Original Article

Using grounded theory methodology to conceptualize the mother–infant communication dynamic: Potential application to compliance with infant feeding recommendations

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Abstract

Excessive, rapid weight gain in early infancy has been linked to risk of later overweight and obesity. Inappropriate infant feeding practices associated with this rapid weight gain are currently of great interest. Understanding the origin of these practices may increase the effectiveness of interventions. Low-income populations in the Southeastern United States are at increased risk for development of inappropriate infant feeding practices, secondary to the relatively low rates of breastfeeding reported from this region. The objective was to use grounded theory methodology (GTM) to explore interactions between mothers and infants that may influence development of feeding practices, and to do so among low-income, primiparous, Southeastern United States mothers. Analysis of 15 in-depth phone interviews resulted in development of a theoretical model in which *Mother–Infant Communication Dynamic* emerged as the central concept. The central concept suggests a communication pattern developed over the first year of life, based on a positive feedback loop, which is harmonious and results in the maternal perception of mother and infant now speaking the same language. Importantly, though harmonious, this dynamic may result from *inaccurate* maternal interpretation of infant cues and behaviours, subsequently leading to inappropriate infant feeding practices. Future research should test this theoretical model using direct observation of mother–infant communication, to increase the understanding of maternal interpretation of infant cues. Subsequently, interventions targeting accurate maternal interpretation of and response to infant cues, and impact on rate of infant weight gain could be tested. If effective, health care providers could potentially use these concepts to attenuate excess rapid infant weight gain.

Keywords: low income, qualitative methods, behaviour, beliefs, communication, infant feeding.

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Introduction

The United States obesity epidemic and related chronic disease risks have increased attention to factors influencing this national health crisis (Dennison *et al.* 2006; Reilly & Kelly 2011; Rao *et al.* 2012). Of particular concern are high rates of childhood overweight and obesity, as the associated co-morbidities of type 2 diabetes, cardiovascular

disease and hypertension are occurring at increasingly younger ages (Reilly & Kelly 2011). Excessive, rapid weight gain in early infancy has been linked to risk of later overweight and obesity (Stettler & Iotova 2010), and evidence suggests that heavier infants are at greater risk for becoming heavier children and young adults (Dennison *et al.* 2006; Stettler & Iotova 2010; DiSantis *et al.* 2011; Druet *et al.* 2012). Infant feeding practices, such as lack of breastfeeding and

early introduction of solid foods, have been associated with excessive rate of infant weight gain (Alder *et al.* 2004; Dennison *et al.* 2006; Stettler & Iotova 2010). Therefore, the first year of life has been suggested as a critical time point for interventions designed to attenuate excessive rapid weight gain (Stettler & Iotova 2010; DiSantis *et al.* 2011).

However, infant feeding practices are complex and likely influenced by multiple factors. For example, the decision to breastfeed or offer infant formula is influenced by factors such as maternal age, education, income, marital status, self-efficacy, race/ethnicity, and region of residence in the United States (Gabriel *et al.* 1986; James & Lessen 2009; CDC 2011). In addition, the infant feeding beliefs and attitudes of close family and friends can influence the timing and introduction of solids, and actual or perceived events can result in infant feeding practices discordant with American Academy of Pediatrics (AAP) recommendations (Gabriel *et al.* 1986; Bentley *et al.* 1999; Heinig *et al.* 2006; Gatti 2008; Kleinman 2009; Kavanagh *et al.* 2010).

