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Mealtime interactions: the role of sensitive parental feeding behavior in the first years of life

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Merel Sophie van Vliet

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Mealtime interactions

The role of sensitive parental feeding behavior in the first years of life

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Chapter 1

General Introduction

In 2006, James and Chrissy have their first child, a healthy boy named Isaac. They are over the moon with their beautiful baby, and are determined to give him everything he needs. Because Chrissy is not able to continue breastfeeding due to several reasons, Isaac receives formula from the second week onwards. James and Chrissy soon find out Isaac does not have a big appetite, and that he structurally drinks less than what is recommended. During the first check-up at the child welfare center at the age of 4 weeks, Isaac is found to be slightly underweight. James and Chrissy decide not to worry, and to simply try to offer the bottle more often and to persist a little longer during every feed. When Isaac is 14 weeks of age, the child welfare center mentions that James and Chrissy may soon start complementary feeding. Because Isaac was slightly underweight during all check-ups so far, they recommend that James and Chrissy start offering complementary food as soon as Isaac turns 4 months. James and Chrissy are happy with the advice and start offering solid food with a lot of motivation and enthusiasm. Because the only advice they received was "you can start at 4 months", they decide to google to find some tips and tricks on complementary feeding. When Isaac is offered his very first bites, he has trouble processing and swallowing the 'new stuff', and starts crying after a few attempts. James and Chrissy offer different kinds of fruit and vegetable purées each day to find out what he likes, but Isaac keeps rejecting the food. Although James and Chrissy notice Isaac does not seem to like the food, they also feel it is important for him to gain some weight. Because they are so determined to increase his food intake, they start pressuring Isaac to eat as much as they think is enough. During the next check-ups at the child welfare center at 8 and 12 months, Isaac is found to have an average weight, and James and Chrissy are happy their strategy pays off. However, Isaac still does not seem to enjoy eating, and family mealtimes are often stressful to Isaac, as well as to James and Chrissy, who have continued their pressuring feeding style. In an attempt to maintain his healthy weight, James and Chrissy teach Isaac to always finish his plate, a habit he eventually internalizes throughout the rest of his childhood. In addition, Isaac starts overeating, by consuming large amounts of mostly unhealthy foods. By the age of 10 years, Isaac has officially become overweight. James and Chrissy are very much surprised by this development, because mealtimes with Isaac had been such a struggle for so many years.

Promoting healthy eating habits in children

Over the past decades, childhood overweight and obesity have increased substantially (Dabas & Seth, 2018; Ebbeling, Pawlak, & Ludwig, 2002; Kiefner-Burmeister & Hinman, 2020; Wang & Lobstein, 2006). The physical and psychological consequences that are associated with childhood overweight are numerous, and may include diabetes, high blood pressure, low self-esteem, bullying and sadness (Bray, Kim, & Wilding, 2017; Janssen, Craig, Boyce, & Pickett, 2004; Strauss, 2000; Widhalm, 2018). Early prevention is considered important to reducing and ultimately ending the obesity pandemic (Widhalm, 2018). To this end, promoting healthy eating habits from infancy onwards is essential.

Obesity is a direct consequence of long-term energy imbalance, where energy intake exceeds energy expenditure. Modernization involving large changes throughout history such as the development of agriculture, industrialization and advances in technology have influenced our dietary pattern (Cordain et al., 2005). For example, following the Industrial Revolution, food-processing procedures were developed that significantly changed the production of food and types of food available to consumers. As a consequence, today's environment is characterized by an almost unlimited supply of convenient, relatively inexpensive, highly palatable, energy-dense foods (Hill & Peters, 1998). Moreover, the same advances in technology brought us modern ways of transport, as well as modern media such as television, electronic games, and computers, which have reduced the necessity of physical activity in daily life. Unless food intake is limited in accordance with the resulting more sedentary life, overweight and ultimately obesity are likely to arise (Hill & Peters, 1998). Taken together, the current environment promotes high energy intake and low energy expenditure, which has resulted in an obesity pandemic. Next to increasing physical activity, changing our dietary pattern is the key to solving the problem. On an individual level, it is essential to adopt a healthy diet from the first years of life onwards.

Poor eating habits, such as eating too much energy-dense food, eating in the absence of hunger, or low vegetable consumption increase the risk of developing overweight and obesity (Lansigan, Emond, & Gilbert-Diamond, 2015; Schwingshackl et al., 2015). From early toddlerhood onwards children already consume too much energy-dense food and too little fruit and vegetables (Denney, Afeiche, & Eldridge, 2017; Emmett & Jones, 2015; Fox, Pac, Devaney, & Jankowski, 2004; Goldbohm, Rubingh, Lanting, & Joosten, 2016; Ocké et al., 2008). In the Netherlands, 40-80% of preschoolers fail to meet daily recommendations for vegetable intake (Goldbohm et al., 2016; Ocké et al., 2008). In addition, in two recent experimental studies, around 40 up to almost 70% of 1 to 4-year-olds ate without being hungry. When children eat without being hungry, they are ineffectively regulating their own energy intake, which in turn puts them at risk of overeating and developing overweight (Fogel et al., 2018; Schultink et al., 2021). Over the

past decade, the modification of self-regulation of eating is more and more considered a promising way to prevent children from becoming overweight (e.g., Lumeng et al., 2017; Murray, Rosanbalm, & Christopoulos, 2016).

In early childhood, parents play an important role in their child's dietary pattern. Every day, parents decide *what* food is offered, *when* food is offered, and *how* food is offered, thereby laying the foundation of experiences with food and mealtimes which the child continues to build upon. To foster healthy eating habits in children from the very beginning and to prevent children from becoming overweight, it is important to study which parental approach to feeding is effective. Although many earlier studies focused on the impact of *what* food is offered, more and more studies emphasize the importance of *how* food is offered, by studying how parents interact with their child during mealtimes (Black & Aboud, 2011; DiSantis, Hodges, Johnson, & Fisher, 2011; Hurley, Cross, & Hughes, 2011). The present dissertation aims to examine these parent-child interactions during mealtimes and their relation to child health outcomes during infancy and toddlerhood.

Feeding during the first years of life

The transitions infants go through in the first years of life regarding eating can be considered a pivotal developmental task. After a few months of an exclusively liquid diet, infants need food other than milk to meet their energy and nutritional requirements (Butte, Lopez-Alarcon, & Garza, 2002; Reilly, Ashworth, & Wells, 2005). This transitional period from milk to a diet that mainly consists of solid food is called the process of complementary feeding, and generally starts around the age of 4-6 months in Western countries. This process can be seen as a window of opportunity in terms of influencing eating behavior, given that the foundation of how children relate to food and eating is formed during those very first experiences (Van Dijk, Hunnius, & van Geert, 2012).

When introducing solid food to their infant, parents usually offer grains, fruits, or vegetables (Chambers, 2016; Voedingscentrum, 2017). To date, there is some evidence that it is beneficial to start complementary feeding with exclusively vegetables instead of fruits, because sweet tastes would impede vegetable acceptance (Barends, de Vries, Mojet, & de Graaf, 2013; 2014; Fildes et al., 2015). In general, other studies have shown ways to teach children to like vegetables and increase vegetable intake, such as for example to a) *repeatedly* expose them to the taste of a certain vegetable (Barends et al., 2013; 2014; Hetherington, Schwartz, & Madrelle, 2015; Maier-Nöth, Schaal, Leathwood, & Issanchou, 2016; Remy, Issanchou, & Chabanet, 2013), and b) to expose them to a *variety* of vegetables (Coulthard, Harris, & Fogel, 2014; Gerrish & Mennella, 2001; Lange, Visalli, Chabanet, Schlich, & Nicklaus, 2013).

As with Isaac in our case study, the transition to complementary food and further development of eating behavior can be influenced by various parent- and child-characteristics. Certain characteristics of the parent and the child will affect their own behavior as well as influence the other's behavior. With regard to infant characteristics, the development of eating behavior is influenced by several factors, such as progress in digestive and oral motor skills, internal cues of hunger and satiety, cognitive skills, and temperament (Figure 1; (Birch, 2016)). Parental characteristics that may influence the feeding process include behavioral habits and values related to food in their own family and broader culture, food access and availability, or their knowledge and abilities around feeding (Figure 1; (Black & Hurley, 2017)). All of these factors might influence a child's feeding experience, and these factors are likely to differ in every family.

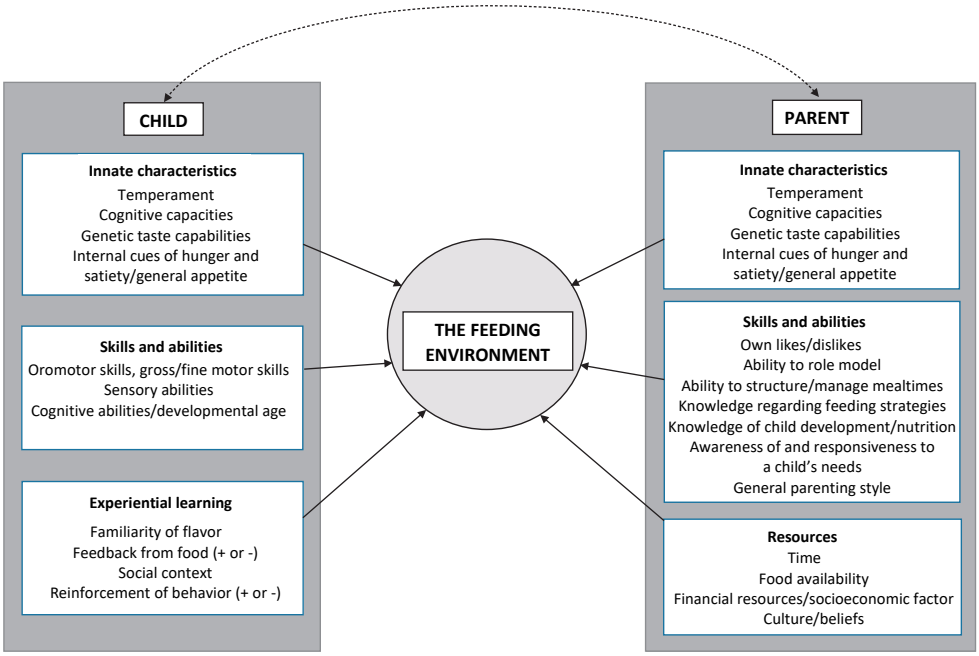

Figure 1. Characteristics influencing the feeding environment. Based on Ross, 2017.

All these parent and child characteristics do not only influence the feeding environment individually, but always as part of a complex interactive system. For example, the resources of the parents, as well as their own likes and dislikes, influence the kind of food they offer to their child, as well as their ability to model consumption of healthy food. Or, a child's genetic taste capabilities and general appetite influence the child's eating behavior, which may in turn influence the level to which the parent is likely to pressure the child to eat.

In order to foster healthy eating habits in children and prevent them from becoming overweight, parental recommendations on child feeding often concern *what* to feed children rather than focusing on parental skills and abilities (i.e. *how* to feed) (Black & Hurley, 2017). Because parents play a substantial role when it comes to influencing their child's feeding experiences, health behavior, and weight, it is important to provide parents with evidence-based guidelines on *what* and *how* to feed their child during the first years of life. The present dissertation mainly focuses on the role of *how* to feed children, and more specifically on sensitive feeding behavior.

Sensitive parenting

During the first year of life, caregivers and infants learn to recognize and interpret each other's verbal and nonverbal communication signals. This reciprocal process underlies the emotional bonding or attachment within a dyad that may foster a healthy social-emotional development (Ainsworth, Blehar, & Waters, 1978). On the other hand, inconsistent and nonresponsive reactions that disrupt communications among caregiver and infant may cause a distrustful and insecure relationship to develop, which may impair the child's social-emotional development (Kochanska, Woodard, Kim, Koenig, Yoon, & Barry, 2010; Kretchmar & Jacobvitz, 2002).

Sensitive parenting reflects parent-child reciprocity, and is often studied in the context of play. Sensitive caregivers observe and interpret their children's signals correctly, and subsequently respond to those signals promptly and adequately (Ainsworth, Bell, & Stayton, 1974). Sensitive parenting does not necessarily mean caregivers should comply with the child's request, but rather that they acknowledge and engage with the child's point of view and communications. Evidence from observational and intervention studies has shown that parental sensitivity is related to positive child outcomes on several domains, such as secure attachment (Bakermans-Kranenburg, Van IJzendoorn, & Juffer, 2003), social functioning (Kochanska, 2002) and adaptive cognitive development (De Wolff & Van IJzendoorn, 1997; Mesman, Van IJzendoorn, & Bakermans-Kranenburg, 2012).

Sensitive parenting in the feeding context

The principles of sensitive parenting can be applied to the feeding context as well. In her feeding observations during the first year of life, Mary Ainsworth observed that mothers who fed on demand, who adapted their feeding pace and who promptly responded to their infant during feeding had infants who cried less in early infancy and demonstrated greater attachment to their mothers at the end of the first year (Ainsworth and Bell, 1969). In the current literature, a distinction is made between a responsive parental feeding style, and nonresponsive parental feeding styles, with a responsive feeding style being

considered the most optimal (DiSantis et al., 2011; Pérez-Escamilla, Segura-Perez, & Lott, 2017; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011). Although responsive feeding has been defined in different ways, the core principle is similar to Ainsworth's definition of parental sensitivity, as it includes that parents correctly perceive their child's hunger and satiety cues and respond appropriately to those cues, for example by letting the child decide how much (s)he eats (DiSantis et al., 2011; Schwartz et al., 2011). By letting the child be in control of its food intake, responsive feeding behavior would foster self-regulation of energy intake, which in turn would promote a healthy weight (DiSantis et al., 2011). To date, responsive feeding has indeed been found to be associated with a reduced risk of overweight and rapid weight gain in early childhood (DiSantis, Hodges, & Fisher, 2013; Lindsay, Sitthisongkram, Greaney, Wallington, & Ruengdej et al., 2017; Spill et al., 2019). However, when promoting responsive feeding behavior in parents, it might be beneficial to not only focus on hunger and satiety cues, but also on other child communications during the meal, for example concerning attachment behavior, or the urge for autonomy. In order to broaden the concept so that it includes sensitive responses to other relevant child behavior during the meal as well, it has recently been suggested to add the term *sensitive feeding* (Van der Veek et al., 2019). Next to sensitivity to all child signals during the meal, sensitive feeding includes the use of positive strategies to deal with challenging child behavior during the meal (Van der Veek et al., 2019). Mealtimes are daily occurring situations that can be stressful to both parent and child. Because parents often have certain goals and expectations regarding their child's food intake and mealtimes in general, conflict situations during mealtime may easily arise, making the use of positive and sensitive disciplining techniques highly relevant. Examples of such sensitive disciplining techniques include showing understanding of the child's point of view, positive reinforcement, distracting the child to prevent conflict, appropriate pacing, and supporting and guiding the child's urge for autonomy (Mesman et al., 2008). Sensitive parental feeding behavior is thought to promote a pleasant atmosphere during mealtimes in which the child feels secure, thereby fostering positive associations with eating and food, as well as the child's willingness to eat and try new foods (Van der Veek et al., 2019).

Insensitive feeding

The majority of research on responsive feeding has focused on the consequences of its counterpart: nonresponsive feeding. Nonresponsive feeding is considered to reflect insensitive behavior to the child's needs, because of a lack of reciprocity between caregiver and child (Black & Aboud, 2011). Caregivers might either take too much control over the child by pressuring the child to eat or restricting them from eating, or too little control by either allowing the child to decide on all the food choices or entirely ignoring the child. Nonresponsive feeding during the first two years of life usually takes on the form of exerting too much control instead of too little. More specifically, the practice of pressure to eat is applied by many parents. For example, one study showed that 54% of parents of 1–3

year-olds sometimes kept insisting after their child refused a food, and that 25% reported to insist after refusal often or all the time (Chan, Magarey, & Daniels, 2011). When a parent takes too much control by pressuring the child to eat, the child's hunger and/or satiety cues are overruled on a regular basis, and the development of the child's autonomy might be disturbed (Birch, Fisher, & Davison, 2003). Indeed, pressure to eat is found to be related to an impaired ability of self-regulation of energy intake (Birch, McPheee, Shoba, Steinberg, & Krehbiel, 1987). Like Isaac in our case study, children that have been pressured to eat from the beginning may not maintain the innate ability to self-regulate feelings of hunger and satiation, thereby being at risk to start overeating and become overweight (DiSantis et al., 2011; Hurley et al., 2011). Moreover, with respect to eating vegetables, pressure to eat has been found to have a counterproductive effect, in such a way that children who are pressured to eat, eat and like vegetables less (Galloway, Fiorito, Francis, & Birch, 2005). However, the reverse scenario is also likely to occur, as parents of children who show picky eating behavior or have a small appetite are often found to start pressuring their child to increase their food intake (Moore, Akhter and Aboud, 2006). In general, it is important to realize that (feeding) interactions are always bidirectional, and that parent and child may end up in a vicious circle.

Challenges around mealtime

Like James and Chrissy at the beginning of this chapter, many parents struggle with the way they should feed their children. Indeed, 25 to 40% of parents report feeding problems with their infants and toddlers, including food refusal and picky eating (Mitchell, Farrow, Haycraft, & Meyer, 2013; Reau, Senturia, Lebailly, & Christoffel, 1996). Infants are generally willing to try several different tastes during the first year of life, but children become more particular in their food preferences from (early) toddlerhood onwards (Carruth et al., 2004; Dovey, Staples, Gibson, & Halford, 2008; Taylor, Wernimont, Northstone, & Emmett, 2015). Many children go through a phase of picky or fussy eating behavior somewhere between the age of 1 and 6. The phase of picky eating often peaks during toddlerhood, when the food neophobia phase, or the unwillingness to try new foods that is considered an integral part of picky eating behavior, often emerges as well (Dovey et al., 2008; Taylor et al., 2015). Because the child's urge for autonomy is often prominent during toddlerhood as well, mealtimes during this developmental period can be highly challenging for parents. Indeed, parents of children who are considered "picky" are found to have more conflicts during mealtime, and to use more pressuring techniques to get their child to eat (more) (Galloway et al., 2005; Jacobi, Agras, Bryson, & Hammer, 2003; Mascola, Bryson, & Agras, 2010; Ventura & Birch, 2008). Because of concerns about their child's intake, appetite, and/or weight, parents of picky eaters often start pressuring their child to increase food intake (Moore et al., 2006). In addition, parents also may confuse their child's urge for autonomy

with poor appetite, thereby misinterpreting their child's signals and wishes. Picky eating, as well as a mismatch in communication between parent and child during the meal, might lead to feelings of frustration in both parent and child, causing mealtimes to become stressful, daily recurring situations. Feeding the child in a sensitive way, by correctly perceiving, interpreting and responding to his/her communications during the meal, might be a powerful way to get through this challenging phase in a positive way, thereby minimizing stress during meals. In order to design parental guidelines, experimental studies testing the effectiveness of parental feeding interventions focusing on sensitive feeding are essential.

The promotion of sensitive feeding behavior

To date, several randomized controlled trials aimed to promote (components of) sensitive feeding behavior (Aboud, Moore, & Akhter, 2008; Daniels et al., 2009; Fangupo et al., 2015; Harvey-Berino & Rourke, 2003; Horodynski, Hoerr, & Coleman, 2004). However, in light of obesity prevention, those interventions included modules on other health topics as well, such as physical activity, dietary advice, or sleeping behavior. Therefore, it is still difficult to infer if and how sensitive feeding behavior alone contributes to child health outcomes. Moreover, although some trials were able to establish changes in sensitive feeding behavior (Daniels et al., 2015; Fangupo et al., 2015), they all evaluated parental feeding behavior through self-report questionnaires instead of observations. However, video observations are thought to more effectively measure parental behavior that reflects real-life behavior than self-report measures, because those are likely to rather capture parental attitudes, i.e. what parents *think* they are doing or even what they think they *should* be doing (Hawes & Dadds, 2006; Hodges Johnson, Hopkinson, Butte, & Fisher, 2013). Therefore, including observations to measure parental feeding behavior is highly important.

The Baby's First Bites study

In an attempt to learn more about the effectiveness of advice on what food to provide (*What*) as compared to advice on sensitive parental feeding behavior during mealtime (*How*), the Baby's First Bites study was designed. The effectiveness of a vegetable-exposure (*What*) and a sensitive-feeding intervention (*How*) on child health outcomes was tested, with child vegetable intake and child self-regulation of energy intake as primary outcomes, and child weight and maternal feeding behavior as secondary outcomes. Interventions were tested both separately and combined, and compared to an attention-control condition, to infer what approach to improving healthy eating behavior is most effective: focusing on the what, the how, or both. The ability to infer the effects of these

distinct types of advice is unique to the Baby's First Bites study, because earlier intervention studies included these different elements all at once. Interventions commenced as soon as the infant was ready to receive its first bites of solid food, and continued until the age of 16 months. Follow-up measurements took place at 18, 24 and 36 months of age. To measure sensitive feeding behavior, self-report measures as well as mealtime observations in the home setting were used.

Focus of the dissertation

The aim of the present dissertation is to examine the relation between sensitive parental feeding behavior and health outcomes in infants and toddlers up to 24 months. **Chapter 2** describes the background and study design of the Baby's First Bites RCT study. In **Chapter 3**, bidirectional prospective relations are studied between maternal feeding behavior and infant vegetable intake and liking during the very first bites of solid food. In **Chapter 4**, differences in maternal sensitive behavior are tested between a mealtime and a free play situation, examining the moderating effects of child eating behavior. **Chapter 5** reports on the results of the Baby's First Bites RCT, in which the effectiveness of a repeated-exposure and a sensitive-feeding intervention on child health outcomes and maternal feeding behavior at age 18 and 24 months was evaluated. In **Chapter 6**, the main findings are summarized and integrated, and future directions for research and practice are considered.

