interpretations of feeding state. A key issue here was assessing satiation when infants ate beyond the expected point. This experience was even reported by the participant who viewed her baby as a poor eater: “*You just don’t know if she’s hungry or not. She’ll eat something else if you put it in front of her” (Rebecca,* BLW). Importantly, for this mother this experience contradicted expectations gained from her reading around infant self-regulation: “*You know, they say they’ll stop eating when they’re not hungry […] well she doesn’t”* (Rebecca, BLW). Other mothers experienced similar difficulty in making sense of eating beyond the point at which satiation was expected: “*I know that she’ll carry on, if left to her own devices she would carry on eating, even though she’s kind of done that is where the messages get really mixed*” (Emily, TW). One participant reported that food preferences played a role in her daughter’s continued eating: “*She would quite happily demolish a whole banana, a whole big banana. No matter how full she is, I think she always finds room for it*” (Eleanor, BLW). For another though, the impact of food preferences on eating behaviour increased the difficulty of assessing hunger and satiation: “*She has preferences for different foods and she can ask for different foods, now it gets slightly more muddled”* (Emily, TW). Such comments again demonstrate some of the challenges mothers face in assessing infant hunger, in this case in situations where palatability might promote overeating and variety might stimulate excess intake.

Infant state also complicated assessments of hunger and satiation where mothers had to differentiate between two explanations for their infants’ behaviour, e.g. hunger versus tiredness: “*And I said you know, just yesterday, else it’s either it’s he’s starving or he’s tired. What, what shall we do first?”* (Christina, TW); “*Yeah, either hungry or tired*” (Keira, TW). Within the meal itself, several mothers reported difficulty differentiating between boredom and satiation: *“I don’t know, it’s like she sort of gets bored halfway through ‘cos she still fidgets […] and it’s like, I don’t know whether that’s where she’s starting to (get full) “*(Suzie, TW); *“I tried to work out whether he was full or whether he was just bored of that”* (Maggie, TW). This was largely a concern for TW mothers though one BLW mother similarly perceived boredom as affecting her infant’s eating behaviour: “*She gets bored of foods quite easily but* *then if you put something new in front of her she'll try that"* (Rebecca, BLW). Importantly, two mothers also expressed the view that boredom could compromise consumption should infants get bored before having consumed 'enough': *"I suppose it's sort of that anxiety that he'll get bored before he's finished eating, so he'll get bored before he's full and then we'll end up in a bit of a cycle of him not eating much at meals"* (Maggie, TW); *"It wouldn't be very long before he'd be throwing the toy or doing something other than letting me feed him, 'cause he'd be bored"* (Christina, TW). In contrast, one BLW mother *equated* boredom with satiation, rather than seeing them as separate states: *"If he's hungry, it doesn't […] touch the sides and nothing goes on the floor until the very end and he's bored"* (Laura, BLW). Thus, interpretations of boredom played a key role in perceptions of infant hunger with this being understood in very different terms: either as a risk to consumption or an indication that the infant had consumed enough. The precise reason why two mothers regarded apparent loss of interest in feeding as boredom, while another interpreted boredom as satiation is unclear. However, this may relate to expectations of consumption i.e. boredom may not have been recognised as satiation if it appeared before infants had consumed what mothers considered necessary to induce fullness.

Finally, in relation to infant state, for one mother, state of health was a factor in interpreting her baby's eating behaviour: "*She's had periods of illness where she's been poorly for a week and her appetite's obviously not there*" (Emily, TW). In this case, awareness that the infant was ill appeared to make cues easier to interpret as this mother could attribute her baby's lack of appetite to poor health. This in turn led to lower expectations about intake and impacted on the mother's response even where this induced some anxiety: "*I might worry internally but I try not to make it an issue at the table for her"* (Emily, TW). Like the issue of boredom, this highlights the importance of 'explainability' in shaping maternal responses to cues. Mothers are likely to respond more readily to behaviours that match expectations than those which do not.

In discussing the challenges of deciphering cues, two mothers expressed a desire for a 'definitive' signal for when to stop feeding: "*I tend to just keep feeding her until she stops putting things in her mouth! But I think it would be useful if she could tell me she's finished so I want to teach her the 'finished' sign"* (Lily, BLW); "*It's trying to find that definite 'I've had enough'"* (Suzie, TW). Suzie also commented that seemingly 'clear' signals could still involve some ambiguity: *"If she has a box of raisins and she eats them she says 'they're all done, all gone', but I don't know whether she's saying when things are empty or when she's full"* (Suzie, TW). Thus, a key issue for these mothers was trying to minimise ambiguity in the reading of their infants' cues, particularly in relation to knowing when to stop feeding.

8.3.4 Theme 2 - What is enough?

Discussions about feeding cues and responses to these often centred on ideas about what was 'enough'. This was conceptualised in three different ways: i) how much to offer infants; ii) enough as 'sufficient'; and iii) enough as 'not too much'. BLW mothers expressed concern about offering the right amount and, in doing so, emphasised the issue of choice as well as quantity. In both cases though, mothers were concerned that their infants should not feel overwhelmed by what was provided: "*It's not an overwhelming choice*" (Laura, BLW); *"I'll see if only just one or two pieces feels may be less, I don't know, overwhelming"* (Katie, BLW): "*Not […] too much at one time because you don't want to outface them"* (Lily, BLW).

In contrast to BLW mothers' focus on how much to offer, TW mothers' accounts tended to focus on the infant having consumed 'enough' within the meal. In this context 'enough' was expressed as a 'straight forward' notion without further elaboration: *"I guess, just making sure she eats enough"* (Suzie, TW) or was talked about in terms of a 'good' amount to eat: "*Wanting them to have a good meal"* (Keira, TW); "*I'd rather he ate a good (amount)"* (Maggie, TW). This idea also appeared in the account of one BLW mother though here the emphasis was on the infant consuming 'enough' in a main meal rather than from snacks: "*I'd rather see her sit and eat a decent amount at lunchtime"* (Rebecca, BLW). Thus, the nature of the eating episode was a factor in this mother's assessment of what was 'enough'.

As with choice of infant food (Chapter 7), nutritional needs also featured strongly in mothers' consideration of what was 'enough' for their infants "*Making sure she does eat enough of everything and she's getting all the right balance of nutrients I suppose for her growth"* (Suzie, TW); "*You don't know whether she's getting, you know, enough of the stuff that you give her at mealtimes that is nutritionally, you know, the right stuff"* (Rebecca, BLW). Here then the idea of enough was expressed in terms of enough of the 'right' kind of food. Another mother's view of 'enough' meanwhile involved the infant's energy needs: *"I'd much rather he felt full at the end of the meal and then had you know enough energy to do everything"* (Maggie, TW). This participant also emphasised the need to keep her infant's hunger at bay: "A*nd didn't get whingey an hour later"* (Maggie, TW). This issue was also raised by another TW mother: "*He'd be hungry if he didn't, he'd be hungrier in between meals later* (Christina, TW). Importantly, this mother also commented that her baby would not stay full sufficiently long, *"If he didn't eat all"* of what was offered. As such 'enough' was equated with eating everything.

Ideas about what was 'enough' were also shaped by 'external' factors and pressures. One mother wanted to stop breastfeeding in order to return to work and so 'enough' meant filling the baby with solids to reduce the demand for breastfeeds: "*You kind of want them to eat the solids 'cos you're thinking you need to stop breastfeeding, you think […] if they eat this they won't want that"* (Jess, TW). Another mother similarly judged 'enough' in relation to stopping night feeds: "*If they eat enough during the day they won't wake up as much at night […] he should be having fewer milk feeds at night, because everyone was telling me he should not be feeding at night anymore*" (Maggie, TW). Again, this difference between observed and expected behaviour caused concern, particularly as it contradicted 'expert' advice: "*Health visitors […] telling me that I was making a rod for my own back by feeding him at night […] which wasn't true because he was, it was just what he needed at the time"* (TW).

Concerns about sufficiency of intake were largely expressed by TW mothers, however, this was also true of the BLW mother who perceived her baby to be a poor eater: "*Because she doesn't tend to eat that much at all […] you're a bit sort of nervous about it and sort of bit anxious really about is she going to get enough*" (Rebecca, BLW). For another BLW mother, concerns about intake waxed and waned with changes and developments in her infant's eating habits. At the beginning of CF she worried that her baby was not eating enough: *"I used to think, oh my God, he's not eating anything! Because it looked like […] he didn't really swallow much"* (Laura, BLW). This worry re-emerged at a later stage when her baby cut down his intake of milk: "*It's now that I worry more that he's not eating enough*" (Laura, BLW).

For some mothers the idea of 'enough' meant sufficient but not 'too much': "*She'll eat the whole yogurt and then I don't give her anything else, just say 'that's' (enough) […] it's like us isn't it, you could eat more cake but you only have one slice!* "(Suzie, TW); "*I will usually only get out enough, I would never get out too much"* (Eleanor, BLW). Here food type appeared pertinent to judgements of 'enough' as both comments related to dessert foods. Within this, this mother showed an awareness of the role that palatability, rather than hunger, may play in feeding behaviour and so imposed control over intake rather than relying on 'passive' appetite regulation by the infant.

Most mothers did not comment on over-consumption in main/savoury courses, though one BLW participant stressed the importance of her infant not consuming too much, regardless of food type. This participant's sense of 'enough' was based on comparisons between her infant and other babies: "*She's solid, she's bigger than her friends because she, I think she enjoys her food an awful lot"* (Katie, BLW) and led to the introduction of portion controls to prevent over eating. Despite being baby-led then, this mother again did not rely purely on her infant to regulate intake, but instead took infant weight gain, and comparable norms, to guide her feeding strategy.

Altogether, ideas about what constituted enough, and decisions about when to end meals, were shaped by numerous maternal concerns. Mothers from both groups, however, also emphasised infant autonomy in determining what was enough: "*You've got to trust their instincts still so you're giving them food and then they'll stop eating when they're full*" (Laura, BLW): "*It doesn't matter, he's had enough […] you just have to remind yourself that it's fine and it's your idea of what he should have"* (Maggie, TW); *" They will decide when they've finished […] she's eaten it, great, let's just leave it at that"* (Katie, BLW). Within this, mothers appeared to need to 'remind' themselves of the idea of infant self-regulation, although this did not always seem an easy thing to do. *S*ome TW mothers, however, reported finding it easier to accept infant autonomy to determine 'enough' as infants started to self-feed: *"Once we got to this stage […] she was feeding herself for the main meal part at least and so I'd kind of just let her carry on and then when she stopped eating she'd stopped"* (Emily, TW); "*With the finger food* (self-feeding), *I don't think you seem as bothered. If they've left it, they've left it, you know they've not eaten it or they've thrown it on the floor, you think, well fair enough"* (Christina, TW). As such, greater feeding independence in infants appeared to be associated with greater maternal acceptance of the infant determining their own intake for these TW mothers.

A final subtheme regarding perceptions of enough was how these differed for some mothers proximally at the time of the feeding interaction and distally on observing the video. This was particularly true for TW mothers, three of whom commented spontaneously on this issue. One mother commented that she had been worried about her infant's intake at the time but recognised her as well-nourished on the video: "*Was I panicking that you weren't eating enough and look at your little chunky arms?*" (Keira, TW). Meanwhile two other TW mothers spontaneously reflected on their own feeding behaviour when watching the video: "*When I was spoon feeding her the yoghurt, I gave her the last mouthful and I don't think, looking* *back at the video, I don't think she needed it, I don't think she wanted it* (Emily, TW); "*I think he could have left it a while ago, […] why am I giving him more blueberries? Poor kid, he's like "oh right, I've been here for hours!" It's funny isn't it when you look back and think God, alright, he's telling me really clearly* (Maggie, TW). For the most part, BLW mothers did not comment on themselves or their infants' intake on the video. However, Rebecca (BLW), who had concerns about her baby's eating, commented that her daughter ate more on the video than she had perceived at the time: "*I didn't realise how much she'd actually eaten there until watching this again […] I always thought she ate a heck of a lot less*". She also added: "*I'm surprised. Makes me think I'm worrying more now than I should be doing*". Importantly then, observing themselves and their infants on the video seemed to give some mothers a different perspective on their own behaviour and that of their infants.

8.3.5 Theme 3 - Strategies

While mothers experienced uncertainty in assessing their infants' level of satiation and determining what was enough, their accounts revealed the use of active strategies to 'read' the infant. For example, monitoring infant responses to continued offers of food was a way of determining when to end meals: "*It was a bit of trial and error thing so usually it was giving her a couple of pieces and then just seeing how she got on with it"* (Katie, BLW); "*She's eaten the pepper that was on her tray I'll just replace it with another piece"* (Lily, BLW)*; "I just keep offering her things until, and she makes it quite clear she doesn't want it"* (Suzie, TW). For one TW mother, observation of the baby's response to the offer of dessert also served as a means of gauging satiation: *"He doesn't eat yoghurt unless he really wants it, it's not like a favourite, a favourite thing, so actually it's quite a good way to tell if he's had enough"* (Maggie, TW).

Allowing more time was another strategy used by both groups to read satiation levels and to determine when to end meals: "*I just give her a few more minutes and see what she does and if she carries on spitting out more than she'd eaten"* (Suzie, TW); "*Just leave her and see if she eats anymore on her own"* (Rebecca, BLW); "*Okay, right, you're all done, you haven't eaten anything in ages*" (Katie, BLW). Meanwhile, time of day and the infant's usual routine were a means of assessing hunger for two TW mothers: "*It was always quite scheduled wasn't it? You'd have a little snack didn't you about 10 o'clock and dinner at 12 o'clock*" (Keira, TW); "*Normally you have a meal at this time, normally you fill your nappy at this time, normally you have a breastfeed or some milk at this time*" (Christina, TW). However, while routine was an aid to mothers' interpretations of infant behaviour, for the latter participant this again involved uncertainty: "*You're routinely following an invisible routine, you know, an invisible map really"* (Christina, TW). For two mothers, meanwhile, assessment of their infant's hunger was based on their own eating routine: "*I don't really know when she's hungry. I eat at morning breakfast and teatime and she eats when I eat"* (Lily, BLW).

Some mothers' accounts emphasised the importance of gaining an overview of the sufficiency of their babies' intake. This was particularly true of BLW mothers, who used several strategies to do this. One mother reported that she gauged intake by monitoring how much food was left, spat out or discarded during individual meals: "*And gets dropped, […] I used to like clear up and put it in the bin and you think, oh gosh, he's not had anything"* (Laura, BLW). BLW mothers also reported assessing infant intake through general signs of the infant being well nourished or through trying to assess intake over the course of a few days: "*It's knowing the signs, […] he's putting on weight, he's sleeping through, his nappies are full, do you know what I mean, so it's just reading the signs"* (Laura, BLW); "*If you work it out over the week, you know, that they've eaten sufficient of everything to get what they need sort of thing"* (Rebecca, BLW); *"It's trying to just get a coherent picture across everywhere about how she's eating"* (Katie, BLW).

Both BLW and TW mothers also relied on specific visual cues to assess intake. Here attention to portion size was used to assess the right amount of different foods by two mothers: "*I think she's kind of had an appropriate portion size for her. Because they say a portion for children is kind of the size of their fist, so, I try to kind of stick with that"* (Eleanor, BLW); "*I used to do it as well with the portion sizes, I'd go with what they'd say was a portion, if it all went then that was it"* (Suzie, TW). TW mothers also reported using food containers to gauge what was enough for their infant: "*I used to do the pouches so I used to just base it on 'well you've eaten a whole one of those, that's what you should be eating"* (Suzie, TW); "*It was just the size of the bowl, I think I was just filling the bowl that I had but for a young toddler"* (Emily, TW). However, this mother also noted that relying on bowl size led to inappropriate expectations: "*It was probably way too much […] I remember thinking, oh yes, she's not eating what's in front of her but then I think, like I say, that was a portion size issue"* (Emily, TW). Another TW mother found that using container size to gauge the appropriate amount created a sense of pressure that the infant should finish what was offered: "*When it's like the pureed mixtures, in the bowls, in the yoghurts pots, you're a bit more, 'Come on you've got finish it, I've opened it*" (Christina, TW). One BLW mother reported a similar experience in relation to yoghurt pots: *"He loves yoghurt but he'll still stop half way through a yoghurt pot and […] the instinct is to go, oh just finish it off!"* (Laura, BLW).

While mothers from both groups reported using strategies to assess the sufficiency of intake, their talk also revealed the use of strategies to *ensure* that infants ate the right amount, whether this was enough or not too much. Participants who viewed 'boredom' as threatening consumption reported trying to combat this by distracting infants or cajoling them into eating more: "*Sometimes maybe he'd like, he'd get bored and I'd think something else might like entice him to have some more*" (Maggie, TW); "*I put a toy on the highchair for him to distract him, to keep him sat quietly so I could carry on feeding him"* (Christina, TW). Another mother commented that she had had to 'encourage' her infant to eat a sufficient amount when she was younger but that this was less of an issue as the infant got older: "*I don't feel the need to encourage her as much. I still will if she's not, if she's picking at it I'll try and get her to eat something, but she does tend to dive in and eat what she wants now"* (Suzie, TW). Meanwhile, another participant provided the solid part of the meal before breastfeeding in order to maximise intake of solid food: *"then you try and replace that with food and try and give her dinner before you breastfeed so that you're trying to fill them on food".* For this mother then, intake of solids was prioritised over that of milk.

Concerns about sufficiency of intake and strategies to ensure infants ate enough were generally reported by TW mothers. However, one BLW mother also reported leaving her baby to continue eating while she cleaned up from the meal to encourage intake: "*I usually […] leave her and see if she eats anymore on her own rather than sort of sitting there because she often does better eating when she's on her own"* (Rebecca, BLW). In contrast to TW mothers' strategies to encourage intake, though, this mother's approach did not involve 'active' encouragement or cajoling to eat, rather, the infant was still allowed to determine her own intake.

Despite aligning themselves with BLW principles of intake being infant led, two BLW mothers also reported using strategies to control intake to ensure that infants did not over-eat. For one mother, limiting what was on view was a means of preventing battles where the infant wanted more than the mother thought appropriate: "*Sometimes she will kind of put up a little bit of a fight, but […] I'd always pull off how much I think is an appropriate portion size for her […] so that then it's easier for me to say, look, it's all gone, there's none left"* (Eleanor, BLW). Another BLW mother introduced portion controls and tried to keep her infant away from snacks: "*Ella doesn't get snacks, we have them but she doesn't get them*" (Katie, BLW).

8.4 Discussion

The aim of this analysis was to explore maternal perceptions of hunger, satiation and 'enough' in BLW and TW feeding interactions, as well as factors shaping responses to these. Three key themes were generated regarding mothers' interpretations of cues, their understandings of 'enough' and strategies used to assess and manage aspects of their infant's behaviour. This discussion will focus on a number of issues raised by the findings: similarities and differences between TW and BLW mothers' reports of hunger and satiation cues, sense-making and expectations during mealtimes, and feeding priorities and their impact on the negotiation of control.

8.4.1 BLW and TW mothers' perceptions

Mothers from both groups showed a similar level of familiarity with infant feeding cues, with many common cues identified by BLW and TW participants. Importantly, however, mothers from both groups reported having encountered difficulties in making sense of their infants' cues during feeding. Mothers from both groups also expressed a desire for certainty in judging when to end meals. Such findings are novel in relation to CF. They are also somewhat unexpected, given suggestions that, in comparison to TW mothers, BLW mothers have greater feeding confidence and lower concerns about filling infants up (Brown & Lee, 2011b).

A key difference was observed between the two groups in mothers' reporting of satiation cues, with TW mothers identifying a wider range of these than their BLW counterparts. Importantly, the additional satiation cues identified by TW mothers tended to be 'late' or 'negative cues', as described by Hodges et al. (2013) i.e. more overt cues which appear later in the development of satiation and/or which involve greater distress e.g. back arching, the infant pushing themselves away from the table etc.

Despite the greater reference to late, more overt satiation cues by TW mothers, they reported a similar range of 'early' satiation cues to BLW mothers. This suggests that TW participants, like BLW mothers, were familiar with their infants' early satiation signs but tended to continue feeding until they observed more prominent cues. This is consistent with reports that TW mothers worry more about intake than BLW mothers and are more controlling in their feeding practices (Brown & Lee, 2011b). It is also consistent with the greater emphasis placed by TW participants in the current analysis on ensuring their infants ate ‘enough’ or were full. However, the responses of two TW mothers to watching the feeding videos indicated that they did not recognise their infants’ satiation cues at the time of feeding, rather than noticing them and choosing not to respond. There were also differences in the interpretation of boredom between two TW mothers and a BLW mother with the former interpreting loss of interest in the meal as boredom, and the latter as satiation. Importantly both TW mothers’ response to this was to try to encourage intake rather than pausing in feeding or terminating the meal. This is important as, while infants may conceivably start to become bored while eating, it is unlikely that this would lead to them consuming significantly less than they require, particularly on a regular basis.