Understanding factors influencing development of these discordant practices is critical to creating effective interventions. However, when exploring infant feeding decisions and behaviours in populations at higher risk for these practices, investigators must be aware of specific barriers to full participation in infant feeding conversations. First, in low-income populations, mothers report health care providers do not fully understand the context in which infant feeding decisions are made, resulting in a lack of desire to share actual behaviours with these providers (Heinig *et al.* 2006). Combined with the well-established phenomenon of reporting of socially desirable behaviours, conversations focusing on infant feeding may immediately trigger mothers to report compliance with recommendations, whether or not this is the true

behaviour, in an effort to avoid perceived judgment (Brown *et al.* 2011). In addition, discussions related to the choice to breast or formula feed can bring up feelings of maternal guilt, resentment and defensiveness (Lakshman *et al.* 2009; Flaherman *et al.* 2012), and may be counterproductive to conducting a global conversation about how infant feeding behaviours develop. Therefore, this study was designed to broadly explore maternal perceptions of mother/infant communications among low-income, primiparous mothers in the Southeastern United States, using grounded theory methodology (GTM), and to subsequently frame findings in the context of potential impacts on compliance with infant feeding recommendations.

Materials and methods

Study design

This was a qualitative study, using GTM to conduct, analyse, and interpret in-depth, one-on-one, recorded phone interviews, and to develop a theoretical model of the daily experiences and interactions between mother–infant dyads that may contribute to development of infant feeding behaviours. The University of Tennessee Institutional Review Board approval was obtained prior to study implementation.

Inclusion criteria

The study was open to first-time mothers of infants <12 months of age, who were also English-speaking, low-income, had telephone access, and reported living in an urban area surrounding the research lab. The US Census Bureau defines ‘urban’ as areas that are unincorporated with a population of $\geq 50\,000$, and suburban areas with a population of ≥ 2500 . Therefore, residents from 58 area zip codes were potentially

Key message

- Unique communication patterns between mothers and infants develop quickly and are strengthened during the first year of life.
- Maternal response to infant cues and behaviours determines this communication pattern.
- Increasing the accurate interpretation of infant cues and behaviours may lead to optimal infant feeding behaviours, resulting in appropriate infant weight gain trajectories.

eligible to participate. Income eligibility was determined using annual guidelines issued by the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) (Food and Nutrition Service 2011).

Recruitment

Participants were recruited via a voluntary birth registry maintained by the University of Tennessee, flyers and postcards distributed to organizations serving the study population (such as WIC), and advertisements posted to two social media websites. Potential participants were either screened upon contacting the research lab in response to recruitment materials, or were contacted as members of the voluntary birth registry. Eligible and interested participants were provided with study details and contact information was collected. If available, upon recording of verbal consent, participants were interviewed during this initial phone call. If an immediate interview was not feasible, a future interview was scheduled at the convenience of the participant. Verbal consent was obtained at that time. Upon completion of the phone interview, a paper copy of the consent form and a \$10 gift card was mailed to the participant.

Interview script

GTM stipulates that an exhaustive literature review be delayed until development of the final theoretical model (Charmaz 2006). This practice attempts to limit primary investigator assumptions that might result from in-depth knowledge of the available literature. Therefore, the interview script was developed *a priori*, based on a brief review of the literature to identify relevant content areas. In keeping with GTM, the interview script could be revised to allow for exploration of emerging, developing themes and central concepts; a technique referred to as theoretical sampling (Charmaz 2006). All interviews were conducted by the primary investigator (JW) to ensure consistency. The protocol was used to guide each interview and was modified with additional questions as new themes and concepts

emerged. As categories became saturated, questions were reframed to allow other concepts to develop. This strategy of intensive interviewing is an appropriate data collection approach for use in grounded theory inquiries (Charmaz 2006).

Data management/analytic strategy

Audio recordings were transferred to a secure, password-protected computer accessible only to study personnel. Interviews were transcribed, verbatim, by trained undergraduate research assistants, using a transcription software program (InqScribe, Inquirium, LLC, Campbell, CA). The co-coder (KB) was provided a coding orientation by the primary investigator, as outlined by Charmaz, whereby coding phases and steps to be administered during each phase were discussed (Charmaz 2006). Initial transcripts were coded independently by these two researchers, who then met to compare agreement. Interviews, transcription and coding were ongoing. The first interview was coded by both researchers, and a meeting was held to discuss the codes. Once an IR (inter-coder reliability) of at least 70% was reached, meetings occurred after each set of three new transcripts was coded. These meetings allowed for development and refinement of the codebook, as new codes were discussed, combined or expanded, depending on the content of the transcriptions. Emergent codes created and used by the primary investigator were available to the co-coder. However, the co-coder was blinded to code placement. QDA Miner (version 3.2, Provalis Research, Salt Lake City, Utah) text analysis software was used to manage the coding process. In keeping with Charmaz's GTM approach, coded transcripts were analysed using constant comparison emergent techniques. These include maintenance of a reflexivity log, memoing, use of open-ended questions during the interview process and theoretical sampling. These techniques allowed themes and the central concept to emerge and facilitated identification of impending saturation. The reflexivity log was used by the primary investigator to record thoughts or suspected main concepts, after completing each interview and during model development. Memoing, conducted by both coders, served