2

Chapter 2

Baby's First Bites: A randomized controlled trial to assess the effects of vegetable exposure and sensitive feeding on vegetable acceptance, eating behavior and weight gain in infants and toddlers

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BMC Pediatrics, 2019

Abstract

Background: The start of complementary feeding in infancy plays an essential role in promoting healthy eating habits. Evidence shows that it is important *what* infants are offered during this first introduction of solid foods: e.g. starting exclusively with vegetables is more successful for vegetable acceptance than starting with fruits. *How* infants are introduced to solid foods also matters: if parents are sensitive and responsive to infant cues during feeding, this may promote self-regulation of energy intake and a healthy weight. However, the effectiveness of the *what* and the *how* of complementary feeding has never been experimentally tested in the same study. In the current project the *what* and *how* (and their combination) are tested in one study to determine their relative importance for fostering vegetable acceptance and self-regulation of energy intake in infants.

Methods: A four-arm randomized controlled trial (Baby's First Bites (BFB)) was designed for 240 first-time Dutch mothers and their infants, 60 per arm. In this trial, we compare the effectiveness of (a) a vegetable-exposure intervention focusing on the *what* in complementary feeding; (b) a sensitive feeding intervention focusing on the *how* in complementary feeding, (c) a combined intervention focusing on the *what and how* in complementary feeding; (d) an attention-control group. All mothers participate in five sessions spread over the first year of eating solid foods (child age 4-16 months). Primary outcomes are vegetable consumption, vegetable liking and self-regulation of energy intake. Secondary outcomes are child eating behaviors, child anthropometrics and maternal feeding behavior. Outcomes are assessed before, during and directly after the interventions (child age 18 months), and when children are 24 and 36 months old.

Discussion: The outcomes are expected to assess the impact of the interventions and provide new insights into the mechanisms underlying the development of vegetable acceptance, self-regulation and healthy eating patterns in infants and toddlers, as well as the prevention of overweight. The results may be used to improve current dietary advice given to parents of their young children on complementary feeding.

Background

In light of today's global obesity epidemic and related diseases, promoting healthy eating habits is essential (WHO, 2015). Children as young as 1-3 years of age already eat too much energy-dense food and too little fruit and vegetables (Denney et al., 2017; Emmett & Jones, 2015; Fox et al., 2004; Goldbohm et al., 2016; Ocké et al., 2008). In the Netherlands, based on surveys between 2006 and 2014, estimates for the percentage of preschoolers failing to meet daily recommendations for vegetable intake vary from 40% up to an alarming 80% (Goldbohm et al., 2016; Ocké et al., 2008). Moreover, a recent experimental study showed that almost 40% of 4 year-olds fail to effectively regulate their own energy intake, showing a tendency to eat even though they are not hungry (Fogel et al., 2018). Poor eating habits, such as consuming too little vegetables and eating in the absence of hunger increase the risk of developing overweight and obesity, and related diseases such as type II diabetes (Camfferman et al., 2016; Hesketh, Wake, Waters, Carlin, & Crawford, 2003; Katzmarzyk, Pérusse, Malina, & Bouchard, 1999; Rotteveel, Felius, van Weissenbruch, & Delemarre–Van de Waal, 2010), cardiovascular disease (Ajala, Mold, Boughton, Cooke, & Whyte, 2017), and certain cancers (Maynard, Gunnell, Emmett, Frankel, & Davey, 2003). Both children's food preferences and their ability to self-regulate their energy intake are influenced by their direct environment already in the first two years of life (Birch & Davison, 2001; Cashdan, 1994; Fox, Devaney, Reidy, Razafindrakoto, & Ziegler, 2006; Mallan, Fildes, Magarey, & Daniels, 2016; Nicklaus, Boggio, Chabanet, & Issanchou, 2005; Skinner, Carruth, Bounds, Ziegler, & Reidy, 2002). Therefore, promoting a healthy diet and healthy eating habits and behavior from infancy is essential. At this young age, parents bear primary responsibility for the diet of their children. The present article describes the study protocol and sample of a randomized controlled trial under the acronym *Baby's First Bites (BFB),* aimed at (a) promoting vegetable intake and liking, and (b) promoting child self-regulation of energy intake, by advising parents *what* and *how* to feed their infants from the very start of complementary feeding. The primary goals of promoting vegetable acceptance and self-regulation of energy intake serve the purpose of reducing the risk of developing overweight in early childhood – our secondary outcome. Three interventions will be compared to an attention-control condition: (1) a *repeated exposure* intervention motivating parents to repeatedly expose their children to the taste of a variety of vegetables during the first year of complementary feeding; (2) a *parenting* intervention promoting sensitive parental feeding; and (3) a *combined* intervention promoting both repeated exposure to vegetables and sensitive feeding.

Repeated exposure to a variety of vegetables from the start of complementary feeding

When parents start complementary feeding, they can choose from a variety of foods to introduce to their children, including (baby) cereals, grains, fruits or vegetables (Chambers,

2016; Voedingscentrum, 2017). Already in the 1970s it was theorized that to improve the acceptance of vegetables, these should be introduced before fruits or other sweet tastes during complementary feeding because infants' inherent preference for sweet tastes will interfere with vegetable acceptance (Gerish & Mennella, 2001). The effects of starting complementary feeding exclusively with vegetables on promoting vegetable acceptance has, however, not been studied often (Chambers, 2016). Two other methods of increasing vegetable intake and liking *have* been studied extensively. First, repeated exposure to the taste of vegetables has been shown effective in increasing its intake and liking in infants and preschoolers (Barends et al., 2013; 2014; Birch et al., 1998; Chambers et al., 2016; Coulthard et al., 2014; Hetherington et al., 2015; Maier, Chabanet, Schaal, Issanchou, & Leathwood, 2007; Mennella, Daniels, & Reiter, 2017; Remy et al., 2013), especially for bitter tastes (Nehring, Kostka, Von Kries, & Rehruess, 2015). Second, being exposed to a variety of vegetables increases vegetable acceptance in infants (Gerish & Mennella, 2001; Coulthard et al., 2014; Lange et al., 2013; Maier, Chabanet, Schaal, Leathwood, & Issanchou, 2008). However, whether it is indeed most effective to start with vegetables *only* was not tested until the trial by Barends et al. in 2013 (Chambers, 2016). This study showed that infants exposed to a variety of vegetables during the first three weeks of complementary feeding – including a target vegetable to which they were repeatedly exposed – nearly doubled their intake of the target vegetable, whereas children who only received fruits showed increased intake of fruits but not of vegetables (Barends et al., 2013). Shortly after this trial, another intervention study found similar results: encouraging parents from the United Kingdom to start complementary feeding with a variety of vegetables significantly increased vegetable intake compared to a control group in which parents were allowed to start complementary feeding with whatever food they wanted (Fildes et al., 2015).

Thus, there is preliminary evidence that starting complementary feeding by repeatedly exposing infants to a variety of vegetables is an effective way to increase vegetable intake and liking in the first year of a child's life. However, the beneficial effects on vegetable acceptance do not seem to last when children grow older (Barends et al., 2014, Hetherington et al., 2015; Maier-Nöth et al, 2016). This is in line with the finding that children are open to trying a variety of different tastes in their first year of life, but tend to become more selective about their diet when they become older (especially in the 'food neophobic phase') (Caruth et al., 2004; Chambers, 2016; Dovey et al., 2008). Indeed, in the Barends et al. trial, starting complementary feeding with vegetables did *not* predict vegetable intake at age two, whereas how selective children were about what they wanted to eat did (Barends et al., 2014). Continuing the active promotion of eating vegetables in the first and second year of the child's life after exposing them to a variety of vegetables at the start of complementary feeding may counteract the negative effects of the food neophobic phase and effectively boost vegetable intake throughout childhood. However, most intervention studies have been conducted with infants in the

early phases of complementary feeding or preschoolers older than 2 years; few studies focus on promoting vegetable acceptance in the difficult period between 12-24 months when children go through the major transition of eating the same meals as their family and enter the food neophobic phase (Birch & Doub, 2014). Therefore, we studied the effectiveness of a more prolonged vegetable-exposure intervention throughout the whole first year of complementary feeding, well into the more 'difficult' second year of the child's life to promote vegetable intake in toddlers.

Sensitive feeding

Apart from *what* parents should offer their children during complementary feeding, *how* they offer this food may also strongly influence a child's acceptance of the offered food, as well as their ability to self-regulate their energy intake. Experimental studies show that pressuring a child to eat decreases children's ability to self-regulate their energy intake and thereby to consume appropriate amounts of calories (Birch et al., 1987). Similarly, pressuring a child to eat vegetables has a counterproductive effect and will make a child eat and like these vegetables less (Galloway et al., 2006). Even giving subtle prompts to eat, like moving food towards a child, may have a counterproductive effect (Blissett, Bennett, Fogel, Harris, & Higgs, 2016). However, if children start to decrease their vegetable intake when they enter the second year of life, parents are likely to use some sort of pressure to make their child eat. Indeed, an Australian study showed that more than half of the parents of 1-3 year-olds sometimes insist on their child eating a food, and 35% reported to pressure their child often or all the time (Chan et al., 2011). As such, it is not surprising that many parents struggle with the question how to feed their infants effectively. Indeed, 25 to 40% report feeding problems with their infants and toddlers, including picky eating and strong food preferences (Mitchell et al., 2013; Reau et al., 1996).

In contrast to pressuring children to eat, *responsive feeding* is often suggested to be the optimal way to feed infants and toddlers (DiSantis et al., 2011; Mennella et al., 2016; Nicklaus, 2016; Pérez-Escamilla et al., 2017; Schwartz et al., 2011). Responsive feeding is generally defined as a style of feeding in which parents correctly perceive the hunger and satiety signals of the child, and respond promptly and appropriately (DiSantis et al., 2011; Schwartz et al., 2011). This feeding style is suggested to promote and reinforce young children's ability to self-regulate their energy intake, because the parent who feeds responsively will not override a child's satiety cues (DiSantis et al., 2011). Indeed, promoting responsive feeding was shown to be associated with a reduced risk of overweight and of rapid weight gain during the first years of life (DiSantis et al., 2011, Paul et al., 2011; Savage et al., 2016). However, although attending to hunger and satiety signals may promote child self-regulation of energy intake, it may not be sufficient to promote healthy food preferences including vegetable acceptance during the first years of the child's life. As children from the age of 1.5 years become more and more autonomous and selective

about their food preferences, parents have to manage that their child eats appropriate quantities, but also the specific (healthy) foods that are served. To promote healthy food preferences, parents will need to stimulate their child to eat vegetables in a non-pressuring way that is sensitive to the child's autonomy-related needs and behaviors. This requires more than just responsiveness to hunger and satiety cues, but also sensitive discipline strategies to challenging child behavior (e.g. when a child throws their food on the ground) and sensitive responses to distracted behavior (e.g. when a child is more interested in what is happening around them than in its plate of food). Sensitive discipline strategies that parents may use entail positive encouragement (e.g. explicitly complimenting the child for positive behavior), appropriate pacing to allow the child sufficient time to adapt to the situation, granting the child appropriate amounts of autonomy (e.g. allowing the child to eat autonomously when the child is able to and shows it wants to) and showing understanding for the child's point of view (Mesman et al., 2008). Using these sensitive discipline strategies has been shown to promote infant's committed compliance, i.e. internally motivated and self-regulated adherence to parental rules (Feldman & Klein, 2003). In the current study we introduce the concept *sensitive* feeding to capture this broader set of sensitive parenting skills relevant to promoting children's committed compliance to parental attempts to feed them healthy foods. Sensitive feeding thus includes the traditional concept of responsive feeding (DiSantis et al., 2011, Schwartz et al., 2011), but with the addition of sensitive discipline as well as autonomy support, also in response to non-food related child behaviors during feeding. We hypothesize that parents showing sensitive feeding will be more successful in increasing their children's vegetable acceptance.

In recent years a number of randomized controlled trials to promote responsive feeding have been performed, some of which incorporated the discipline component described above (Aboud et al., 2008; Daniels et al., 2009; Fangupo et al., 2016; Harvey-Berino et al., 2003; Horodynski et al., 2004; Willis, Roberts, Berry, Bryant, & Rudolf, 2016) whereas others merely focused on teaching parents how to effectively respond to the hunger and satiety cues of their child (Paul et al., 2011; Savage et al., 2016). However, none of these interventions focused on promoting responsive or sensitive feeding alone. Instead, they incorporated a much broader range of topics such as dietary advice, advice on general feeding practices, guidelines for physical activity, or even more broad advice on how to manage the sleeping and crying behavior of the child. As such, it is impossible to isolate the specific effect of responsive feeding on the diet and eating behavior of the child, and whether this is in fact an element that should be targeted to promote healthy eating patterns. Moreover, all previous trials evaluated changes in parenting behavior via self-report questionnaires, whereas expert observations of parent-child interaction is considered the gold standard to measure parenting behavior (Hawes & Dadds, 2006). An important disadvantage of self-reports of parenting behavior specifically is that

it is questionable whether these data represent the actual parenting behavior parents show, or rather attitudes about what they think they are or should be doing. Indeed, the correlation between self-reported and observed parenting behavior is often low, both in the field of parental feeding (Camfferman, 2017; Lewis & Worobey, 2011; Sacco, Bentley, Carby-Shields, Borja, & Goldman, 2007) and in other fields (Price & Hyde, 2011). Therefore, we will test the effectiveness of an intervention focusing solely on the enhancement of sensitive feeding, by evaluating its outcomes using repeated observations of family meals at home in addition to self-reports.

Repeated exposure and sensitive feeding

Whether a combination of repeatedly exposing infants to vegetables and encouraging sensitive feeding may lead to a better vegetable intake and liking than each of the interventions alone, has never been tested before. However, there is evidence that presentation of beneficial food choices (succeeding at the *what*) in a non-responsive manner (failing at the *how*), and the presentation of unhealthy food choices (failing at the *what*) in a responsive manner (succeeding at the *how*) may lead to overweight and eating problems in children (Galloway et al., 2006; Saavedra, Deming, Dattilo, & Reidy, 2013). For instance, an experimental study by Galloway and colleagues showed that pressuring a child to eat, even if this pressure is mild in nature, decreases the beneficial effects of repeated exposure to the taste of vegetables (Galloway et al., 2005). This suggests that an intervention aimed at both elements may be particularly powerful.

Aims and hypotheses

In summary, the *Baby's First Bites (BFB)* study aims to test whether promoting the *what* and/or promoting the *how* of complementary feeding will result in increased vegetable consumption and liking and a better self-regulation of energy intake in infants and toddlers up until the age of 36 months. To this end, we will perform a superiority randomized controlled trial with parallel groups, comparing a) an intervention focusing on vegetable exposure (=what), b) an intervention focusing on sensitive feeding (=how), c) an intervention focusing on vegetable exposure and sensitive feeding (=what and how), and d) a control condition. The interventions will begin when the infant starts receiving complementary food (child age 4-6 months, as recommended by the Dutch Nutrition Center) and continue until the child is 16 months old. We hypothesize that a) all interventions are more effective in improving vegetable consumption and vegetable liking than the control condition without guidance on complementary feeding; b) the sensitive feeding and combined intervention will be more effective in supporting child self-regulation of energy intake than the vegetable exposure or control conditions; and c) the combined intervention is more effective than the other two interventions alone in promoting vegetable intake and vegetable liking. As the inclusion phase of the *BFB* study

has already successfully been completed, the present article describes the characteristics of the sample of included participants as well as the design of this ongoing study.

Methods/Design

Study design

The *BFB* study is a collaboration between Leiden University, Wageningen University and Research, Danone Nutricia Research and Nutricia Early Life Nutrition. The study is a multicenter trial that is currently being performed at Leiden University and Wageningen University and Research, using a superiority randomized controlled design. The protocol has been approved by the Ethical Review Board of Education and Child Studies, Leiden University (protocol number ECPW-2015/116) and the Medical Ethical Review Board of Wageningen University and Research (METC-WU protocol number NL54422.081.15). The inclusion phase started in May 2016 and ended successfully in November 2017. Mothers and their 4-6 month-old infant were randomly allocated to receive either repeated exposure to a variety of vegetables (RVE), the parenting intervention Video-feedback Intervention to promote Positive Parenting-Feeding Infants (VIPP-FI), RVE and VIPP-FI combined, or an attention-control intervention (see figure 1 and table 1). Families receiving the RVE intervention were further randomly allocated to one of two types of vegetables the infant is repeatedly exposed to (see *Interventions* below): green beans or cauliflower. Two target vegetables were chosen as the current feeding schedule is based on the 19-day feeding schedule as described by Barends and colleagues (Barends et al., 2013; 2014). Green beans and cauliflower are commonly consumed in the Netherlands. Randomization into these conditions was done using the online program TenALEA, which assured that the exact same randomization procedure was used at both study sites (Mathoulin-Pelissier, Bellera, Gregoire, Yang-Ting, & Malfilatre, 2008). To make the groups allocated to the different conditions as comparable as possible concerning relevant potential confounders, randomization was stratified by age of the child at the start of complementary feeding (4, 5 or 6 months), gender of the child and study location, using minimization procedures. The online randomization program TenALEA has been used previously in other clinical trials (Ten Cate-Hoek et al., 2018; Van der Veek, Derkx, Benninga, Boer, & De Haan, 2013). Participants were allocated to a condition by one of the PhD-students or research assistants at each study location.

Intervention effects are assessed both during and after conclusion of the interventions by performing a pre-test at the first two days of complementary feeding (child age 4-6 months; t_0), two assessments during the interventions (at the end of the 19-day feeding schedule (child age 5-7 months; t_1) and when the child is 12 months old (t_{12})), a post-test at the age of 18 months (t_{18}) and two follow-ups when the child is 24 (t_{24}) and 36 months old

(t_{36}). T_0 and t_1 are not scheduled at a standard, fixed child age but rather within a certain age range because we wanted to allow parents to start complementary feeding when they thought their child was ready. The other measurements *are* scheduled at set child ages because the intervention sessions following the very first start of complementary feeding are scheduled at fixed time points (see *Timing of intervention sessions* below). The timeline for participants is depicted in Table 2. Participants are allowed to stop at any point during the study if they no longer want to participate. If participants decide to withdraw from the study, discontinue an intervention or are unable to complete a specific assessment, they will be asked once whether they would still be willing to complete (parts of) the intervention, the post-test and/or follow-up assessments to come.

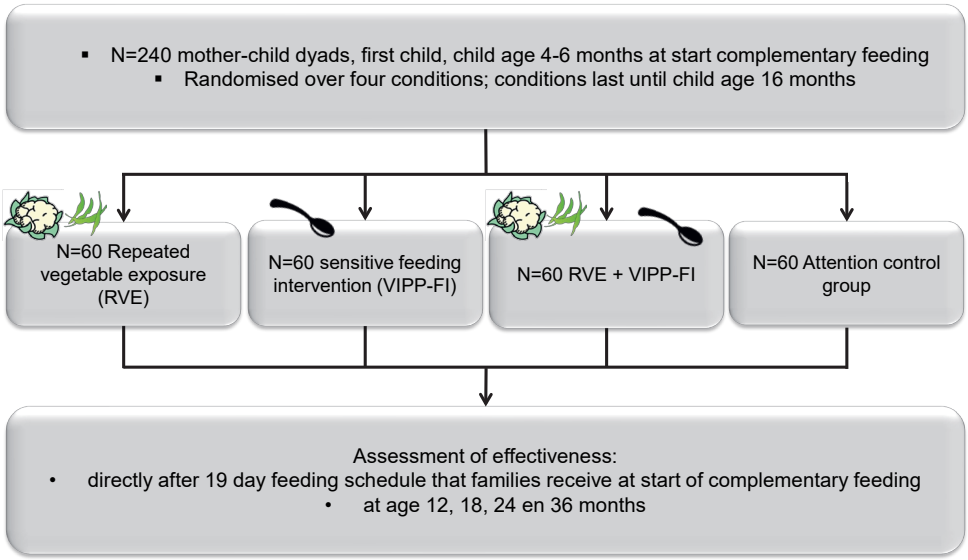

Figure 1. General overview of study design.

Calculation of sample size

A power analysis was conducted to calculate the sample size necessary to detect a moderate effect size of .50, which is based on previous studies of the effects of repeated exposure to vegetables (Barends et al., 2014) and the effects of VIPP (Juffer et al., 2008). Given a power of .80 and an alpha of .05 the analysis showed that a sample size of 51 participants per group would be sufficient. Taking attrition into account, we aimed to include a total of 240 mothers, 60 per group (see Figure 1 and Table 1).

Table 1. Overview of conditions and intended N per condition.

Name	Description of condition	N
RVE	Repeated vegetable exposure intervention: - exposure to either green beans or cauliflower as target vegetable during the first 19 days of weaning - five phone calls to motivate parents to expose children to vegetables at child age 4-6, 8, 13 and 16 months	60
VIPP-FI	VIPP-Feeding Infants: - exposure to fruits and a sweet vegetable (carrots) during the first 19 days of weaning - five home-visits using video-feedback to promote sensitive feeding at child age 4-6, 8, 13 and 16 months	60
COMBI	Combination of RVE and VIPP-FI	60
AC	Attention control group: - exposure to fruits and a sweet vegetable (carrots) during the first 19 days of weaning - five phone calls on development of child at age 4-6, 8, 13 and 16 months	60

Note. RE = repeated exposure; VIPP-FI= VIPP-Feeding infants; COMBI = repeated exposure and VIPP-Feeding infants combined; AC=attention-control condition

Table 2. Timeline for participants.