The lower reporting of more overt satiation cues by BLW mothers, may have arisen from BLW infants having fewer opportunities to show such cues because of the autonomous and less dyadic nature of their feeding. If a baby is offered food their behaviour is reactive to the offering, however, if a baby is BLW then they can refuse a food or stop eating without needing to signal this to the mother. Nonetheless, there is some evidence from the present analysis that some TW mothers were less responsive to satiation cues than BLW mothers.

8.4.2 Sense making and expectations

Mothers were actively involved in making sense of their infants’ cues and participants drew on a range of information to decipher infant behaviour. For both groups, decisions about ending meals were reached cumulatively, over time, and often through the ‘active testing’ of satiation. This is a novel finding which reflects the utility of video elicited interviewing for accessing maternal accounts of their feeding interactions. Specifically, the videos enabled mothers to observe and explain their own behaviour directly rather than having to rely on recall.

The importance of mothers’ expectations was also observed in their perceptions of and responses to infant behaviour. For one BLW mother, the expectation that her daughter’s intake would be routinely poor appeared to interfere with her assessment of intake at the time of feeding, though on watching the video, she observed that her infant had eaten much more than she had thought. This highlights the impact that anxiety can have on feeding perceptions and interactions. Such anxiety was also evident in other mothers’ accounts when infant behaviour did not meet feeding expectations e.g. infants continued to eat despite expectations that they would be full. This is consistent with Price et al.'s (2012) finding that the observation of continued hunger cues following breastfeeding caused mothers difficulty in interpreting feeding state. In the current analysis, contradictions between observed and expected behaviour caused concern for mothers from both groups, particularly where behaviour contradicted 'expert' advice from health visitors, expectations about infant self-regulation and expectations of appropriate intake for infants. In such instances, mothers from both groups employed a number of feeding interventions, for example, restricting access to snacks in response to infants perceived to overeat (Figure 8.1). This highlights the variability in infant feeding behaviour with important implications for professionals supporting mothers' CF.

Figure 8.1- Maternal responses to unexpected infant feeding behaviour

Maternal expectation	Contradictory infant behaviour	Maternal response
Infant will signal hunger and satiation clearly	Feeding cues are unclear or absent	Initiation or continuation of feeding despite lack of hunger cues
Infant will self regulate (not over-eat) 'Subjective' and objective expectations of intake*	Continued eating/ hunger does not abate	Control to restrict intake
Eating is driven by hunger not preference	Infant continues to eat preferred/sweet foods despite adequate intake in meal.	Limit access to sweet foods
Most eating should occur in main meals/meals are enough to satisfy infant	Infant shows greater interest in snacks than main meals	Control snack consumption
Infant will self regulate (not under-eat) 'Subjective' and objective expectations of intake*	Infant eats less than expected within a meal, satiation signs appear sooner than expected	Control to increase intake, encouragement cajoling, strategies to increase intake

*Subjective expectations – mothers' 'sense' of what infants should consume

Objective expectations – recommended portion sizes

8.4.3 Feeding priorities, feeding responses and control

TW mothers' talk indicated that different priorities shaped judgements of what was enough in BLW and TW mothers. Consistent with Heinig et al. (2006) and Johnson et al. (2015), these included concerns about meeting energy and nutritional needs and infants staying full for sufficiently long. Differences were observed between BLW and TW mothers' priorities, with the former placing less emphasis on filling the infant, but more on monitoring intake and getting an overall sense that the infant was consuming enough. This is likely to arise from the lower control mothers have over infant intake in BLW and is consistent with reports from Arden and Abbott (2015) of BLW mothers expressing a need to monitor consumption, especially early in CF. Importantly it also provides evidence that while BLW mothers were more led by their infants' appetites, they were nonetheless appropriately vigilant for signs of adequate nutrition. It also demonstrates how CF may shape, as well as reflect, what mothers prioritise.

Maternal feeding priorities were also shaped for some TW mothers by a wish to decrease night feeds or a need to reduce breastfeeds in order to return to work. The former point is consistent with findings from Bentley et al. (1999) and Price et al. (2012). This highlights the fact that night waking is often interpreted as a sign of hunger, as well as sleep being a shared priority for mothers of young infants. Importantly, it also highlights potential barriers to responsive feeding, as such issues were cited as reasons for mothers trying to ensure infants were as full as possible.

Three TW mothers reported feeling less need to control intake once infants were self-feeding. This is interesting as it suggests independent infant feeding may engender a more relaxed feeding situation than TW. However, it may be that these mothers felt more able to trust their infants' consumption by the time they were self-feeding, in which case infant age and maturity may have influenced the negotiation of control. Interestingly, this is consistent with reports of BLW mothers' increasing confidence in their infants' self-feeding ability with increasing age (Cameron Heath & Taylor, 2012).

Notwithstanding indications of greater feeding control by TW mothers in this analysis, there were signs of BLW mothers also using strategies to encourage or discourage consumption. Such strategies tended to differ from those of TW mothers in terms of being less directive, e.g. leaving the infant to eat for longer while the mother cleared up or restricting what food was visible to the infant. One BLW mother however, intervened more directly by controlling portion sizes and access to snacks. Thus, BLW mothers were not entirely led by their infants' appetites. This is consistent with previous findings that BLW mothers may adapt the approach where concerns arise regarding sufficiency of intake (Arden & Abbott, 2015; Cameron et al., 2012). It also demonstrates that, while BLW affords fewer opportunities for maternal control than TW, BLW mothers ultimately retain control over how much, how often and what kind of food they offer. Furthermore, it highlights the fact that BLW mothers, like TW mothers, experience concerns about intake *and* that concerns can relate to over as well as under-consumption. In this case, BLW may be seen as a guide to intake rather than a specific, rigid approach. As least as far as self-report data can illustrate, BLW principles appear to encourage trust in the infant and flexibility by the caregiver to accept variability and to adapt to situations as needed.

8.5 Evaluation

The present analysis has a number of limitations as previously described in relation to the studies of mothers' choice of CF approach and choice of infant foods (Chapters 6 and 7). Furthermore, coding using the template developed for this analysis achieved a lower level of inter-rater agreement than the templates for other aspects of maternal decision making (moderate rather than substantial). Nonetheless, findings shed light on issues which may compromise mothers' ability to feed responsively in both BLW and TW contexts. In so doing, they provide a fuller understanding of mothers' perceptions of, and responses to, feeding cues across different CF approaches, with implications for the development of feeding interventions which are likely to be seen as relevant by mothers.

8.6 Conclusion

Findings from this analysis provide some support for reports of BLW as a more responsive feeding approach than TW in relation to infant satiation. They indicate that TW mothers, while recognising infant cues, may have been less inclined to follow these. However, there were also indications of satiation cues being missed or misinterpreted by some TW mothers. Meanwhile, findings suggest that some BLW mothers were not entirely 'infant led' in their feeding practices but that they intervened to encourage or restrict intake and were particularly able to exert control over the latter.

As with the question of food choices (Chapter 7), the use of video elicited interviewing appeared to facilitate maternal reflection on feeding decisions by enabling mothers to observe and account for these directly. This enabled the generation of novel insights into feeding practices. These suggest that mothers may benefit from advice regarding responses to infant behaviour which differs from expectations, particularly where there are concerns about infant self-regulation. Similarly, it may be productive for health professionals to encourage an awareness that infant 'boredom' may represent developing satiation and to encourage mothers to pause in feeding in response to perceived boredom to allow infants to indicate if they are still hungry, rather than responding by encouraging further intake. In particular, findings suggest that mothers may benefit from practical advice about managing sleep in older infants without resorting to feeding and timescales for gradually reducing breastfeeding where mothers are returning to work. Support in these areas may assist mothers in feeding more responsively.

Chapter 9 - The development and feasibility testing of an online, self-directed responsive feeding resource

9.1 Introduction

Studies have identified the importance of responsive feeding for the development of healthy appetite regulation and children's eating behaviour (de Lauzon-Guillain et al., 2012; Hurley et al., 2011;). However, evidence suggests that responsive feeding can be difficult to achieve, particularly where mothers are under stress (Hurley, Black, Papas & Caufield, 2008) or with infants with difficult temperaments (McMeekin et al., 2013). Mothers may also have difficulty feeding responsively, where they have concerns about their children's intake, or where children are perceived to be under or over weight (Galloway, Fiorito, Francis & Birch, 2006; Gregory, Paxton, & Brozovic, 2010; Keller, Pietrobelli, Johnson, & Faith, 2006). Despite this, information to help parents understand and respond to infant feeding cues appears to be limited, particularly in the area of CF (Mitchell, Farrow, Haycraft, & Meyer, 2013). The need for the development of good quality, accessible, information to assist parents in feeding responsively is therefore indicated.

9.1.1 Intervening to promote responsive feeding

A number of studies have indicated that educational interventions can be effective in promoting responsive feeding and preventing overweight in infants and toddlers. Savage, Birch, Marini, Anzman-Frasca, and Paul (2016) conducted a randomised controlled trial with 291 first time mothers to examine the impact of a responsive parenting programme on infant weight gain between birth and 28 weeks and overweight status at 12 months. The intervention group received a video and demonstration and guidance on infant sleep, emotion regulation and responsive feeding at home from nursing staff when infants were 3, 16, 28 and 40 weeks of age. The responsive feeding component provided information on hunger and satiation cues, appropriate portion sizes and encouraged mothers to use food only in response to hunger, rather than to soothe or reward infants. Control group participants received a home safety intervention visit at the same intervals. An adapted version of the Infant Feeding Practices Study 2 food frequency questionnaire (Centers for Disease Control, 2015 cited in Savage, et al., 2016) was administered to both groups at 2 weeks, 16 weeks, and 28 weeks. Infant weight and length were measured at each home visit. Conditional weight gain scores (CWG - variation in weight gain not explained by age, birth length, or birth weight) were also calculated at 28 weeks for both groups. Savage et al. (2016) found significantly lower mean CWG scores for the intervention group than control infants, indicating that the former gained weight more slowly than control group. Furthermore, this effect did not differ with feeding method (breast milk or formula). Intervention group infants were also significantly less likely to be overweight at 1 year than controls and had significantly lower mean weight scores.

Despite Savage et al.'s (2016) findings, they did not measure responsive feeding outcomes directly and, as their intervention targeted several aspects of parenting, it is unclear how far the responsive feeding element of the intervention accounted for the obesity outcomes. Evidence from other studies, however, indicates that responsive feeding techniques can be taught and that this may impact positively on infant weight. Daniels et al. (2015), used the Infant Feeding Questionnaire (Baughcum et al., 2001) and children's BMI Z scores to evaluate outcomes in the NOURISH trial for 698 first time mothers with infants between 3 and 5 months. Mothers were randomly allocated to a control group, or a two module group feeding intervention, concerning: the introduction of solids, variability of infant consumption, hunger and satiation cues, managing feeding behaviour and food refusal. The control group had self-directed access to information on the internet and to generic child health services. Families were followed up 6 months after module 1, when infants were 14 months old; 6 months after module 2, at age 2, and again at 3.5 and 5 years of age. At the first follow up the control group reported significantly more non-responsive feeding practices and their infants had significantly higher BMI- Z-scores than the intervention group. In subsequent follow ups between ages 2 and 5, the intervention group reported significantly less use of nonresponsive feeding practices and more appropriate responses to food refusal.

Horodynski (2015) also provides evidence of the effectiveness of responsive feeding education, in this case delivered on a one to one basis in the home environment. The intervention was delivered in a randomised controlled trial with 547 low income mothers and included guidance regarding infant cues, temperament and behavioural states, maternal feeding responsiveness and feeding skills and strategies (Horodynski et al., 2011). Details of control group treatment were not provided. Data were collected at baseline and two follow ups, i.e. when infants were six and 12 months old. At follow ups the intervention group showed significantly greater knowledge of infant feeding and greater feeding responsiveness than control group mothers. Horodynski (2015) also found a significant difference between the weight of intervention and control group infants within weight bands (i.e. under-weight, normal weight and over-weight).

9.1.2 Self-directed parenting programmes

Despite evidence of the effectiveness of educational programmes delivered on a face to face basis, such programmes are costly (Franke, Keown & Sanders, 2016). Self-directed parenting programmes, however, offer a cost-effective, accessible and flexible alternative (Metzler, Sanders, Rusby, & Ryann Crowley, 2012). It has also been suggested that self-directed programmes provide parents with greater power in the learning process (Mitchell et al., 2013) and that they may also be more accessible to groups such as socially disadvantaged parents (Metzler et al., 2012).

Importantly, studies suggest that self-directed parenting programmes can be as effective as face to face ones. Sanders et al. (2000) compared levels of improvement in a self-directed, workbook-based intervention for managing disruptive behaviour compared with face to face versions of the same programme in a randomised controlled trial of 305 three-year olds. All versions of the programme ran for 15 weeks with the face to face group receiving weekly one to one sessions of 60 to 90 minutes, while the self-directed group only received the manual and instruction on how to use this. At a one year follow up Sanders et al. (2000) noted higher levels of parent reported improvement in children's behaviour in the face to face versions of the intervention but similar levels of clinical improvement in the self-directed group to that seen in the face to face groups.

More recently, self-directed interventions delivered through audio-visual and online media have shown positive outcomes in increasing parents' knowledge and responsiveness to typically developing infants and children with autism (Feil et al., 2008; Kobak et al., 2011; Nefdt, Koegel, Singer, & Gerber, 2010), and in increasing scores on the Parenting Sense of Competence Scale (Johnston & Mash, 1989) in parents of young children with ADHD (Franke, Keown & Sanders, 2016). There is also evidence of high satisfaction in parents using such online interventions (Nefdt et al., 2010) and evidence that parents may prefer these to face to face programmes **(**Metzler et al., 2012).

Despite evidence of the effectiveness of self-directed parenting education, few studies have been conducted on feeding interventions. One such study, by Scheinmann, Chiasson, Hartel and Rosenberg (2009) involved a quasi-experimental study of a video based, self-directed infant feeding intervention with 272 mothers of infants aged 5 months or younger. The intervention group were provided with a DVD including information about age appropriate feeding which was also designed to encourage breastfeeding and the delay of CF until 6 months of age. Mothers and infants were followed up 3 and 6 months post-intervention. At 3 months a significantly higher proportion of the intervention group demonstrated knowledge of the appropriate age for introducing solids than the comparison group. At 6 months, both groups' feeding knowledge had increased, but the intervention group showed significantly higher knowledge scores and introduced CF significantly later than the comparison group.

Research regarding the use and development of self-directed feeding programmes for parents is limited; a few such programmes have been produced by commercial companies, for example the Taste for Life programme (Organix, 2017). However, this is concerned with the development of healthy eating habits and the prevention of fussy eating in pre-school children, rather than parental knowledge of responsive feeding and infant feeding cues. Furthermore, its effectiveness has not been investigated and there is evidence that parents may distrust health information delivered by commercial organisations (Mitchell, et al., 2013).

In addition to commercially produced online programmes, many mothers are now using pregnancy and parenting mobile phone applications (apps) to access information about infancy and feeding (Lupton, 2017). In a survey of 410 women who were pregnant or had given birth in the previous three years, Lupton and Pedersen (2016) found half had used a pregnancy or parenting app. Of these, 43% did so to obtain feeding advice, 35% used the app to obtain information on diet and nutrition and 34% used it to monitor their child's feeding habits. Despite this, the authors found that 68% of those that had used a parenting app did not know the provenance of the information it contained. Furthermore, as Abroms, Padmanabhan, Thaweethai and Phillips (2011) have identified, the content of health apps is currently unregulated.

9.1.3 Study rationale and aims

Taken together, evidence suggests that responsive feeding interventions are effective in increasing parental feeding knowledge and promoting responsive feeding practices. There is also evidence that online and video based, self-directed programmes may achieve similar outcomes while reaching a wider audience than face to face interventions. However, no self-directed online tutorial currently appears to exist for parents to learn about infant feeding cues and responsive feeding. In view of this, this study had two sets of aims:

1. <u>Resource development</u>

- To develop a prototype video based, online, self-directed responsive feeding resource using UK videos of infant feeding cues as illustration and informed by reputable research evidence and relevant theoretical considerations (discussed below)
- To examine issues in resource development

2. <u>Resource testing</u>

- To examine satisfaction with resource content among parents and childcare and nutrition professionals.
- To examine satisfaction with the resource among parents with different levels and kinds of feeding experience (i.e. in terms of number of children, experience of feeding difficulties)
- To assess perceived knowledge gains from using the resource
- To assess perceived applicability of learning from the resource to real feeding situations
- To identify aspects of the resource requiring further development
- To examine issues in resource delivery

9.3 Resource development

The online responsive feeding resource was designed using Articulate Presenter 13 and Articulate Quizmaker 13. It consisted of textual information and video illustrations of infant behaviours associated with hunger and satiation and was hosted by Articulate Online for an eight-week period.

9.3.1 Theoretical considerations

A number of theoretical and research considerations informed the development of the resource. These included:

i) Attachment theory and the related concept of mind mindedness
ii) Principles of good web design and effective online programmes

Attachment theory posits that maternal sensitivity and responsiveness play a central role in the development of maternal-infant bonds, and, that the stability of such bonds is critical to subsequent personal and interpersonal development (Bowlby, 1969; Ainsworth, 1989). Mind mindedness meanwhile refers to the extent to which mothers are attuned to their infants' thoughts, feelings and state (Meins et al., 2002) and, it has been suggested, is a key factor in promoting maternal sensitivity and appropriate maternal responses (Meins et al., 2012). Importantly, there is evidence that maternal sensitivity and mind mindedness are associated with greater attunement to feeding cues and more responsive feeding practices (Black, & Aboud, 2011; Farrow, & Blissett, 2014). Furthermore, studies suggest that maternal sensitivity and mind mindedness can be 'taught' by developing mothers' observational skills and their attention to their children's communicative signals (Kalinauskiene et al., 2009; Schacht et al., 2017). Therefore, a key aim of resource development was to facilitate attunement to infant feeding cues through three main means:

1. The development of greater knowledge and recognition of infant feeding cues through the provision of information and video illustrations of behaviours associated with hunger and satiation.

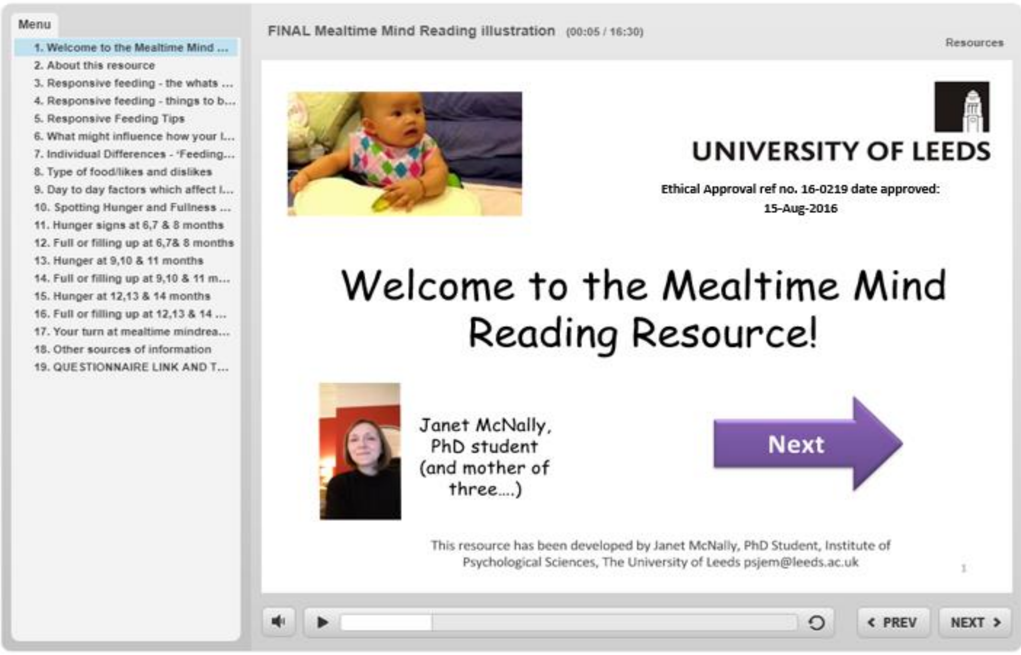
2. By highlighting a range of behaviours which have communicative value in inferring infant state i.e. gaze, gesture, orientation, vocalisation, affect and interest (Pepper & Weitzman, 2004)

3. Encouraging participants to view the infant in the video illustrations as an intentional and feeling being - video clips were captioned with descriptions which emphasised infant emotion and intentionality as well as describing behaviour e.g. 'Once Evie settles into her meal she is *happy to take in the view'*, and, 'Evie is *more interested in exploring* than eating'.