to identify imminent category saturation, and to compare data with data, data with category, category with category and category with concept. This process allowed properties and dimensions of emergent categories and codes to develop (Scott 2004).

Once the central concept was identified, a reflective coding matrix (Table 1) assisted with further identification and development of emergent dimensions and properties, as well as other major themes and supporting concepts. Upon identification of the central concept, model development was initiated, and the progression from initial, to focused, to axial and finally theoretical coding began. Emergent themes identified during focused coding were compared with each other and to the central concept to identify relationships between categories. This process advanced model development and allowed supporting concepts to emerge within main themes. During theoretical coding, relationships between subcategories and categories were described. For example, a subcategory 'Points of Maternal Education', within the category 'Learned Coping/Insightfulness', emerged during theoretical coding. Lastly, main emergent themes were finalized and the overall model developed. Per GTM protocol, recruitment, data collection, analysis and model development occurred simultaneously (Charmaz 2006).

To increase trustworthiness of results, the protocol addressed credibility, transferability and transparency. Credibility was addressed by utilizing an independent co-coder, and by oversight of the corresponding author (KK), an infant feeding expert, and by an expert in qualitative research (MS). Transferability and transparency were achieved using several strategies. First, completion of a reflexivity log after each interview provided record of first impressions and thoughts, and allowed for increased confidence of accurate detection of emergent themes and impending saturation. Memoing, an ongoing process completed by both coders, provided record of code-development and identification of new themes or concepts. Saturation of the major themes and related concepts occurred by the 12th interview. The reflective coding matrix was used to assess the reliability of emergent themes and concepts during the final three interviews.

Table 1. Reflective coding matrix, modified from Scott (2004)

Central phenomenon: mother-infant communication dynamic					
Properties	Process	Perception	Interpretation	Product	Purpose
Processes	Interaction	Development	Insightfulness	Coping	Communication
Dimensions	<ul style="list-style-type: none"> • Mother mimics infant noises and actions • Maternal repetition of communication pattern • Infant ways of communicating 	<ul style="list-style-type: none"> • Exhibited infant cues/behaviours • Weak cues/behaviours • Controlled cues/behaviours • Infant-care easier with age/development • Low-self efficacy with newborn • Observed infant sleep pattern • Frequent waking • Sleeping through night 	<ul style="list-style-type: none"> • Maternal feelings projected onto infant • Content after eating • Feels forgotten about • Fake coughing for attention • Fights sleep • Different cries 	<ul style="list-style-type: none"> • Trying different things • Wants to make infant happy • Wants infant to turn out well • Wants to do everything right • Wants to be perceived as a Good Mom 	<ul style="list-style-type: none"> • Older infant easier to understand • Bonding actio • Better bonding
Contexts	Bi-directional	Infant age	Past/life experience	Negotiation	Unique bond
Modes for understanding consequences	Toward a set pattern	Schedule helps to establish pattern	Trial and error	Doing the best you can	Better understanding and self-efficacy