	Enrolment	Intervention-period					Post-test	Follow-up	
Child age (in months)	2 - 4	4 – 7		8	12	13	16	18	24	36
Time point		t_0	t_1		t_{12}			t_{18}	t_{24}	t_{36}
Enrolment & allocation										
1. Invitation e-mail	x									
2. Information and informed consent	x									
3. Screening	x									
4. Allocation	x									
5. Rice-flour porridge	x									
Interventions										
RVE										
Feeding schedule		days 1-19								
Phone-call		Twice in period days 3-17		x		x	x			
Provision of vegetable purees		X		x	x					
VIPP-FI										
Feeding schedule		days 1-19								
Home-visit		Twice in period days 3-17		x		x	x			
Provision of fruit and carrot purees		X		x	x					
Combined RVE+VIPP-FI										
Feeding schedule		days 1-19								
Phone-call + home-visit		Twice in period days 3-17		x		x	x			
Provision of vegetable purees		X		x	x					
Attention-control										
Feeding schedule		days 1-19								
Phone-call		Twice in period days 3-17		x		x	x			
Provision of fruit and carrot purees		X		x	x					
Assessment of study outcomes[a]		Days 1+2	Days 18+19		x			x	x	x

Note. [a]Primary outcomes: vegetable intake and liking, child self-regulation of energy intake. Secondary outcomes: child anthropometrics, child eating behavior and maternal feeding behavior. RVE=repeated exposure to vegetables. VIPP-FI=Video-feedback Intervention to promote Positive Parenting-Feeding Infants.

Recruitment and participants

We decided to focus all interventions on mothers, because in Dutch households women most often fulfil the role of primary caregiver. Participants were recruited from the general population in four Dutch provinces (Zuid-Holland, Noord-Holland, Gelderland and Utrecht) that are closest to the two universities performing the trial, Leiden University and Wageningen University and Research. Participants were recruited by sending emails with information about the study and a link to the website of the study to mothers of 2-4 month-old infants. Addressees included parents who had signed up for the 'Nutricia for parents group' or were parents who had ordered a free gift box containing baby merchandise from 'WIJ Special Media'. All addressees had indicated that they were interested in receiving information on additional opportunities and/or activities. Names and e-mail addresses were available to only a limited number of researchers, ensuring the privacy of the addressees. Finally, we approached potential participants through handing out brochures at youth health care centers within the vicinity of Wageningen University and Research. We cannot ascertain how many families were invited at the youth health care centers, but the total number of families invited through the two e-mail lists was 5565. A total of 409 families expressed interest in our study, 255 of which fulfilled in- and exclusion criteria (see below) and were randomly allocated to the groups (62.3%; see Figure 2).

Families that showed interest in our study received a phone-call from one of our trained researchers/students, explaining the study in detail. Families still expressing interest in the study at the end of the call received a detailed information brochure as well as consent forms. Both mothers and fathers were asked to sign and return the consent forms. After receiving the signed consent forms, mothers were asked to fill out an online screening questionnaire which assessed inclusion criteria. Families had to fulfil the following inclusion criteria: a) first-time mothers; b) healthy term infants (37-42 weeks of gestation); c) planning to start complementary feeding at child age of 4-6 months (families that already started complementary feeding were excluded) and d) sufficient knowledge of the Dutch language to receive advice on complementary feeding in Dutch and to be able to fill out Dutch questionnaires. Mothers with major psychiatric diagnoses (e.g., depression, schizophrenia or borderline personality disorder) were excluded, as these may affect parenting (Lovejoy Graczyk, O'Hare, & Neuman, 2000). Following the study protocol of Barends and colleagues (Barends et al., 2013), families were also excluded when the first-borns were twins or in the case of medical problems in the infants that influence the ability to eat, such as food allergies, swallowing or digestion problems. Finally, for standardization purposes, mothers who were not willing to commit to the outcome of the randomization procedure were excluded, e.g. the child was assigned to a VIPP-FI group, but the mother was objecting to being video-taped. A flowchart of the inclusion phase can be found in Figure 2.

In total, 255 first-time mothers and their babies were randomly allocated to the various conditions. Directly after randomization, prior to starting the intervention-phase, 12 mother-infant dyads dropped out (for reasons, see Figure 2). A total of 243 families successfully started the intervention-phase. Mean age of the mothers was 30.4 years (*SD* = 4.7, range 18-44). Concerning educational level, 41.6% of mothers had a lower education (finished high school or vocational school), 38.7% finished higher education (higher vocational school) and 19.8% finished university. The trial was thus successful in including a large group with lower education, which is generally considered a risk factor for having less healthy eating habits (Boak et al., 2016) and less beneficial parental feeding styles (McPhie, Skouteris, Daniels, & Jansen, 2014). About 18% of mothers worked fulltime, and 63 worked part-time, and 19% did not have paid work. Gender of the child was roughly equally distributed (47.3% boys); mean age of the children at the start of the intervention-phase was 4.68 months (*SD* = .42, range 3.98-6.38 months); median age was 4.57 months.

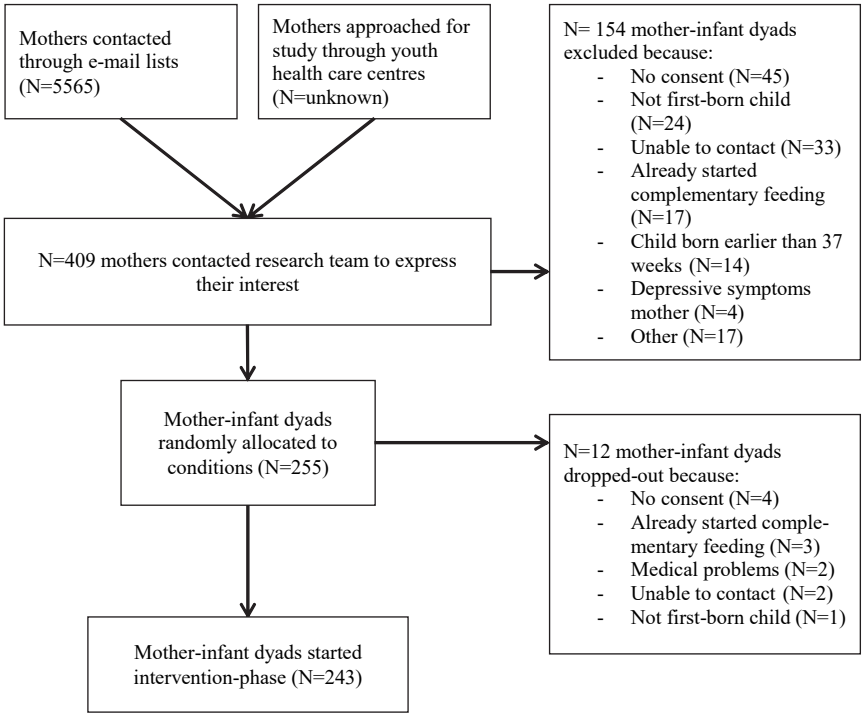

Figure 2. Flow chart of the inclusion phase.

Interventions

The specific content and timing of the RVE and VIPP-FI interventions are specified in Table 1. To control for possible placebo-effects due to receiving attention from researchers/interveners, the number of contacts with researchers/interveners and time in between

contacts are the same for all conditions. The interventions in all groups as well as the attention control condition is performed by trained researchers or Master's students in the fields of nutrition or child and family studies. Participants in all conditions are allowed to seek any type of concomitant advice on infant feeding during the trial; to control for potential co-intervention bias we ask participants after the interventions are completed whether they sought advice concerning feeding elsewhere, and if so, where and how often.

All groups/conditions

Feeding schedule and provision of foods in all groups

Prior to the start of each intervention, all mothers are instructed to give their infant rice-flour porridge with a spoon for at least five days, to accustom the infant to eating food from a spoon (Barends et al., 2013). Each intervention starts with providing infants their first bites of complementary foods according to a specific 19-day feeding schedule (see Table 3). The infants in the repeated exposure and combined conditions receive a variety of commercially available jars of vegetable purees, whereas the infants in the VIPP-FI and attention-control condition receive similar jars containing both fruits and a sweet vegetable puree (carrots). During the first two days and the last two days of the feeding schedule, the target and control vegetables (cauliflower and green beans) are provided to infants in all conditions. During these days, families are visited at home by the research team and the feed is videotaped; researchers measure at home how much the child has eaten (see *Measures*). During the other days of the feeding schedule, the mother feeds her child at home without the presence of the researchers. To facilitate compliance to the feeding schedule, mothers receive a printed overview of the feeding schedule indicating which puree to feed their child on each of the 19 days. In addition, each jar of food is labelled with a sticker indicating the day of the feeding schedule.

After this feeding schedule has been completed, all families are provided with a total of 100 jars of age-appropriate fruits and/or meals with vegetables, depending on the condition they are in, up until the child is approximately 12 months of age (distributed on five different occasions; 20 jars per occasion). Parents are free to decide whether they want to feed their baby using homemade foods or the jars provided to them. The provision of these foods serves as a means to facilitate prolonged exposure to vegetables in the repeated vegetable exposure conditions by making sure age-appropriate meals containing vegetables are available to the families. Whether or not families use these jars and how much the child eats of these jars is reported by the mother.

Table 3. Feeding schedules used within each intervention group and the control group.

	Day																	
Condition	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
RE and COMBI	TV	CV	TV	V1	TV	V2	TV	V1	TV	V2	TV	V1	TV	V2	TV	V1	TV	CV	TV
VIPP-FI and AC	CF	GB	F1	F2	F3	V3	F1	F2	F3	V3	F1	F2	F3	V3	F1	F2	F3	GB	CF

Note. RE = repeated exposure; COMBI = repeated exposure and VIPP-Feeding infants combined; VIPP-FI= VIPP-Feeding infants; AC=attention-control; TV=target vegetable (either green beans or cauliflower); CV=control vegetable (either green beans or cauliflower); V1=spinach; V2=broccoli; CF=cauliflower; GB=green beans; F1=apple; F2=pear; F3=banana; V3=carrot.

Timing of intervention sessions

The five sessions of each intervention and the phone calls in the control condition are timed to take place when the infant goes through major transitions in eating (see Table 2). It was decided to give advice specifically during these major transitions to optimize the potential effectiveness of the interventions. The first two sessions are scheduled when the infant has just started eating complementary foods (approximately one and two weeks after the start). The third session is scheduled when the child reaches the age of 8 months and parents should start introducing their child to more lumpy foods to facilitate their infants' acceptance of different food textures (Nicklaus, 2016). The fourth session is scheduled when the child is approximately 13 months and is allowed to eat the same foods as the rest of the family. Finally, the fifth session is scheduled when the child is 16 months of age to prepare parents for the potentially difficult 'food neophobic phase' that infants tend to reach in their second year (Carruth et al., 2004; Dovey et al., 2008).

Repeated exposure to a variation of vegetables (RVE)

The repeated vegetable exposure (RVE) intervention focuses on *what* to feed infants. The RVE intervention starts with vegetables only according to a 19-day feeding schedule as described by Barends and colleagues (Barends et al., 2013; 2014), and further promotes vegetable exposure in the first year of complementary feeding until 16 months of age using a protocol developed specifically for the current study. We conducted a needs assessment and applied the Intervention Mapping (IM) process (Bartholomew Eldregde, 2016; Kok, Schaalma, Ruiter, Van Empelen, & Brug, 2004; Kok, Bartholomew, Parcel, Gottlieb, & Fernandez, 2014) to develop this protocol.

In short, to promote vegetable exposure in the first year of eating complementary foods the method of repeated exposure to vegetables is used because it has been found to be the most effective way to increase vegetable intake and liking in infants (Birch & Doub,

2014; Holley, Farrow, & Haycraft, 2017). To support this method, we motivate mothers both during and after the feeding schedule to offer their child vegetables daily. From an analysis of risk factors and determinants that may influence children's vegetable consumption we selected the determinants *knowledge, attitude, self-efficacy, skills, modelling, availability of vegetables, beliefs of the parent, positive reinforcement,* and *costs* to target in the intervention.

The main goal of the RVE intervention is for mothers to increase the child's acceptance and liking of vegetables by a) starting the first 19 days of complementary feeding with vegetables only and b) offer vegetables to their child daily after this first period. The risk factors and determinants described above are targeted with the feeding schedule and the five telephone calls. Each phone call focuses on a different theme (Table 4) and discusses basic information material and optional additional information material that is sent to mothers by post. Mothers are asked to read the basic information before the scheduled telephone call with the researcher. Conversations are structured according to the general principles of Motivational Interviewing (MI)(Rollnick, Miller, & Butler, 2008). Interveners are instructed to act as a coach and guide mothers through the feeding schedule and – during later sessions – the family meal. The telephone protocol contains guidelines with questions mothers might ask and possible responses.

The Stages of Change Model (Prochaska, DiClemente, & Norcross, 1992) is used to achieve behavior change. The model identifies five stages that people move through when modifying behavior; 1) pre-contemplation; 2) contemplation; 3) preparation; 4) action; 5) maintenance. During the first two sessions (during the 19 day feeding schedule) it is assumed that mothers are motivated to offer their child a vegetable puree daily (preparation/action phase). For session three to five, the stage of change is monitored based on the conversation with the mother. When the mother appears not to be motivated to offer vegetables or encounters barriers in doing so, the protocol contains a series of possible questions and arguments to be discussed to motivate or come up with solutions for the encountered barriers.

Interveners are explicitly not allowed to give advice on *how* to feed the infant to avoid overlap with the VIPP-FI intervention. If mothers have any specific questions about feeding issues, they are referred to their youth health care center or the website of the Dutch? Nutrition Centre where parents get standard advice available for the general public.

In summary, the standardized telephone protocol for each intervention session contains the following elements:

- General part with standardized questions about adherence of mother and child to the vegetable guidelines
- Classifying the stage of change
- Testing the extent to which goals (e.g. knowledge of the topics discussed) of the previous session were achieved by asking questions and repeating information when necessary (sessions 2, 3, 4, 5)
- Discussing the basic information material that mothers receive per post and presenting the option to tailor the conversation by addressing the optional information and questions the mother might have
- Discussing continuation and goal setting with regard to vegetable consumption (sessions 2, 3, 4, 5)

To optimize adherence of interveners to the intervention protocol, interveners familiarize themselves with all the information in the protocol and are trained on how to approach the mothers during the telephone calls. In addition, the interveners have regular meetings to discuss the RVE intervention, exchange experiences and discuss difficulties that may arise. To allow further monitoring of adherence and achievement of the intervention goals, notes are made of each interaction with the parent. In addition, important individual details and information discussed are noted.

VIPP-Feeding Infants (VIPP-FI)

The VIPP-Feeding Infants intervention focuses on *how* to feed an infant. The intervention is based on an existing parenting intervention that has repeatedly been proven effective in enhancing both parental sensitivity in general and sensitive discipline in particular: the Video-feedback Intervention to promote Positive Parenting-Sensitive Discipline (VIPP-SD) (Juffer, Struis, Werner, & Bakermans-Kranenburg, 2017). For the present study, the VIPP-SD was adapted to the specific situation of feeding infants (VIPP-FI) and aims to enhance sensitive parenting during feeding. The intervention consists of five sessions that take place at home and makes use of a detailed protocol that can be requested from the first author, SV. To avoid overlap with the RVE intervention, interveners are explicitly not allowed to give any advice on what type of food to give the infant. If mothers have any specific questions about this, they are referred to their youth health care center or the Dutch Nutrition Centre.

The goal of VIPP-FI is to increase mothers' sensitive reactions to her child's hunger and satiety cues and to increase sensitive discipline and autonomy support during feeding. To reach this goal, mothers are shown videotapes of their own feeding-interaction with their infant and receive feedback on these tapes by a trained intervener. For each session a different type of meal-setting is filmed. The videos also include potentially

challenging situations like introducing the child to a new taste. The mealtimes are filmed approximately one week before the session takes place, to allow the intervener to prepare the feedback they want to give mothers. The different settings that are filmed and topics that are discussed during each session are displayed in Table 4.

One of the core principles of VIPP is to always provide positive feedback to a mother (Juffer et al., 2008). Every moment where a mother shows sensitive ways of responding to infant cues of hunger, satiety, or other cues are pointed out during the sessions. Instances of insensitive behavior by the mother during the video are also discussed but the intervener always provides the mother with an alternative by referring to a more sensitive response that the mother showed during the video. In doing so, the mother becomes her own role model for showing sensitive reactions to the infant's needs. Another core principle of VIPP is that to improve maternal sensitivity, mothers need to be trained in observing and interpreting the behavior of their child (in essence, how does my child signal hunger, satiety, interest in their surroundings, etc. (Juffer et al., 2008)). Therefore, during the first sessions mothers do not get direct feedback on their own behavior, as this likely distracts them from observing the behavior of their infant while watching the video. In the standard VIPP protocol mothers do not get specific feedback on their own behavior until the third session. However, in VIPP-FI we allow interveners to do this from the second half of the second session. We made this alteration as there is a relatively long time gap between the second and third session (2 to 4 months) and we wanted to give mothers as many pointers as possible to practice sensitive feeding in the months between the sessions. Examples of techniques used for providing feedback to mothers are *speaking for the child* (i.e. the intervener stops the video and talks with a mother about what the infant is trying to communicate at that point in the video) and *corrective messages* (i.e. the intervener stops the video after an example of insensitive behavior of the mother and gives an example of a more sensitive approach she could have used and showed at another point during the video).

To ensure the adherence of interveners to the intervention protocol, interveners receive five days of training in VIPP-SD and a one-day training in VIPP-FI. Moreover, they perform the VIPP-FI in one pilot-family before performing the intervention for the present trial. The progress of the intervention in this pilot-family is discussed extensively with interveners who have experience with the VIPP-FI protocol. Adherence is further optimized by scheduling regular meetings with all interveners at each study location, where the progress of each family receiving the intervention is discussed, as well as any issues that may arise while providing the interventions. Finally, the interveners from both study sites have regular meetings to make sure that adherence is similar at both sites. Similar to the procedure in the RVE intervention, notes are made of each interaction with the parent to allow further monitoring of adherence and achievement of the intervention goals. In addition, important individual details and information discussed are noted.

Table 4. Content of each of the RVE and VIPP-FI intervention sessions.

Session	Child age	RVE			VIPP-FI	
		Theme	Topics discussed	Optional information	Situation filmed	Topics discussed
1	4-6 m	Discovering vegetables	· Why should children learn to eat vegetables? · Keep offering, also if child rejects (at least 10 times)	· Benefits of eating vegetables · Development of taste in young children	Mother feeding infant pureed vegetables/fruits	Learn to observe and interpret child feeding cues (hunger, satiation, liking)
2	4-6 m	Keep on offering vegetables	· How long should I persist? (at least 10 times) · Daily variation, steady increase of portion size	· Tips about offering vegetables to children on a daily basis and the preparation of age appropriate vegetable meals	Mother feeding infant pureed vegetables/fruits	Five tips: Timing, routine, adequate pacing, stop at the right time, enjoy
3	8 m	Being creative with vegetables	· Increase level and variety of texture · Set a good example	· Additional information about introducing more lumpy foods to children. · Tips about preparing and storing age appropriate vegetable meals · Tips to cut costs	Child eating sandwich with mother; new topping on sandwich	What to do when infants a) want more autonomy during mealtimes and b) don't want to eat
4	13 m	Vegetables are part of a balanced diet	· Eating with the whole family · Recommendations for vegetable intake	· Achieving the recommended intake for vegetables	Dinner with whole family; child is served a new vegetable	Positive ways of dealing with negative behavior during dinner
5	16 m	Keep eating vegetables	· Inform parents on possible food neophobia phase, and how to respond	· Involving children in the preparation of vegetables	Dinner with whole family; child is served something new	Inform parents on possible food neophobia phase, and how to respond to that

Note. m=months.

Vegetable exposure + VIPP-Feeding Infants (COMBI)

Participants randomly allocated to the combined intervention receive both the RVE intervention and the VIPP-FI as described above. Similar to these interventions, families receive five phone calls for the RVE intervention and five home visits for VIPP-FI, at the same moments as in the two separate interventions.

Attention control condition (AC)

Participants in the attention control condition receive five phone calls, scheduled at the same time that the intervention sessions in the RVE, VIPP-FI and COMBI conditions take place. The researchers/students that make the phone calls are explicitly not allowed to give any advice on the what and how of complementary feeding; instead, they are instructed to simply inquire after the development of the child, using a semi-structured interview, listen to mothers and show interest and empathy. Topics that are discussed concern the general development of the child (e.g., sleeping behavior, motor development, language development) as well as what the mother's experiences are with the complementary feeding of her child. If mothers have any specific questions about complementary feeding, they are referred to their youth health care center or the Dutch Nutrition Centre.

Measures

Primary outcome measures

Vegetable intake. For the duration of the 19-day weaning schedule the child's consumption of the purees is assessed. On days 1, 2, 18, and 19 of the feeding schedule researchers visit the families' homes and measure the amount of the vegetables the infants eat in grams (maximum of 125 grams per day, as this is the amount available per day). This is done by weighing the jar of food, bowl, spoon, bib and the cloth mother plans to clean the baby with both before and after the meal by using a standard small kitchen scale (Soehnle, Fiesta 65106). For the other days of the feeding schedule, mothers are asked to put all the leftover puree back in the jar as precisely as possible and store it in the fridge until the researchers collect the jars of food at day 18. The researchers determine the amount of puree eaten on these days by weighing the jars.

At t_{12}, t_{18}, t_{24}, and t_{36} vegetable intake is measured by asking mothers to fill out web-based 24-hour recalls on three randomly assigned, non-consecutive days using the online program, Compl-eat, developed by Wageningen University and Research. Compl-eat is based on the multiple pass method (Conway, Ingwersen, Vinyard, & Moshfegh, 2003) to

increase accuracy of dietary recalls and uses the Dutch food composition table (Meijboom et al., 2017) to calculate energy and nutrient intake. The program was adapted to assess the diets of infants and young children for this study (e.g., inclusion of smaller portion sizes, and special baby foods). The recall days are scheduled in advance. The parent is provided with a paper food diary to be filled out throughout the day if the child is not in the parents care, but for instance with a babysitter or at a day-care center, making it possible for the parent to enter the data in Compl-eat afterwards. In addition, the parent is asked to weigh all vegetables consumed by the child on a digital scale. Instructions on how to fill out Compl-eat are given during the home visits of t_{12}, t_{18}, t_{24}, and t_{36}; invitations to fill out the recalls are sent after the home visits.