Finally, the development of the resource was informed by principles of effective online parenting interventions identified by Williams, Mughal and Blair (2008). A key concern was ensuring an appropriate level of readability. Text from all non-video slides was tested against the Flesch Reading Ease score using an online assessment tool (Readability formulas.com, 2016). The resource was found to have a score of 65.2, i.e. 'standard' or 'average' reading level in line with many online parenting interventions (Williams et al., 2008). Textual elements of the resource were kept minimal and icons and images were used to enhance navigability, to make the resource engaging and to highlight key points.

The resource particularly focused on the provision of 'straightforward' information and concrete illustrations of infant behaviour, as these have been shown to be effective in increasing both parental knowledge and parenting skills (Nieuwboer, Fukkink, & Hermanns, 2013). Information was organised into discrete topics and the resource was designed so that it could be navigated through a menu, links on individual slides or through the use of forward and back buttons, meaning participants could navigate it in a non-linear way according to their own interests (Figure 9.1). They could also review information and videos as they wished, and at the end of the resource there were links to other sources of information and advice.

Figure 9.1 – Example navigation options slide from responsive feeding resource



9.3.2 Resource content

9.3.2.1 Informational content

The resource aimed to promote an understanding of responsive feeding and its role in promoting positive feeding outcomes, to acknowledge the issues which may compromise mothers' ability to feed responsively, to raise awareness of factors which impact on infant feeding behaviour and to provide video illustrations of different feeding cues across a range of age groups. As such, content was selected for inclusion across these areas, resulting in a resource containing 64 slides as follows:

i) resource introduction (n = 2)

ii) the nature of responsive feeding (n = 1)

iii) challenges to responsive feeding and responsive feeding tips (n = 2)

iv) issues affecting infant feeding behaviour (n= 4)

v) tabulated descriptions of feeding cues in infants from 6 to 14 months (n = 7),

vi) videos of slides illustrating different feeding cues (n = 45)

vii) practice/feeding cues quiz slide (n=1)

viii) other sources of information and acknowledgements (n = 2)

The informational content for each area was informed by evidence from a number of sources (Table 9.1). Evidence from the systematic review and infant feeding literature informed the content regarding the nature of responsive feeding and potential outcomes of low responsivity (DiSantis et al., 2011; Hurley et al., 2011; Worobey et al. 2009). Evidence from the systematic review also provided the basis of slides concerning issues affecting infant feeding behaviour e.g. infant feeding traits and food preferences (Forestell & Mennella, 2012; Llewellyn et al.,2011; Llewellyn et al., 2012; Mennella et al., 2009)

Significant findings from the observational component of the thesis (Chapters 3,4 and 5) informed tables outlining behaviours associated with hunger and satiation at different ages. This was supplemented by evidence regarding feeding cues from the systematic review and the wider feeding literature (Hodges et al., 2008; Skinner et al., 1998; Sumner & Spitz, 1994). Information regarding hunger and fullness behaviours was also informed by principles of communication theory and developmental psychology e.g. the use of gaze to establish joint attention to request food.

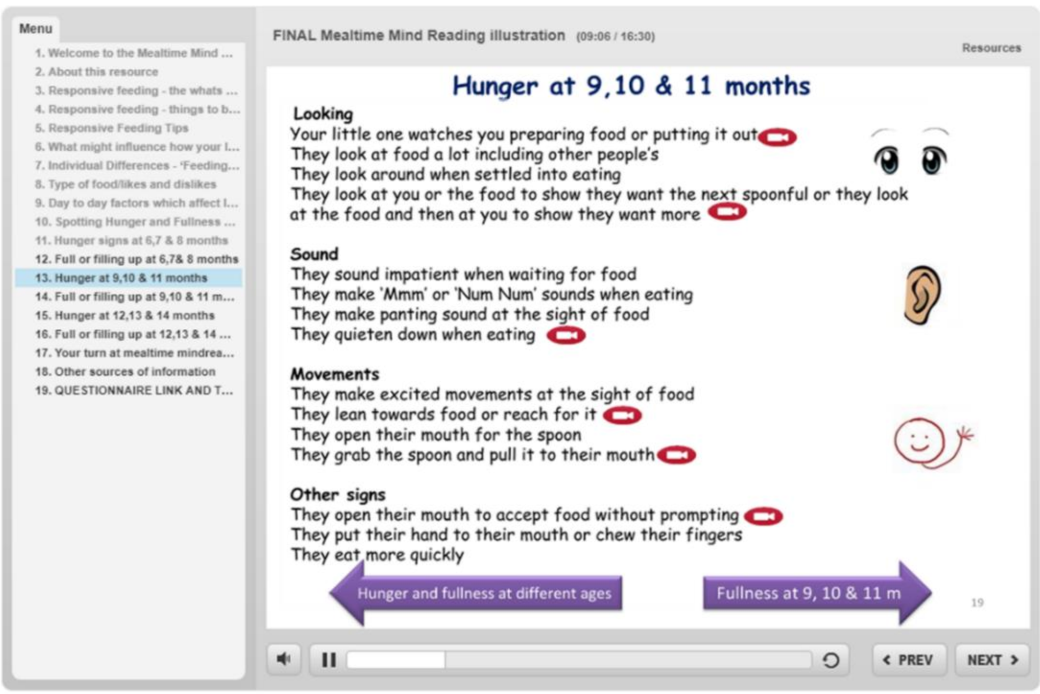
Findings from the qualitative phase of thesis research regarding mothers' decisions about when to terminate feeding (Chapter 8) informed resource content regarding issues which may make it difficult for mothers to feed responsively e.g. concerns about filling infants to drop breastfeeds etc. Content in this area was also informed by evidence from the wider literature regarding issues which may lead to unresponsive feeding practices such as the perceived need to fill babies in order to minimise night time waking (Bentley, Gavin, Black & Tedi, 1999; Heinig et al., 2006; Price et al., 2012).

Table 9.1 – Resource sections and corresponding information sources

Resource content	Information source
Nature of responsive feeding	Systematic review/ Infant feeding literature
Challenges to responsive feeding	Thesis Chapter 8
	Infant feeding literature
Issues affecting infant feeding behaviour	Systematic review/ Infant feeding literature
Hunger and satiation cues slides	Systematic review/ Infant feeding literature, thesis Chapters 3,4 and 5
	Communication theory

Feeding cues information was organised into six pages i.e. a page of hunger and fullness cues for infants in three different age groups (6, 7 and 8 months; 9, 10 and 11 months and 12, 13 and 14 months). Feeding cues pages included links to video footage (using a camera icon) illustrating cues in the same infant at different ages (Figure 9.2).

Figure 9.2 – Example feeding cues slide from responsive feeding resource



The lower age limit of 6 months was used as recommended by the WHO for starting CF. The upper age of 14 months was chosen as most infants observed during the observational phase of the PhD were feeding independently beyond this.

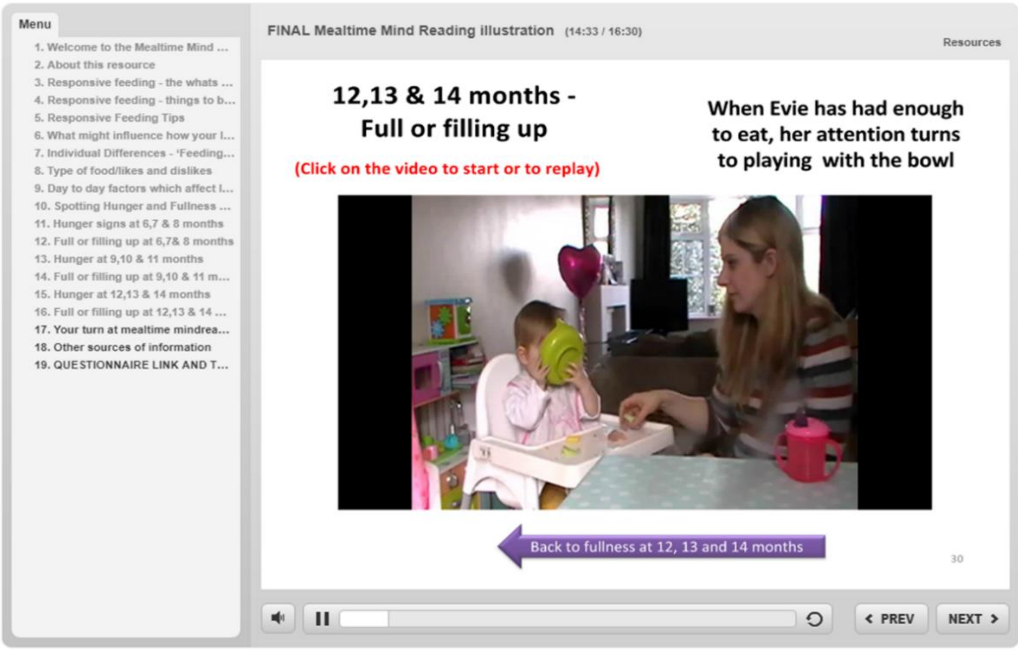
Age groupings in the information tables were developed to reflect broad milestones in the development of feeding and communication, for example, at 6, 7 and 8 months the introduction of CF and the development of feeding and intentional communication skills (Crais et al., 2009: McComish, 2008; Wright, Cameron, Tsiaka, & Parkinson, 2011,) at 9, 10 and 11 months, the development of more competent feeding skills and the emergence of conventional communication (Carruth, and Skinner, 2002: Crais et al., 2009), and at 12, 13 and 14 months, the ability to cope with most food textures, increasingly independent feeding and the development of first words (Bates & Dick, 2002; Delaney, 2010).

9.3.2.2 Video content

Video illustrations of feeding cues were developed from video clips of the same female infant filmed at approximately monthly intervals from the age of 6 months to 14 months in the home environment. The infant's mother provided filming consent for herself and the baby, and for video clips to be used for the purposes of the study. The mother also approved the video content for the final resource before data collection commenced. Entire mealtimes were filmed with a hand-held camera at a distance enabling video footage to capture both mother and infant, with a view to demonstrating changes in social interaction with meal progression. The mother was instructed to behave normally throughout the meal. There was no interaction between the researcher and the mother or infant during filming. Videos were subsequently examined by the researcher for illustrations of behaviours associated with hunger and satiation. Some difficulty arose in relation to capturing discrete, subtle and often fleeting behaviours in clips of a suitable length for viewing. This was particularly the case with earlier (i.e. younger) footage of the infant. However, where relevant behaviours could be identified and isolated, clips were prepared across a range of ages using Microsoft Movie Maker version 8.1. Videos ranged from 4 to 25 seconds in length with a mean length of 11.18 seconds. Videos were captioned within the resource to describe the behaviours they illustrated and the age ranges to which they applied (Figure 9.3).

Video content for the resource was selected to provide a balance of examples of hunger and satiation cues and to provide a similar number of examples across different age groups. Examples of non-age specific behaviours (e.g. exploratory activity) were repeated across different age groups to ensure that such behaviours were not missed by virtue of only being included in one age grouping. Video clips were also selected on the basis of their clarity and ability to illustrate discrete behaviours effectively.

Figure 9.3 – Example of captioned video slide from responsive feeding resource



In addition to the use of video for illustrative purposes, participants had the option of viewing two video clips (1.03 and 1.41 minutes) as a multiple-choice practice exercise for identifying cues. Participants were able to view the video and complete the quiz as many times as they wished, however technical constraints meant it was not possible to provide feedback to answers.

9.4 Method - Resource testing

9.4.1 Ethics

Approval for the study was given by the University of Leeds Department of Psychology Research Ethics Committee, ethics reference: 16-0219 approved August 15th 2016. Participants received study information and completed consent online prior to viewing the responsive feeding resource (Appendices D1, D2).

9.4.2 Participants

Flyers were posted on Mumsnet and Netmums and sent to local nurseries and childcare providers (Appendix D3). Parents, childcare and nutrition professionals were invited to take part in the study. Parents were eligible to take part if they had current or recent CF experience (i.e. had an infant between 6 and 18 months); professionals were eligible if they worked in nursery, childminding or nutrition settings. Forty-two participants completed consent forms of which, twenty-three (twenty females, one male, one gender un-recorded) completed the final questionnaire to evaluate the resource. The mean age of those who completed the questionnaire was 33.82 $\pm$ 4.47 years. Half of the sample had an under-graduate degree or higher. The majority of participants described themselves as being from a white UK background (n = 18), three participants identified as white non-UK, two identified as dual heritage and one participant identified as British Asian. Infants came from a range of ages and parent participants reported using a range of infant feeding practices (Table 9.2).

Table 9.2: Infant demographics

		Standard Deviation	**Range**
Mean infant age (months)	11.79	3.54	6 -18
Mean CF age (months)	5.90	1.26	3 - 10
Sibship size			
- 1	13	N/A	N/A
- 2	4	N/A	N/A
- 3	1	N/A	N/A
- 4	1	N/A	N/A
Complementary feeding:			
***Staged**	5	N/A	N/A
Baby led weaning	6	N/A	N/A
**** Mixed**	8	N/A	N/A

*** Staged** – spoon feeding with subsequent introduction of finger foods

**** Mixed** – spoon feeding combined with use of finger foods from the outset of CF

9.4.3 Measures

9.4.3.1 Satisfaction with resource

Participant satisfaction with the resource was measured using an adapted version of the User Satisfaction Questionnaire (USQ) (Kobak et al., 2011) which rates satisfaction with the content of Web-based programmes. It contains 15 statements rated on a 4-point Likert scale (strongly agree, agree, disagree, strongly disagree) and has been reported to have good internal consistency (Cronbach's alpha = 0.92) (Kobak et al., 2011). For the purposes of the current study, a 5-point Likert scale (including neither agree nor disagree) was used as it was felt important that participants should not have to provide an opinion on a particular item if they did not have one, and to reduce response bias which is more likely with even numbered scales (Randall & Fernandes, 1991).

Twelve of the fifteen statements from the original USQ were used. Two additional questions were asked (how helpful participants found the resource and how far they had gained knowledge of feeding cues/feeding behaviour from it). The final questionnaire consisted of 14 items. A mean score of 4 (agree) was considered to represent an acceptable level of satisfaction for individual items, consistent with Kobak et al. (2011). Satisfaction with the resource was also assessed with reference to question 14 (Overall, I was satisfied with the resource). A Cronbach's Alpha was applied to test the internal consistency of the adapted USQ.

In addition to the Likert scale statements, participants were asked to provide brief qualitative comments on the most and least helpful aspects of the resource. Metrics regarding the percentage of slides viewed and the duration of resource viewings were also compiled via the data capture features of Articulate Online.

9.4.3.2 Perceived knowledge gains, applicability and application of learning

Responses to questions seven and eight of the adapted USQ (i.e. The resource increased my knowledge of my baby's hunger and fullness signals/ issues affecting my baby's eating behaviour) were used as measures of perceived learning from the resource. The response to question ten (i.e. I feel I could apply learning from the resource to feeding my baby/my work) was taken as a measure of the applicability of the information to a real feeding experience.

Participant performance on the two feeding cues quizzes was also taken as an indicator of application of learning via correlational analyses to examine associations between duration of resource viewings, percentage viewed and total correct answers on the two quizzes. These were undertaken with the caveat that they could provide only a preliminary indicator of learning given the small sample size in the study.

9.4.3.3 Parental feeding experience, satisfaction and perceived knowledge gains

In addition to examining satisfaction with the resource for all participants (i.e. parents and professionals), Spearman's correlations were conducted to explore satisfaction and perceived knowledge gains for parents with different degrees and types of feeding experience according to: number of children, infant age, perceived ease in judging infant hunger and satiation and the degree to which parents experienced concerns about their infant's feeding behaviour. Satisfaction scores were again taken from question 14 of the adapted USQ and mean scores across all questionnaire items. Again, these were undertaken only as a preliminary indicator of satisfaction with or perceived knowledge gains from the resource for different parents.

9.4.4. Procedure

Prior to viewing the resource, participants completed the online consent form and basic demographic questions hosted by Bristol Online Surveys. Participation was anonymous though participants were asked to provide a unique identifier code so demographic information collated prior to viewing the resource could be linked to evaluation questionnaires. Participants were also given the option of entering a prize draw as part of the consent process; where this was the case, participants provided a contact email address. Following the consent process and the provision of demographic information, participants were provided with access to the resource and were able to navigate this according to their own interests. At the end of the resource, participants had the option to complete two practice exercises for identifying feeding cues from two different video clips

9.4.4.1 Treatment of data

Examination of consent forms, resource viewing metrics and quiz responses revealed that some participants had attempted to visit the resource, or the quiz (n = 3, and n = 1), more than once. As such, data were cleaned to remove duplications with data relating to most complete visits and first attempts on the quiz retained. Descriptive statistics (mean, range and standard deviations) were compiled for demographic data, percentage of resource viewed and duration of resource viewings. Total quiz scores were calculated across the two feeding cues quizzes. Descriptive statistics were also collated for the USQ responses. Post hoc power calculations were carried out in G-Power using the relevant Pearson's r, $\alpha = 0.05$ and the sample size for the analyses (n = 19 in both cases).

9.5 Results

9.5.1 Internal consistency of adapted USQ

The Cronbach's Alpha showed the adapted 14 item USQ reached a slightly lower, but acceptable, level of internal consistency than that reported for the original scale (α = 0.83). All fourteen items including those which differed from the original scale reached the minimum item total correlation of 0.3 (Cristobal, Flavián, & Guinaliu, 2007).

9.5.2 Adequacy of sample size and power

The calculation for the correlation between overall satisfaction with the resource and parental concerns about infant feeding (r = .564) showed an adequate level of power ($1 - \beta$ = .80) (Banerjee, Chitnis, Jadhav, Bhawalkar & Chaudhury, 2009) indicating that the sample size was sufficient for this analysis and that the likelihood of a type II was low. The power calculation for the correlation between duration of resource views and total quiz scores (r = .053) however, revealed an extremely low level of power ($1 - \beta$ = .06), indicating the inadequacy of the sample size for this analysis and the high likelihood of a type 2 error.

9.5.3 Participation rates

In total, 80.9 % of participants who completed consent forms viewed the online resource. The mean number of slides viewed was 29.24 (± 30) which equates to 45.68% of the resource. Mean duration of viewing was 6.93 minutes (± 7.59). Just under fifty five percent of participants completed the final questionnaire and 45.20 % completed the feeding cues practice exercise/quiz (Table 9.3). Around a third of parents (31.60%) completing the questionnaire reported some difficulty in identifying when then their infant was either hungry (10.50%) or full (21.10%) and 26.30% reported having concerns about their infant's eating.

Table 9.3: Participation by parents and professionals

	Parents	Professionals	Total group
Completed consents	35	7	42
Trackable resource viewings	30	4	34
Completed questionnaires	19	4	23
Complete quiz	16	3	19

9.5.4 Resource satisfaction - clarity of objectives

Mean ratings of the clarity of resource objectives were high (4.30, SD 0.94) for the whole group (parents and professionals) though this item received a low rating of two from one parent. Parents' mean ratings on this item tended to be lower than those of professionals (4.16, versus 5.00).

9.5.5 Resource satisfaction – attributes

Resource attributes (presentation, clarity of ideas and length) received high mean ratings from parents (Table 9.4) with the highest rating given for the illustrative value of the video clips. Two parents gave relatively low ratings (2.00) for presentation of the material and length of the resource. Satisfaction with the number of video examples also received a rating of 2.00 from one parent.