Results

Recruitment sources and participant characteristics

From June 2011 to February 2012, 253 mothers were screened. Though online and print media generated most of the screens, the majority of eligible participants were recruited from local community health programs. Nearly 81% of those screened ($n = 204$) were ineligible, with primary reasons being residence outside of predetermined eligibility area (33%), having more than one child (40%), not having an appropriately aged child (11%), and reporting a household income above the eligible level (10%). These were not mutually exclusive, and potential participants could be excluded for multiple reasons. Of the 49 eligible mothers, 30 were never re-contacted after the screen, primarily due to disconnected numbers or an inadequate availability of cellular phone minutes. Therefore, 19 mothers completed the phone interview. However, three interviews were lost due to equipment malfunction and one was deemed unacceptable, secondary to limited maternal response. Thus, the final sample consists of 15 mothers. Table 2 outlines sample characteristics. In general, mothers were in their mid-20s and white, with most having at least a high school education. Infants were, on average, 5.2 months of age. Four infants were less than 3 months old; five were between 3 and 5 months old; two were between 5 and 7 months old; and four were older than 7 months.

Theoretical model

The term ‘central concept’ describes the core of the emergent model. The use of GTM resulted in a model depicting the central concept (Mother–Infant Communication Dynamic), three main themes, and four underlying, interconnected, supporting concepts (Fig. 1). Quotes are provided to illustrate each supporting concept (Table 3) and main theme (Table 4).

The first supporting concept, *Hectic Guessing Game*, emerged as mothers described early infancy as

Table 2. Participant characteristics of sample of 15 mothers

Variables	Number (%) of participants
Maternal age (years) (mean = 25.5; SD = 3.95)	
20–25	8 (53%)
26–30	6 (40%)
31–35	1 (7%)
Infant age (months) (mean = 5.2; SD = 3.30)	
Birth–2.9 months	4 (27%)
3–4.9 months	5 (33%)
5–6.9 months	2 (13%)
7–8.9 months	1 (7%)
9–10.9 months	2 (13%)
11–12 months	1 (7%)
Race/ethnicity	
White	10 (67%)
Black/African American	5 (33%)
Highest level of school completed	
Less than high school	1 (7%)
High school graduate	6 (40%)
Some college/trade school	1 (7%)
Bachelor's degree	4 (27%)
Graduate degree	1 (7%)

a time of uncertain trial and error. Some mothers described an unsettling combination of novelty and great infant need, which resulted in testing various coping strategies until the desired infant behaviour was achieved. If infant behaviour changed in the desired way, interpreted as a direct response to maternal action, this reinforced subsequent use of the coping strategy. In this way, coping strategies resulting in desired infant behaviors were considered useful and others were discarded. The second supporting concept, *Starting to Understand*, describes mothers who now have an increasing sense of ‘knowing’ their infants. As infants increase the ability to express needs, the perception of a communication pattern unique to each mother–infant dyad begins to emerge. For example, mothers express belief in their ability to detect ‘different cries’. The third supporting concept, *Better Interaction*, appeared sometime during middle infancy, defined here as 3–6 months of age. Here, mothers described increasing quality of infant interactions leading to a deeper relationship. As infant development progressed and resulted in more controlled cues and behaviours, mothers perceived a greater ability to identify and respond to their own

Fig. 1. Theoretical model representing the mother–infant feeding dyad: birth to 12 months in a primiparous, low-income, South-eastern United States population.

infant's needs, resulting in the maternal perception of *Speaking the Same Language* (the final supporting concept).

These supporting concepts of the central concept emerged related to infant age and developmental stage, and were interconnected to the 3 main themes: (1) *Perceived Infant Development and Communication Capabilities*, (2) *Maternal Focus Dictates Maternal Response* and (3) *Resulting Feeding Practices*. Each theme encompasses several interrelated ideas, which ultimately influenced the central concept. Quotes illustrating each main theme can be found in Table 4.