Vegetable liking is measured every day of the feeding schedule by asking mothers to note their infants liking of the vegetables in a diary. Using the same scale as used in the trial by Barends and colleagues (2013), mothers are asked to rate their infant's liking on a 9-point Likert scale, ranging from 1 (dislikes very much) to 9 (likes very much). At t_{12}, t_{18}, t_{24}, and t_{36}, liking of the target and control vegetables (cauliflower and green beans) is measured using the same scale, filled out by the mother.

Child **self-regulation of energy-intake** is measured using questionnaires and observation. Mothers are asked to fill out the Baby Eating Behavior Questionnaire (BEBQ (Wardle, Guthrie, Sanderson, & Rapoport, 2001)) at t_0 and the Child Eating Behavior Questionnaire – Toddler (CEBQ-T(88)) at all other *t*'s. The BEBQ and CEBQ-T assess several aspects of eating behavior including satiety responsiveness and food responsiveness. These scales are used as indicators of the infant's self-regulation of energy-intake.

In addition, at t_{18}, t_{24} and t_{36}, a home-based *eating in the absence of hunger (EAH)* paradigm is used. This is done according to the free-access procedure, which is considered the gold-standard for this type of measurement (Fisher & Birch, 1999; 2002; Lansigan et al., 2015; Remy et al., 2015). During the home visit the researcher carefully assesses what and how much the child eats during dinner to determine the weight, energy and macronutrient content of the meal. In addition, the mother is asked to indicate how satiated she thinks her child is after consuming dinner. Directly after dinner an 8-minute free play session takes place after which the researcher provides a plate with savory and sweet age-appropriate snacks and the child is told that these are for him/her to eat. The mother is asked not to interfere with the child's behavior during this time. Using these data, the EAH-score, the percentage of energy intake from the snacks relative to the energy intake from the dinner, is calculated.

Secondary outcome measures

Child anthropometrics are measured at all *t*'s. Infants' body weight is measured by asking mothers to first stand on a calibrated electronic personal scale (KERN MPC/SECA robusta 813) themselves, and then again while holding their infant. The difference between these two weights produces the child's weight. As of t_{24}, children are invited to stand on the scales themselves. Weight is measured in 0.1 kilograms. Infants' length is measured by lying them down on a small mat with an indication of centimeters printed on top of it. As of t_{24} child length is measured using a stadiometer (SECA 213, Chino, USA/Garant).

Child eating behavior is measured by the mother-reported Baby Eating Behavior Questionnaire at t_0 (BEBQ (Llewellyn et al., 2011)) and the Child Eating Behavior Questionnaire – Toddler (CEBQ-T (Herle, Fildes, Van Jaarsveld, Rijsdijk, & Llewellyn, 2016)) at all other *t*'s. The BEBQ and CEBQ-T are both derived from the Child Eating Behavior Questionnaire (CEBQ), a well-validated, reliable and widely used questionnaire that assesses different aspects of child eating behavior (Sleddens et al., 2008; Wardle et al., 2001). We use the CEBQ-T as of t_1 as it is more appropriate for assessing children's eating behavior in relation to eating solid foods. However, since the scale 'emotional over-eating' is largely inapplicable for infants under the age of 2 years (e.g., "My child eats more when upset") this scale is only added to t_{18}, t_{24} and t_{36}.

Maternal feeding behavior is measured using both observations of family meals at home and questionnaires. When the child is 4-7 months of age (t_0 and t_1), a videotape is made of the mother feeding the child one of the pureed foods of the feeding schedule. At all other time points, a family dinner is videotaped. These videos are coded by trained researchers/ students for maternal sensitive feeding using the Ainsworth scale (Ainsworth et al., 1974). In addition, maternal responsiveness to child satiety cues is coded using a scale based on the Responsiveness to Child Feeding Cues Scale (Hodges et al., 2013), and maternal pressure to eat is coded using a scale based on a large Dutch study that observed family meals in 4-6 year-olds (Camfferman, 2017).

In addition, at each time point the Infant Feeding Style Questionnaire (Thompson et al., 2009) is administered. This questionnaire has shown adequate internal consistency and validity and measures the following parental feeding styles: laissez-faire, restrictive, pressuring, responsive and indulgent. As of t_{18} the following scales from the validated Comprehensive Feeding Practices Questionnaire (Gubbels, Sleddens, Raaijmakers, Gies, & Kremers, 2015; Musher-Eizenman & Holub, 2007) are added which are appropriate at that age: restriction, monitoring, modelling, encourage balance and variety, pressure to eat, child control, emotion regulation and food as reward. Scales from the Feeding Practices and Structures Questionnaire (Jansen, Mallan, Nicholson, & Daniels, 2014) are also added

as of t_{18} (reward for eating, overt restriction) and t_{24} (reward for behavior, persuasive feeding, structured meal setting, structured meal timing).

Other measures

The following potential covariates will be assessed: demographic variables such as maternal and paternal education and job status, family income, cultural background (t_0); type of milk feeding (breast/formula: t_0-t_{18}); maternal depression (t_0-t_{36}: Center for Epidemiologic Studies Depression Scale (Radloff, 1977)); maternal vegetable intake (t_{12} and t_{36}: Food frequency questionnaire (Siebelink, Geelen, & De Vries, 2011)); maternal anthropometrics (t_0-t_{36}); use and amount of purée consumed of the 100 distributed vegetable- and fruit jars in the 5 months after the feeding schedule (t_{12}); maternal self-efficacy related to feeding their child (t_0-t_{36}: Parental Feeding Self-Efficacy Questionnaire (Dolan, 2013)); maternal emotions during feeding the child (t_0-t_{36}: measure designed for this study); structure of family meals (t_0-t_{36}: Meals in our Household (Anderson, Must, Curtin, & Bandini, 2012)); maternal perception of feeding (t_0-t_{36}: Five Minute Speech Sample (Gottschalk & Gleser, 1969)); child temperament (t_0-t_{12}: Infant Behavior Questionnaire-Revised (Putnam et al., 2014); t_{18}-t_{36}: Early Childhood Behavior Questionnaire (Putnam et al., 2006)); general parenting styles (t_0-t_{36}: observed maternal intrusiveness during mealtimes and observed maternal sensitivity and intrusiveness during free-play situations (Ainsworth et al., 1974); t_{18}-t_{36}: Comprehensive General Parenting Questionnaire (Sleddens et al., 2014)).

Blinding

Researchers coding video data are blinded for intervention-allocation. It is impossible to blind participants for intervention-allocation, because they will be informed prior to randomization about what types of advice they can receive in the study and it will be clear after randomization what type of advice they are receiving.

Participant reimbursement and efforts to prevent drop-out

As a compensation for the time and effort participants invest in our study, families receive several compensations. Apart from the pureed vegetables or fruits during the feeding schedule and the 100 jars of baby foods until the infant is 12 months of age, families receive gift tokens of 25 euros and a gift for the child of approximately 5 euros at t_{18}, t_{24}, and t_{36}. Additionally, all videos made throughout the study are shared with the families at completion of the study, and families randomly allocated to receive VIPP-FI receive the videos used for the intervention during the last session of the intervention.

To involve participants in the study we will send families biannual newsletters about the study, mentioning interesting facts (e.g., inclusion rates, presentations at symposia, pictures of researchers/students involved in the project). Also, we aim to stimulate a pleasant relationship between researchers and participating mothers by for example

sending birthday cards to the family when the child will have its birthday. In a similar effort, and to diminish any additional burden for the participating families, we will strive to provide continuity in the researchers/students that are in direct contact with a family (e.g., at home visits or telephone calls). Moreover, we will make sure during every home visit to check whether participants have any questions about the measurements and/or interventions and to provide assistance in filling out questionnaires or dietary recalls whenever needed.

Confidentiality, data management and access

All data will be stored using numbers to identify participants at the secured databases of Leiden University and Wageningen University and Research. Only one document exists that links participant numbers to personal data, and this file is only available to the main researchers performing data collection at Leiden University and Wageningen University. Data that need to be entered manually (e.g., measured weight and height during home visits, codes of video material) will be entered in the latest version of the statistical software package IBM SPSS Statistics by trained researchers/students. The quality of this data entry will be checked regularly by another (independent) trained researcher/student.

As detailed in the consortium agreement-contract of the project, only researchers and students involved in the project working at any of the academic parties (Leiden University, Wageningen University and Research) will be allowed access to the data. With the exception of the video-recordings (VIPP-FI), which contain privacy-sensitive information, research data will be open access where possible (e.g. when a peer-reviewed journal requests or offers the uploading of anonymized datasets into an open access database. In these cases, all personal information will be removed from data files and replaced by participant identification numbers. The file linking these numbers to personal information will be stored digitally in a separate password protected file that will only be accessible to the researchers). Large video-files will be shared between the two universities by making copies on external pass-word protected hard-drives and personally exchanging these hard-drives.

Analyses

The intention-to-treat principle will be applied to all analyses. Whether the interventions differentially affect primary and secondary outcomes over time will be analyzed using linear mixed models analyses, a technique that makes use of every data point for every participant, irrespective of their missing data. The three intervention groups will be compared to the control group, and the combined group will be compared to the repeated exposure and the VIPP-FI group. A significance level of $\alpha = .05$ will be used. The analyses will be corrected for relevant covariates such as family socioeconomic status, maternal consumption of vegetables, parental body mass index (BMI), child temperament, etc.

Monitoring of interventions and trial progression

Participants will be asked to fill out an evaluation form concerning the interventions following the last session. These forms will assess participants' satisfaction with the intervention as well as with the person delivering the intervention. In addition, participants will be asked to note any other comments about the interventions, allowing for spontaneously reported adverse events. As the interventions are not invasive and merely provide parents support, advice and commercially available foods with a history of safe use, no adverse events are expected and no stopping guidelines are formulated. For the same reasons, a data management committee is not needed. Principle investigators at each study site (i.e. JM, SV, KG, JV and GJ) will supervise data collection and data management. We will not perform any interim analyses as we want to avoid the risk of the results of such analyses influencing the overall results of the trial. No explicit trial conduct audit is planned; however, yearly reports on the progress of the project will be sent to the major funder of the trial (The Netherlands Organization for Scientific Research). If any major changes will occur in the study protocol (e.g., changes to outcomes or assessment periods) the ethical review boards that approved the study as well as the funder of the trial will be notified of these changes.

Dissemination policy

It is planned to publish the results of our trial in peer-reviewed journals, as well as present the results at (inter)national conferences. Also, participants will receive a report of the results of our study after completion of the study. Publication in magazines for healthcare professionals and the general public are also intended. Authorship to any publications will be granted to those who fulfil the ICMJE recommendations(109). We will not hire any professional writers.

Discussion

Baby's First Bites will be the first trial explicitly testing the separate and combined effects of promoting the *what* and *how* of complementary feeding. By comparing three prolonged, intensive interventions, we will be able to draw firm conclusions on what is most important to focus on when promoting vegetable acceptance and children's self-regulation of energy intake in early childhood; what food to offer, how to offer this food, or a combination of the two. Moreover, this will be the first trial to include an intervention specifically manipulating sensitive feeding practices without manipulating any other variables, evaluating its effects using both self-report and observational measures. This allows conclusions on whether this parenting practice will indeed promote healthier food preferences in children and will foster children's ability to self-regulate their energy intake, as is often suggested in the literature.

The planned study also provides some points of discussion to be considered. First, the channels of recruitment we have chosen pose the risk that participating families are not representative of the general population, as they are partly recruited from a database of pregnant women who showed interest in information about infant nutrition. Thus, these families may be more motivated to provide a healthy eating environment for their infant than the general public. However, it should be noted that time-consuming randomized controlled trials (RCTs) like the present study will always elicit this potential selection bias, irrespective of the channels of recruitment chosen. Also, this drawback is negated somewhat by the fact that this study succeeded in including participants at all educational levels. Nevertheless, this potential selection bias should be taken into account when considering the implementation of the results of this study. Second, we chose to give parents the opportunity to start complementary feeding from the age of 4 months, thereby making sure that we followed parental preferences in starting complementary feeding. There is still some discussion in the literature about when to start complementary feeding. The general recommendation from the World Health Organization (WHO) is to exclusively breastfeed until the age of 6 months and introduce complementary foods from 6 months onwards. For the European Region, WHO recommends that all infants should be exclusively breastfed from birth to about 6 months of age, and at least for the first 4 months of life, but that some infants may need complementary foods before 6 months of age, and that these should not be introduced before 4 months (Michaelsen, 2000). The European Food and Safety Authority (EFSA) panel (Fewtrell et al., 2014), as well as the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) recommend that complementary foods including allergens are introduced between 4 and 6 months, and this has been shown to be associated with a reduced risk of food allergies (Abrams, Greenhawt, Herscher, & Chand, 2017). Starting complementary feeding between 4-6 months is also in accordance with recommendations from the Dutch Nutrition Centre (Voedingscentrum, 2019) and the Dutch youth health care centers and thus reflects official Dutch guidelines and probably the daily practice of parents in the Netherlands.

Third, we chose to deliver the combined intervention by simply following the same procedures as used in each separate intervention, and the intervention was provided by two different researchers/students (one delivering RVE, and one delivering VIPP-FI). As such, it can be debated whether this really constitutes a *combined* intervention or simply *two* interventions. Also, from the families' point of view, receiving advice from two different persons might not be ideal. An alternative approach would have been to incorporate all information of both interventions in the home visits. However, we decided against this as the VIPP-FI home visits already took up 60 to 90 minutes. Including the information of the RVE intervention in this session would result in too much information for the mother to properly process in one sitting, increasing the risk that the effects of the intervention

would diminish. Fourth, considering the time-consuming nature of this study for families, there will be a considerable risk of drop-out during the study. This risk is even higher in the selected sample of first-time mothers, as it is likely that many families will expand their family during the study period, making the time they have available for participating in this study more limited. We plan to accommodate families as much as possible to make sure that they will be able to finish the study, for instance by offering assistance where necessary (e.g., filling out questionnaires together or sending personal reminders) and by being flexible in planning the home-visits.

Finally, if the proposed RCT will prove the interventions effective, the labor intensiveness of the tested interventions may pose problems for their implementation to the general public. Although this is not so much a limitation of the current study, it is a drawback for implementing its results, as it will be necessary to translate the interventions to scalable prevention programs before the interventions can be implemented for a larger group.

In conclusion, the planned trial has the potential to provide valid evidence on the question how parents may promote healthy eating habits from the very first start of eating solid foods. If proven effective, these interventions could be useful to large scale effective prevention of childhood obesity.

3

Chapter 3

Baby's first bites: Association between observed maternal feeding behavior and infant vegetable intake and liking

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Abstract

Positive experiences with the introduction of solid food in infancy may lead to positive associations with feeding in both parent and infant. During this transitional period, parental feeding behavior and infant eating behavior might mutually reinforce each other. A feeding style that is found to be associated with positive child eating behavior, is sensitive feeding. In the present study we tested bidirectional prospective relations between mother and infant behavior in a cross-lagged model using observations of two feeds on two consecutive days on which the first bites of solid food were offered. The sample consisted of 246 first-time mothers and their infants, whose feeding interactions were videotaped during two home visits. Maternal sensitive feeding behavior (consisting of responsiveness to child feeding cues, general sensitivity and non-intrusiveness) and maternal positive and negative affect were coded. In addition, infant vegetable intake was weighed and vegetable liking was reported by mother. Results showed at least some stability of maternal feeding behavior and infant vegetable intake and liking from the first to the second feed. In addition, during the second feed maternal sensitive feeding and positive affect were associated with infant vegetable intake (r=.34 and r=.14) and liking (r=.33 and r=.39). These associations were mostly absent during the first feed. Finally, infant vegetable liking during the first feed positively predicted maternal sensitive feeding behavior during the second feed (β=.25), suggesting that the infant's first response might influence maternal behavior. Taken together, mother and infant seem more attuned during the second feed than during the first feed. Future studies might include multiple observations over a longer time period, or micro-coding. Such insights can inform prevention programs focusing on optimizing feeding experiences during the weaning period.

Introduction

In the first year of an infant's life, the feeding process is a central feature of infant-caregiver interaction (Lindberg, Bohlin, & Hagekull, 1991). While the infant initially feeds solely on milk, after approximately 6 months this is no longer sufficient in terms of both energy and nutritional requirements (Butte et al., 2002; Reilly et al., 2005). In Western countries, the introduction of foods other than milk, i.e. the process of complementary feeding, generally starts around the age of 4-6 months. The first experiences with offering solid food can be challenging for parents, as they have to learn how to offer food other than milk, and to deal with new infant behavior at the same time (Van Dijk, Hunnius, & Van Geert, 2018). The first steps in this process might be particularly important, given that the foundation of how children relate to food and eating is formed during those very first experiences (Van Dijk, Van Voorthuizen, & Cox, 2012). This transitional period may be seen as a window of opportunity during which parents can influence eating behavior. Therefore, the present study focuses on observed maternal behavior (sensitive feeding and affect) when offering the infant his/her first bites of solid food (i.e., vegetable purées), and its bidirectional relation to infant intake and liking of those first bites.

Parents play a very important role in the process of complementary feeding, as they not only decide *what* foods to provide, but also *how* to feed their infant. The way parents feed children is suggested to impact children's eating behavior and related health outcomes, either positively, or negatively. For instance, pressuring children to eat was related to more pickiness in eating (Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Galloway et al., 2006; Wardle, Carnell, & Cooke, 2005) as well as to eating in the absence of hunger (Costanzo & Woody, 1985; DiSantis et al., 2011; Hurley et al., 2011), and caused children to eat and like vegetables less (Galloway et al., 2006). In contrast, responsive feeding has been suggested to be the best way to feed young children. Definitions of responsive feeding vary widely, but the core principle is that parents who feed responsively, correctly perceive hunger and satiety signals of the infant during the feed, and respond promptly and appropriately to these signals (Disantis et al., 2011; Schwartz et al., 2011). Indeed, responsive feeding has been shown to relate to several beneficial health outcomes for young children, such as healthy eating behavior, and a healthy BMI (DiSantis et al., 2011; Lindsay et al., 2017; Spill et al., 2019). However, it has recently been suggested that responsive feeding might not be sufficient to promote outcomes such as healthy food preferences, because it mostly concerns how parents respond to signals of hunger and satiety, and not to other infant signals during the feed (Van der Veek et al., 2019). Alternatively, *sensitive feeding*, which broadens the concept of responsive feeding to incorporate sensitive parental responses to all infant cues during a feed, might be more effective in promoting healthy eating habits (Van der Veek et al., 2019). Sensitive feeding is based on Ainsworth's concept of parental sensitivity (Ainsworth et al., 1974) and includes understanding and anticipating

the child's point of view, by sensitively responding to child signals of for example (dis)liking or rejection of food, distracted behavior, the wish to do things themselves (autonomy), or emotions in general. Such sensitive parental behavior is likely to foster a pleasant and safe atmosphere during mealtimes and may facilitate the child to associate eating with positive emotions, thereby encouraging young children's willingness to eat and try new (healthy) foods.

In addition to sensitive feeding, parental positive affect during mealtimes might also contribute to a positive atmosphere during a meal and thereby influence a child's eating behavior. Positive affect is not necessarily sensitive behavior, as it does not always include an appropriate response to child signals but rather is a general parental state (Mesman & Emmen, 2013). In the literature, parental affect indeed distinguishes from parental sensitivity, as it is found to be associated with different aspects of child behavior than sensitivity (Davidov & Grusec, 2006). With respect to feeding, high levels of parental positive affect (e.g., smiling, complimenting) may encourage children to eat or try something new, by showing them that it is safe to do so. In contrast, showing signs of negative affect (e.g., irritation, harshness) might signal unsafety to children, contributing to (even more) resistance when eating, or to the development of negative associations with eating in general. However, within the feeding context, little research has been done on parental affect, and studies that do exist were conducted with older children. These studies found that a positive affective atmosphere was indeed related to more positive child outcomes, such as a lower BMI in 8-12 year-olds (Berge et al., 2014; Rhee et al., 2016), and more healthy eating behavior in teens (Neumark-Sztainer, Wall, Story, & Fulkerson, 2006). Therefore, the present study will investigate maternal affect while feeding infants in addition to the concept of sensitive feeding, and how this relates to infant food intake and liking.

When studying parent-child interactions, it is important to take into account that parent and child behavior often, if not always, influence each other. Indeed, there is growing evidence that parent-child interactions within the feeding context are reciprocal, meaning that the child may influence parent behavior just as much as the parent might influence child behavior (Jansen et al., 2018; Skouteris et al., 2011). So far, cross-lagged model analyses have provided evidence for such bidirectional effects between parental feeding practices on the one hand, and child characteristics on the other hand, such as child appetite, BMI and fussy eating (Afonso et al., 2016; Fildes et al., 2015; Jansen et al., 2017; Webber et al., 2010). This is in line with the literature on other parenting constructs, as a large amount of evidence supports the idea of parent-child relationships being bidirectional (Newton, Laible, Carlo, Steele, & McGinley, 2014). Therefore, the present study will test bidirectional prospective relationships between mother and child behavior in a cross-lagged model using two feeds on two consecutive days.