Table 9.4 – Parents' mean ratings for resource attributes

	N (participants)	Range	Mean	SD
The resource was well-organised	19	3.00-5.00	4.32	0.67
The material was presented in an interesting manner	19	2.00-5.00	4.00	0.94
There were enough examples and illustrations	19	2.00-5.00	4.26	0.81
The ideas were clearly presented and easy to understand	19	4.00-5.00	4.37	0.50
The video examples were helpful in illustrating hunger and fullness behaviours	19	4.00-5.00	4.58	0.51
The length of the resource was about right	19	2.00-5.00	4.05	0.97

Professionals' ratings of resource attributes again tended to be higher than parents' (Table 9.5) (from 4.25 - 5.00 and 4.00 - 4.58 respectively).

Table 9.5 – Professionals' mean ratings for resource attributes

	N (participants)	Range	Mean	SD
The resource was well-organised	4	4.00 – 5.00	4.25	0.50
The material was presented in an interesting manner	4	4.00 – 5.00	4.75	0.50
There were enough examples and illustrations	4	4.00- 5.00	4.75	0.50
The ideas were clearly presented and easy to understand	4	4.00- 5.00	4.50	0.58
The video examples were helpful in illustrating hunger and fullness behaviours	4	5.00 – 5.00	5.00	0.00
The length of the resource was about right	4	4.00- 5.00	4.75	0.50

9.5.6 Resource satisfaction - Knowledge, informative value and application

Mean ratings for the informational content of the resource were also high for both parents (Table 9.6) and professionals (Table 9.7) though one parent gave a rating of 2.00 on this item. Ratings for the applicability of learning to infant feeding from the resource were amongst the highest of those for learning related items. Professionals' mean ratings for learning related items were again marginally higher than those of parents, 4.25 – 4.75, compared to 3.95 – 4.26 (Table 9.7).

Table 9.6 – Parents' mean ratings for knowledge, informative value and application

	N (participants)	Range	Mean	SD
The resource increased my knowledge of infants' hunger and fullness signals	19	3.00 – 5.00	4.21	0.63
The resource increased my knowledge of issues affecting infants' eating	19	2.00 – 5.00	3.95	0.78
I found the information in this resource helpful	19	4.00 – 5.00	4.26	0.45
I feel I could apply learning from the resource to feeding my infant or my work	19	3.00 – 5.00	4.26	0.73

Table 9.7 – Professionals' mean ratings for knowledge, informative value and application

	N (participants)	Range	Mean	SD
The resource increased my knowledge of infants' hunger and fullness signals	4	3.00 – 5.00	4.50	1.00
The resource increased my knowledge of issues affecting infants' eating	4	3.00 – 5.00	4.25	0.96
I found the information in this resource helpful	4	4.00 – 5.00	4.75	0.50
I feel I could apply learning from the resource to feeding my infant or to my work	4	4.00 – 5.00	4.50	0.58

9.5.7 Enjoyment and other satisfaction mean ratings

Enjoyment ratings and ratings of how far participants would recommend the resource were high (Tables 9.8 and 9.9). Professionals' mean ratings were again marginally higher than parents' ratings, 4.66 – 4.75 and 4.21 – 4.42 respectively. Overall satisfaction ratings and mean ratings across all questionnaire items were high (Figure 9.4).

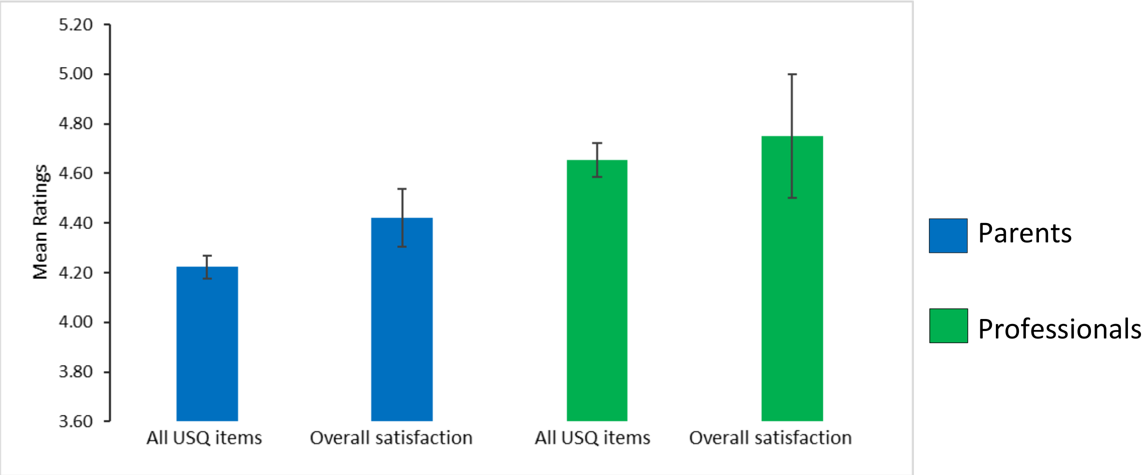
Table 9.8 - Parents' mean recommendation and enjoyment ratings

	N (Participants)	Range	Mean	SD
I would recommend the resource to others	19	3.00 – 5.00	4.26	0.65
I enjoyed looking at the resource	19	3.00 – 5.00	4.21	0.54

Table 9.9 - Professionals ' mean recommendation and enjoyment ratings

	N (Participants)	Range	Mean	SD
I would recommend the resource to others	4	4.00 – 5.00	4.75	0.50
I enjoyed looking at the resource	4	4.00 – 5.00	4.75	0.50

Figure 9.4 – Parents' and professionals' overall satisfaction ratings, mean ratings across all USQ items and standard errors



9.5.8 Qualitative responses

Eighteen out of nineteen parents and all four professionals commented on the most useful aspects of the resource, while thirteen parents and all professionals commented on the least useful aspects (Table 9.10).

9.5.9 Most useful aspects of the resource

The video clips were identified as the most useful features of the resource by more than half of the participants (n = 13). Importantly, there were indications from two parents that they recognised their infants' behaviour in video clips and that the videos helped them to understand this better: "*I didn't know if my baby was disliking her food or being naughty throwing spoons. It's nice to see this is normal*"; "*The [...] videos were useful. I have noticed a few times recently that my son has been rubbing his eyes during meals [...] now I know why!*". Meanwhile, one childcare professional commented that viewing the videos made her think more about what she was observing when feeding infants.

Eight participants also commented on the usefulness of the textual content regarding feeding cues. Some participants reported that they especially found the information on satiation cues helpful and two parents commented that they intended to put this to use in feeding their infants: "*I am looking forward to our next meal so that I can look for these cues*"; *"(This) should be read as a signal I need to stop feeding".* Two participants suggested that feeding cues information may be especially helpful for parents new to CF: "*It was fab [...] for* *first time parents*"; "*The list of signals […] was useful, especially as we have just recently weaned our baby*".

Table 9.10: Most and least useful aspects of the resource reported by participants (parents and professionals)

Most useful	Least useful
Video content (n = 13)	Download/longer viewing would be helpful (n= 3)
Information about feeding cues (n = 8)	More information needed (n = 5) re: - Cues in self-feeding/BLW babies (n = 2) - Feeding problems: under/over/ picky eating (n = 3)
Helped with understanding infant behaviour (n = 2)	Presentation/design (n = 3): - Voiceover would be good (n = 1) - Clearer video quality (n = 1) - Visual appeal (n = 1) - Too many video links (1)
Helped with knowing when to stop feeding (n = 2)	Technological problems viewing videos on phone (n = 1)
Links to other resources (n = 1)	Examples not needed (n = 1)
Age specific information (n = 2)	Reading cues is harder than resource suggests (n = 1)
Good for first time parents/first time CF (n = 2)	Not useful for older babies (n = 1)
Made me think about what I am seeing when feeding (n = 2)	Too much overlap between age groups in videos and tables of cues (n = 3)
Practice exercise (n = 1)	
Easy to use/clear (n = 1)	

9.5.10 Least useful aspects of the resource

Five parents commented that they would have liked more information from the resource in relation to specific aspects of infant feeding, for example, that information on dealing with fussy eating, under or over eating would have been useful: "*I worry a lot about a limited diet and how she only likes runny food […] These types of preferences weren't explored*"; "*My* *daughter eats a bit more than she should [...] it would have been good to have more information about knowing how much is an ok amount for a baby"*. Two parents also identified that it would have been helpful to have seen more examples of feeding cues in self-feeding infants: "*Recognising hunger seemed more focused on mum feeding than BLW".*

Two parents' comments related to the length of the resource. One commented that she would have liked to just view slides relating to her own infant's age rather than having to work though the slides for all ages. However, the resource menu allowed participants to navigate the resource as required and so it seems that this had been overlooked. Another parent identified that the resource was too long to view in a single sitting, rather than in absolute terms: "*It is a bit long to look at in one go. It would be good to be able to go back to it or download it*." Similarly, another parent commented that being able to download the resource would have been helpful so as to view more of it: "*I would have liked to be able to download some of the information but there wasn't an option*".

In terms of content, three participants (one professional and two parents) commented that repetition of feeding cues information in infants of different ages was unhelpful, while three participants identified that aspects of presentation could be developed, e.g. video quality, font, visual appeal, possible use of voice overs for video clips and fewer video links. Importantly, one participant reported having had difficulty opening some videos when viewing the resource on her phone rather than a computer.

9.5.11 Feeding experiences, parental satisfaction and knowledge gains

Significant inverse correlations were found between overall satisfaction with the resource and parents' level of concern about their infants' eating $r_s(17) = -.588$, $p = .008$. No significant correlations were found between overall satisfaction, infant age, number of children, or how easy parents found it to identify hunger and satiation. In addition, no significant correlations were found between these items and perceived knowledge gained re infant feeding cues or behaviour.

9.5.12 Resource exposure and feeding cues quiz performance

A significant inverse correlation was found between the length of time that all participants (professionals and parents) spent viewing the resource and total score across the two quizzes: $r_s(17) = -.503$, $p = .028$. However, no significant correlations were found between duration of resource views and percentage of slides viewed or percentage of resource viewed and quiz scores. No significant results were found for analyses of duration of viewings, percentage of resource viewed and quiz scores for parent data alone.

9.6 Discussion

This is the first known report of the development and testing of a prototype self-directed online responsive feeding resource. It proved possible to incorporate a range of information relevant to responsive feeding in the resource and to illustrate a range of feeding cues across different ages, using naturalistic video clips. Overall, the resource was well received and participants appeared to find it engaging and informative.

9.6.1 Participation

There was a relatively high attrition rate in the study (just over half of those that consented completed the final questionnaire). This may be explained by several issues. Firstly, participant reports and resource use metrics indicate that some participants may have encountered technical difficulties viewing videos on mobile phones, thereby being unable to complete the final evaluation. While the resource should have been accessible via different platforms, such findings highlight the potential of technical issues to compromise the delivery of online studies and self-directed learning.

Both quantitative and qualitative feedback regarding the length of the resource may also explain the relatively low completion rate. Mean ratings for the appropriateness of resource length, while high overall, were lower than for most other items. Therefore, some participants may have found the resource too long. Qualitative data support this view to some extent. However, they also qualify it; comments that the resource was too long for a single sitting, or that a download would have been helpful, indicate that time constraints, rather than resource length per se, may have been a factor in non-completion rates. Resource use metrics also support this, as the lack of correlation between viewing durations and the percentage of resource viewed suggest some participants may have 'rushed' viewings. Similarly, some individuals may have 'browsed' the resource without the intention of completing the study. While greater access and control are potential benefits of online interventions, they also mean that individuals have greater control over how and whether they engage with them (Cavanagh et al., Jones, 2013; Eysenbach, 2011).

9.6.2 Participant satisfaction with the resource

All questionnaire items received mean ratings indicating acceptable levels of satisfaction. It is important to note that such high ratings may result from extreme response bias. However, the observed variability in responses between and within participants would suggest this is not the case. Acquiescence response bias might also be a factor in the high ratings given that all items on the USQ are positively worded (Solís Salazar, 2015). However, some researchers have questioned the benefits of using both positively and negatively worded statements for internal consistency (Barnette, 2000; Solís Salazar, 2015) and there is evidence that the use of positively worded statements alone means participants are less likely to make mistakes in their responses (Sauro & Lewis, 2011).

Ratings for the usefulness of the resource's video content, along with qualitative feedback, indicate that this mode of delivery was valued by participants. This is consistent with evidence that video-based resources can facilitate learning (Yousef, Chatti, & Schroeder, 2014) and the fact that several research and clinical interventions have used video as a medium for increasing maternal sensitivity to infant cues (Green, et al., 2013; Schacht et al., 2017). As such, observational learning may be a particularly helpful tool for developing awareness of infant feeding cues and promoting attunement to these.

While the resource's ability to increase knowledge of issues affecting feeding behaviour received a mean high score, it received a low rating relative to other items. This most likely reflects dissatisfaction with the resource from parents with concerns about their infants' feeding, as indicated by qualitative findings and the inverse correlation between satisfaction ratings and feeding concern scores. This is an important finding regarding the acceptability of the resource to these parents, particularly given that they may experience particular difficulty in responsive feeding (Galloway et al. 2006; Gregory et al., 2010).

Professionals expressed slightly higher satisfaction ratings for the resource than parents. This may be attributable to the lower satisfaction expressed by parents with feeding concerns. Feedback that some BLW mothers would have liked more video examples of feeding cues in independently feeding infants may also be a factor. Importantly this suggests that BLW mothers, like TW mothers, were motivated to understand their infants' signals better, rather than seeing the resource as not relevant to independent infant feeding.

9.6.3 Learning from the resource

The high ratings for the learning aspects of the resource indicate that most participants felt they had gained knowledge from it. Importantly, there were also indications that participants felt this could be applied to their own feeding interactions. However, the significant inverse correlation between resource viewing durations and correct quiz answers for the whole group was unexpected. It seems likely though that participants with the greatest skill/experience in recognising cues did not feel the need to view the resource for long, as borne out by the lack of a significant correlation when data for childcare professionals were excluded from the analysis.

9.7 Evaluation

While, overall, participants found the resource satisfactory and perceived themselves as deriving useful information from it, these points need to be considered in light of several limitations. While the development of the online resource was informed by evidence regarding effective online interventions, it was not designed with explicit reference to a behaviour change model such as the Theory of Planned Behavior (Ajzen, 2002) or the Health Belief Model (Zimmerman & Vernberg, 1994). These have informed the development of a number of health interventions and have been shown to have utility in predicting health behaviours (Taylor et al., 2006). However, aspects of resource design are consistent with principles of behaviour change proposed by such models. For example, it sought to engender positive attitudinal beliefs towards responsive feeding by outlining its benefits, to raise awareness of negative outcomes associated with non-responsive feeding and to encourage a sense of self efficacy over the behaviour through the responsive feeding cues quiz/practice exercise. Furthermore, while responsive feeding may be seen as a health-related behaviour, it may equally be seen as a parenting issue. As such, the intervention was largely designed around attachment-based principles in common with other video-based parenting interventions, for example, such as the Video-feedback Intervention to promote Positive Parenting (VIPP) (Juffer, Bakermans-Kranenburg, & van IJzendoorn, 2012). Given the emphasis on parenting principles in the design of the resource therefore, a more likely limitation is that parents were not directly involved in its development and it was not possible to obtain parental feedback prior to feasibility testing.

In addition to the challenges of resource design, there are inherent challenges to evaluating and assessing the ‘real world’ use of online resources in research contexts. Within this, the brief, time limited nature of the present study is likely to have limited its ecological validity. Furthermore, the accuracy of the metrics for resource viewings is somewhat uncertain. These essentially reflect the length of time participants kept the resource open, rather than for how long they necessarily viewed it (Eysenbach, 2011).

The study would also have benefitted from the use of more robust measures of learning, for example, pre- and post- viewing tests of quiz performances (these were not used in order to limit the time taken to complete study tasks). Furthermore, the ability of the resource to elicit actual behavioural change was not investigated, and the small sample size means some analyses were under-powered, while the limited representation of professionals and BLW mothers in the study meant statistical analyses of satisfaction by parent/professional status or feeding method were not possible. In addition, the sample's relative homogeneity means it is unclear whether the resource would be equally well received by parents from different demographic backgrounds. Despite these points, it is common for feasibility studies to be underpowered (Bowen et al., 2009). Moreover, the greater likelihood of a type 2 than a type 1 error with underpowered samples means that significant findings here are likely to be trustworthy (Banerjee et al., 2009). In addition, the primary function of feasibility studies is not effectiveness testing but to generate evidence regarding the acceptability of interventions to target groups, and the feasibility of implementing larger studies (Bowen, et al., 2009; Tickle-Degnen, 2013). Within these parameters, the study provides useful insights for further resource development and future piloting.

9.8 Conclusions and future development

The study provides preliminary indications of the feasibility of developing an evidence based, self-directed responsive feeding resource which is acceptable to parents and professionals. It also provides indications that such a resource has the potential to increase perceived knowledge of feeding cues as a first step towards increasing sensitive responding. Within this, the use of video illustrations was especially valued by participants. As such, this merits further investigation to assess its effectiveness for self-directed learning, ideally by comparing learning between video-based and non-video-based versions of the resource.

Findings also suggest that the current resource would benefit from a reduction in content, for example, presenting information in two rather than three main age groups (e.g. 6 – 10 months and 11-14 months) would reduce its length and the repetition of information thereby potentially reducing attrition rates in future trials. However, findings also indicate a need for the development of *additional* content regarding feeding difficulties and strategies for dealing with these, in order to meet the needs of parents with feeding concerns better. Further testing of the resource with parents and childcare professionals would prove helpful in determining the most acceptable and useful balance of content. This may be facilitated by the use of focus groups followed by further survey work.

Technical support for resource development and delivery were limited in the study. Therefore, there is scope to develop aspects of resource presentation for example to improve the visibility of navigation options. There is also scope to develop a more interactive resource. Principles of effective online interventions suggest opportunities to apply learning, to receive feedback, and to interact with peers (e.g. through online forums), promote learning and engagement (Feil et al., 2008; Williams et al., 2008). Findings from the present study meanwhile suggest that extended access to a future resource by duration of availability and mode of delivery (for example via a mobile app) would be beneficial in facilitating more thorough resource evaluation and a larger participant sample.

In summary, the present study provides valuable insights regarding the feasibility and acceptability of an online, self-directed, responsive feeding resource for parents and professionals. Importantly, it also foregrounds the practical issues involved in delivering and evaluating such a resource and highlights avenues for future developments and investigations.

Chapter 10 – Discussion and synthesis

The implication of low maternal feeding responsivity in childhood obesity risk means there is a need to understand better how infants communicate hunger and satiation and how mothers interpret this communication. Gaps in our understanding of these issues mean we do not yet have sufficient knowledge to improve maternal responsiveness effectively. The first aim of the suite of studies in this thesis was therefore to enhance our understanding of infant communication of hunger and fullness, particularly within CF (Studies 1 and 2). A second aim was to explore the factors that shape mothers' feeding decisions, perceptions and responses across different CF practices (BLW and TW) (Study 3). The final aim was to develop and feasibility test a prototype, evidence based, self-directed online resource to increase knowledge of feeding cues and responsive feeding (Study 4). Key findings from the four studies appear in Figure 10.1 and are discussed in this chapter with reference to:

- What we have learned about infant communication of hunger and satiation in CF meals
- Mothers' own accounts of their feeding decisions and interactions
- Self-directed learning in responsive feeding.

10.1 What have we learned about infant communication of hunger and satiation in CF meals?

Study 1, the systematic review, indicated that infant expressions and maternal perceptions of hunger and satiation are influenced by physical, environmental and psychological factors (including infant and maternal attributes) (Chapter 2). The review also revealed gaps in our knowledge about how infants express hunger and satiation and identified a lack of validated tools for observing and documenting infant behaviour during feeding. In addition, review findings highlighted the impact that food preferences can have on consumption with implications for differentiating between hunger and liking cues.