Theme 1 – perceived infant development and communication capabilities

This first theme describes maternal conceptualization of changes in infant communication ability. For example, mothers describe infants as relatively inac-

tive or disengaged in the early weeks of life. During these early weeks, mothers reported guessing how to respond to crying, describing weak infant cues and characterizing behaviours and sleep patterns as confusing. Further, mothers reported that frequent night waking or inconsistent sleep patterns were especially problematic. As infants developed, resulting in more advanced ability to communicate, mothers described more 'active' infants and reported the emergence of a 'routine' between themselves and their infants. The idea of a shared routine emerged as infants began to sleep for longer periods at night and the perception of 'different cries' emerged. As infant development progressed, mothers reported infants sleeping through the night and exhibiting more controlled cues/behaviours such as pointing, eye rubbing, and intentional smiling. Mothers of ambulatory infants reported infants able to identify and retrieve desired objects, to self-feed, and to more clearly indicate desires and needs.

Table 3. Mothers' quotes illustrating the four underlying concepts supporting the three themes and central phenomenon (Mother–Infant Communication Dynamic)

Supporting concept	Participant quote(s) [participant number/infant age in months]
Hectic guessing game	... [I]t was very difficult ... probably more so for me than him [because] I would get so anxious and so upset when I didn't know what was wrong. I would call my boyfriend and ... I was like ... I just fed him, changed his diaper, I tried to give him (type of medicine) in case it's gas and he would just cry and [... I didn't know what was wrong]. So it's really stressful when you feel like you can't help them ... sometimes babies just cry. ... [I]t was definitely difficult at first not knowing and not having any previous experience with a newborn. [#20/6.2]
Starting to understand	... [D]istinctive crying is one I've noticed ... [W]hen he's upset or when he's ... in pain he'll cry a certain way, if he's hungry, he'll cry a certain way. [#21/2.2] [...] all of a sudden it was just like it's weird but I just felt like one day I kind of knew. Um uh my guess and I'm trying to actually like think about it but would be between like 6 and 8 weeks. I know a lot changed about 6 weeks I don't know I was probably kind of figuring it out before that but I felt kind of like at 6 or 8 weeks like I actually I knew her. Like I felt like I wasn't constantly like let me try all four different things and you know it's okay that's the one it is. It's then it was just like oh she's this, she's this, she needs this. [#23/3.2]
Better interaction	[...] But as she got older, she smiled, she recognized you ... you got to play with her, you get to hug on her. ... [I]t just it seems like she loves you back where as in the beginning ... you're the sole care provider and it was harder for me to get attached personally. [#24/10.7]
Speaking the same language	I think she's just excited that someone else can maybe understand her and somebody else is kind of talkin[g] to her. I think that she feels the bond ... and she's like oh I'm brought into this world and have no idea what's going on but somebody else understands me. [#19/4.0]

Theme 2 – maternal focus dictates maternal response

The second theme describes a similar temporal pattern in which response was driven by different foci, specific to infant age and developmental stage. As

Table 4. Mothers' quotes illustrating the three main themes interconnected to the central phenomenon (Mother–Infant Communication Dynamic)

Main theme	Participant quote(s) [participant number/infant age in months]
1. Perceived infant development and communication capabilities	'[...] when they're newborns ... they can't do much body language or ... you [are] jus[t] ... so new at it, you don't understand what cry is which ...' '[...] as they get older, I guess you get used to it and into a routine of ... things.' [#4/5.1] '[...] I mean he just basically slept. He wouldn't, he didn't really do anything. He liked to just sleep and eat and use the bathroom; there was really no interaction'. '[...] at first I thought ... he doesn't do anything but eat. But now, he is very active'. [#12/2.3]
2. Maternal focus influencing maternal response	'... [I]'m out of the stage where I was worried about SIDS. ... and they say it peaks at 3–4 months, and so once I got that out I felt comfortable ... because you worry about every little thing as a new mom, and I'm sure any mom really. But now it's keeping him happy, and of course healthy, but um helping him meet his milestones; like he can sit up now by himself with you know little pillows around him, and ... just kind of fostering a learning environment now, now that he's old enough and wants to interact more with things'. [#20/6.2]
3. Resulting feeding practices	'When she was first born she woke up probably every hour and a half ... consistently. She never slept through the night, not even close, until about six months and then she'd wake up 2 times a night so it just took her a long time to sleep through the night; nothing, no cereal, no solid foods, none of that helped.' [#24/10.7] '... I would get so anxious and so upset when I didn't know what was wrong. I would call my boyfriend and ... I was like ... I just fed him, changed his diaper, I tried to give him (type of medicine) in case it's gas and he would just cry'. [#20/6.2]