In addition, the present study focuses on the stability of the investigated maternal and infant behaviors. Feeding an infant is a daily occurring situation for both parent and infant. Although parental behavior may vary from day to day due to all kinds of factors such as the parent's or the child's mood, many studies have shown some stability in parental behavior over time, both in short-term (Bornstein, Motti, Joan, Diane, & Haynes, 2006; Endendijk, Groeneveld, Dekovic, & Van den Boomen, 2019), and in the long term (Dallaire & Weinraub, 2005; Landry, Smith, Swank, Assel, & Vellet, 2001). However, according to dynamic system theory, systems in transitional periods are found to be extra vulnerable to contextual influences, which would lead to increased behavioral variability (Thelen & Smith, 1993). Performing behavior for the first time, such as during the first phase of complementary feeding, would lead to instability of the system. In the context of feeding, only a few studies have looked at the short-term stability of parental feeding behavior and infant eating behavior in the first year of life (Van Dijk et al., 2009; 2012; 2018). In those studies, more variability of behavior was found during the first two weeks of complementary feeding compared to later on, which was the case for infant food intake, as well as synchronization between mother and infant in terms of offering and accepting food. However, these studies did not examine the variability of maternal behavior on its own, and sample sizes were very small. Insights are relevant with respect to (reliable) measurement of early feeding situations, as well as for health professionals supporting parents in the first phase of complementary feeding.

In the present study, the following research questions are addressed: (1) Are maternal sensitive feeding behavior and maternal affect stable from the first to the second feed? (2) Are infant vegetable intake and liking stable from the first to the second feed? (3) Are maternal sensitive feeding behavior and maternal affect associated with infant vegetable intake and liking during the same feed? (4) Are maternal sensitive feeding behavior and maternal affect during the first feed predictive of infant vegetable intake and liking during the second feed? (5) Are infant vegetable intake and liking during the first feed predictive of maternal sensitive feeding behavior and maternal affect during the second feed? A visualization of the cross-lagged path model that will be tested, by evaluating the fit of the models, is depicted in Figure 1.

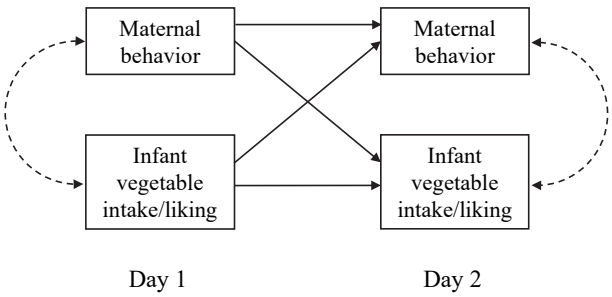

Figure 1. Diagram of the research questions.

Several characteristics of both mother and infant in earlier studies have been found to be related to either parental feeding practices, child vegetable intake, or both. Important examples are breastfeeding duration (DiSantis et al., 2013; Sullivan & Birch, 1994), maternal educational level (Cooke, Ingwersen, Vinyard, & Moshfegh, 2003; Vereecken, Keukelier, & Maes, 2004), child eating behavior (Cooke et al., 2006; Haycraft & Blissett, 2012), child BMI (Afonso et al., 2016; Jansen et al., 2014; Wardle & Carnell, 2007), and child temperament (Anzman-Frasca, Stifter, & Birch , 2012; Stifter, Anzman-Frasca, Birch, & Voegtline, 2011), which will all be taken into account as covariates when analyzing the data.

Method

Participants

The study included 246 first-time mothers and their infant. Mean age of the mothers was 31.0 years (*SD* = 4.7). Infants (48% boys) were between 17.3 and 27.7 weeks of age during the first home-visit (*Mean* = 20.3 weeks, *SD* = 1.9). With respect to highest achieved educational level, 41.6% of mothers had a lower educational level (finished high school or vocational school), 38.7% finished a degree comparable to a bachelor's degree and 19.8% obtained a master's degree. Up until the first home-visit at child age of 4-6 months, 57% of the mothers bottle-fed their infant, 23% breastfed their infant and 20% used a combination of breast and bottle feeding.

Procedure

The present study is part of a large longitudinal randomized controlled trial called Baby's first bites, in which one of the main goals is to enhance vegetable intake in infants (Van der Veek et al., 2019). The study was approved by the Ethics Review Board of the Institute of Education and Child Studies, Leiden University (ECPW-2015/116), as well as by the Medical Research Ethics Committee of Wageningen University and Research (NL54422.081.15). For the present study, pretest data were used. Participants were recruited from the general population in the four Dutch provinces close to the two participating universities. Information was sent to potential participants by email, using email addresses obtained from Nutricia Nederland B.V. (a company focussing on nutrition during the first years of life) and WIJ Special Media (a company focusing on pregnancy and the first years of life in general). In addition, only within the vicinity of Wageningen, brochures were handed out at youth health care centres. The following inclusion criteria had to be met: first-time mothers; healthy term infants (37-42 weeks of gestation); planning to start complementary feeding at child age of 4-6 months; sufficient knowledge of the Dutch language; willing to start complementary feeding with commercially available vegetable/fruit purées; willing to be videotaped. Mothers with major psychiatric diagnoses were excluded, as well as twins or children with medical problems that could influence their

ability to eat. Further details about how participants were recruited can be found in the study protocol (Van der Veek et al., 2019). Both parents of the infants signed an informed consent form, unless the father did not live with the mother and did not have parental authority. If mothers were interested in the study, they received a short list of signals that might help them decide whether their infant was ready to start complementary feeding (e.g., "child can sit-up straight and stabilize head"; "child shows interest in your food"). As soon as mothers contacted the research team by e-mail or telephone to inform us their infant was ready, the first home visit was planned within two weeks. Prior to the first home visit, all mothers filled out online questionnaires, which assessed among other things child drinking behavior, child temperament, self-reported maternal feeding style, and maternal depression. In addition, they were instructed to give their infant rice-flour porridge with a spoon for 5-7 days prior to the first home visit (*Mean* = 6.5 days; *Median* = 7 days), in order to familiarize the infant with eating from a spoon. Subsequently, all mothers were asked to feed their infant pure-vegetable purée in commercially available jars (brand Olvarit) provided by the researchers, during two home visits on two consecutive days. All infants received cauliflower and green beans, in counterbalanced order. During the first home visit on Day 1, the mother was asked about some background characteristics such as educational level and whether she breast- or bottle fed her infant. In addition, during the first as well as the second home visit, a feeding interaction was videotaped, during which the mother was asked to feed the infant the vegetable purée. Finally, we recorded when the observed feed started, as well as when the mother had last offered a milk feed.

Measures

Maternal behavior during feeding. Feeding interactions were taped and coded from the beginning of the feed (first spoon offer) until the end (final spoon offer). The duration of the video was used as an indication of the duration of the feed, and was 8 minutes and 36 seconds at Day 1 (*SD* = 4m36), and 8 minutes and 49 seconds at Day 2 (*SD* = 5m01). Shortest video duration was 2 minutes and 10 seconds, the longest duration 35 minutes. The following aspects of maternal feeding behavior were coded: responsiveness to stop signals of the child, sensitivity, positive and negative affect. After intensive training, a reliability set of 30 videos was coded by all four coders, yielding intercoder reliabilities (intraclass correlations, single rater, absolute agreement) of > .70 for all scales between all individual coders (Cortina, 1993). For all 246 mother-infant pairs, videotaped feeding interactions of Day 1 and Day 2 were coded by the four coders. The coders were not familiar with the family they were coding. For the benefit of the large RCT where the scores of Day 1 and Day 2 will be combined, the two videos made of each family were scored by the same coder, with a few months in between coding Day 1 and Day 2. Also for the benefit of the RCT, we made sure that coders were blinded for group status of the family.

Responsiveness to infant's stop signals. This scale was based on the responsiveness to child fullness cues scale as described in the Responsiveness to Child Feeding Cues Scale coding instrument (RCFCS; (Hodges et al., 2013)). In the original scale, the responsiveness of the mother was based on her response to the fullness cues expressed by the child, taking into account the frequency and intensity of child fullness cues prior to the mother's decision to stop the feed. In essence, mothers that stop the feed in response to less intense and/or frequent child satiety cues, score higher on responsiveness. However, because our feeding interactions concerned the infant's very first bites, some adaptations had to be made to the original scale. A description of the scale we used can be found in Appendix I. The first adaptation we made, was broadening the content of the scale to infant stop signals in general, instead of labelling them as fullness cues. This was done because the feeding sessions concerned the very first bites, and most infants were only tasting a little without reaching satiety before they showed disinterest and stop signals. The second adaptation we made, was removing the frequencies of child satiety/stop signals as anchors for the scores. The various fullness cues as described by Hodges and colleagues were, in contrast to the original instrument, not coded separately, because this was not the objective for the current study, nor for the larger RCT. Instead, all coders were trained on recognizing the signals and on distinguishing them in terms of intensity. As in the original scale, maternal responsiveness was scored on a 5-point scale, ranging from highly unresponsive (1) to highly responsive (5). In other words, the decision of the mother to end the feed was scored as far too late (1), too late (2), slightly late (3), on time (4), or prompt (5). In case this maternal behavior could not be observed, for example when the child finished all the food without showing any stop signals, or the mother restricted the child from finishing all the food, mother was given a score of 9 (not applicable). Interrater reliability was good (ICC = .75 - .87).

Sensitivity. To rate maternal sensitivity towards all child behavior shown during the feed, the Ainsworth sensitivity scale was used (Ainsworth et al., 1974). Mothers were scored on the original 9-point scale, ranging from highly insensitive (1) to highly sensitive (9). The highly sensitive mother (9) "virtually always responds sensitively, with any lapses being small and extremely rare", while the highly insensitive mother (1) "responds insensitively almost all of the time, with sensitive responses being extremely rare or absent, gearing almost exclusively to her own wishes, moods, and activity." Examples of maternal insensitive behavior are not responding to infant signals of distress (serious lapses), or not responding to infant vocalizations or interest in surroundings (mild lapses). Interrater reliability was good (ICC = .73 - .85).

Non-intrusiveness. Maternal non-intrusiveness, which is the equivalent of the "interference-cooperation-scale" as defined by Ainsworth (Ainsworth et al., 1974), included the extent to which the mother did or did not interfere with the child's signals or behavior. Again,

mothers were scored on the original 9-point scale, ranging from highly intrusive (1) to highly non-intrusive (9). The highly *non*-intrusive mother (9) **"**Never interferes with the child's behaviors or intentions unnecessarily and lets child lead the interaction", while the highly intrusive mother (1) "Almost continuously interferes with the child's behaviors or intentions unnecessarily, while the child virtually never gets room to lead the interaction". Examples of maternal intrusive behavior are physical or forceful interruptions or restraints (serious lapses), or redirecting the child's attention towards mother when exploring surroundings (mild lapses). Interrater reliability was good (ICC = .73 - .90).

Positive Affect. This scale was developed using several maternal affect scales that have been widely used in different contexts (Miller et al., 2002) as a basis. Both verbal (e.g., compliments) and non-verbal (e.g., smiling, caressing) expressions were included to score maternal positive affect. Positive affect was scored on a 5-point scale, ranging from no positivity towards the child at all (1) to positivity in almost the entire video (5). Interrater reliability was good (ICC = .73 - .92).

Negative Affect. This scale was developed using several maternal affect scales that have been widely used in different contexts (Miller, McDonough, Rosenblum, & Sameroff, 2002) as a basis. Both verbal (e.g., name-calling, punishing) and non-verbal (e.g., irritated, harsh behavior) expressions were included to score maternal negative affect, which was scored on a 5-point scale, ranging from no negativity towards the child at all (1) to negativity throughout almost the entire interaction (5). Interrater reliability was good (ICC = .72 - .92).

Vegetable intake. During the two feeds on Day 1 and Day 2, all infants received cauliflower during one feed and green beans during the other, in counterbalanced order. Commercially available jars (125 gr, brand Olvarit) were provided, and the mother was allowed to either feed from the jar or put the purée in a bowl. In order to measure infant vegetable intake, the jar/tray was weighed before and after the feed using a standard small kitchen scale (Soehnle, Fiesta 65106). In order to limit error, next to the jar and/or bowl, the spoon, bib and cloth the parent used to clean the child were weighed before and after as well. Before the feed was about to start, the mother was told the duration of the feed was entirely up to her and that she should act as she would normally do, in order to make sure the feeding interaction occurred as natural as possible. In order to facilitate this, the researcher stayed out of sight as well. The weight in grams before and after the feed was written down and the mean difference was calculated, to one decimal point. In case some purée was spilled (e.g., fell on the floor while feeding), the mother was asked to use the cloth that was about to be weighed to wipe it clean. In addition, the mother was asked not to take any bites from the purée herself.

Vegetable liking. The procedure to assess vegetable liking followed the procedure used by Barends and colleagues (Barends et al., 2013). At the end of each feeding session, the mother was asked how much she thought the infant liked the food, by means of a 9-point scale ranging from 1 (dislikes very much) to 9 (likes very much).

Covariates

The models were adjusted for theoretically relevant mother and child characteristics (assessed before the first home-visit) that were significantly related to either maternal behavior or infant vegetable intake/liking. The following factors were adjusted for: maternal age, the number of weeks the mother breastfed the infant, maternal educational level, child age, gender, temperament (distress to limitations; IBQ-R; (Putnam et al., 2014)), child eating behavior with respect to breastmilk and/or formula intake (food responsiveness, satiety responsiveness, slowness in eating, enjoyment of food; BEBQ; (Llewellyn et al., 2011)), place of study (Leiden or Wageningen), whether the child's behavior during the home-visit in general was representative or not according to the mother, the degree of alertness of the child during the home visit, and which vegetable (cauliflower or green beans) was offered. Representativeness of child behavior, child alertness, and type of vegetable were added to the models twice: for Day 1 as well as Day 2. The number of hours the child had not eaten prior to the observed feed, maternal depression, maternal age, child age, maternal BMI, child BMI, and other child temperamental factors were not related to core variables and therefore not corrected for.

Statistical analysis

Hypotheses were specified before the data were analyzed and the analysis plan was pre-specified. Any data-driven analyses will be clearly identified and discussed appropriately.

Bivariate associations between all variables were assessed by means of Pearson's correlations. Subsequently, structural equation models (SEMs) with robust standard errors were estimated to evaluate the parameters in a cross-lagged model (Hom & Griffeth, 1991). Because some cases missed values on certain variables (e.g., 7 cases were not observed on Day 2), restricted full information maximum likelihood (FIML) was used to estimate model parameters using the maximum available pairwise data for each association (Enders & Bandalos, 2001). Two separate models were tested: one for the outcome Vegetable Intake, and one for the outcome Vegetable Liking. In both models the latent predictor "Sensitive Feeding" was used, defined by linear contributions of Responsiveness to stop signals (Responsiveness), Sensitivity and Non-Intrusiveness. In addition, Positive Affect and Negative Affect were tested as separate predictors of the two outcome measures, resulting in six models in total. All variables and models were corrected a priori for the time-specific covariates described earlier, by computing residualized scores before entering them into the model. Because residualized scores (artificially) reduce the model

degrees of freedom, all models were evaluated with df-corrected fit indices (Zimmerman, 2007). All models were evaluated with and without covariates. In case any differences arose in terms of results, those were reported in the results section. The fit of the models was considered acceptable-to-good if the comparative fit index (CFI) was >.90 and the root mean square error of approximation (RMSEA) was <.08 (Browne & Cudeck, 1992). Finally, following Feingold (Feingold, 2015), Cohen's *d* effect sizes were obtained and reported for all models by rescaling the path coefficients for the standard error of the estimate (beta). Values of .20, .50 and .80 were considered a small, moderate and large effect, respectively (Cohen, 1992). With respect to correlations calculated between mother and child behavior within the same day, .10, .30 and .50 were used as cut-offs for a small, moderate and large correlation, respectively (Evans, 1996). Analyses were performed using SPSS version 25 and the lavaan package 0.6-5 in R version 3.6.2.

Results

Preliminary analyses

Descriptives of all variables are depicted in Table 1. Observational data was available for all 246 mothers on Day 1. For 7 mothers no observational data was present on Day 2, due to various reasons (i.e., technical problems with the camera, child had already eaten before the visit took place, father fed the child because the mother was absent). With respect to the variable Responsiveness to infant's stop signals, 21 and 23 out of 246 mothers had missing data on Day 1 and Day 2, respectively, because the mothers' responsiveness could not be judged during those observations (score 9). With respect to Vegetable Intake, 1 mother had a missing value on Day 2, because the child had already eaten before the home visit took place. Finally, another 10 values on Vegetable Liking were missing on both Day 1 and Day 2, because the mother did not write down the liking score. Skewness was indicated in some instances, however because a) the sample size ($N = 246$) was large, b) robust standard errors were used when estimating the models, and c) multivariate correction took place for all models, skewness of variables and outliers were not considered problematic in terms of assumptions and interpretation of outcomes. The only exception was Negative Affect, as this variable was extremely positively skewed due to only a very small number of scores >1. Therefore, this variable was dichotomized for both Day 1 and Day 2 (0 = no negativity, 1 = at least some negativity). Although Positive Affect and Vegetable Intake were also (negatively) skewed, it was decided not to dichotomize these variables, as this skewness was much less severe. Finally, Pearson's correlations were calculated, as depicted in Table 2. With respect to assumptions, no multicollinearity was present, and residual distributions did not reveal significant deviations from normality.

Table 1. Descriptive statistics.

Variable	Day 1			Day 2		
	N	M (*SD*)	Range	N	M (*SD*)	Range
Responsiveness to stop signals	225	3.47 (*1.31*)	1-5	216	3.47 (*1.31*)	1-5
Sensitivity	246	6.18 (*1.85*)	2-9	239	6.18 (*1.85*)	1-9
Intrusiveness	246	5.99 (*1.94*)	1-9	239	6.00 (*1.93*)	1-9
Positive Affect	246	4.45 (*0.83*)	2-5	239	4.41 (*0.83*)	2-5
Negative Affect	246	1.27 (*0.61*)	1-4	239	1.31 (*0.63*)	1-4
Infant vegetable intake	246	22.95 (*23.53*)	1-124	245	24.95 (*26.11*)	1-126
Infant vegetable liking	236	5.68 (*1.72*)	1-9	235	5.56 (*1.89*)	1-9

Table 2. Pearsons correlations between all variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Intake^{D1}	-												
2. Intake^{D2}	.67**	-											
3. Liking^{D1}	.50**	.37**	-										
4. Liking ^{D2}	24**	.47**	.44**	-									
5. Responsiveness ^{D1}	.07	-.06	.24**	.07	-								
6. Sensitivity ^{D1}	.08	-.01	.26**	.09	.83**	-							
7. Intrusiveness ^{D1}	.07	-.03	.24**	.09	.83**	.93**	-						
8. Positive Affect ^{D1}	-.06	-.03	.10	.07	.44**	.67**	.61**	-					
9. Negative Affect ^{D1}	.15*	.10	.07	-.05	-.27**	-.43**	-.42**	-.63**	-				
10. Responsiveness ^{D2}	.05	.14*	.22**	.29**	.33**	.26**	.26**	.07	-.07	-			
11. Sensitivity ^{D2}	.07	.20**	.28**	.37**	.36**	.45**	.43**	.37**	.23**	.75**	-		
12. Intrusiveness ^{D2}	.06	.21**	.27**	.37**	.35**	.38**	.39**	.23**	-.20**	.75**	.92**	-	
13. Positive Affect ^{D2}	-.12	.04	.14*	.26**	.15*	.29**	.27**	.50**	-.38**	.29**	.63**	.53**	-
14. Negative Affect ^{D2}	.14*	.04	-.02	-.24**	-.18*	-.27**	-.29**	-.31**	.37**	-.34**	-.55**	-.53**	-.70**

Note. *p < .05; ** p < .01. ^{D1} = Day 1, ^{D2} = Day 2. Responsiveness = Responsiveness to stop signals.

Main analyses

Sensitive Feeding and Vegetable Intake. The model had a good fit (Table 3) and is shown in Figure 2. Sensitivity and Intrusiveness fitted slightly better on the latent variable Sensitive Feeding compared to Responsiveness to stop signals on both measurement days, although all three variables showed high factor loadings. First, Sensitive Feeding on Day 1 predicted Sensitive Feeding on Day 2, by showing a small to moderate positive association (d = .40). Second, a small to moderate amount of stability was found for Vegetable Intake (d = .47). Third, a moderate correlation was found between Sensitive Feeding and Vegetable Intake, but only on Day 2. Fourth, Sensitive Feeding on Day 1 showed a small but significant negative association with Vegetable Intake on Day 2 (d = -.14). However, this association was not present in the model without covariate correction, nor was there a significant correlation between the three separate concepts gathered under the construct Sensitive Feeding on Day 1 on the one hand, and Vegetable Intake on Day 2 on the other hand (Table 2). Finally, Vegetable Intake on Day 1 was not found to be associated with Sensitive Feeding on Day 2.

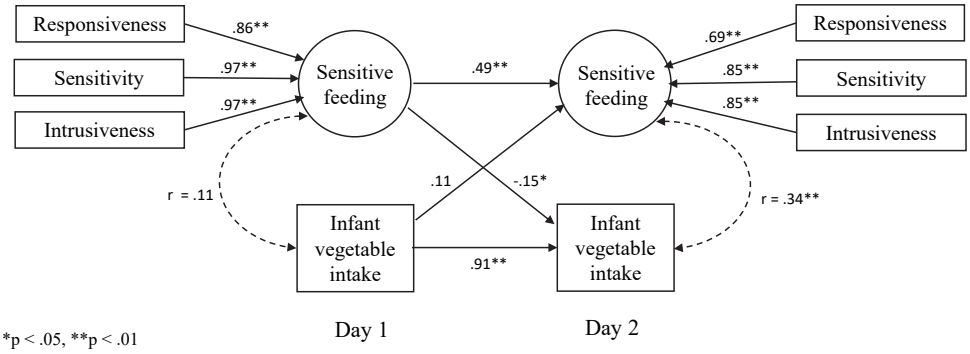

Figure 2. SEM Sensitive feeding and infant vegetable intake.