Figure 10.1 – Thesis main findings

Systematic review

Physical, environmental and psychological factors (including infant and maternal factors) impact on expressions and perceptions of hunger and satiation

There is a lack of observational studies of feeding cues and validated tools for examining these

There is a need to understand better how food preference cues might be differentiated from hunger and satiation cues

Observational phase

A range of communicative behaviours can be tracked reliably across feeding episodes to investigate changes associated with hunger and satiation

Gazing at food, exploratory gaze, social gesture, social and self-vocalisation may have utility as indicators of hunger and fullness

Infant behaviour may differ in response to savoury and sweet foods

Qualitative phase

Unresponsive feeding may arise from a failure to respond to cues rather than poor recognition of cues

Misinterpretation of cues though is also likely to contribute to poor responsiveness

BLW may represent a more responsive feeding approach than TW but this is not guaranteed

Feeding practices are driven by a wide range of issues beyond hunger and nutritional needs

Feasibility testing

Self-directed, online, video-based learning appears to offer a feasible way to increase knowledge of feeding cues and responsive feeding

The use of video illustrations of cues appears popular with parents and may facilitate reflective learning

Responsive feeding resources should include information on feeding difficulties (poor intake, food fussiness) to engage parents with feeding concerns

Study 2 set out to develop tools to investigate the communication of infant hunger and satiation during feeding (Chapters 3, 4 and 5). Rather than categorising behaviours as hunger or fullness cues from the outset as previous studies have (Gross et al., 2010; Hodges et al., 2008; Hodges et al., 2016), a novel, explicitly communication-based approach was adopted on the assumption that behaviours such as gaze, gesture and vocalisation provide important information regarding infant state, interest and motivation, including motivation to eat (Rowland & Fried-Oken, 2010). Within this it was assumed that behaviours occurring early in feeding would be indicative of hunger and those occurring later would indicate fullness.

The approach taken within Study 2 also involved attending to the communicative 'functions' of gestural and vocal behaviours such as behaviour regulation (rejection and requesting) and social interaction, again, providing a new perspective on infant feeding cues. Findings from the study demonstrate the feasibility of codifying infant gaze, gesture and vocalisation and doing so reliably, during feeding (Chapters 3 – 5). They also suggest that such observations may have value for drawing inferences about infant hunger and satiation; changes in these behaviours appeared to be consistent with phenomena such as SSS and the behavioural satiety sequence. In particular, shifts towards exploratory and social activity (increases in exploratory gaze, self-vocalisation/vocal play, social vocalisation and social gesture) appeared later in feeding episodes and therefore may indicate diminished interest in feeding. These are novel findings which suggest that attention to broad behavioural patterns may assist mothers in recognising declining levels of hunger in their infants. Importantly, however, as noted in Chapters 3-5, further testing is required to address alternative explanations for observed associations between changes in gaze, gesture and vocalisation and feeding progression reported here, for example infant boredom or changes in infant interest with the introduction of novel stimuli. Future research to address alternative interpretations of thesis findings is therefore discussed below.

Findings from Study 2 also suggest that attention to the communicative function of behaviours provides new insights which may be instructive in deciphering feeding cues; the study provides indications that the same kind of gesture or vocal behaviour (e.g. giving a bowl to the mother or agitated vocalisation) may signify either hunger or satiation (Chapters 4 and 5). It is important, therefore, to recognise the different meanings that can be conveyed by the same behaviour and to encourage mothers to attend to the context in which cues occur in order to interpret their meaning accurately.

The systematic review also highlighted the fact that infant intake and rate of consumption are driven by food preference and liking as well as hunger (Mennella et al., 2009; Young & Drewett, 2000). This has implications for maternal perceptions of hunger and satiation as it raises the possibility of preference related behaviour being misconstrued as hunger. In view of this, the observational phase of the thesis (Chapters 3-5) involved separate examinations of main and dessert courses. This again represents a new approach to investigating the expression of infant hunger and satiation as no previous studies have attempted a detailed and systematic examination of infant behaviours in different courses. Importantly, performing separate analyses of courses in Study 1 provided preliminary indications of differential responses to these (i.e. higher rates of excited vocalisations and requesting in desserts than main courses) (Chapters 4 and 5). Such findings require further investigation as they may reflect differences in maternal feeding practices in different courses or they may arise from order effects in the presentation of courses. However, if found to be robust, they have implications for healthy feeding practices. Responsive feeding principles encourage mothers to follow their infants' cues on the premise that they reflect hunger and satiation. However, this may be unhelpful and cause confusion where continued interest in a given food represents liking rather than hunger. This is supported by findings from Study 3. While some mothers used portion size to determine the appropriate amounts of sweet and other foods, both BLW and TW mothers expressed some difficulty in responding to food preferences rather than hunger (Chapters 7 and 8). Providing explicit guidance on distinguishing between hunger and liking cues may therefore help to reduce maternal stress around feeding and support healthy feeding practices, for example by highlighting the importance of portion size, rather than infant cues alone for determining intake of sweet and preferred foods.

10.2 What do maternal perceptions, decisions and feeding practices mean for responsive feeding?

A key question for responsive feeding interventions is whether low responsivity to satiation arises from a lack of recognition of cues or from cues being more actively 'ignored'. Little is known about this despite its importance for understanding responsive feeding. Furthermore, findings from the systematic review (Chapter 2) suggest that that milk feeding method (breast or formula feeding) may influence how feeding cues are expressed or perceived (Llewellyn et al., 2011; Shloim et al., 2016). However, the potential of CF method to impact on infant expression and maternal perceptions of hunger and satiation has not been studied. This is important since mothers now have a choice of CF approach (TW or BLW) but we do not know whether CF approach has an impact on the communication of cues, or mothers' perceptions of these. In view of these gaps in knowledge, a second aim of the thesis was to conduct a qualitative investigation of the factors that shape mothers' feeding perceptions, responses and decisions, and to do so across BLW and TW. This is a new area of investigation. Qualitative studies of feeding method to date (Abbot & Arden, 2015; Brown & Lee, 2013: Cameron et al., 2012) have focussed on BLW mothers' experiences rather than examining feeding choices and perceptions across BLW and TW. In addition, no studies so far have examined mothers' accounts of their own feeding interactions and decisions within these. Study 3 therefore addressed these gaps using video elicited interviewing. This has been used previously to explore interactions between health professionals and patients (Gao, Burke, Somkin, and Pasick, 2009; Henry and Fetters, 2012). Its use for eliciting insights into feeding interactions, however, is new. It proved to be highly productive for generating insights regarding feeding approach and responsiveness, feeding attitudes and responsiveness, and the challenges of infant led feeding across different weaning methods. Examples of such insights are provided in Appendix E3.

10.2.1 Feeding method and responsiveness

Findings from Study 3 provide preliminary insights regarding maternal perceptions of feeding cues and mothers' responses to these in BLW and TW feeding (Chapter 7). These suggest that poor feeding responsiveness may arise either from difficulty in recognising/interpreting cues, recognition but failure to respond, or a combination of both. Both BLW and TW mothers expressed some difficulty in reading their infants' signals; however, TW mothers appeared less likely than BLW mothers to terminate meals in response to early fullness cues despite reporting familiarity with such cues. That is to say TW mothers reported many more late and prominent satiation cues than BLW mothers. Discussions with TW participants also indicated that they placed greater emphasis on ensuring that infants were full. This was on the basis of concerns about meeting infants' energy needs, ensuring infants would not become hungry again quickly and in response to pressures such as wanting to drop night feeds or reduce breastfeeding (Chapter 8). Such findings are consistent with studies which suggest that parents of older children place a high value on them being full and that feeding is used to 'ensure' infant sleep (Orrell-Valente et al., 2007; Price et al., 2012).

Findings from the current thesis however also indicate that some TW mothers did not recognise their infants' satiation signals. Furthermore, evidence from Study 3 suggest that food choices and feeding practices may be used for purposes other than nutrition and abating hunger, e.g. to manage mealtimes, to maximise intake etc. (Chapters 6-8). It is important therefore that responsive feeding interventions incorporate information *both* on recognising cues and guidance on issues which contribute to coercive feeding e.g. difficulties managing infant sleep or reducing breastfeeding. Feeding interventions also need to address beliefs about the 'need' to fill infants and to provide clear information regarding infant consumption needs.

10.2.2 Feeding attitudes, ideas and feeding responsiveness

The greater reporting of late satiation cues by TW than BLW mothers suggests the latter may involve a more responsive feeding approach than the former (Chapter 8). However, this observed difference may be an artefact of the differing communicative contexts of the two approaches; self-feeding infants are less likely to need, or to have the opportunity, to signal 'active' rejection. It is unlikely though that self-feeding alone promotes responsivity; studies of older self-feeding children suggest many parents encourage or cajole them to eat more than they otherwise would (Orrell-Valente et al., 2007). Rather, it seems that feeding attitudes and confidence support responsive feeding. TW mothers in Study 3 expressed greater confidence in older infants' ability to appropriately determine their own consumption and reported using less encouragement for them to feed (Chapter 8). Meanwhile trust in the infant to determine their own intake (both quality and amount) and respect for infant autonomy were key 'attitudes' of BLW mothers. BLW mothers' accounts also prioritised infant self-regulation, rather than adult regulation, showing consistency with feeding interventions which emphasise the role of the infant, rather than the mother in determining what is 'enough' e.g. the Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) programme (Savage et al., 2016).

10.2.3 Challenges of infant-led feeding

Notwithstanding indications that BLW may be more conducive to responsive feeding than TW, it is important to note that the approach in itself does not guarantee responsivity.

Chapter 6 highlights the high level of trust that BLW mothers placed in 'expert' sources (health professionals and BLW books). This was despite two BLW mothers experiencing significant difficulty using the approach and despite its currently limited evidence base. This raises a number of concerns. Firstly, mothers' reports suggest that BLW may not suit all infants equally and that an inflexible adherence to the approach may result in stressful feeding experiences for some mothers and infants (Chapter 6). Findings also underline the importance of perceived feeding experts providing evidence-based guidance so mothers can make informed feeding choices. Mothers may be less inclined to persist with an approach that is not 'working' for them or their infants if they have a fuller understanding of the status of the evidence behind it.

Findings from Study 3 also further highlight the complexities of infant-led feeding or allowing the infant to determine what is enough (Chapters 6-8). While BLW and responsive feeding principles emphasise infant self-regulation, mothers' reports suggest that self-regulation may not be an obvious process. Rather, infant behaviour may contradict expectations of what self-regulation should look like, causing maternal confusion, stress or the imposition of feeding controls. This is consistent with evidence that mothers of infants perceived to have poor or avid appetites may have greater difficulty in 'allowing' the infant to determine their own intake (Dinkevich et al., 2015; Fildes, van Jaarsveld, Llewellyn, Wardle, & Fisher, 2015). The question is, therefore, how mothers should respond to apparent over or under-eating. As such, responsive feeding interventions need to help mothers to understand their infants' individual feeding traits and to guide them on responding to these, where behaviour differs from expectations about self-regulation.

10.3 What are the implications of self-directed learning in responsive feeding for responsive feeding interventions?

The final phase of the thesis involved the development and feasibility testing of a prototype self-directed, video-based, online feeding resource. While self-directed learning has been used in relation to other aspects of parenting (Feil et al., 2008; Kobak et al., 2011; Nefdt, Koegel, Singer, & Gerber, 2010), this is the first known self-directed responsive feeding resource to be developed, thereby offering the first low cost, accessible prototype intervention in this area. Furthermore, it is the first known responsive feeding resource (delivered face to face or self-administered) which draws explicitly on principles of mind-mindedness (encouraging maternal awareness of child state, affect, intentionality and interest) to promote responsive feeding.

The resource was well received by participants (parents and childcare and nutrition professionals) including BLW mothers, for whom its relevance might not be anticipated, as a consequence of their infants feeding independently. BLW participants expressed satisfaction with the resource and a desire for more illustrations of cues in independent feeding contexts; thus, knowledge of feeding cues is valued by mothers even when their infants are self-feeding. It is also consistent with evidence from Chapter 8 of BLW mothers reporting some difficulty in understanding their infants' cues and one BLW mothers' desire for greater certainty about when to end the meal.

A second key finding from Chapter 9 is that the responsive feeding resource was less well received by parents who had concerns about their infants' feeding, than those who did not. This applied across concerns about over and under-eating and fussy eating. Parents with such concerns indicated a need for more information in dealing with such issues. Like findings from Study 3 and previous research (e.g. Fildes et al., 2015), this again foregrounds the need for responsive feeding programmes to tailor guidance around specific issues and needs, i.e. individual infants' eating traits and appropriate responses to these.

In terms of more general aspects of the acceptability of the online responsive feeding resource, the delivery of learning though the medium of video appeared to be highly valued by parents and professionals. There were also indications that observing feeding interactions in the medium of video may have helped some participants to reflect on their own feeding interactions. This is corroborated by findings from Chapter 8, whereby viewing themselves on video helped some mothers to observe aspects of the feeding interaction more fully, along with their own responses to these. Video therefore appears to be an effective medium for raising awareness of infant feeding cues and encouraging mothers to video and watch their own feeding interactions may in itself be a means of enhancing responsive feeding.

10.4 Implications of learning for responsive feeding interventions

In summary, thesis findings suggest the need for a more sophisticated conceptualisation of responsive feeding which promotes evidence-based practices, recognises the impact of food preferences, as well as hunger and satiation, on feeding behaviour, and which promotes flexibility to the needs of individual mothers and infants. Within this, findings highlight the need for responsive feeding interventions to address two main issues which are, to some extent, interlinked (Figure 10.2). These are:

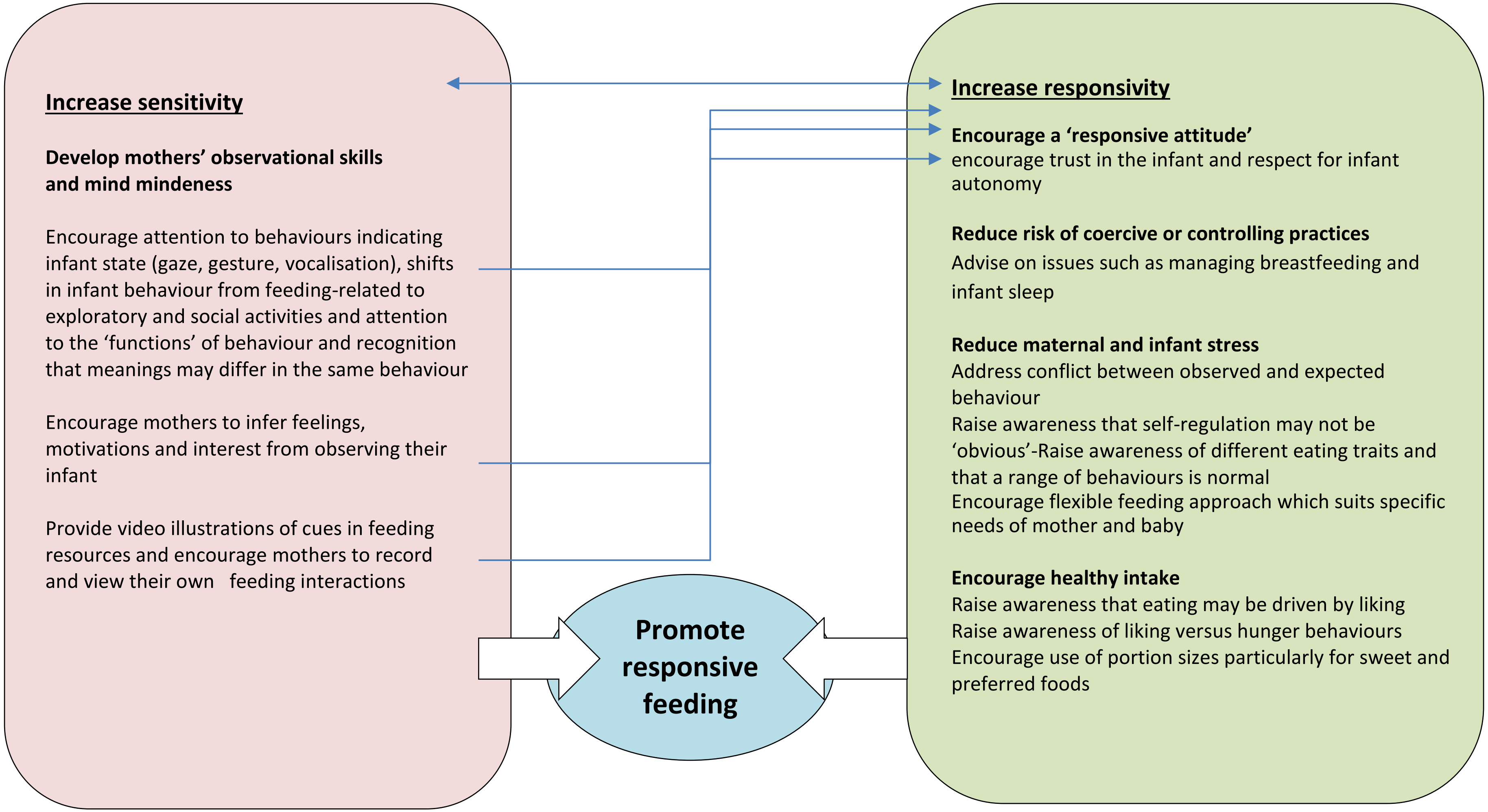
- The need to increase mothers' recognition of hunger, satiation and preference cues (sensitivity)
- The need to increase the likelihood of mothers following cues (responsivity)

The issue of enhancing sensitivity has received attention in effective feeding interventions to date via teaching about hunger and satiation cues for example in the NOURISH and Healthy Babies Trials (Daniels et al., 2009; Horodynski et al., 2011; Savage et al., 2016).

Such interventions have also addressed issues likely to enhance responsiveness e.g. trusting the infant to determine intake (Daniels et al., 2009); raising awareness of the potential of infant attributes (temperament) to impact on feeding (Horodynski et al., 2011) and discouraging the use of feeding to soothe distressed infants (Savage et al., 2014). As such, recommendations for responsive feeding interventions from the thesis are consistent with strategies shown to be effective previously.

However, recommendations from the current thesis build on and extend knowledge regarding responsive feeding interventions. They provide potential, additional strategies for assessing infant hunger and satiation, offer a higher resolution on issues and practices which may compromise responsiveness, and do so across different CF approaches. In addition, findings indicate the feasibility of a self-directed responsive feeding intervention and provide indications of intervention methods and content which are likely to be acceptable and useful to parents.

Figure 10.2 – Implications of thesis findings for responsive feeding interventions



10.5 Thesis evaluation

The main limitations of the thesis are discussed in each chapter. These relate largely to issues with sample size and sample representativeness across almost all phases of the research (Chapters 3-9). As discussed, it is unclear how far findings might apply to mothers and infants from different demographic groups. It is also unclear how far they might apply to fathers' feeding practices or those of professional child care providers. Sample size also restricted potential additional investigations in the observational phase of the thesis, e.g. it was not possible to examine differences in gaze, gesture, vocalisation or the relative use of request and rejection gestures in TW and BLW infants. Similarly, it was not possible to conduct comparative statistical analyses of different groups of parents' responses to the self-directed feeding resource, or to compare the responses of parents and professionals in a robust way. Furthermore, the under-powered nature of Studies 2 and 4 means that small effect sizes in these are unlikely to have been detected.

While it is a strength of the observational work undertaken for Study 2 (Chapters 3-5) that a novel approach was taken to examining behavioural change during CF episodes, further research is needed to exclude alternative explanations for observed associations between changes in gaze, gesture and vocalisation during infant feeding. Furthermore, while the naturalistic nature of the feeding observations conducted for Study 2 is a strength, this may have been compromised to some degree by reactivity to feeding interaction being filmed. In the first instance, infants may have been distracted by the camera, thereby altering their normal pattern of behaviour. Mothers' behaviour may also have been affected; some mothers may have fed more responsively as a result of being observed, while others may have fed for longer than they otherwise would in order to 'demonstrate' how their infants behaved when satiated. In addition, only two observations were conducted for each infant and it was not possible to standardise intervals between observations. Similarly, it was not possible to standardise intervals between the filming of meals and follow up interviews with mothers for the qualitative phase of the research. Therefore, some mothers' recollection of choice of CF approach in particular, may have been more accurate than others'. Furthermore, while the use of video-elicitation appears to have facilitated interviews regarding mothers' feeding decisions, mothers may have felt 'challenged' by this. This may have led some to feel the need to 'justify' actions or decisions thereby compromising the 'naturalness' of discussions.

Additional limitations relate to the feasibility testing of the online feeding resource. It would have been helpful for participants to have had longer to view the resource and therefore to evaluate it more thoroughly. Furthermore, the data capture functions of the resource software provided only relatively limited information regarding its use, and it was not possible to ascertain which aspects of the tutorial were viewed most or for longest. Therefore, we have only a partial picture of which elements of the resource were of most interest to participants.

Notwithstanding the limitations of Studies 2-4, it is a strength across studies that these examined novel issues using novel methods. Furthermore, all studies were conducted with appropriate attention to issues such as reliability and involved systematic analyses of data. In addition, while studies in the thesis produced a number of novel insights, the consistency of many findings with those of previous research underlines their credibility.