infants aged and developed, maternal concerns shifted. For example, during early infancy, mothers were primarily concerned with infant survival and growth. During this period, responses based on the focus on survival/growth included switching infant

formula (to reduce gas) or adding infant rice cereal to the bottle (to reduce spit-up). In addition, if breast milk was perceived to be inadequate, supplementation with infant formula or early weaning could occur, as the focus was to ensure infant survival and perceived adequate growth. As infant development continued, maternal focus shifted to infant happiness and gross motor skill development. Mothers described a desire for infant happiness, indicated by infant smiling, excited gesturing, screeching and flapping arms. For example, if mothers believed early introduction of solid foods would result in infant happiness, these inappropriate feeding practices were considered acceptable, despite acknowledged discouragement from healthcare providers. Signals used to determine infant readiness for solid foods included infants staring at family foods during meal times and leaning towards these foods. In situations where such foods had been previously introduced, perceived infant desire positively reinforced this feeding practice, regardless of infant age, developmental readiness or contradictory recommendations from health care providers. Increased interest was also expressed for achievement of gross motor development milestones, such as crawling, sitting up independently and rolling over. Mothers of older infants reported a focus on supporting infant intellectual development, describing desire for a smart or intellectually advanced infant, and reporting attempts to stimulate this type of development, such as reading, singing and counting.

Theme 3 – resulting feeding practices

The final theme emerged as a combination of the first two themes interacting with the core concept (Fig. 1). For example, mothers described early infancy as a period of uncertainty, with the main focus on infant survival and perceived adequate growth. If mothers interpreted positive responses from current feeding practices, in the form of perceived adequate growth, acceptable levels of infant 'fussiness', or adequate sleep duration, these practices continued. However, if mothers perceived inadequate growth, moderate to severe fussiness, frequent or voluminous spit-up or inadequate sleep duration, then alternative feeding strategies, outside of current infant feeding recom-

mendations, may be tested. Over time, perception shifts gradually away from the view that the newborn infant is difficult and confusing to care for, to a greater ease with the older infant. Through a complex interaction of infant development and maternal perception of infant cues, communication between mothers and infants is built and solidified.

Discussion

Though infants appear likely to be born with the ability to self-regulate energy intake (Dewey & Lonnerdal 1986), it has been suggested that continuation of this ability may depend on parental infant feeding behaviours (DiSantis *et al.* 2011). Therefore, interventions to develop optimal infant feeding behaviours may be most effective when occurring early in infancy. This theoretical model suggests a dynamic communication pattern, which culminates in the maternal perception of *Speaking the Same Language*, and may provide assistance with creation of effective interventions. The mother–infant communication pattern is rapidly established, continues to strengthen, and likely reaches a point when it becomes difficult to change. This bidirectional interaction between caregiver and infant is not particularly novel (Bell & Ainsworth 1972; Forcada-Guex *et al.* 2006), but has only recently been explored in the context of infant feeding practices (Anderson *et al.* 2001; McCarter-Spaulding & Kearney 2001; Thompson *et al.* 2009; DiSantis *et al.* 2011). For example, DiSantis and colleagues hypothesise that caregiver response to infant hunger and satiety cues, if interpreted incorrectly, may lead to overfeeding of the infant. If this 'cue/incorrect interpretation/incorrect response-cue' cycle, in the context of overfeeding, becomes a chronic behavioural loop, it may result in a decreased ability to self-regulate energy intake (DiSantis *et al.* 2011). This is one hypothesized mechanism for rapid infant weight gain, a factor which has been linked to later obesity (Dennison *et al.* 2006; Stettler & Iotova 2010; DiSantis *et al.* 2011; Druet *et al.* 2012).