Sensitive Feeding and Vegetable Liking. The model had a good fit (Table 3) and is shown in Figure 3. Again, Sensitive Feeding on Day 1 predicted Sensitive Feeding on Day 2, by showing a small to moderate positive association (*d* = .34). Second, a moderate to large amount of stability was found for Vegetable Liking, from Day 1 to Day 2 (*d* = .51). Third, moderate positive correlations were found between Sensitive Feeding and Vegetable Liking on both Day 1 and Day 2. Fourth, Sensitive Feeding on Day 1 was not found to be related to Vegetable Liking on Day 2. Finally, Vegetable Liking on Day 1 predicted Sensitive Feeding on Day 2, by showing a small positive association (*d* = .20).

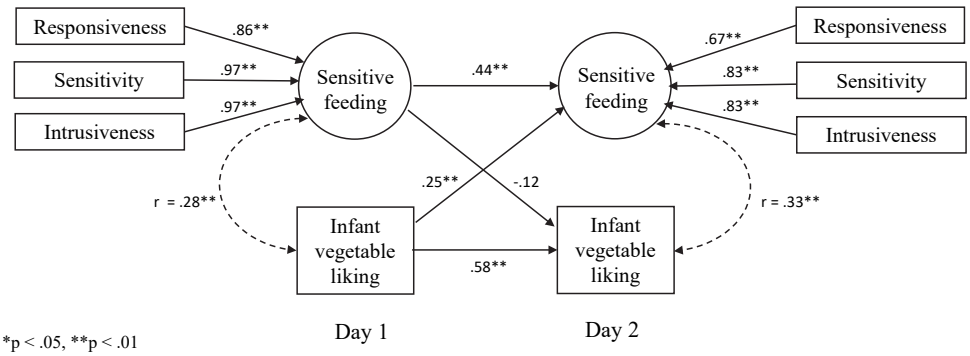

Figure 3. SEM Sensitive feeding and infant vegetable liking.

Maternal affect

With respect to the four models considering maternal affect (positive and negative affect), the first model fit resulted in four fully satiated models (RMSEA = 0.00, CFI = 1.00). To prevent overfitting, the (four) intercept parameters were not estimated, but fixed to a value of 0. As the actual estimations of the intercepts in these models were all close to 0, no loss of fit was detected: the range and maximum of the residuals were equivalent to those from the non-fixed models.

Positive Affect and Vegetable Intake. The model had an adequate fit, with a RMSEA score that was slightly too high (.10) and an adequate CFI score (.90; Table 3), and is shown in Figure 4. First, Positive Affect on Day 1 predicted Positive Affect on Day 2, by showing a small to moderate positive association (*d* = .43). Again, a small to moderate amount of stability was found for Vegetable Intake, from Day 1 to Day 2 (*d* = .47). Third, a small positive correlation was found between Positive Affect and Vegetable Intake, but only on Day 2. Finally, neither cross-over path was significant, indicating that Positive Affect on Day 1 did not predict Vegetable Intake on Day 2, and Vegetable Intake on Day 1 did not predict Positive Affect on Day 2.

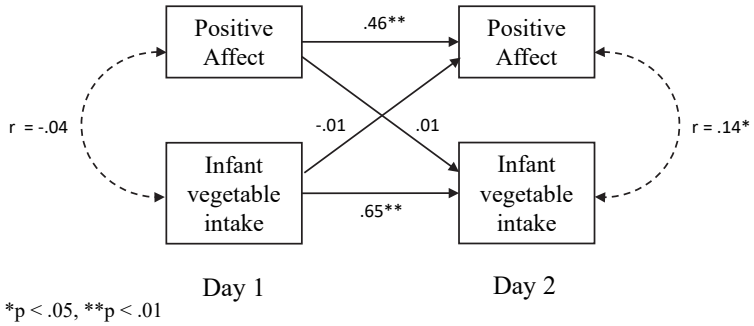

Figure 4. SEM Positive affect and infant vegetable intake.

Positive Affect and Vegetable Liking. The model had a good fit (Table 3) and is shown in Figure 5. First, Positive Affect on Day 1 predicted Positive Affect on Day 2, by showing a small to moderate positive association (*d* = .43). Second, a moderate to large amount of stability was found for Vegetable Liking, from Day 1 to Day 2 (*d* = .55). Third, a small positive correlation was found between Positive Affect and Vegetable Liking, but only on Day 2. Finally, neither cross-over path was significant, indicating that Positive Affect on Day 1 did not predict Vegetable Liking on Day 2, and Vegetable Liking on Day 1 did not predict Positive Affect on Day 2.

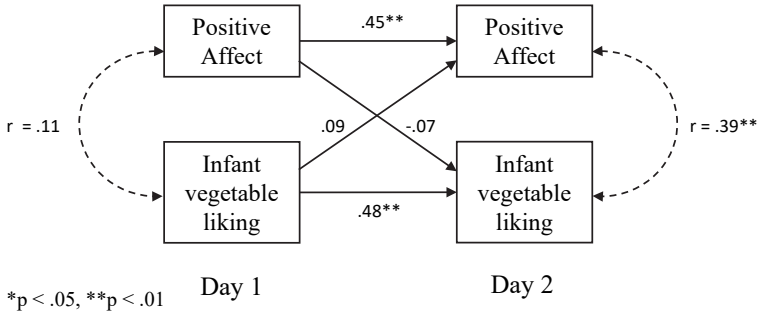

Figure 5. SEM Positive affect and infant vegetable liking.

Negative Affect and Vegetable Intake. The model had an adequate fit (Table 3) and is shown in Figure 6. First, Negative Affect on Day 1 predicted Negative Affect on Day 2, by showing a small positive association (*d* = .19). Second, a small to moderate amount of stability was found for Vegetable Intake, from Day 1 to Day 2 (*d* = .46). Finally, no associations were found between Negative Affect and Vegetable Intake.

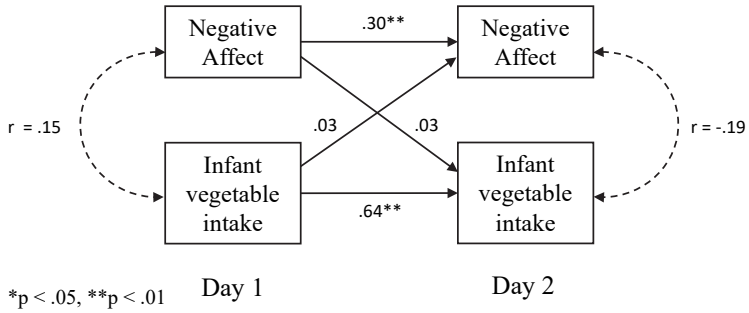

Figure 6. SEM Negative affect and infant vegetable intake.

Negative Affect and Vegetable Liking. The model had a good fit (Table 3) and is shown in Figure 7. First, Negative Affect on Day 1 predicted Negative Affect on Day 2, by showing a small positive association (*d* = .21). Second, a moderate to large amount of stability was found for Vegetable Liking, from Day 1 to Day 2 (*d* = .55). Third, a small negative correlation was found between Negative Affect and Vegetable Liking, but only on Day 2. Finally, neither cross-over path was significant, indicating that Negative Affect on Day 1 did not predict Vegetable Liking on Day 2, and Vegetable Liking on Day 1 did not predict Negative Affect on Day 2.

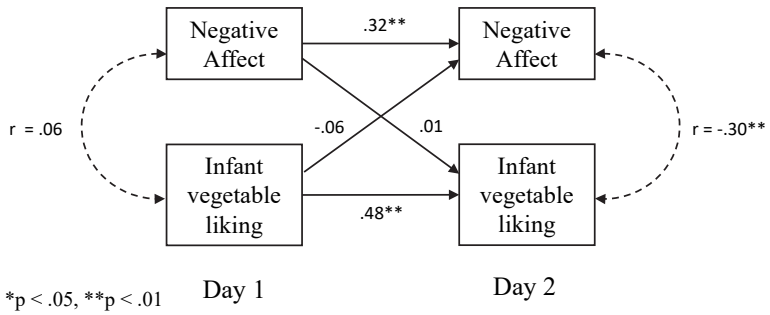

Figure 7. SEM Negative affect and infant vegetable liking.

Discussion

The present study is the first to show that maternal behavior during feeding is associated with infant vegetable intake and liking of the very first bites of solid food. Moreover, some stability was found from the first feed to the second feed one day later, with respect to both maternal behavior and infant vegetable intake and liking.

With respect to stability of maternal behavior, small to moderate associations were found from the first to the second feed, for all maternal behaviors, indicating at least some stability for sensitive feeding as well as affect. Other studies measuring observed maternal sensitivity show similar results, although associations were usually somewhat stronger (Bornstein et al., 2006; Endendijk et al., 2019). Our findings of lower stability are in line with the effects of transitional periods as described in dynamic system theory, as a lack of routine probably leads to more behavioral variation between the two observations (Thelen & Smith, 1993). Studies of Van Dijk et al. looking at synchronization of mother and infant behavior during feeding confirm this idea as well, as they found less synchronization to be present between mother and infant in the early stage of complementary feeding compared to feeds later on (Van Dijk et al., 2012; 2018). The two-day stabilities of sensitive feeding and positive affect were quite similar in our study, but for maternal negative affect less stability was found. This might be an emotional state even more dependent on situational factors (such as a child not willing to eat, or parent or child being tired) compared to the other measures.

With respect to both vegetable intake and liking, moderate to strong stability was found from the first to the second feed. These findings are in line with other studies conducted in older children (Moore et al., 2005), although stability in our study was somewhat weaker than in those studies. However, our results are not in line with the findings by Van Dijk and colleagues (Van Dijk et al., 2009), where a lot less stability (i.e., higher variability) was found during the first bites. An explanation could be that their measurements were performed on several days within two weeks time, while ours were performed on two consecutive days, possibly leading to less "noise" between our measurements. Finally, vegetable intake was found to be more stable than mother-reported vegetable liking. This might be explained by the subjective nature of our liking measure. Compared to our concrete measure of vegetable intake, the mother's estimate of the child's appreciation of the taste might be more sensitive to other factors, such as the child's general facial expressions or mood, or maternal characteristics (e.g., optimism vs. pessimism, quality of reflective functioning, her own appreciation of the particular vegetable).

In addition to the stability found for maternal and child behavior, significant associations between maternal feeding behavior and infant vegetable intake and liking were found.

Notably this was often only the case on Day 2, while on Day 1 very few significant associations were found. An explanation for this might be that mother and infant behavior during this very first feed on Day 1 fluctuated even more than on Day 2, when the dyad already had one previous experience to build upon. However, standard deviations of Day 1 and Day 2 were similar. A more likely explanation, therefore, seems to be that mother and infant were indeed more attuned during the second feed, compared to the first feed, which is in line with findings of Van Dijk and colleagues of increased synchronization of mother and infant in the first few weeks (Van Dijk et al., 2012; 2018). Associations with infant vegetable intake and liking were consistent for sensitive feeding as well as affect: the more sensitively and positively and the less negatively the infant was fed by the mother, the more grams of vegetables s(he) consumed and the more signs of liking the food were noticed by the mother. One explanation might be that infants feel more safe and comfortable in a positive atmosphere where the mother responds to their needs, for example in terms of pacing, empathy, sharing emotions, and are therefore more willing to keep eating and are expressing more joy during the feed. However, it might also be that it is easier for a mother to be positive and respond sensitively to an infant who is actively eating while showing enjoyment, compared to an infant who responds less positively to the food. It is likely that the more enthusiastically the infant accepts the vegetables, the more relaxed and happy the mother might feel during concurrent and future feeds, which could positively influence the way she responds to her infant's cues.

The significant cross-over effect found in this study implies this latter direction of effect. Infant vegetable liking on the first day was found to significantly relate to higher rates of maternal sensitive feeding on the second day. Vegetable liking was mother-reported and entirely reflected her perception of the feed. This underlines the suggestion that a positive feeding experience during the first feed might influence the mother's behavior during the second feed, by making her more willing or eager to attune to the infant's needs, or in case the feeding experience was negative, nervous or tense and therefore less capable to attune. Child behavior predicting parental behavior during feeding, instead of the other way around, is something that was found in some other studies as well. For example, in a large twin study in the UK, evidence was found for the influence of infant weight and infant appetite on parental feeding behavior (Fildes et al., 2015; Van Jaarsveld, Johnson, Llewellyn, & Wardle, 2010). It is noteworthy that the present study only found some support for the idea that infant behavior might influence maternal behavior, and none for the possible influence of maternal behavior on infant behavior during feeding. Many studies emphasize the path from parental to child behavior more than the other way around, but this study underlines the importance of taking bi-directionality into account when studying feeding interactions.

Another less expected small negative cross-over effect was found from maternal sensitive feeding on Day 1 to infant vegetable intake on Day 2. However, because this negative association, contrary to the significant effects in all other models, was entirely absent without covariate correction and absent in correlations with the three single components of our sensitive feeding construct, it is likely to be a spurious effect and too unstable to interpret. The other cross-overs that were tested were not significant. To be able to study possible cross-over effects more extensively, future studies might include more feeding interactions than just two, possibly leaving some more time in between. Another possibility is studying the interaction in even more detail, for example using a micro-coding system as described in the studies of Van Dijk and colleagues (Van Dijk et al., 2009, 2012; 2018). In those studies co-regulation during feeding was studied by coding all maternal and infant behavior using a time-series analysis technique, but sample sizes were small and no associations with child characteristics were examined.

With respect to the latent construct sensitive feeding, responsiveness to infant stop signals, general maternal sensitivity and maternal non-intrusiveness all fitted nicely into the overarching construct. High factor loadings on our construct of sensitive feeding underline that responsive feeding might involve more than is generally measured, and supports the suggestion that it might be better to broaden the construct to *sensitive* feeding (Van der Veek et al., 2019). Such a broader construct is more in line with Ainsworth's concept of parental sensitivity (Ainsworth et al., 1974) and entails responding to all kinds of child signals during the feed, which is likely needed to create a feeding situation where the child feels safe and understood in general and is even more equipped to form a positive association with family mealtimes and (healthy) food.

Strengths and limitations

Strengths of the present study include the focus on the first bites of solid food, studying bidirectional relationships, and the use of video observations. With respect to the latter, most studies use self-report measures to assess parental feeding behaviors. However, video observations might capture parental behaviors that would not be captured by means of self-report measures, because self-reports may more readily measure what parents think they are doing or even what they think they should be doing (i.e. attitudes) than actual behavior (Hodges et al., 2013).

The present study has several limitations that should be mentioned as well. First, no conclusions on cause and effect can be drawn as we did not employ an experimental design. Second, the observations of Day 1 and Day 2 were coded by the same coder, for the purposes of the larger study. Although coding of the two days occurred with at least two months in between, the coder might have recognized some families when coding them for the second time, which may have inflated estimates of stability somewhat. Third,

infant vegetable liking was measured by means of mother-reports. It would have been useful to also have an observed measure of this concept. However, results of vegetable liking were quite similar to results of vegetable intake, suggesting the validity of the self-report measure of liking. In addition, generalizability of the results is somewhat limited because a) the study only concerned mothers, b) participants had to be willing to start complementary feeding with jarred purées, and c) the majority of our participants was Caucasian and highly educated. Future studies should aim to include a more diverse sample (e.g., fathers, more families with a lower socioeconomic status).

Conclusion

In conclusion, the present study observed interactions in the earliest phase of complementary feeding. Results show at least some stability of all measured constructs of both mother and child behavior from the first to the second feed. In addition, sensitive and positive maternal feeding behavior was found to be positively associated with both infant vegetable intake and liking, mostly during the second feed, suggesting increased synchronization of the dyad. Finally, infant vegetable liking was found to predict maternal sensitive feeding from one day to the next. As such, our results point out that it is important to take bi-directionality into account when studying parent-infant interactions during feeding, and not to merely assume that parental behavior will influence child behavior. Future research should further explore whether and how feeding experiences of both parent and infant mutually reinforce each other during this first phase of complementary feeding and if this actually affects child eating behavior in the long run, for example by observing repeatedly and for a longer period of time, or by using micro-coding. Such insights are relevant for prevention efforts trying to improve maternal sensitive feeding, because these will only be effective if maternal sensitive feeding indeed positively influences child eating behavior. When positive experiences are created during the very beginning, they are likely to set the tone for future feeding interactions, enabling children to develop healthy eating habits and behaviors.

4

Chapter 4

Maternal sensitivity during mealtime and free play: Differences and explanatory factors

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Abstract

Mealtime is a parent-toddler interaction that occurs multiple times a day. This study examined whether observed maternal sensitivity differed between a mealtime and free-play setting, aiming to explain differences between the two situations by studying moderating effects of children's eating behavior. The sample consisted of 103 first-time mothers and their 18-month-old children. Maternal sensitivity was assessed by coding videotaped interactions of free-play sessions and mealtimes, using the Ainsworth Sensitivity Scale (range 1-9). Additionally, child eating behavior during the meal was coded, and also assessed through the Child Eating Behavior Questionnaire - Toddlers. First, a small but significant amount of stability was found between sensitivity during mealtime and sensitivity during play (r = .24). Second, mothers were more sensitive during free play (Mean=7.11) than during mealtime (Mean=6.52). Third, observed child eating behavior was related to maternal sensitivity during mealtime, with more food enjoyment being associated with higher levels of sensitivity, and more challenging child behavior with lower levels of sensitivity. Finally, when children showed a high degree of challenging behavior during the meal, there was more discrepancy between sensitivity during mealtime and free play. Our results highlight the importance of taking context into account when observing parental sensitivity.

Introduction

Parental sensitivity, or the ability to perceive a child's signals, to interpret these signals correctly, and to respond to them promptly and adequately, is an important indicator of the quality of parent-child interaction (Ainsworth et al., 1974). Parental sensitivity has been shown to be related to positive child outcomes in several domains (Bakermans-Kranenburg et al., 2003; De Wolff & Van IJzendoorn, 1997; Kochanska, 2002; Van IJzendoorn, Vereijken, Bakermans-Kranenburg, & Riksen-Walraven, 2004), and interventions that increase parental sensitivity improve parent-child attachment (Bakermans-Kranenburg et al., 2003; Juffer et al., 2017). However, the expression and degree of parental sensitivity can be situation-dependent (Branger, Emmen, Woudstra, Alink, & Mesman, 2019; Costanzo & Woody, 1985; Joosen, Mesman, Bakermans-Kranenburg, & van IJzendoorn, 2012; Seifer, Sameroff, Anagnostopolou, & Elias, 1992). Indeed, parents appear to vary more in their level of sensitivity across different situations (e.g., free play vs. caregiving situations) than across time within the same situation (Bornstein, et al., 2006; Branger et al., 2019; Braungart-Rieker et al., 2014; Endendijk et al., 2019; Mills-Koonce et al., 2007).

There is one specific parenting situation that has received surprisingly little attention throughout the literature on parental sensitivity, and this concerns mealtime interactions. Although the related but narrower construct of responsive feeding behavior, which involves responding sensitively to a child's hunger and satiety cues during a meal, has frequently been studied within the field of child nutrition (Black & Aboud, 2011; DiSantis et al., 2011; Hurley et al., 2011), parental sensitivity to all child signals during mealtime has not. Moreover, in the general parenting field, mealtimes have rarely been studied in comparison to other parenting situations. One study with 2-30 month-old African American children examined maternal nurturance during mealtime and free play, which included for example enthusiasm, initiative towards the child, and verbalization. This behavior was found to correlate moderately between mealtime and free play (Black et al., 1996).

Mealtime is an important part of daily parent-child interaction and can be quite challenging for parents. Indeed, earlier studies show that 25-40% of parents report feeding problems with their infants and toddlers (Mitchell et al., 2013; Reau et al., 1996). Therefore, it is plausible that levels of parental sensitivity are lower during mealtime than during other parenting situations. Because the few studies that have examined parental sensitivity during mealtime found lower sensitivity to be associated with overweight in (pre)school-aged children (Camfferman, 2017; Rhee et al., 2016), it is important to know whether such lower levels of sensitivity are already present at an earlier age, and what factors might contribute to lowered sensitivity in this specific context. The present study aims to examine differences in observed maternal sensitivity towards 18-month-

old children during mealtime and free play, to explain possible differences between the two situations by examining child eating behavior, and to examine the relation between maternal sensitivity during mealtime and child eating behavior.

Having a meal with your child might be a lot more challenging than interacting in different situations, like (watching them) play, evoking different expectations and behavior in both parent and child. During a meal, parents often have certain goals related to the child's food intake, as well as routines and rules they expect their child to follow. Such goals and expectations may easily lead to conflict situations where the child's behavior differs from the parents' wishes. To date, only a few studies have been published that assessed parental sensitivity during mealtime, and even fewer compared sensitive parenting during mealtime to other parenting situations. One study with 4-month-old children compared maternal sensitivity during feeding to a bathing session, and indeed observed less responsive and more negative maternal behavior during feeding than during bathing (Seifer et al., 1992). The study of Black and colleagues on maternal nurturance only examined the association between mealtime and play, rather than the difference between the two situations (Black et al., 1996). Other studies comparing parental sensitivity across different settings did not include mealtimes, and all focused on babies in the first six months of life (Branger et al., 2019; Joosen et al., 2012; Maas, Vreeswijk, & Van Bakel, 2013). Studies conducted in toddlerhood are still lacking, as well as studies comparing mealtime to free play.