10.6 Conclusions and future research

The thesis provides new insights into the expression of infant feeding cues and potentially new methods for researchers to examine these. Observed associations between infant behaviour and the progression of feeding episodes appear consistent with previous findings and changes predicted by the behavioural satiety sequence from feeding related (e.g. gazing at food) to non-feeding related behaviour (e.g. exploratory or social behaviour). Findings also appear to be consistent with the effects of SSS and a renewal appetite with the presentation of a novel food i.e. dessert. However, further research is required to examine and validate these observed associations. Experimental work involving greater standardisation of mealtimes, supplementary measures of hunger and manipulations of feeding episodes would prove especially helpful for doing so. Furthermore, given that findings from Study 2 suggest that changes in visual attention to food and social and exploratory behaviours may offer insights into hunger and satiation, future work could be conducted using a simplified coding scheme including gazing at food, single, separate codes for rejection and request behaviours and codes for exploratory and socially oriented actions. Such a scheme would be easier to administer than those developed in the thesis for the detailed observation of separate gaze, gesture and vocalisation. In addition, a simplified scheme capturing a smaller number of broader, developmentally universal behaviours is likely to be applicable to infants across a range of ages.

In the event of future work supporting the proposition that changes in gaze, social and exploratory behaviour are indicative of infant hunger and satiation, it would be useful to investigate if, or how far, attention to behavioural shifts in exploratory and social behaviours assist mothers, fathers and childcare professionals in assessing satiation, and feeding more responsively.

Findings from the qualitative phase of the research provide key insights into mothers' feeding decisions and practices and issues which impact on these. In doing so, they highlight the challenges that mothers face in feeding responsively and have implications for developing interventions which speak to mothers' feeding priorities and concerns. Again, findings from the qualitative phase of the thesis provide indications for future research. In particular, it would be helpful to explore a wider range of experiences of using BLW than have been reported to date, for example, in relation to difficulties that mothers and again, fathers, have experienced with the approach. Such research may be best suited to focus groups and or examination of online forum discussions of BLW in order to capture a wide range of experiences. This may help to provide insights into which infants are most and least suited to independent feeding. In addition, it would be useful to investigate whether practices such as coercion and restriction are indeed more common in TW and BLW respectively. Insights in this area may assist health professionals in tailoring their feeding advice to mothers more appropriately to their specific feeding method.

The development of the online responsive feeding resource demonstrates the feasibility of self-directed learning in relation to knowledge of infant feeding cues. Findings from the study also suggest that such a resource is of interest to parents and professionals. Further research is now needed to refine our understanding of parents' information needs in the area, and importantly, whether learning from such a resource translates into more responsive feeding practices. It would be beneficial to involve parents in developing resource content further through the use of focus groups and to involve parents from a wider range of demographic backgrounds in doing so. It would also be especially useful to involve parents with feeding concerns in developing content in order to improve the acceptability of the resource for this group. Larger scale acceptability and feasibility testing would then be beneficial in order to make final revisions to the resource before conducting a pilot study to examine its effectiveness for increasing parental understanding of feeding cues and for supporting responsive feeding practices.

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Appendices

Appendix A1 – Systematic review quality assessment measure

QUESTIONS	Yes = 2 Partly = 1 No = 0
1. Is the Qualitative/Quantitative approach appropriate? - Could another approach have better addressed the research question?	
2. Is the study clear in what it seeks to do? Qualitative: - Is the purpose of the study discussed? - Are the research question(s) presented? - Is there adequate/appropriate reference to the literature? - Are underpinning values/assumptions/theory discussed? Quantitative: - Is the purpose of the study discussed? - Are the hypotheses presented? - Are the Outcomes to be measured clearly stated?	
3. How defensible/rigorous is the research design/methodology? - Is the design appropriate to the research question? - Is a rationale given for using the approach?	
4. How well was the data collection carried out? - Are the data collection methods clearly described? - Were the appropriate data collected to address the research question?	
5. Is the context clearly described? Both: - Are the characteristics of the participants and settings clearly defined? - Was context bias considered? Qualitative: - Has the relationship between the researcher and the participants been considered? - Does the paper describe how the research was explained and presented to the participants?	
6. Was the analysis sufficiently rigorous? Qualitative: - Is the procedure explicit – is it clear how the data were analysed to arrive at the results? - How systematic is the analysis – is the procedure dependable? - Is it clear how the themes and concepts were derived from the data? Quantitative: - Were the measures used valid and reliable?	
7. Is the analysis reliable? Qualitative:	

- Did more than one researcher theme and code transcripts/data? - Did participants feedback on the transcripts/data? (if possible and relevant) <u>Quantitative:</u> - Were the statistical tests used to assess the main outcomes appropriate?	
8. Are the findings convincing? <u>Both:</u> - Are the findings clearly presented? - Are the findings internally coherent? - Are the data appropriately referenced? - Is the reporting clear and coherent? <u>Qualitative:</u> - Are extracts from the original data included? <u>Quantitative:</u> - Have actual probability values been reported?	
9. Are the findings relevant to the aims of the study?	
10. Are the conclusions adequate? - How clear are the links between data, interpretation and conclusions? - Have alternative explanations been explored and discounted? - Does this study enhance understanding of the research subject? - Are the implications of the research clearly defined? - Is there adequate discussion of any limitations?	
11. How clear and coherent is the reporting of ethical considerations? - Have ethical issues been taken into consideration? - Are ethical issues discussed adequately – do they address consent and anonymity? - Have the consequences of the research been considered; for example, raising expectations, changing behaviour?	**TOTAL**

(Developed by Moore, 2012, from Downs and Black, 1998 and National Institute of Clinical Excellence, NICE, 2007).

Appendix B1 – Observational study participant information

UNIVERSITY OF LEEDS

'Hungry Babies, Full Babies' study – Participant information sheet

This study has been approved by the University of Leeds Research Ethics Committee
(Ethics Ref No: 14-0010 date approved: 15-Jan-2014)

Dear Parent / Guardian,

1) What is the purpose of the study?

I am a PhD student at the Institute of Psychological Sciences at the University of Leeds. I am interested in finding out how parents respond to their babies' signals of hunger and fullness. Before I can look into this I need to understand more about how babies communicate their feelings of hunger and satiety. I am also interested in how babies' mealtime communication may change as they develop and whether babies with different temperaments (the part of personality that they are born with) or different eating styles (e.g. good eaters or not so good eaters) communicate hunger and fullness differently.

I would like to invite you to take part in the first stage of my research which is an observational study of infants' communication at mealtimes. The study is subject to ethical guidelines set out by the British Psychological Society and has been approved by the Institute of Psychological Sciences (University of Leeds) Ethics Committee (ref 14-0010).

2) Why have I been chosen?

I hope to recruit 20 babies between the ages of 6 and 18 months into the study. Potential participants will be approached via contact with nurseries and play groups. Each child's parent/ caregiver can decide whether or not their child will take part in the research. Participation in this study is voluntary.

3) What do I have to do?

If you feel happy to take part you will be visited at home on 2 occasions (or if you prefer you are welcome to visit our Infant Lab at the university instead); then at a later date you may be asked to be filmed again to check whether there are any changes in feeding when your baby is older.

At the first visit there will be the opportunity to ask any further questions about the research and you will be given 2 questionnaires to complete about your baby. At the second visit I will record a video of your baby being fed a solid food meal. You will also need to be in the video so I can see how your baby directs communication to you. You will be provided with a copy of the video to keep.

4) Are there any risks/benefits from taking part?

It is not anticipated that there will be significant benefits of taking part in the study. However often where people take part in research they find this interesting or enjoyable.

Risks associated with this study are minor. If you choose to feed your baby at our Infant Lab risks are likely to equal to the same risks associated with consuming food at nursery. Within the lab risks are minimized by adherence to relevant safety and hygiene standards.

As such the main 'risk' of taking part in the study will be one of the inconvenience associated with the time involved in taking part. It is estimated that this is unlikely to be more than 2 ½ hours in total across the 2 visits. In recognition of the time commitment involved you will receive a £10 gift voucher at each visit. If you are agreeable to future filming where this is requested again you will be compensated for your time with another gift voucher.

5) What will happen to my data if I take part? (How long will the data be kept for?)
All data will be anonymised with the exception of the recruitment questionnaires containing personal data. All participants will be allocated a participant ID number (participant names will not be used) and all data files will password protected and stored in a locked office. Video data will not contain participants' names an will be stored on recordable DVDs in a locked cabinet in a locked office. Data will remain completely anonymous and securely stored for a period of 5 years. Data collected during the study, may be looked at by individuals from the University research team, collaborators on the research project and the University of Leeds for the purposes of research governance.

6) Will my taking part in the study be kept confidential? (How will you achieve this?)
The study records identifying you and your child and all the information that is collected about you/your child during the course of the research will be kept strictly confidential. Participation in this study is voluntary.

7) What will happen to the results of the study? (Will they be included in a report, thesis for an educational qualification? etc.)
Results may be published for dissemination to scientific peers. However, confidentiality and anonymity will be maintained and it will not be possible to identify any Parent/Guardian/Caregiver or any child from any publications. If you are agreeable, film clips which demonstrate hunger or fullness behaviours may be shown to demonstrate findings, but if this is the case you will be asked directly for permission before clips are used. This permission will be sought separately.

8) What if I decide that I want to withdraw my data from the study?
I can withdraw my child from the study or my child can withdraw from the study at any time without providing any reason for doing so.

9) Who can I contact for further information?
If you have any questions regarding any aspect of our research please feel free to contact **Janet McNally, PhD student** (email: psjem@leeds.ac.uk) or **Professor Marion Hetherington on 0113 343 8472** (email: m.hetherington@leeds.ac.uk).

Appendix B2 - Observational study consent form

UNIVERSITY OF LEEDS

Informed Consent Form – Hungry Babies, Full Babies Study

This study has been approved by the University of Leeds Research Ethics Committee
(Ethics Ref No: 14-0010, date approved: 15-Jan-2014)

Please complete this form after you have read the Information Sheet

'nitial the box if you agree with the statement to the left

1. I confirm that I have read and understand the information sheet explaining the ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any. In addition, should I not wish to answer any particular question or questions, I am free to decline. ☐
3. I understand that my responses will be kept strictly confidential. ☐
   I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I give my consent for the video recordings made during this research to be used for analysis and may be used for illustration in conference presentations and lectures with permission.
4. I agree to take part in the above research project and I consent to feeding my child, according to the study outline, to being videotaped feeding my child and ☐
   to answering the questionnaires from this study. I will inform the principal investigator should my contact details change.
5. I agree for the data collected from me to be used in future research ☐

Name of participant (***or legal representative***)	**Date**	**Signature**
________________________	______________	___________________

Name of child: ______________ **Date of birth:** ________________

Contact telephone number/ email address: ____

____

________________________	______________	___________________
Researcher	**Date**	**Signature**

To be signed and dated in presence of the participant

Appendix B3 –Observational study recruitment flyer

UNIVERSITY OF LEEDS

'HUNGRY BABIES, FULL BABIES' STUDY

Research ethics no 14-0010 date approved: 15-Jan-2014

HUNGRY BABIES WANTED!

Do you have a baby aged 18 months or younger?

I am running a PhD research project on infant feeding signals and am looking for volunteers to take part in this. I am recruiting up to October 2014. Long term I hope to investigate whether parent/infant interaction at mealtimes has any impact on eating behaviour in later life. However, first of all I want to understand better how infants communicate hunger and fullness. The study will involve video- taping babies between 6 and 18 months eating a typical solid food meal in order to better understand their hunger and fullness signals.

Taking part will involve3 home visits by the researcher (or you can visit our university infant lab if you prefer). You will need to answer a few questions about your baby, to complete 2 questionnaires and to be happy for 2 mealtime videos to be taken of your baby eating or being fed

Taking part in the study is entirely voluntary and any visits will be arranged at your convenience. Participants will receive a £10 Love to Shop voucher at the first and last visit as compensation for the time involved. If you would like to take part in the study please contact Janet McNally PhD student at: psjem@leeds.ac.uk, tel: 0744 609 3257.

Appendix B4 - Observational study coding scheme - gaze

Gaze behaviour definitions and coding instructions.

- Selection of the relevant coding item is made according to the **primary direction of gaze**, e.g. where the infant is watching the caregiver placing food on the table the appropriate code is ‘Gazes at food’ so long as the infant’s gaze is orientated to the food.

- Gaze is coded from the beginning of the video.

Coding of individual items:

Behaviour	Descriptor
Unobservable	Gaze cannot be seen or ascertained because of obstruction
Watches care-giver	Infant watches the care-giver for example in food preparation, picking up food from the floor etc. Gaze is generally orientated to the care-giver rather than being specifically orientated to the care-giver’s face. Code may be used where the infant is watching the care-giver at a distance or off camera as long as the infant is orientated to the voice of the caregiver and/or to the direction in which the care-giver has moved. **If in doubt, code ‘Gazes at other’**
Gazes at care-giver	Infant’s gaze is orientated to the care-giver’s face regardless of whether the care-giver is attending to the infant. Code ‘gazes at caregiver’ if caregiver is off camera but infant’s posture indicates gaze at carer’s face (e.g. infant appears to look up to meet carer gaze). **If in doubt, code ‘Gazes at other’**
Gazes at food	Infant’s gaze is orientated to food or feeding utensil **containing** food (e.g. loaded spoon, bowl) **and the infant is not engaged in exploratory gazing**.
Gazes at drink	Infant’s gaze is orientated to drink or feeding utensil including the drink of the care-giver **and the infant is not engaged in exploratory gazing**.

Gazes at other	Infant gazes at item not covered by other codes **and the infant is not engaged in exploratory gazing**. The code may also be used where the infant stares into space or if infant is blinking or gaze is unclear on video frame. Also use when infant's head is turned away but direction of gaze can reasonably be defined as 'gazes at other'.
Exploratory gaze	1. The infant attends closely to an item usually **while touching it, manipulating it or approaching it for exploration.** 2. Code may also be used where infant is clearly engaged in sensorimotor play, e.g. dropping food or object and following with eyes. 3. Code may be used where an infant briefly appears to 'inspect' an item including food removed from mouth or inspected before being placed in mouth. 4. if in doubt, observe the behaviour in context e.g. infant may vocalise to self when engaging in this kind of gaze behaviour, or may be difficult to distract from the behaviour. need to observe what infant is doing with the object in question. Looking should involve a serious expression (Ruff and Salterelli, 1993). Infant may grasp an object (including food or a feeding utensil) while the care-giver is still holding it. **This code should not be used where the infant does not attempt to** touch the object though **can be used if video frame shows infant approaching object for purpose of exploration**. This code should not be used where a young infant looks at food intently while trying to pick it up or when selecting on food and food is placed in the mouth **directly** on being picked up.
Active gaze aversion	Infant actively averts eyes and face from care-giver **in response to** offer of food. active aversion of gaze involves slight or complete head turn. **Instantaneous sampling may mean a frame is captured a second or two after active gaze aversion – in this event the behaviour may still be coded if the infant's head remains turned or gaze remains averted (infant has not**

Appendix B5 – Inter-rater and test-retest intraclass correlations for gaze codes

Inter rater intraclass correlations

Behaviour	ICC (single measures)	95% Confidence Interval Lower Bound	Upper Bound	F Test with True Value
Unobservable	.74	.61	.84	F (47,94) = 10.60, *p* < .001
Watches caregiver	.91	.86	.95	F (47,94) = 31.16, *p* < .001
Gazes at caregiver	.96	.94	.98	F (47,94) = 78.68, *p* < .001
Gazes at drink	.86	.79	.92	F (47,94) = 20.37, *p* < .001
Gazes at food	.93	.89	.96	F (47,94) = 40.69, *p* <.001
Gazes at other	.95	.91	.97	F (47,94) = 54.63, *p* < .001
Exploratory gaze	.88	.81	.92	F (47,94) = 22.41, *p* < .001
Active gaze aversion	.84	.82	.92	F (47,94) = 24.65, *p* < .001

Test-re-test intraclass correlations

Behaviour	ICC (single measures)	95% Confidence Interval Lower Bound	Upper Bound	F Test with True Value
Unobservable	.99	.99	.99	F (47,47) = 488.51, *p* < .001
Watches caregiver	.99	.99	.99	F (47,47) = 462.06, *p* < .001
Gazes at caregiver	.99	.98	.99	F (47,47) = 185.79, *p* < .001
Gazes at drink	.92	.86	.96	F (47,47) = 23.84, *p* < .001
Gazes at food	.94	.90	.97	F (47,47) = 33.75, *p* <-.001
Gazes at other	.98	.96	.99	F (47,47) = 91.26, *p* < .001
Exploratory gaze	.94	.90	.97	F (47,47) = 32.13, p < .001
Active gaze aversion	.93	.89	.96	F (47,47) = 30.85, *p* < .001

Appendix B6 - Mean gaze frequencies at the three time points of the main courses

Behaviour and Time Point	N (participants)	Range	Mean	Std. Deviation
Active gaze aversion 1	20	0.00 – 0.50	0.03	0.11
Active gaze aversion 2	20	0.00 - 3.50	0.28	0.83
Active gaze aversion 3	20	0.00 - 1.50	0.20	0.44
Exploratory gaze 1	20	0.00 - 8.50	2.00	2.49
Exploratory gaze 2	20	1.00 - 32.00	7.58	7.06
Exploratory gaze 3	20	0.00 - 26.50	8.13	7.34
Gazes at caregiver 1	20	0.00 - 13.50	6.05	3.99
Gazes at caregiver 2	20	0.00 - 18.50	8.13	5.16
Gazes at caregiver 3	20	1.50 - 18.00	9.08	5.59
Gazes at drink 1	20	0.00 - 19.50	3.65	5.68
Gazes at drink 2	20	0.00 - 15.00	3.20	4.33
Gazes at drink 3	20	0.00 - 11.00	3.25	3.06
Gazes at food 1	20	1.50 - 39.50	14.55	10.36
Gazes at food 2	20	0.50 - 29.00	11.30	8.35
Gazes at food 3	20	1.50 - 25.00	8.68	5.90
Gazes at other 1	20	5.00 - 63.50	23.18	14.68
Gazes at other 2	20	6.00 - 62.50	22.80	13.64
Gazes at other 3	20	3.00 - 60.00	23.85	14.39
Watches caregiver 1	20	0.00 - 31.50	6.03	8.35
Watches caregiver 2	20	0.00 - 26.50	2.28	6.08
Watches caregiver 3	20	0.00 - 13.00	1.60	3.19

Appendix B7 - Mean gaze frequencies at the three time points of the dessert courses

Behaviour and Time Point	N (participants)	Range	Mean	Std. Deviation
Active gaze aversion 1	16	0.00 - 0.00	0.00	0.00
Active gaze aversion 2	16	0.00 - 0.50	0.03	0.13
Active gaze aversion 3	16	0.00 - 2.00	0.13	0.50
Exploratory gaze 1	16	0.00 - 6.00	1.13	1.62
Exploratory gaze 2	16	0.00 - 15.00	4.94	4.19
Exploratory gaze 3	16	0.00 - 13.50	4.03	4.33
Gazes at caregiver 1	16	0.00 - 7.00	3.00	2.28
Gazes at caregiver 2	16	0.50 - 19.50	4.59	5.04
Gazes at caregiver 3	16	0.50 - 19.50	7.22	5.09
Gazes at drink 1	16	0.00 - 5.50	0.88	1.43
Gazes at drink 2	16	0.00 - 1.50	0.22	0.41
Gazes at drink 3	16	0.00 - 4.00	1.22	1.22
Gazes at food 1	16	0.50 - 26.00	10.53	7.67
Gazes at food 2	16	1.00 - 25.00	7.38	6.61
Gazes at food 3	16	0.00 -13.50	4.09	4.03
Gazes at other 1	16	2.50 - 18.00	9.28	4.44
Gazes at other 2	16	4.00 - 17.50	9.84	3.79
Gazes at other 3	16	0.00 - 22.50	11.44	5.89
Watches caregiver 1	16	0.00 - 12.00	2.72	3.77
Watches caregiver 2	16	0.00 - 11.00	1.94	3.39
Watches caregiver 3	16	0.00 - 5.00	0.84	1.59

Appendix B8 - Observational study coding scheme – gesture

Gesture definitions and coding instructions

Coding begins at the start of the video. Where no gesture takes place, this is also coded.
Gestures are defined as actions produced for the purpose of communication and may be expressed using, hands, arms and body movements (Crais et al, 2004).