In this final model, four supporting concepts functioned through three emergent themes, to support the central concept of dynamic mother–infant

communication. As infants mature, and developmental skills become more apparent, maternal focus correspondingly shifts. The relatively relaxed infant–mother interactions described by those with older infants (*Speaking the Same Language*) likely represents a communication pattern initially forged during the frantic learning phase described by mothers with very young infants (*Hectic Guessing Game*). When attempting to increase compliance with infant feeding recommendations, recognizing the dynamic process occurring between mother and infant may provide important targets for interventions designed to reduce risk of later overweight/obesity, as sensitivity to maternal perceptions at different infant ages may result in more meaningful messages.

Early weaning and/or overfeeding

Early infancy is well recognized as a potentially sensitive period for establishment of health promoting behaviours (Fall *et al.* 1992; Lavelli & Poli 1998; Heinig *et al.* 2006). However, transmission of messages designed to increase compliance with infant feeding recommendations in early infancy may be more effective if there is acknowledgement of the potentially fragile status of maternal self-efficacy at this time point, and this may be especially important among first-time mothers. Results of this qualitative work indicate that new mothers may be primarily concerned with infant safety and survival. Very young infants may be perceived as confusing and high-need, a combination that may result in first-time mothers feeling as if their infants are ‘*speaking a different language*’. Because cues transmitted by young infants are weak and possibly ill-understood, and because their sleep patterns are perceived as erratic, it appears that these mothers felt infants were difficult to care for and extremely vulnerable. These findings may provide a context for two important infant feeding concerns arising during the first 2–3 months of life: lack of breastfeeding/early weaning (James & Lessen 2009), and offering infant cereal in the bottle (Bentley *et al.* 1999; Karp & Lutenbacher 2011). For example, as maternal self-efficacy is known to be an important factor in a successful breastfeeding experience

(McCarter-Spaulling & Kearney 2001; Blyth *et al.* 2002; Nichols *et al.* 2009), uncertainty in the ability to breastfeed, combined with the concern with infant survival and growth expressed here, may create optimal circumstance for early weaning. Breastfeeding mothers with low maternal self-efficacy may be at increased risk for early weaning, in addition to adoption of other inappropriate feeding practices (Lucarelli *et al.* 2003; DiSantis *et al.* 2011). In this sample of first-time mothers, a hectic guessing-game strategy was employed, with infant responses informing subsequent maternal actions (the infant survives and grows after being offered infant rice cereal in the bottle). These results support the call for health professionals and nutrition educators to focus on concrete examples of adequate intake (Nommsen-Rivers *et al.* 2008) or education regarding infant satiety cues.

Early introduction of solid foods

Introduction of foods, other than breast milk (prior to 6 months of age), or infant formula (prior to 4 months of age) is not recommended by the AAP (Kleinman 2009). However, early introduction is relatively common, and mothers in the Southeastern United States are significantly more likely to introduce solids before the recommended age, as compared with other regions of the United States (Gabriel *et al.* 1986; CDC 2011). Research indicates that behaviours, such as infants staring at family food during meal times or leaning towards family foods, are consistently interpreted by mothers as readiness for solid foods (Anderson *et al.* 2001). Mothers in this sample reported similar interpretations. As infants emerge from the neonatal period, maternal response is increasingly influenced by a desire for infant happiness and achievement of developmental milestones. If maternal perception is that an infant would/does enjoy solid foods, then these foods are introduced/continued, regardless of recommendations. In addition, if maternal response is driven by achievement of gross motor development milestones, inappropriate feeding practices meant to encourage this development may occur, a concept supported by other research (Anderson *et al.* 2001; Heinig *et al.*

2006). The perceived ability to understand the meaning of different cries has been reported in previous literature (Gilbert & Robb 1996; LaGasse *et al.* 2005). However, it is likely that any detectable difference in crying signals increased infant distress, rather than a specific need (St James-Roberts 2008). Regardless, mothers in this sample believe that understanding these 'different cries' increases the ease of infant management, and may result in a feeling of increased self-efficacy. That this perception parallels normal advancements in infant development, such as increased ability to control cues and behaviours and lengthening sleep cycles, is important and warrants further exploration. Understanding that mothers emerging from the neonatal period change focus to infant happiness and development may assist with creation of successful interventions to delay early introduction. During this time, information about infant sleep patterns couched in messages related to gross motor development may support the delay of early solid food introduction. However, well-designed studies should evaluate effectiveness of these concepts before drawing any conclusion.