Because of their clear (health-related) goals, mealtimes may evoke more conflict situations between parent and child than play situations, thereby making it more challenging to show sensitive responses. Moreover, the way children behave during mealtime (i.e. child eating behavior) might either further complicate or simplify the situation for a parent. Indeed, many studies have emphasized the transactional nature of parent-child interactions in general, whereby the actions of each party are dependent on the perceptions and actions of the other (e.g. Crnic & Greenberg, 1985; Sameroff, 2009). This transactional pattern is also very relevant for mealtimes, as from the second year of life onwards, parents often start experiencing more difficulties with their child during mealtimes due to the growing need for autonomy in most children, as well as the emergence of picky or fussy eating behavior (Dovey et al., 2008). Picky or fussy eating behavior occurs in many children between 1 and 6 years of age. It often peaks during toddlerhood, when the food neophobia phase, or the unwillingness to try new foods that is considered an integral part of fussy eating behavior, emerges (Dovey et al., 2008; Taylor et al., 2015). In contrast to parents of children who eagerly and easily respond to food and generally enjoy eating, parents of so-called "fussy eaters" have more conflicts with their children during mealtimes and use more pressure or coercion to increase their child's food intake (Galloway et al., 2005; Jacobi et al., 2003; Mascola et al., 2010; Ventura & Birch, 2008).

Although there are many studies on the relation between challenging child eating behavior like fussiness and *in*sensitive feeding behavior like pressuring, few studies have examined its relation with parental sensitivity. One study showed a non-significant trend concerning a negative association between maternal sensitivity at 10 months and challenges around child eating at 10 months and 2 years (Hagekull, Bohlin, & Rydell, 1997). Another study showed a reciprocal relation between maternal sensitivity and challenges around child eating, with a negative association between maternal sensitivity at 3 months and challenges around child eating at 18 months, as well as between child problems with milk feeding at 3 months and maternal sensitivity at 3 and 18 months (Bilgin & Wolke, 2017). These studies suggest that more challenges around child eating are indeed related to lower levels of maternal sensitivity, possibly in a reciprocal way. However, these two studies assessed maternal sensitivity during play sessions rather than mealtimes. Studies assessing challenges around child eating and their relation to maternal sensitivity during mealtimes are still lacking. Because the onset of fussy food-related behavior often lies in early toddlerhood, it is important to study the relation between parental sensitivity and child eating behavior in this age group. Moreover, it is likely that child eating behavior not only directly relates to the level of parental sensitivity during a meal, but it may also explain differences between mealtime sensitivity and play sensitivity. After all, it is plausible that mothers of children who show more challenging behavior during mealtime respond less sensitively during mealtimes than during free play, thereby increasing the discrepancy in sensitivity between the two situations.

The aim of the present study is to examine differences in maternal sensitive behavior between a mealtime and free-play situation when the child is 18 months old, as well as study child eating behavior as a potential explanation for such differences. First, based on earlier studies on sensitivity between contexts, we expect maternal sensitivity during mealtime and free play to be moderately positively correlated. Second, we hypothesize that less maternal sensitivity will be observed during mealtime than during free play. Third, we expect to find a positive association between positive child eating behavior (enjoyment of food) and maternal sensitivity at mealtime, and a negative association between challenging child eating behavior (food fussiness) and maternal sensitivity at mealtime. Finally, we hypothesize that child eating behavior moderates the difference in maternal sensitivity between mealtimes and free play, with higher levels of child food fussiness and lower levels of enjoyment of food related to lower levels of sensitivity during mealtimes compared to free play.

Method

Participants

The present study is part of a large longitudinal randomized controlled trial called Baby's First Bites, in which the effects of two different interventions (one focusing on vegetable exposure, the other on sensitive feeding) are evaluated separately and combined in order to enhance vegetable intake in infants and toddlers (Van der Veek et al., 2019). The overarching study included 246 mothers and their infant at baseline (4-6 months), and 213 at age 18 months. Because the sensitive feeding intervention was effective in enhancing maternal sensitive feeding behavior at age 18 months (Van Vliet et al., 2022), including these participants in the present study might bias the findings concerning differences between sensitivity during mealtime and sensitivity during free play. Therefore, in the present study the mothers who received an intervention focusing on sensitive feeding were excluded, resulting in a sample of 105 first-time mothers and their infant at 18 months. Families who received an intervention focusing on repeated exposure to vegetables were included, because this intervention was not expected to influence maternal sensitivity. Study condition was included as a covariate to ensure that the intervention on vegetable exposure was not a factor in the results. For two dyads no observational data were collected, resulting in a total sample of 103 dyads included in the present study. Mean age of the mothers was 32.5 years (*SD* = 4.7; comparable to first-time mothers in the general Dutch population), mean age of the children (48% boys) was 18.5 months (*SD* = 0.6). 86% of the mothers had a Dutch ethnic background, and 92% of the mothers lived together with a partner, who was the child's biological father for 98% of these families. With respect to highest achieved educational level, 39% of the mothers had a lower educational level (finished high school or vocational school), 41% finished a degree comparable to a bachelor's degree and 20% obtained a master's degree.

Procedure

The present study was conducted according to guidelines laid down in the Declaration of Helsinki, with written informed consent obtained before any data was collected. All procedures involving the participants in this study were approved by the Ethics Review Board of the Institute of Education and Child Studies, Leiden University (ECPW-2015/116), as well as by the Medical Research Ethics Committee of Wageningen University and Research (NL54422.081.15). For the present study, data collected during the post-test of the RCT at 18 months of age was used. Participants for the RCT were recruited from the general population in the four Dutch provinces nearby the two participating universities. Information about the RCT was sent to potential participants by email, using email addresses obtained from Nutricia Early Life Nutrition (a company focussing on nutrition during the first years of life) and WIJ Special Media (a company focusing on pregnancy and the first years of life in general). In addition, only within the vicinity of Wageningen,

brochures were handed out at youth health care centres. The following inclusion criteria had to be met for the overarching RCT: first-time mothers; healthy term infants (37-42 weeks of gestation); planning to start complementary feeding at child age of 4-6 months; sufficient knowledge of the Dutch language; willing to start complementary feeding with commercially available vegetable/fruit purées; willing to be videotaped. Mothers with major psychiatric diagnoses were excluded, as well as twins or children with medical problems that could influence their ability to eat. Further details about how participants were recruited can be found in the study protocol (Van der Veek et al., 2019). Interventions tested in the overarching RCT started when infants were between 4-6 months old, and contained five sessions divided over the course of approximately 1 year. After the final session had taken place when the infants were around 16 months old, the post-test measurement took place around 18 months. Prior to this home visit, all mothers filled out online questionnaires. During the home visit, among other tasks, a family meal was videotaped. The family was asked to prepare a warm meal that they would normally choose to cook on that particular week day, and that was already familiar to the child. In addition, the family was instructed to behave like they would usually do. As soon as the camera was installed, the researcher left the room and returned when the meal was finished. Afterwards, an 8-minute free-play observation was conducted. For this free-play interaction, mother and child received a set of four standardized age-appropriate toys (a car slide, a puzzle, a book, and wooden fruits that could be cut in half), and mothers again were instructed to behave as they would normally do. After the home visit, mothers received a gift voucher of €25 and the child received a small present.

Measures

Maternal sensitivity

To rate maternal sensitivity towards all expressed child behavior during mealtime and free play, the Ainsworth sensitivity scale was used (Ainsworth et al., 1974). This scale is a general rating scale of parental sensitivity which can be used to code sensitivity during any type of parent-child interaction (Ainsworth et al., 1974). As such, we applied it in the same way to code both mealtime and free play. Mothers were scored on the original 9-point scale, ranging from highly insensitive (1) to highly sensitive (9). The highly sensitive mother (9) "virtually always responds sensitively, with any lapses being small and extremely rare", while the highly insensitive mother (1) "responds insensitively almost all of the time, with sensitive responses being extremely rare or absent, gearing almost exclusively to his/her own wishes, moods, and activity" (Ainsworth et al., 1974). Examples of maternal insensitive behavior are not responding to infant signals of distress (serious lapses), or not responding to infant vocalizations or interest in surroundings (mild lapses). Regarding mealtimes, feeding interactions were taped and coded from the beginning of the feed (first spoon offer of the meal) until the end (final spoon offer of the meal) to measure, among other maternal and child behaviors, maternal sensitivity. In case the

child was offered dessert after the meal, this was not coded. With respect to free play, coding started as soon as the mother received a bag with age-appropriate toys, and ended after 8 minutes. Regarding mealtimes as well as free play, after intensive training, a reliability set of 30 videos was coded by all coders (4 coders for mealtimes, 3 other coders for free play). The training resulted in intercoder reliabilities (intraclass correlations (ICC), single rater, absolute agreement) of >.70 for all scales between all individual coders, which is considered good reliability (Cortina, 1993). Intercoder reliability ranged from .73-.87 for mealtimes, and .81-.88 for free play. Coders were not familiar with the family they were coding and were not aware of which condition the family was enrolled in in the overarching RCT.

Child eating behavior

Observation. Child eating behavior was observed by the same four coders who scored maternal sensitivity during the meal. Two types of child behavior were coded, namely Enjoyment of food, and Challenging behavior. The Enjoyment of food scale was designed by the authors, and was rated on a 3-point scale ranging from 1 (= no enjoyment/neutral attitude towards the food) to 3 (a high amount of enjoyment towards the food). Scores of 2 were given to children who for example enjoyed part of the mealtime or part of the food on the plate. Examples of food enjoyment that were coded were the child saying "yummy" or "mmmm", or the child eating in an eager and enthusiastic way (e.g. opening the mouth widely in response to the food throughout the meal, or eagerly self-feeding). Intercoder reliability ranged from ICC = .83-.89. The Challenging behavior scale was based on a similar scale as designed by Camfferman and colleagues (Camfferman, 2017), and included all kinds of child behavior that could be *perceived* as challenging by the mother. Challenging behavior was scored on a 5-point scale ranging from 1 (no/negligible challenging behavior) to 5 (prominent challenging behavior). Examples of challenging behavior during the meal concern mild/innocent child behaviors such as unintentionally dropping something on the floor, making funny noises or messy eating, or more pronounced child behaviors, such as crying, intentionally throwing with food or cutlery or temper-tantrums. Intercoder reliability ranged from ICC = .79-.85.

Mother-report. Mother-reported child eating behavior was assessed with the Child Eating Behavior Questionnaire-Toddler (CEBQ-T, based on the widely used instrument CEBQ (Wardle et al., 2001)). The CEBQ-T has the same content as the CEBQ, but with some small adaptations to make the instrument more applicable for toddlers. The CEBQ-T assesses several aspects of eating behavior, including two scales used in the present study: Enjoyment of food, and Food fussiness. Mothers reported on a 5-point Likert scale (from "1 = never" to "5 = always") how frequently they observed eating behavior characteristics on a typical day. Enjoyment of food captures an infant's perceived liking of food in general and the extent of pleasure experienced while feeding (e.g. "My child enjoys feeding time").

Food fussiness measures a child's tendency to be highly selective in the foods he or she is willing to eat, as well as the tendency to refuse to try new food items (e.g. "My child decides that he/she does not like a food, even without tasting it"). Regarding the original CEBQ, earlier studies found adequate two-week test-retest reliability (correlation coefficients ranging from .52 to .87 (Wardle et al., 2001)) as well as construct validity (Carnell & Wardle, 2007). In the present study, the internal consistency for the Enjoyment and Fussiness scales of the CEBQ-T were α = .85 and α = .90, respectively.

Statistical analysis

Analyses were performed using SPSS version 25. In every analysis, condition (1 = vegetable intervention, 2 = control) was added as a covariate, to control for possible effects of the intervention with exposure to vegetables. To test whether a positive correlation was present between free play and mealtime (Hypothesis 1), Pearson's partial correlations (controlling for study condition) were performed. In order to test whether less maternal sensitivity would be observed during mealtimes than during free play (Hypothesis 2), mean level differences were assessed by means of repeated measures ANOVA. Next to condition, breastfeeding duration and child BMI-z score (i.e. a standardized indicator of child weight) were considered relevant covariates, but because no relations were found with any of the core variables, breastfeeding and child BMI-z were not included as covariates. Cohen's *d* effect size was obtained and reported regarding the mean difference between situations (Cohen, 1992). Values of .20, .50 and .80 were considered a small, moderate and large effect, respectively (Cohen, 1992).

To test whether (observed and mother-reported) enjoyment of food and maternal sensitivity were positively related, and whether mother-reported food fussiness/observed challenging child behavior and maternal sensitivity were negatively related (Hypothesis 3), a multiple regression analysis was performed. Child sex, age, maternal age, maternal education, breastfeeding duration, maternal BMI and child BMI-z were explored as potential covariates by means of Pearson's correlations. Because mother-reported child fussiness significantly correlated with child age and maternal age and because observed food enjoyment marginally significantly correlated with child BMI-z, analyses were performed correcting for condition, child age, child BMI-z and maternal age, by entering them together in the first block. In the second block, the four child eating behavior predictors were entered together with the covariates. If applicable, the final regression model only consisted of predictors significantly adding variance to the model.

Finally, to test whether child eating behavior moderated the difference between maternal sensitivity during free play and during mealtimes (Hypothesis 4), another repeated measures ANOVA analysis was performed, by examining the interaction between "setting" (mealtime or free play) and the moderators mother-reported enjoyment, mother-reported

fussiness, observed enjoyment, and observed challenging behavior during the meal, which were all tested simultaneously. Regarding covariates, the same approach was taken as for Hypothesis 1, so only condition was included as a covariate.

Results

Descriptive statistics of core variables and correlations among core variables are depicted in Table 1 and Table 2, respectively. Six mothers who were observed during mealtime and free play did not fill out online questionnaires, resulting in a missing score on mother-reported child behavior. Outliers (*SD* ± 3.29 around the mean) were detected for all variables except observed child eating behavior. However, because none of the assumptions of repeated measures ANOVA or multiple regression analysis were violated and these outliers contain valuable information, they were included in the analyses.

Table 1. Descriptive statistics of maternal sensitivity and child eating behavior.

Variable			
	N	M (*SD*)	Range
Maternal sensitivity – Free play	103	7.11 (*1.30*)	1-9
Maternal sensitivity – Mealtime	103	6.52 (*1.74*)	1-9
Mother-report – child food enjoyment	97	4.11 (*0.61*)	1.75-5
Mother-report – child food fussiness	97	2.49 (*0.52*)	1-4.33
Observed child food enjoyment	103	1.98 (*0.78*)	1-3
Observed child challenging behavior	103	2.26 (*1.13*)	1-5

Table 2. Pearson's correlations of maternal sensitivity and child eating behavior.

Variable	1.	2.	3.	4.	5.	6.
1. Maternal sensitivity – Free play	-					
2. Maternal sensitivity – Mealtime	.24*	-				
3. Mother-report – Enjoyment of food	.09	.15	-			
4. Mother-report – Food fussiness	-.06	-.19	-.69**	-		
5. Observation – Enjoyment of food	.29**	.46**	.30**	-.20	-	
6. Observation – Challenging child behavior	-.09	-.41**	-.19	.30**	-.37**	-

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Observed maternal sensitivity during mealtime and free play

Corrected for study condition, a small to moderate significant positive partial correlation was found between maternal sensitivity during mealtime and maternal sensitivity during free play, $r = .24$, $p = .02$, confirming Hypothesis 1. The partial correlation was equal to

the uncorrected correlation. With respect to Hypothesis 2, corrected for condition, mean-level differences tested by means of repeated measures ANOVA revealed that observed maternal sensitivity was lower during mealtimes (M = 6.52; SD = 1.74) than during free play (M = 7.11; SD = 1.30), F = 8.29, p = .01, d = 0.38, confirming our hypothesis.

Relation between child eating behavior and maternal sensitivity during mealtimes

Regarding Hypothesis 3, results of the multiple regression analysis are depicted in Table 3. Statistical assumptions like homoscedasticity and absence of multicollinearity were checked, and no problems were revealed. The first block, containing covariates, did not significantly contribute to the prediction of maternal sensitivity during mealtimes (F = .165, p = .96), explaining 1% of the variance. The second block, adding the four predictors concerning child eating behavior, explained 34% of the variance in maternal sensitivity during mealtimes, on top of covariates (F = 4.98, p < .001; Table 3). When examining individual predictors, only the two observed child eating behavior measures significantly contributed to the model. Observed child enjoyment of food was positively related to maternal sensitivity during the meal, β = .423, t = 4.07, p < .001, and observed challenging child behavior was negatively related to maternal sensitivity during the meal, β = -.261, t = -2.49, p = .02. Examining the final model in which only the significant observed predictors were included, revealed that observed child eating behavior accounted for 29% of the variance (Table 3).

Table 3. MRA of child eating behaviors predicting maternal sensitivity during the meal.

	Model 1			Model 2			Model 3		
	B	*SE B*	*B*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Covariates									
Condition	-.03	.13	-.03	-.04	.11	-.04			
Child age	.12	.32	.04	-.04	.28	-.01			
Maternal age	.03	.04	.08	.06	.04	.17			
Child BMI-z	.06	.18	.04	-.06	.16	-.04			
Core predictors									
Mother-reported food enjoyment				.23	.40	.08			
Mother-reported food fussiness				.01	.47	.01			
Observed food enjoyment				.91	.22	.42**	.80	.20	.36**
Observed challenging behavior				-.40	.16	-.26*	-.43	.14	-.28**
Adjusted R^2 change		.01			.34**			.29**	
F for change in R^2		.17			9.73**			19.53**	

Note: Model 3 is a parsimonious model, testing only significant main predictors
*p < .05. **p < .01.

Moderating effects of child eating behavior

The moderation hypotheses were partly supported. Observed challenging child behavior during mealtime significantly moderated the difference between observed maternal sensitivity during mealtime and free play, $F = 5.42$, $p = .022$, $\eta^2 = .06$. Aiken and West's (Aiken & West, 1991) method for plotting interactions with continuous data was used to illustrate the differences between children with low levels of challenging behavior (−1 SD) and those with high levels of challenging behavior (+1 SD; Figure 1). As depicted in Figure 1, when children showed a high amount of challenging behavior during the meal, there was more discrepancy between sensitivity during mealtime and during free play. However, when the levels of challenging behavior were lower, differences between maternal sensitivity during mealtime and free play were much smaller. Observed enjoyment of food, mother-reported enjoyment of food and mother-reported food fussiness did not significantly moderate the difference between maternal sensitivity during mealtime and free play.

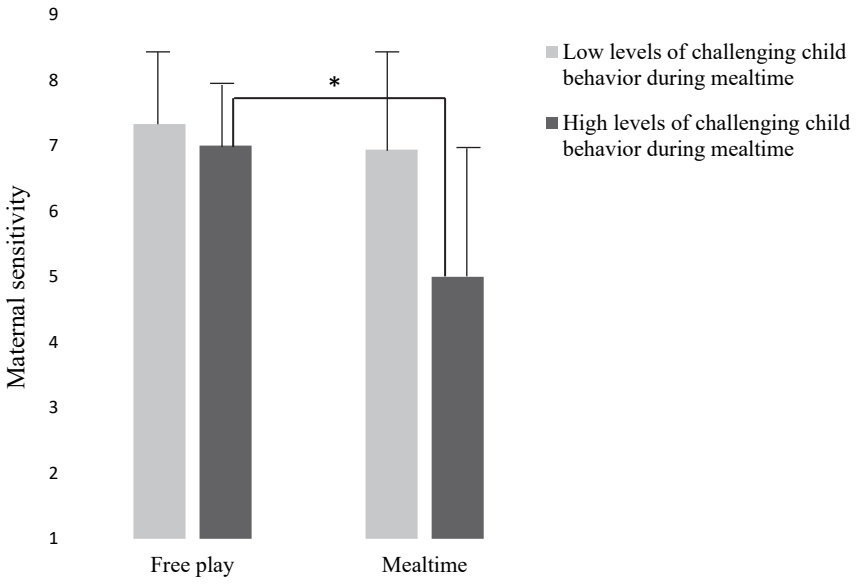

Figure 1. Moderating effect of observed challenging child behavior during mealtime.

Discussion

The present study examined maternal sensitivity towards their 18-month-old children during mealtime and free play. First, a small to moderate significant association was found between sensitive behavior during mealtime and free play, indicating a limited level of stability of maternal behavior between the two situations. Second, mothers showed more sensitive behavior towards their child during free play than during mealtime. Third,

observed but not mother-reported child behavior during the meal was related to maternal sensitive responses during mealtime, with more food enjoyment being associated with higher levels of sensitivity, and more challenging child behavior with lower levels of sensitivity. Finally, when children showed a high amount of challenging behavior during the meal, there was more discrepancy between sensitivity during mealtime and free play, which implies that challenging child behavior might impair sensitive responses during mealtime.

Maternal sensitivity was positively related across contexts, which is in line with the findings of Black and colleagues who studied the related construct 'maternal nurturance' across mealtime and play (Black et al., 1996), as well as with other studies examining maternal sensitivity in different settings (Branger et al., 2019; Braungart-Rieker et al., 2014; Mills-Koonce et al., 2007). However, in relation to the majority of comparisons made in other studies, the correlation was relatively low. This low degree of stability suggests that mealtime to a certain extent elicits different maternal behavior compared to free play. In addition, also in line with our expectation, maternal sensitivity was found to be lower during mealtime than during free play. As argued earlier, an explanation for this discrepancy might be that mealtimes are generally more demanding situations for parents compared to free play, which might be because they feel more is 'at stake' (wanting the child to eat healthily), because they feel obliged to feed their child in a certain way, based on beliefs and influences through their surroundings and culture, or because they are being confronted with more challenging child behavior. In our study, we found the way children behaved during the meal to be associated with maternal sensitivity during that same meal. Mothers responded more sensitively to children who showed more food enjoyment, and less sensitively to children who showed higher levels of challenging behavior during the meal. This is in line with other studies that found more difficulties around child eating to be related to more *in*sensitive feeding practices, although none of these studies used observational data to measure either eating behavior or parental feeding behavior (Galloway et al., 2005; Jacobi et al., 2003; Jansen et al., 2017; Mascola et al., 2010).