A distinction must be made between behaviours which are intentionally communicative and those which are simply actions – the latter do not constitute gestures and must not be coded.

i) Gestures associated with rejection are made **in response** to caregiver action or vocalisation and may involve movement away from the caregiver, the caregiver's action or the item being offered.

ii) Gestures associated with requests should be spontaneous and involve initiation by the infant e.g. infant giving caregiver an item to take away is considered gestural if initiated by infant rather than occurring at caregiver's request; infant grabbing spoon that caregiver is holding, to feed self or to speed up feeding is gestural but infant taking spoon when offered by caregiver is not.

iii) Social gestures are likely to be accompanied by vocalisation, pointing or other hand gesture and/or gaze at the caregiver's face

iv) If unclear if a behaviour is gestural, code 'no gesture'

v) If unclear what the goal of a request gesture is, code ‘request other’

vi)If unclear what the function of a gesture is (e.g. social or behaviour regulation) code ambiguous. In relation to the use of pointing, request gestures with an instrumental/behavioural regulation function rather than a social function can usually be identified by the infant repeating the same behaviour towards the relevant object. In the case of declarative (social) pointing the infant may point repeatedly but at different objects, for example to draw the caregiver’s attention to these or to request that the caregiver names different objects for them.

For the purposes of the Observer, gesture behaviours are coded as being mutually exclusive. However, it is possible for some behaviours to occur together – e.g. infant arches back and pushes an item away. In the event of such ‘clusters’, code the most developmentally advanced behaviour (behaviours lower in coding scheme are more advanced than those above for the same behaviour group) and note the other behaviours which occurred.

Behaviour	**Modifier**	**Descriptor**
No gesture	N/A	No gesture occurs Code must be used when infant is not gesturing. To determine the start and end of a gesture, gesture starts when movement involved starts and ends when infant changes
Ambiguous	N/a	Unable to determine communicative function of gesture e.g. unclear if point is request or declarative (i.e. social in nature)
Reject outburst	food/feeding utensil drink other	tensing accompanied by tray pound/swipe/agitated hand clasp/ arm flap or flail. If accompanied by body turn or pulling back code reject body

Reject body	food/feeding utensil drink other	Arch back in response to caregiver offer of food, drink wiping etc, turn away, head movement/ head turn/squirm
Reject push	food/feeding utensil drink other	Push away
Reject grab	food/feeding utensil drink other	Infant grabs spoon or other item to stop caregiver action (e.g. grabs spoon but not to feed self)
Reject give	food/feeding utensil drink other	Giving is always gestural except in response to request from care-giver. Code reject give where infant is giving caregiver items as request to take them away, e.g. gives caregiver food, plate or spoon to take away, gives caregiver drink cup to take away. N.B. Giving needs to be coded according to its communicative function. If giving is part of social interaction e.g. offering food to caregiver as part of a game code social gesture.
Reject hand halt	food/feeding utensil drink other	Hand Held up palm facing outwards to indicate 'stop'
Reject head shake	food/feeding utensil drink other	Code if used appropriately i.e. to reject. If used playfully, code as social gesture
Request outburst	food/feeding utensil drink other	Infant expresses agitation through arm flail/flap to request more food, return of spoon, drink etc. or at mother attempting to remove food

Request-body	food/feeding utensil drink other	Requests additional food/drink etc by bodily movement – e.g. caregiver offers cup for drink, infant drinks, caregiver retracts cup and infant gestures with head by moving towards cup with open mouth. In the case of infant requesting by opening the mouth the infant needs to clearly do this to
Request- reach	food/feeding utensil drink other	Infant reaches for food etc. to prompt caregiver or to show that they want the item. N.B. Only code Reaches for food/feeding utensil if request clearly involves a desire to eat, e.g. if food is put to the mouth. If infant requests bowl/spoon/cup etc. for purpose of playing,
Request grab	food/feeding utensil drink other	Infant spontaneously grabs item caregiver is holding e.g. spoon and feeds self. Infant may also grab the spoon with the appearance of wanting to speed up feeding. N.B. Code should not be used where infant is accepting an item when offered by caregiver as this is an action rather than a gesture.
Request out	N/A	Infant raises hands up to be picked up, squirm in high chair directed at caregiver, request to take off bib
Request point or sign	food/feeding utensil drink other	Point must be associated with request (not declarative). Likely to involve eye/attempted eye contact with carer. also use code if infant signs. Requests for food/feeding utensil must be feeding/drinking related. if infant requests bowl/spoon/cup etc. for purpose of playing code ‘request other’.
Social gesture	N/A	Showing off behaviour e.g. blowing raspberries as part of social interaction (Capone and Mcgregor, 2004), wave, clap, initiate or respond to game/action song using gesture, nod/ head shake in response to caregiver. Comment/question (but not offer of food), Declarative/ interrogative point, showing or offering spoon or drink to caregiver for her to eat/drink

Appendix B9 - Inter-rater intraclass correlations for gesture

Behaviour	ICC (single measures)	95% Confidence Interval Lower Bound	Upper Bound	F Test with True Value
Unobservable	1.00	N/A	N/A	N/A
Ambiguous	.64	.43	.78	F (47,47) = 4.48 *p* < .001
Reject with the body	.46	.21	.65	F (47,47) = 2.85 *p* < .001
Reject by giving	.76	.61	.86	F (47,47) = 7.61 *p* < .001
Reject by grabbing	.00	.28	.28	F (47,47) = 1.00 *p* = .500
Reject head shake	.02	-.23	.28	F (47,47) = 1.05 *p = .440*
Reject outburst	.00	.28	.28	F (47,47) = 1.00 *p = .500*
Reject push	.61	.39	.76	F (47,47) = 1.05 *p = .440*
Request with the body	.76	.62	.86	F (47,47) = 7.50 *p < .001*
Request by giving	1.00	N/A	N/A	N/A
Request by grabbing	.73	.56	.85	F (47,47) =7.11 *p < .001*
Request outburst	.00	-.28	.28	F (47,47) =1.00 *p* = .500
Request out of highchair	0.0	-.27	.28	F (47,47) =1.00 *p* = .500
Request with point/sign	.81	.68	.89	F (47,47) =9.41 *p < .001*
Request with reach	.89	.80	.93	F (47,47) = 16.19 *p < .001*
Social gesture	.77	.62	.86	F (47,47) = 7.95 *p < .001*

Appendix B10 - Test-retest intraclass correlations for gesture type

Behaviour	ICC (single measures)	95% Confidence Interval Lower Bound	Upper Bound	F Test with True Value
Unobservable	1.00	N/A	N/A	N/A
Ambiguous	.50	.25	.69	F (47,47) = 2.95 *p < .001*
Reject with the body	.87	.79	.93	F (47,47) = 5.09 *p < .001*
Reject by giving	.52	.29	.70	F (47,47) = 3.24 *p < .001*
Reject by grabbing	.00	-.28	.28	F (47,47) = 1.00 *p* = .500
Reject head shake	.49	.19	.65	F (47,47) =2.62 *p < .001*
Reject outburst	0.00	-.27	.28	F (47,47) =1.00 *p* = .500
Reject push	1.00	N/A	N/A	N/A
Request with the body	.63	.43	.78	F (47,47) =4.52 *p < .001*
Request by giving	.81	.69	.89	F (47,47) =9.89 *p < .001*
Request by grabbing	.86	.76	.92	F (47,47) =13.17 *p < .001*
Request outburst	0.00	- .28	.28	F (47,47) =1.00 *p* = .500
Request out of highchair	0.00	- .28	.28	F (47,47) =1.00 *p* = .500
Request with point/sign	.82	.70	.90	F (47,47) =9.89 *p < .001*
Request with reach	.93	.88	.96	F (47,47) = 29.18 *p < .001*
Social gesture	.70	.53	.82	F (47,47) = 5.89 *p < .001*

Appendix B11 Mean gesture rates at the three time points of the main courses

Behaviour and Time Point	N (participants)	Range	Mean	Std. Deviation
Reject with the body 1	20	0.00 - 0.80	0.08	0.20
Reject with the body 2	20	0.00 - 1.15	0.14	0.33
Reject with the body 3	20	0.00 - 1.14	0.15	0.30
Reject by giving 1	20	0.00 - 0.19	0.01	0.04
Reject by giving 2	20	0.00 - 0.00	0.00	0.00
Reject by giving 3	20	0.00 - 0.22	0.03	0.07
Reject by pushing 1	20	0.00 - 0.29	0.02	0.08
Reject by pushing 2	20	0.00 - 0.00	0.00	0.00
Reject by pushing 3	20	0.00 - 0.59	0.04	0.14
Request with the body 1	20	0.00 - 0.71	0.06	0.17
Request with the body 2	20	0.00 - 0.65	0.04	0.15
Request with the body 3	20	0.00 - 0.37	0.03	0.11
Request by giving 1	20	0.00 - 0.00	0.00	0.00
Request by giving 2	20	0.00 - 0.00	0.00	0.00
Request by giving 3	20	0.00 - 0.00	0.00	0.00
Request by grabbing 1	20	0.00 - 1.37	0.08	0.31
Request by grabbing 2	20	0.00 - 1.73	0.09	0.39
Request by grabbing 3	20	0.00 - 1.10	0.07	0.25
Social gesture 1	20	0.00 -0.80	0.18	0.25
Social gesture 2	20	0.00 - 3.57	0.92	1.00
Social gesture 3	20	0.00 - 3.88	1.01	1.15

Appendix B12 Mean gesture rates at the three time points of the dessert courses

Behaviour and Time Point	N (participants)	Range	Mean	Std. Deviation
Reject with the body 1	16	0.00 - 1.65	0.18	0.50
Reject with the body 2	16	0.00 - 1.24	0.08	0.31
Reject with the body 3	16	0.00 - 1.79	0.22	0.52
Reject by giving 1	16	0.00 - 0.71	0.09	0.21
Reject by giving 2	16	0.00 - 0.00	0.00	0.00
Reject by giving 3	16	0.00 - 0.71	0.06	0.18
Reject by pushing 1	16	0.00 - 0.00	0.00	0.00
Reject by pushing 2	16	0.00 - 0.33	0.02	0.08
Reject by pushing 3	16	0.00 - 0.51	0.05	0.14
Request with the body 1	16	0.00 - 0.95	0.10	0.27
Request with the body 2	16	0.00 - 1.51	0.26	0.43
Request with the body 3	16	0.00 - 0.00	0.00	0.00
Request by giving 1	16	0.00 - 0.00	0.00	0.00
Request by giving 2	16	0.00 - 0.00	0.00	0.00
Request by giving 3	16	0.00 - 1.16	0.07	0.29
Request by grabbing 1	16	0.00 - 0.50	0.05	0.14
Request by grabbing 2	16	0.00 - 0.95	0.10	0.27
Request by grabbing 3	16	0.00 - 1.48	0.21	0.46
Social gesture 1	16	0.00 - 1.87	0.42	0.61
Social gesture 2	16	0.00 - 3.37	0.87	1.14
Social gesture 3	16	0.00 - 4.15	1.32	1.45

Appendix B13 - Observational study vocalisation coding scheme

Vocalisation behaviour definitions and coding instructions

- Vocalisation codes noted from beginning of video including ‘no vocalisation/silence’.
-If unsure, if a vocalisation is socially directed or a vocalisation to self, code ‘vocal self’
-If unsure of communicative function of a directed vocalisation (e.g. accompanies point but unclear if function is social or behaviour regulation), code ambiguous.

- Request vocalisations can usually be differentiated from social vocalisations as they are likely to be made repeatedly with reference to the same object (if they are not met with the desired response in line with toddlers’ ‘repair’ strategies (Fagan, 2008). Alternatively, request vocalisations may be identified through caregiver’s response – if caregiver responds as to a request, code ‘request’. If the object requested is unclear, code ‘request other’.

-Directed vocalisations are evidenced by infant gaze at care-giver, accompanying actions or gestures or are made in response to caregiver behaviour/caregiver vocalisation.
-Negative emotion/fractiousness which appears to relate to discomfort code as ‘unknown distress’.
-Vocalisations are classed as speech like if they have vowel or consonant type qualities (Hsu, Fogel and Cooper, 2000)
-Vegetative sounds e.g. coughs, hiccups are not coded

Code	**Modifier**	**Descriptor**
No Vocalisation	**N/A**	Infant is silent
Ambiguous	**N/A**	Unable to determine vocalisation’s communicative function e.g. unclear if vocalisation is request or comment/response to caregiver etc

Agitation	**N/A**	Expression of negative affect through vocalisation (grunt, whine, fuss, cry). Infant appears agitated but not in the context of clear requesting or rejecting behaviour. Code according to function. If negative vocalisation occurs in context of rejecting food, drink, other or requesting food, drink, other (i.e. accompanied by other actions e.g. head turning, open hand, reaching etc) code non-speech or speech reject, non-speech or speech request.
Unknown distress	**N/A**	Infant is fretful, unsettled or distressed – cause unknown, may involve discomfort or generally being fractious. infant does not settle in response to food, drink etc though may respond to being picked up. Distress vocalisation reappears with only brief periods of being settled.
Undirected/vocalise to self		
Self-vocal		Infant vocalises to self – (gaze is not directed towards care-giver) includes squeals/grunts/ babble
Eat vocal		Infant makes vocalisations associated with eating to self - 'mmm', 'amm' 'yum' while eating (gaze is not directed towards care-giver). vocalisations not associated with eating (sounds other than 'mmm' etc' are scored as vocalise to self, 'squeal, babble, other' if they occur during eating. 'mm' sounds or comments like 'yum' are coded as interaction if they are directed to caregiver.
Excited vocalisation		Infant gasps or squeals excitedly
Raspberry blowing		Infant blows raspberries to self. If raspberry blowing involves interaction, code as social vocalisation

Directed **Non-speech reject** **Speech reject**	**food/utensil** **drink** **other** **food/utensil** **drink** **other**	Cries, whines, fusses, squeals, grunts while gazing at caregiver's face or in direct response to offer of food etc. (likely to be accompanied by other action, e.g. pushing food away, throwing food, active gaze aversion) Consonant and/or vowel sounds or combined CV sounds - (u, u,da, ag, ab), babble (dadada, bababa, bada) proto-words/words to reject food etc while gazing at caregiver's face or in direct response to offer of food. (likely to be accompanied by other action, e.g. pushing food away, throwing food, active gaze aversion). All gone vocalisation may be associated with rejection/request to end meal but may also be social vocalisation
Directed **Non-speech request** **Speech request**	**food/utensil** **drink** **other** **food/utensil** **drink** **other**	Cries, whines, fusses, squeals, grunts as request, likely to be associated with imperative eye point/ imperative manual point/reaching, gaze at caregiver. Requests, food, drink, object or assistance, e.g. to get out of high chair. Consonant and/or vowel sounds or combined CV sounds- (u, u,da, ag, ab), babble (dadada, bababa, bada) proto-words/words to request food etc, likely to be associated with imperative eye point/ imperative manual point/reaching, gaze at caregiver. Requests, food, drink, object or assistance, e.g. to get out of high chair.
Directed **Social**		Grunt/squeal/growl/babble, words or laughter directed to caregiver (gaze at caregiver) or in response to caregiver question, comment or caregiver imitating infant, Proto-conversation/vocal play with care giver (Dyadic)/declarative or interrogative vocalisation, verbal comment on food to caregiver -' yummy', 'all gone' comment if used as declarative or imitative of mother (Crais et al 2004)

Appendix B14 – Test-re-test intraclass correlations for vocalisation

Behaviour	ICC (single measures)	95% Confidence Interval Lower Bound	Upper Bound	F Test with True Value
Agitation	.81	.69	.89	F (47,47) = 9.97 *p < .001*
Ambiguous	.62	.41	.77	F (47,47) = 4.25 *p < .001*
Unknown distress	.98	.97	.99	F (47,47) = 98.40 *p < .001*
Non-speech reject	.32	.05	.54	F (47,47) =1.98 *p* = .011
Speech reject	.75	.59	.85	F (47,47) =6.95 *p < .001*
Non-speech request	.39	.13	.61	F (47,47) =6.95 *p < .001*
Speech request	.98	.96	.99	F (47,47) = 102.52 *p < .001*
Social vocalisation	.85	.75	.92	F (47,47) = 12.74 *p < .001*
Eating vocalisation	.99	.98	.99	F (47,47) =261.64 *p < .001*
Excited	.93	.87	.96	F (47,47) = 26.06 *p < .001*
Raspberry blowing	1.00	N/A	N/A	N/A
Self-vocalisation	.86	.76	.92	F (47,47) = 13.06 *p < .001*

Appendix B15 Mean vocalisation rates at the three time points of the main courses

Behaviour and time point	N (participants)	Range	Mean	Std. Deviation
Agitation 1	20	0.00 - 3.92	0.67	1.16
Agitation 2	20	0.00 - 0.29	0.05	0.10
Agitation 3	20	0.00 - 1.56	0.31	0.47
Eating vocalisation 1	20	0.00 - 1.62	0.17	0.40
Eating vocalisation 2	20	0.00 - 4.51	0.31	1.01
Eating vocalisation 3	20	0.00 - 1.61	0.14	0.37
Excited vocalisation 1	20	0.00 - 0.99	0.09	0.23
Excited vocalisation 2	20	0.00 - 0.35	0.02	0.08
Excited vocalisation 3	20	0.00 - 0.31	0.02	0.08
Raspberry blowing 1	20	0.00 - 0.00	0.00	0.00
Raspberry blowing 2	20	0.00 - 0.32	0.02	0.07
Raspberry blowing 3	20	0.00 - 0.35	0.02	0.08
Self vocalisation 1	20	0.00 - 2.76	0.89	0.89
Self vocalisation 2	20	0.00 - 3.27	0.99	0.96
Self vocalisation 3	20	0.12 - 4.72	1.47	1.30
Social vocalisation 1	20	0.00 - 3.40	0.77	0.98
Social vocalisation 2	20	0.00 - 8.02	1.77	2.25
Social vocalisation 3	20	0.00 - 7.30	1.64	2.16
Speech reject 1	20	0.00 - 0.00	0.00	0.00
Speech reject 2	20	0.00 - 0.00	0.00	0.00
Speech reject 3	20	0.00 - 0.17	0.01	0.04
Speech request 1	20	0.00 - 0.64	0.07	0.16
Speech request 2	20	0.00 - 0.62	0.07	0.18
Speech request 3	20	0.00 - 2.09	0.18	0.48

Appendix B16 - Mean vocalisation rates at the three time points of the dessert courses

Behaviour and time point	N (participants)	Range	Mean	Std. Deviation
Agitation 1	16	0.00 - 2.30	0.60	0.83
Agitation 2	16	0.00 - 1.03	0.21	0.36
Agitation 3	16	0.00 - 3.31	0.44	0.82
Eating vocalisation 1	16	0.00 - 4.66	0.35	1.17
Eating vocalisation 2	16	0.00 - 5.07	0.50	1.39
Eating vocalisation 3	16	0.00 - 1.07	0.07	0.27
Excited vocalisation 1	16	0.00 - 1.47	0.33	0.53
Excited vocalisation 2	16	0.00 - 1.16	0.09	0.29
Excited vocalisation 3	16	0.00 - 0.11	0.01	0.03
Raspberry blowing 1	16	0.00 - 0.48	0.03	0.12
Raspberry blowing 2	16	0.00 - 0.89	0.06	0.22
Raspberry blowing 3	16	0.00 - 0.30	0.02	0.07
Self vocalisation 1	16	0.00 - 4.28	1.23	1.30
Self vocalisation 2	16	0.00 - 3.08	1.01	1.10
Self vocalisation 3	16	0.00 - 4.17	1.42	1.22
Social vocalisation 1	16	0.00 - 5.78	1.48	1.70
Social vocalisation 2	16	0.00 - 5.29	1.88	2.12
Social vocalisation 3	16	0.00 - 6.52	2.29	2.12
Speech reject 1	16	0.00 - 0.32	0.02	0.08
Speech reject 2	16	0.00 - 0.35	0.04	0.12
Speech reject 3	16	0.00 - 0.71	0.10	0.22
Speech request 1	16	0.00 - 2.95	0.59	0.82
Speech request 2	16	0.00 - 2.30	0.60	0.83
Speech request 3	16	0.00 - 1.03	0.21	0.36

Appendix C1 – Participant information – qualitative study of infant feeding decisions

UNIVERSITY OF LEEDS

Mothers' feeding decisions in the context of baby led weaning and traditional spoon-feeding - Participant information sheet

This study has been approved by the University of Leeds Research Ethics Committee
Ethics approval ref no: 14-0116; date approved: 16-Jun-2014

Dear Parent / Guardian,

1) What is the purpose of the study?