Strengths and limitations

This study had several strengths. First, all interviews were conducted by the primary investigator, providing a level of consistency not likely to occur with use of multiple interviewers. Second, using outlined systematic strategies (Charmaz 2006), inter-coder reliability was high. Third, due to the use of a purposeful sampling strategy, a homogenous sample was achieved, lending strength to findings specific to low-income, first-time, urban mothers in the Southeastern United States. Finally, the GTM selected, resulted in a rigorous and systematic analysis that incorporated emergent techniques. As a result, the authors are confident that the final theoretical model is grounded in the experiences and perceptions of the sample and can inform future research.

However, there are also several limitations to consider. Having the primary investigator conduct all interviews can be considered a weakness as well as a strength. Because the primary investigator was

involved in all aspects of research design, data collection and data analysis, the presence of value imposition is inherent to any qualitative study. Although the primary investigator attempted to limit bias by conducting an exhaustive literature review only after major themes and categories emerged, and followed a rigorous, systematic data analysis process, perceptions, values and beliefs developed prior to study conduct may have unduly influenced the research process. Several additional limitations existed in this study. First, this was not a longitudinal conversation, following mothers over the first year of life. Instead, responses were based on past and current experiences. Therefore, mothers of very young infants would not have contributed to data used to develop concepts related to the older infant. However, because of the striking similarity of shared experiences of early infancy expressed by all mothers in this study, it is likely that the interview would generate similar responses, should these mothers be revisited and asked to reflect on experiences with their now-older infants. Second, the sample included only Southeastern white and black mothers and results may not reflect the perceptions or experiences of mothers from different racial or ethnic backgrounds. Third, only those able to communicate in English were eligible to participate, therefore no perspectives of non-English-speakers are represented. Fourth, a technique termed 'Member Checking' could have been applied in which original participants were interviewed a second time after theoretical model development to ensure trustworthiness of outlined concepts (Lincoln & Guba 1985). This would have provided further evidence of concepts being 'grounded' in the data. Finally, telephone interviews prevented observation of mother-infant interactions, thus eliminating visual assessment of cue interpretation. However, this lack of in-person interaction may have increased the comfort level of participants, allowing more freedom to share experiences.

Conclusion

Mothers in this sample reported responding to the perceived needs of their infants based on their particular focus at the time. During early infancy,

mothers report concern with the health and well-being of their infants, potentially increasing the risk of early weaning and/or over-feeding. As the mother–infant communication pattern matures, mothers report the desire for happy infants and to achieve developmental milestones. Interventions to delay early introduction of solid foods likely should be designed with these desires in mind. The mother–infant communication dynamic, based on a positive feedback loop, continues to strengthen and ultimately results in an established pattern. Once established, this pattern is likely difficult to modify, which is of concern if it results in *inappropriate* feeding practices. Future research should test this theoretical model using direct observation of mother–infant communication to increase the understanding of maternal interpretation of infant cues. Subsequently, interventions targeting accurate maternal interpretation of and response to infant cues and impact on rate of infant weight gain could be tested. If effective, health care providers could potentially use these concepts to attenuate excess rapid infant weight gain.

Acknowledgements

The authors wish to acknowledge the mother–infant dyads who participated in this project, as well as the undergraduate students who assisted with transcription of phone interviews.

Source of funding

This research was supported by the University of Tennessee, Professional Development Funds.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

JW contributed to the study design, data collection, data analysis and manuscript drafting. KMB contributed to data analysis and manuscript drafting. MS contributed to study design, data analysis and manu-

script drafting. KFK contributed to study design, data analysis and manuscript drafting.

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