While carrying out the 'Hungry Babies' study I have had many interesting discussions with parents about their experiences and decision making in relation to feeding their babies. I would very much like to capture some of these as part of my ongoing PhD research into how parents respond to their babies' signals of hunger and fullness.

As such, I would like to invite you as a previous research participant to take part in a brief interview-based study. The study is subject to ethical guidelines set out by the British Psychological Society and has been approved by the Institute of Psychological Sciences (University of **Leeds Ethics Committee ref 14-0116**).

2) Why have I been chosen?
You have been approached about the research as a previous participant in the 'Hungry Babies' study. However, participation in this study is entirely voluntary.

3) What do I have to do?
If you feel happy to take part you will be visited at home once for a brief interview regarding the decisions involved in feeding your baby. (Or if you prefer you are welcome to visit our Infant Lab at the university instead). As well as asking the interview questions I will play back the video taken at my last filming visit to help you to reflect on the feeding process. The interview will be recorded on a digital voice recorder so that it can be transcribed for later analysis.

4) Are there any risks/benefits from taking part?
It is not anticipated that there will be significant benefits of taking part in the study. However, it is hoped that you will find this to be an interesting experience.
Risks associated with the study are minimal and the main 'risk' or disadvantage of participating will be one of the inconvenience associated with the time involved. It is estimated that this is unlikely to be more than 1 hour in total. In recognition of the time commitment involved you will receive a £10 gift voucher at the.

5) What will happen to my data if I take part? (How long will the data be kept for?)
All interview data will be anonymised and participant names will not be used. All data files will password protected and stored in a locked office. Audio data will not contain

participants' names and will be stored on data files on a password protected computer in a locked office. Data will remain completely anonymous and securely stored for a period of 5 years. Data collected during the study, may be looked at by individuals from the University research team, collaborators on the research project and the University of Leeds for the purposes of research governance.

6) Will my taking part in the study be kept confidential? (How will you achieve this?)
The study records identifying you and all the information that is collected about you during the course of the research will be kept strictly confidential. Participation in this study is voluntary.

7) What will happen to the results of the study? (Will they be included in a report, thesis for an educational qualification? etc.)
Results may be published for dissemination to scientific peers. However, confidentiality and anonymity will be maintained and it will not be possible to identify any Parent/Guardian/Caregiver or any child from any publications.

8) What if I decide that I want to withdraw my data from the study?
You can withdraw your child from the study or your data from the study at any time without providing any reason for doing so.

9) Who can I contact for further information?
If you have any questions regarding any aspect of our research please feel free to contact **Janet McNally, PhD student** (email: psjem@leeds.ac.uk) or **Professor Marion Hetherington on 0113 343 8472** (email: m.hetherington@leeds.ac.uk).

Thank you for taking the time to read this information.

Appendix C2 - Participant consent form – qualitative study of infant feeding decisions

UNIVERSITY OF LEEDS

Informed Consent Form – Hungry Babies, Full Babies Study
<u>Mothers' feeding decisions in baby led weaning and spoon-feeding contexts.</u>

This study has been approved by the University of Leeds Research Ethics Committee
(Ethics Ref No: 14-0116 date approved: 16-Jun-2014)

Please complete this form after you have read the Information Sheet

Initial the box if you agree with the statement to the left

1. I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any. In addition, should I not wish to answer any particular question or questions, I am free to decline. ☐

3. I understand that my responses will be kept strictly confidential. I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I give my consent for the audio recordings made during this research to be used for analysis and for anonymous quotations from these to be used for illustration in conference presentations and lectures with permission. ☐

4. I agree to take part in the above research project and I consent to being interviewed, according to the study outline and to the interview, being recorded on an audio file. I will inform the principal investigator should my contact details change. ☐

5. I agree for the data collected from me to be used in future research ☐

Name of participant (***or legal representative***)	**Date**	**Signature**
___________________________	_________________	______________________

Date of birth: _________________ **Phone number/ email address:** ______________________

___________________________	_________________	______________________
Researcher	**Date**	**Signature**

To be signed and dated in presence of the participant

Appendix C3 – Email invitation to take part in qualitative study of feeding decisions

Dear X

I hope that this email finds you well.

My work on the Hungry Babies study is ongoing at the moment and I'm starting to analyse my video data. As things have progressed I've had some interesting discussions with mums about their experiences of feeding their babies and the decisions involved in this. Because of these I'm conducting a small qualitative study alongside the original research with a view to better understanding the decisions and experiences involved in infant feeding.

Taking part in this study would involve a short interview about your experiences of feeding Bobby. I am sure that he will have grown quite a bit, so as part of the interview it would be helpful for us to also watch and discuss the video from my last visit.

Of course, there is no obligation to take part in this follow up interview but it would be great to hear from you if you think this is something you might like to be involved in. If you're interested I would be able to visit at a time to suit you.

I'm attaching some more information about the study.

Best Wishes, Janet

Appendix C4 – Qualitative study of infant feeding decisions - sample interview/sample reliability coding

JANET MCNALLYP01INT

So, the reason that I wanted to do this extra bit is really just the more I've gone round and talked to people about their kind of feeding decisions and stuff, the more sort of interesting conversations I've had and it's been quite nice to just hear about people's decisions and their experiences and what-not and so I wanted to try to capture some of that as part of my PhD...

Yeah.

...so yeah, so I'm just seeing about seven or eight people to just, you know, talk about...

Yeah, get a bit more.

Yeah, yeah. Yeah.

Yeah. No, that's fine.

So yeah, so I don't know if you can remember because it's a while ago now...

Yeah, I know.

...isn't it since you weaned X but what I'm asking people to do is just think back about when they were thinking about weaning and the sort of decisions they made and I suppose why they chose to do what they do...

Yeah.

...what they did rather so...

Well I think... You think about weaning a lot sooner than you need to cos although your midwives and your health visitors are telling you six months, all your products on the baby shelves all say four months so I think even before that you're kind of thinking about it quite a lot and I didn't find that you got much information from your health visitor, you got a leaflet as such and so there was a lot of going away and your first port of call's Google so...

Commented [A1]: 1.1 Formal Influences

Commented [A2]: 1.2.3 Google/own research

Commented [A3]: Agreement – influences/info - 2

Oh right, okay.

Yeah, so you kind of like do your Google searches about weaning and that's when I found out about baby-led weaning and it was from that that it just led me to start thinking about, oh, how am I going to, or oh gosh, yes, food's really important, how am I going to make sure that you do it right and so then got the Gill Rapley book because she is the queen of *[laughs]* baby-led weaning and then just reading her book it kind of made me realise that that was the road I wanted to go down. The main reason for it was because X had been exclusively breastfed and the idea of the baby-led weaning is that it follows on from breastfeeding quite well so this idea that when you're breastfeeding baby stops when he's full, you're not like feeding him, looking at the bottle going, oh he's got two ounces left, I need to get that two ounces in him because you don't know and then this idea of... What I was quite concerned about then going onto feeding was how am I going to know when he's hungry, how am I going to know when he's full, how much food do I feed him but then reading the Gill Rapley book it was like you've got trust their instincts still so you're giving them food and then they'll stop eating when they're full, just how they've gone on from breastfeeding and I quite liked that idea of letting them be in control again rather than, not shovelling food down them but that's how I kind of felt it was so that was the main decision to do it and then I didn't make a conscious decision to start feeding him, he was sat eating breakfast with me and he took some toast off my plate and started gumming it himself so it was when he did that I was like, oh right then, he's ready to eat so we just started, I just started at toast really and I gave him quite, I gave him like the crusty bits because I didn't want him to choke or anything and then the more... It was really true that for the first two months he didn't eat, he wasn't swallowing, it was very much learning about food and he was following everything that like the book said and things and I was on all the forums, do you know like following what people were saying and he was just like following, he was a bit of a model baby with it really because you worry, oh he's not swallowing any, he's not filling up but then, you know, because he's still taking all his milk so and after about two months you'd look and you'd realise that actually not that much went on the floor and he was eating it, then you notice it coming through his poo and you think, oh yeah, he's swallowing and the first time he had carrot in his poo I was like, oh yeah, he's swallowing the carrot! *[Laughs]* And you just think, oh no, I'm obsessed with his poo! *[Laughs]*

[Laughs]

And then I noticed that his milk, he was taking less milk through the day and so it was really strange because your constant worry is, is he full but then all your signs as a mum, well he's sleeping through and he was following it so it worked really well. I think after about three months I became a bit more relaxed with it so before then I was like, no, I'm not spoon feeding but I spoon feed yoghurt because there was no way I'd let him, *[laughs]* I'd let him

Commented [A4]: 1.2.3 Google/own research
1.3 BLW book

Commented [A5]: Agreement – influences/info - 2

Commented [A6]: 2.3 Beliefs about TW
2.3.4 TW is forceful

Commented [A7]: Disagreement
Not about TW – 0 – about background – continuity with BF

Commented [A8]: Agreement – info/influence - 2

Commented [A9]: 1.3 BLW book

Appendix D1 - Responsive feeding resource feasibility study participant information and consent form

UNIVERSITY OF LEEDS

Parents' Mealtime Mind Reading Consent Form

Please read the following information about the study. If you are happy with this, please complete the questions about consenting to take part. You will then be able to follow a link to the online feeding resource.

Mealtime Mind Reading Study Information and consent
School of Psychology Research Ethics Committee ref no: 16-0219; date approved: 15-Aug-2016
Researcher: Janet McNally; psjem@leeds.ac.uk

What is the purpose of the study?
The purpose of the study is to test an online responsive feeding resource for parents. We need feedback from parents to see if this would be useful to them and also whether any changes are needed.

Why have I been invited to take part?
You've been invited to take part as the parent of a baby between 5 and 24 months old. The feeding resource has been designed for parents of babies in this age group and so your feedback would be very helpful. To participate you'll need access to a computer and the Internet and to able to easily watch and listen to a range of video clips'. **You can take part regardless of whether you spoon feed your baby, use a mixture of spoon feeding and finger foods or if you practise Baby Led Weaning.**

Do I have to take part in the research?
It's up to you to decide if you wish to take part – this information is designed to help you decide. If you're interested after reading this, you'll be asked to answer some questions to show that you're happy to be involved.

What will happen if I decide to take part?
You'll have the opportunity to look at the online feeding resource. Once you've done this, you'll be asked to complete a questionnaire to evaluate it. It'll take about 15 minutes to look at the resource and 5 minutes for the questionnaire. Data will also be collected on how you navigate the resource, as this will help us to understand what information is of the most interest to parents.

There is an option to take part in a prize draw as a thank you for the time you have taken to be involved in the research. If you want to take part in the draw you'll be asked to provide a contact email address. You won't be asked to provide any other personal information which would identify you.

What are the potential risks and benefits of taking part?
Taking part is likely to help develop your knowledge of your baby's feeding behaviours and their hunger and fullness signals. Your responses will also help us learn what information helps parents to understand their babies' feeding behaviour. There aren't any foreseeable risks involved in participating other than the inconvenience associated with the time involved. In recognition of the this **you'll have the opportunity to be entered into a prize draw to win a £100, £50 or £25 gift voucher.**

What will happen to my data if I take part?
All data will be anonymous with the exception of the provision of your email address for entry into the prize draw. This will be stored in a password protected spreadsheet on a password protected computer in a locked office. Data collected during the study will remain completely anonymous and securely stored for a period of 5 years. Data may be looked at by individuals from the University of Leeds research team, collaborators on the research project and the University of Leeds for the purposes of research governance.

What will happen to the results of the study?
Results may be published for sharing with scientific peers. However, confidentiality and anonymity will be maintained and it will not be possible to identify you.

What if I decide that I want to withdraw my data from the study?
You can withdraw data from the study at any time up to September 30th 2016. On starting the evaluation questionnaire you will be asked to leave a date of birth and your initials so these can be used to identify your data should you choose to withdraw from the study. **In the event of wanting to withdraw, please email the lead researcher Janet McNally, with details of your date of birth and initials and ask for your data to be removed (psjem@leeds.ac.uk).**

What do I need to do now?
If you would like to take part in the study, please complete the following consent questions, click 'finish' and follow the link to the online resource. Once you have looked at the resource please follow the link to the evaluation questionnaire where you can also enter the prize draw.

Who can I contact for further information?
If you have any questions regarding any aspect of our research please feel free to contact Janet McNally, PhD student (0744 609 3257, email: psjem@leeds.ac.uk) or the study supervisor, Professor Marion Hetherington (0113 343 8472 email: m.hetherington@leeds.ac.uk).

*1.*Please enter your date of birth and first and last initials (e.g. 21/04/80GH) so we can use these to identify your data should you wish to withdraw from the study. You may do so up to 30.09.16.

*2.*I confirm that I have read and understand the information sheet explaining the above research project.

*3.*I understand that my participation is voluntary and that I am free to withdraw my survey data at any time up to September 30th 2016 without giving a reason. In addition, should I not wish to answer any particular question or questions, I am free to decline.

*4.*I understand that my responses will be kept strictly confidential.
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified
or identifiable in the report or reports that result from the research.

*5.*I agree to take part in the above research project and to answering the survey questions from this
study.

*6.*I agree for the data collected from me to be used in future research.

*7.*I confirm that I am 18 years of age or over

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THANK YOU FOR GIVING YOUR CONSENT TO TAKE PART IN THE STUDY.

PLEASE FOLLOW THE LINK TO VIEW THE ONLINE FEEDING RESOURCE

http://responsivefeed.articulate-online.com/p/7583235849/DocumentViewRouter.ashx?Cust=75832&DocumentID=7259608f-1027-4a53-84fe-79f86d3ab1a1&Popped=True&v=1&InitialPage=presentation.html&content_token=d6423e10-cc72-45ad-9acf-8edc09f84bbc&content_endpoint=http%3a%2f%2fresponsivefeed.articulate-online.com

Appendix D2 - Responsive feeding resource feasibility study questionnaire

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Mealtime Mind Reading Study Parents' Evaluation Questionnaire

Thank you for reviewing our online feeding resource. Please answer the following questions to tell us a bit about yourself and your thoughts on the resource.

1. Please enter your date of birth and first and last initials (e.g. 21/04/80GH) so we have these to refer to should you wish to withdraw from the study.

2. Please tell us where you heard about the study.

3. What is your age in years?

4. What is your gender?
    - M
    - F

5. Please state your marital status
    - Married/civil partnership
    - Co-habiting
    - Divorced/separated/widowed
    - Single (never married or cohabiting)

6. How would you describe your ethnicity? E.g. White British, British Asian, Mixed, etc.

7. What is your highest level of academic qualification?
    - No formal qualifications
    - Standard grade GCSE or equivalent
    - Higher grade A level or equivalent
    - HNC, HND, SVQ or RSA
    - Undergraduate degree

- Postgraduate degree

8. What is your occupation?

9. How many children do you have including your little one?

- 1
- 2
- 3
- 4
- 5 +

10. Which of the following best describes your experience of feeding your little one?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I find it easy to tell when my little one is hungry					
I find it easy to tell when my little one is full					
I have concerns about my little one's eating					
Feeding my little one is an enjoyable experience					

11. What is your little one's age in months?

12. What is your little one's gender?

- M
- F

13. What was his or her birthweight? (Please state in kgs or lbs)

14. Please describe how your little one was fed from birth

- Fully breastfed from birth
- Fully breastfed for a period followed by formula
- Mixed feeds from birth (breast and formula)
- Fully formula fed from birth

15. If fully breastfed from birth, for how long did you feed this way?

- 0-4 weeks
- 1-3 months
- 4-6 months
- 7-9 months
- 10-12 months
- Longer than 12 months

16. At what age in months did you introduce solids?

17. Which of the following best describes how you have fed your little one solids so far?

- Spoon-feeding only
- Spoon-feeding with finger foods offered at a later stage
- Mixture of spoon-feeding and solids from the beginning
- Baby led weaning (allowing your little one to feed themselves from the beginning)

18. Which of the following best describes your little one's eating (please tick all that apply)

- My little one eats too much
- My little one eats too little

- My little one eats about the right amount most of the time
- My little one eats a variety of foods
- My little one eats a limited range of foods

19. Please indicate how much or how little you agree with the following statements about the online feeding resource:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
The objectives of the feeding resource were clear					
The feeding resource was well-organized					
The material was presented in an interesting manner					
There were enough examples and illustrations					
The ideas were clearly presented and easy to understand					
The video examples were helpful in illustrating hunger and fullness behaviours					

The resource increased my knowledge of my baby's hunger and fullness signals					
The resource increased my knowledge of issues affecting my baby's eating behaviour					
I found the information in this resource helpful					
I feel I could apply learning from the resource to feeding my little one					
The length of the feeding resource was about right					
I would recommend this resource to others					
I enjoyed looking at the feeding resource					
Overall, I was satisfied with the feeding resource					

20. Finally, what you did you find to be the most useful aspects of the online resource?

And what did you find to be the least useful aspects of the resource?

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE. PLEASE INDICATE BELOW IF YOU WISH TO BE ENTERED INTO THE PRIZE DRAW AND/OR IF YOU WISH TO RECEIVE A SUMMARY OF THE RESEARCH FINDINGS:

21. I wish to be entered into the prize draw

- Yes
- No

I wish to receive a summary of the study findings

- Yes
- No

My email address is:

Thank you for your help with the Mealtime Mindreading Study. If you wish to withdraw your data from the study, you may do so up to September 30th 2016 by emailing Janet McNally, PhD student at psjem@leeds.ac.uk details of your log in.

Appendix D3- Responsive feeding resource feasibility study participant flyer

UNIVERSITY OF LEEDS

Mealtime Mind Reading:

Understanding your baby's signals in the solid food stage

School of Psychology Research Ethics Committee Approval 16-0219
Date of approval: 15-Aug-2016

I am PhD student researching infant feeding. I have designed an online resource for parents to help them to better understand their babies' feeding signals during solid food meals. I now need to test the resource to see if the information in it is helpful. As such, I'm looking for parents' and early years professionals' or students' views on this. Taking part involves:

1. Viewing and navigating the resource according to your interests.
2. Completing an online evaluation questionnaire.

Participating in the study is entirely voluntary and is likely to take about 40 minutes of your time. You will need access to a computer and to the Internet and to be able to watch a series of video clips. **As a thank you for taking part there is the option to be involved in a prize draw: 1st prize, £100 in shopping vouchers, 2nd prize, £50 in shopping vouchers 3rd prize, £25 in shopping vouchers**

If you would like to know more or would like to take part in the study please use the relevant link below:

Parents' link: https://leeds.onlinesurveys.ac.uk/parents-mealtime-mind-reading-feeding-resource-questionna-3

Professionals'/students' link: https://leeds.onlinesurveys.ac.uk/professionals-students-mealtime-mind-reading-feeding-re

If you would like to discuss any aspect of the study please contact Janet McNally PhD student at: psjem@leeds.ac.uk, 0744 609 3257 or Prof. Marion Hetherington, m.hetherington@leeds.ac.uk, +44(0)113 343 8472

Appendix E1 – Examples of mothers' comments in relation to viewing feeding videos and insights for Study 3 analyses.

Participant	Comment in response to video	Insight for analysis
Rebecca (BLW)	At that point I usually take the plate away from her now and just leave her and see if she eats anymore on her own rather than sort of sitting there because she often does better eating when she's on her own.	Mum identifies strategy to encourage intake
Maggie (TW)	Whereas I think I'm… see that's me like he's' taken a tiny piece, I'm like, "mmm, okay", like this, a bit more, a bit more going in or we'll be here all day. See he's getting fuller now you can see, because he didn't automatically, he was more interested in the bit he could pick up than the bit that I had on the spoon.	Mum identifies herself as encouraging further eating. Mum identifies signs of fullness in infant.
Jess (TW)	So, she's kicking herself away from the table I think now so it's like she's completely lost all, you know, her attention's just gone, she's not bothered so we'll move onto the next course, she wants to get down.	Mum identifies sign of fullness in infant
Lily (BLW)	She was choking on there! […] I thought she was actually choking, whereas there's been a few times where she's coughed a bit and she kind of kicks her legs and I think that's when she's having difficulty, like chewing it or swallowing it, but I've never really felt like she was gonna choke […] the book that I read really made me feel confident with it	Mum reflects on concern about choking and role of Baby Led Weaning book (Rapley and Murkett, 2008) in instilling confidence in relation to this