Whereas observed maternal sensitivity during mealtime was associated with *observed* child eating behavior, it was not associated with *mother-reported* child eating behavior. The observation of eating behavior concerned one specific situation, while the mother-report concerned the way the parent would generally describe the child's eating behavior. Moreover, the mother's perspective in general might deviate from the observers' perspective. Another explanation might be that parents adapt their behavior to the situation they are currently dealing with, rather than to more generally perceived characteristics of their child's eating behavior. Studies that did find significant associations with mother-reported child eating problems, solely studied *in*sensitive feeding practices

such as pressure to eat (Galloway et al., 2005; Jansen et al., 2017; Mascola et al., 2010). However, we did find a marginally significant association between mother-reported fussiness and sensitivity during mealtime (p = .07). An explanation for not finding larger associations similar to those in studies involving pressure to eat might be that pressuring a child to eat is more directly related to fussy child behavior than parental sensitivity, which incorporates broader parenting behavior than pressure to eat. Finally, it is possible that at least part of the relation between observed child behavior and observed maternal sensitivity can be explained by so-called *observer bias*. Parent and child behavior were coded by the same person and always in the same order (parent behavior first when watching the video for the first time; followed by child behavior when watching the video for the second time). Therefore we cannot rule out the possibility that the parental behavior the coder observed may have influenced the way the behavior of the child was coded, potentially somewhat inflating the relation.

In line with the finding described above, only observed challenging child behavior during the meal moderated the difference between maternal sensitivity during mealtime and free play, and mother-reported child eating behavior (i.e., perceived food enjoyment and food fussiness in general) did not. However, in contrast to observed challenging behavior, child enjoyment during the meal did not explain the difference in maternal sensitivity during mealtime and free play. This might be explained by the fact that observed food enjoyment was not only positively associated with sensitivity during mealtime, but also with sensitivity during free play. This in turn suggests that expressed enjoyment during the meal may more readily reflect the child's general affect or character in terms of expressiveness and joy, while challenging child behavior was more specific to the mealtime situation. Future studies may include more context-specific as well as general moderators (e.g., child temperament) when explaining differences in parental sensitivity across contexts. In addition, it would be relevant to learn more about the implications of the discrepancy in sensitive behavior during mealtime and free play for child development. Future studies might aim to replicate this finding, as well as investigate associations with several child outcomes. For example, it would be relevant to see how sensitivity during mealtimes in early childhood relates to a child's emotional development, compared to sensitivity during free play or other contexts, to learn more about the relative importance of sensitive behavior during several specific parenting situations. Moreover, previous studies show that inconsistent parenting is associated with psychological problems in children (Dwairy, 2009; Halgunseth, Perkins, Lippold, & Nix 2013; Kassing, Lochman, & Glenn, 2018). However, these studies often concern adolescents rather than young children, parental discipline styles rather than sensitive behavior, and inconsistency between parents rather than within parents across contexts. Therefore, it would be highly relevant to study the impact of inconsistent sensitive behavior towards young children across situations. Suggestions made above could contribute to theories on parent-

child interaction, child feeding, or to clinical recommendations related either to typical development or to concerns about feeding problems.

Finally, it should be noted that it is likely that the relation between child eating behavior and parental behavior is bidirectional. Parents may adapt their responses to expressed child behavior, and children may adapt their behavior to parental sensitive responding. In our study, challenging child behavior during the meal moderated the difference in sensitivity during mealtime and free play. This relation can also be interpreted in a bidirectional way. For example, if maternal behavior is highly discrepant between two situations, this might cause children to perceive the situation where the mother is less sensitive as unsafe or unpleasant, which in turn might cause the child to show more difficult behavior throughout that specific interaction. However, the direction of effects assumed in this paper, in which challenging child behavior during the meal might have decreased maternal sensitivity, is also highly plausible and supported by previous studies. Indeed, earlier studies have demonstrated that parents adapt their behaviors depending on variable child characteristics such as mood or behavior (Hudson, Doyle, & Gar, 2009; Lee & Bates, 1985; Russell, 1997). With respect to feeding, a recent longitudinal study performing prospective analyses showed that parents adapted their feeding behavior in response to child food fussiness (Jansen et al., 2017). To inform health care professionals and to better support families, future studies of parent-child interactions should continue to unravel the issue of "who influences whom".

Although the present study extends our knowledge on differential expression of maternal sensitivity across situations, several limitations should be mentioned. First, as mentioned earlier, mother and child behavior during the meal were coded by the same coder, which may have inflated the relation between observed mother and child behavior. Second, we did not observe food fussy behavior as a distinct construct, but observed child challenging behavior in a more general way. Therefore, we cannot conclude whether it is specifically fussiness with respect to food that challenges parents during the meal, or rather more general difficult behavior (or both). Third, we designed the observed measure of food enjoyment ourselves, and our observed measure of challenging child behavior was only used in one earlier study. However, both observed measures moderately correlated with child behavior reported by mother through the frequently used CEBQ, which pleads for the validity of our observed measure and which is in line with the moderate correlations between self-report and observation that are generally found in other studies (Fernandez et al., 2018; Morsbach & Prinz, 2006). Fourth, we solely focused on mothers, limiting generalizability to other caregivers. Fifth, we did not employ an experimental design and therefore cannot draw conclusions about causality. Finally, we did not observe child behavior during the free-play situation, so we could not examine this in relation to sensitivity during free play or as an explanatory factor in the same way we did with child

eating behavior. Future studies should aim to include multiple explanatory factors when studying the expression of parental behavior in different contexts, in order to inform (clinical) practice for the purpose of intervention programs.

In summary, the present study demonstrated that mothers are less sensitive during mealtime than during free play, which was partly explained by the degree of challenging child behavior during the meal. This implies that parent as well as child behavior can be context specific, and that parents may show other strategies in one context compared to another. Therefore, it is important for researchers as well as practitioners to take context into account when observing parental sensitivity. It is essential to be aware that an observation of parental behavior in a certain context is not entirely generalizable to parental behavior in another context, let alone to the general quality of parental behavior. Indeed, others have already plead for examining parenting practices in a context-specific way, in order to increase ecological validity and maintain a closer alignment with daily parent-child interaction (Sorkhabi & Middaugh, 2018). To optimize assessments of parent-child interaction that reflect a variety of daily family life situations, it is necessary to include diverse situations. Daily family life with young children is dynamic, and different situations evoke different behavior in both parents and children. When children show challenging behavior in a certain situation, it is harder for parents to respond in a sensitive way, complicating the interaction for both parent and child. It is important to increase awareness in professionals as well as parents that certain daily life situations are more challenging than others, and that parents can always ask for assistance if needed. In the meantime, more knowledge on differential expression of parent-child interaction across situations is needed to better understand parent-child dynamics, as well as to be able to more effectively support parents in the upbringing of their children.

5

Chapter 5

The Baby's First Bites RCT: Evaluating a vegetable-exposure and a sensitive-feeding intervention in terms of child health outcomes and maternal feeding behavior during toddlerhood

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Abstract

Background. Parenting interventions during the first years of life on *what* and/or *how* to feed infants during complementary feeding (CF) may promote healthy eating habits. **Objective.** An intervention promoting repeated exposure to a variety of vegetables (RVE; *what*) and an intervention promoting to respond sensitively to child signals during mealtime (VIPP-FI; *how*) were compared, separately and combined (COMBI), to an attention control condition (AC). Primary outcomes were vegetable consumption and self-regulation of energy intake; secondary outcomes were child anthropometrics and maternal feeding practices (sensitive feeding, pressure to eat). **Methods.** Our four-arm randomized controlled trial included 246 first-time Dutch mothers and their infants. Interventions started when infants were 4-6 months old and ended at age 16 months. The present study evaluated effects at 18 (t18) and 24 (t24) months of age. Vegetable acceptance was assessed using three 24h dietary recalls, self-regulation of energy intake by an eating-in-the-absence-of-hunger experiment and mother-report, and maternal feeding behavior by observation and mother-report. **Results.** Linear Mixed Model and ANOVA analyses revealed no follow-up group differences regarding child vegetable intake or self-regulatory behavior. The proportion of children with overweight was significantly lower in the COMBI group, compared to the VIPP-FI group at t18 (2% vs. 16%), and AC group at t24 (7 vs. 20%), although this finding needs to be interpreted cautiously due to the small number of infants with overweight and non-significant effects on the continuous BMI-z measure (*p*-values .29-.82). Finally, more sensitive feeding behavior and less pressure to eat was found in the VIPP-FI and COMBI groups, compared to the RVE and AC group, mostly at t18 (significant effect sizes: $d = .23$-$.64$). **Conclusion.** Interventions were not effective in increasing vegetable intake or self-regulation of energy intake. Future research might do well to focus on risk groups such as families who already experience problems around feeding.

Introduction

Adults with overweight or obesity have a higher risk of developing type II diabetes, cardiovascular disease and certain cancers (Carter, Gray, Troughton, Khunti, & Davies, 2010; Rotteveel et al., 2010; Sinha et al., 2002). Because overweight in childhood is predictive of overweight in adulthood, promoting healthy eating habits such as sufficient vegetable consumption (Aune et al., 2017; Barends et al., 2019) and self-regulation of energy intake (i.e. the ability to act on one's feelings of hunger and satiety; (Fox et al., 2006; Reigh, Rolls, Savage, Johnson, & Keller, 2020)) from an early age onwards is crucial (Whitaker et al., 1997; Williams, Mesidor, Winters, Dubbert, & Wyatt, 2015). Since parents largely determine *what* and *how* children are fed in the first years of life, early interventions focussing on parental feeding strategies during the transitional period of complementary feeding (CF) seem a promising way to foster healthy eating habits from the very beginning. To promote vegetable consumption (the "*What"* of CF), repeatedly exposing infants to a variety of vegetables is found to be an effective method (Ahern, Caton, Blundell, & Hetherington, 2014; Barends et al., 2019; Maier et al., 2007). To foster self-regulation of energy intake and thereby reduce the risk of developing overweight (DiSantis et al., 2011; Hurley et al., 2011), promoting parental responsive feeding behavior (the "*How"* of CF) is thought to be important, as responsively feeding parents adequately respond to infant hunger and satiety cues and do not pressure infants to eat beyond satiation (DiSantis et al., 2011; Hurley et al., 2011). Moreover, although not previously studied, responsive feeding might have beneficial effects on vegetable intake as well. Experimental evidence shows that *non*-responsive feeding strategies such as pressuring a child to eat can have adverse effects on vegetable intake and can foster negative affective responses to foods (Galloway et al., 2006). In contrast, parents who feed in a responsive way allow their child to be in control of its food intake, thereby possibly contributing to more appreciation and intake of vegetables in the long run.

To date, two large RCTs showed that parenting interventions successfully promoted healthier child (dietary) outcomes (increased combined fruit and vegetable intake (Hohman, Paul, Birch, & Savage, 2017) and less rapid weight gain (Daniels et al., 2012; Savage et al., 2016)): the NOURISH and the INSIGHT trial (Daniels et al., 2009; Paul et al., 2014). In the NOURISH trial, mothers received twelve interactive group sessions divided over two modules, one at the start of complementary feeding (age 4-6 months), and one at the age of 13-16 months. The content of the intervention sessions concerned repeated exposure to healthy foods, avoiding unhealthy foods, responsive feeding, modelling, and avoidance of coercion or food rewards (Daniels et al., 2009). At 14 months, less rapid weight gain and lower BMI-z scores were found in the intervention group. Moreover, mothers reported less use of some nonresponsive feeding strategies (Daniels et al., 2012). Finally, when averaging data of 3.7 and 5 years, a greater combined fruit and vegetable

intake was reported for children in the intervention group. Effects on child BMI were no longer present on those time points. In the INSIGHT trial, four home visits took place at 3, 16, 28 and 40 weeks of age, where several topics on *what* (e.g. fruit and vegetables, water, and snacking), *when* (e.g. introducing solid food, introducing a cup or a spoon) and *how* (e.g. repeated exposure, hunger and fullness cues, avoiding pressure to eat, modelling, and family meals) were addressed (Paul et al., 2014). Moreover, advice was given on physical activity and sleeping behavior. At the age of 1 year, they did not find effects on vegetable intake, but did find children in the intervention group to show less rapid weight gain (Savage et al., 2016). Moreover, less non-responsive feeding practices were reported in the intervention group (Savage et al., 2018). Although both trials found some positive effects on dietary outcomes, no effects were found on vegetable intake alone. Moreover, (non-)responsive feeding behavior was assessed by self-report instead of observation, and therefore prone to social desirability. Finally, these interventions included many different elements on a broader level and included advice on the *what* and the *how* of CF simultaneously, making it impossible to determine the relative effect of these types of advice. Evaluating the effects of what, how and their combined effect within the same study allows for inferences about the efficacy of these different types of advice.

In the present study, a vegetable-exposure intervention promoting vegetable consumption (RVE; focusing on the "*what*") was compared to a parenting intervention to promote sensitive feeding behavior (VIPP-FI; focusing on the "*how*") (Van der Veek et al., 2019). Within an RCT design, the two interventions were administered separately as well as combined (COMBI), and were compared to an attention control condition (AC). The interventions started when children were offered their first bites of complementary foods (age 4-6 months; baseline t0) and lasted throughout the first year of CF, up until the age of 16 months. In the present paper, the effects of the interventions two months after completion when the age of the child is 18 months (t18) and at eight months follow-up when the age of the child is 24 months (t24) are evaluated. With respect to child outcomes, we hypothesized that a) all interventions (RVE, VIPP-FI, COMBI) are more effective in improving vegetable intake than the control condition; b) the sensitive-feeding and combined intervention are more effective in supporting self-regulation of energy intake and in reducing anthropometric indicators of obesity risk than the vegetable-exposure or control condition; and c) the combined intervention is more effective than the other two interventions alone in promoting vegetable intake. With respect to maternal outcomes, we hypothesized that d) the sensitive-feeding and combined intervention are more effective in promoting positive maternal feeding behavior than the vegetable exposure or control conditions.

Subjects and Methods

Participants

The Baby's First Bites study is a multicenter trial using a superiority randomized controlled design that was conducted from two study locations (Wageningen University and Research, and Leiden University) and carried out in four provinces (Zuid-Holland, Noord-Holland, Gelderland and Utrecht) in the Netherlands. Information regarding for example recruitment of participants and randomization can be found in the study protocol, as well as in the flow chart depicted in Supplemental Figure 1 (Van der Veek et al., 2019). As soon as parents decided to participate, written informed consent was obtained from both parents. The protocol was approved by the Ethical Review Board of Education and Child Studies, Leiden University (protocol number ECPW-2015/116) and the Medical Ethical Review Board of Wageningen University and Research (METC-WU protocol number NL54422.081.15). The trial was registered during inclusion of participants at the Netherlands National Trial Register (identifier NTR6572) and at ClinicalTrials.gov (NCT03348176).

A total of 246 mother-child pairs started the intervention phase. Participant characteristics are shown in Table 1. Parents received a small present for their child after each home visit, as well as a €25 gift voucher for each post intervention assessment.

Table 1. Baseline characteristics of 246 mother-child pairs allocated to intervention or control conditions.

	Mean ± SD or n [%]				
Variable	**Total (n=246)**	**RVE (n=61)**	**VIPP-FI (n=62)**	**COMBI (n=60)**	**CONTROL (n=63)**
Mother					
Education (uni degree)	47 (19.1%)	15 (24.6%)	12 (19.4%)	10 (16.7%)	10 (15.9%)
Age at baseline (y)	31.0 ± 4.7	30.3 ± 4.8	31.4 ± 4.5	30.6 ± 4.8	31.7 ± 4.6
BMI (kg/m^2) at baseline	27.1 ± 5.5	26.7 ± 5.2	27.1 ± 6.1	26.9 ± 5.3	27.5 ± 5.5
Child					
Sex (male)	117 (47.6%)	28 (45.9%)	29 (46.8%)	28 (46.7%)	32 (50.8%)
BMI-z at baseline[a]	-0.20 ± 0.10	-0.20 ± 0.92	-0.29 ± 1.11	-0.14 ± 1.04	-0.15 ± 0.91
Age at baseline (wks)	20.1 ± 3.9	20.5 ± 2.1	19.7 ± 7.2	20.0 ± 1.5	20.2 ± 1.9
Ever breastfed	189 (77%)	8.5 ± 8.6	8.0 ± 7.9	11.6 ± 8.4	7.0 ± 7.0

[a] World Health Organization Standards
RVE = Repeated Vegetable Exposure Intervention, VIPP-FI = Video Intervention to Promote Positive Parenting Feeding Infants intervention, COMBI = Combined condition of RVE and VIPP-FI, CONTROL = attention-control condition

Procedure

As soon as parents consented to participate, they received a short list of signals to help them decide whether their infant (aged 4-6 months) was ready to start complementary feeding (e.g. "child can stabilize head"; "child shows interest in food"). After they indicated their child was ready, they were asked to give their infant rice-flour porridge with a spoon for at least five days to familiarize the infant with eating from a spoon. Subsequently, all participants started with a 19-day feeding schedule as described in more detail elsewhere (Van der Veek et al., 2019), which specified one purée meal per day in addition to usual milk feeding. These feeding schedules were provided for the benefit of the RVE intervention. For standardization purposes commercially available jars of vegetable and fruit purées were provided. Home visits were performed by one of the researchers on days 1, 2, 18 and 19 to videotape the feeding interaction between mother and child, assess how much the child had eaten, and perform other measurements, such as mother and infant weight and height. On these four days all conditions received the same vegetable purées (green beans and cauliflower, in counterbalanced order). On day 3-17 of the feeding schedule, the mother fed her child the purées at home without the presence of the researchers. During the feeding schedule, we advised families not to offer other complementary food besides the prescribed purée.

Intervention sessions started concurrently with the feeding schedules. These interventions took place in five sessions over the course of a year, timed in accordance with major transitions in eating. Two sessions took place at child age 4-6 months and the other three at 8, 12 and 16 months. The focus of the RVE intervention was to motivate mothers to repeatedly expose their children to vegetables. The focus of the VIPP-FI intervention was to enhance maternal sensitive responses to her child during mealtimes. More detailed information about the development and content of the interventions can be found in the protocol paper (Van der Veek et al., 2019) and in Supplemental Table 1. At 18 as well as 24 months another home visit took place, which contained the same elements as the pretest home visit. Finally, about a week before each home visit, mothers were asked to fill out several questionnaires online (see (Van der Veek et al., 2019) for more detail).

Supplemental Table 1. Content of each of the RVE and VIPP-FI intervention sessions.

Session	Child age	RVE			VIPP-FI	
		Theme	Topics discussed	Optional information	Situation filmed	Topics discussed
1	4-6 m	Discovering vegetables	· Why should children learn to eat vegetables? · Keep offering, also if child rejects (at least 10 times)	· Benefits of eating vegetables · Development of taste in young children	Mother feeding infant pureed vegetables/fruits	Learn to observe and interpret child feeding cues (hunger, satiation, liking)
2	4-6 m	Keep on offering vegetables	· How long should I persist? (at least 10 times) · Daily variation, steady increase of portion size	· Tips about offering vegetables to children on a daily basis and the preparation of age appropriate vegetable meals	Mother feeding infant pureed vegetables/fruits	Five tips: Timing, routine, adequate pacing, stop at the right time, enjoy
3	8 m	Being creative with vegetables	· Increase level and variety of texture · Set a good example	· Additional information about introducing more lumpy foods to children. · Tips about preparing and storing age appropriate vegetable meals · Tips to cut costs	Child eating sandwich with mother; new topping on sandwich	What to do when infants a) want more autonomy during mealtimes and b) don't want to eat
4	13 m	Vegetables are part of a balanced diet	· Eating with the whole family · Recommendations for vegetable intake	· Achieving the recommended intake for vegetables	Dinner with whole family; child is served a new vegetable	Positive ways of dealing with negative behavior during dinner
5	16 m	Keep eating vegetables	· Inform parents on possible food neophobia phase, and how to respond	· Involving children in the preparation of vegetables	Dinner with whole family; child is served something new	Inform parents on possible food neophobia phase, and how to respond to that

Note. m=month

Outcome measures

Child measures

Primary outcome: Vegetable intake

For the duration of the 19-day feeding schedule that all families commenced with from the first bite onwards (age 4-6 months), the child's consumption of purée was assessed daily by weighing the amount eaten from the provided jars (125g per jar) on standard small kitchen scales (Soehnle, Fiesta 65106). Vegetable intake was assessed at t18 and t24, by asking mothers to fill out web-based 24-hour dietary recalls on three randomly assigned, non-consecutive days within a 3 week period using the online program Compl-eat (Meijboom et al., 2017). Compl-eat used the Dutch food composition database (NEVO) edition 2016/5.0 for the calculation of energy and nutrient intake and food grouping of vegetables. Pre-packaged foods or jars of baby food that were not yet available in the database were manually added by checking the product's package label. The dietary data were processed by trained dietitians, and in case of uncertainties participants were contacted via email or telephone to clarify their entry. More information on measuring vegetable intake is provided in the study protocol (Van der Veek et al., 2019).

For outcome measures where a logical cut-off could be determined, it was established whether a participant was unsuccessful (1) or successful (2) at this outcome measure (success rate). With respect to vegetable intake, a cut-off of 50 grams per day (Dutch daily recommended vegetable intake for children of this age) was used to determine if a child on average consumed enough vegetables or not, in order to compare the four study groups on this binary outcome.

Primary outcome: Self-regulation of energy-intake

Experimental task. Self-regulation of energy intake was assessed by an eating in the absence of hunger (EAH) experiment at t18. The procedure for measuring EAH was based on the free-access procedure for children aged 3-5 years old in a laboratory setting as described by Fisher and Birch (Fisher & Birch, 1999), and adapted for 18-month-old children in a home setting. The protocol for the present study and adaptations to the original procedure have recently been described elsewhere (Schultink et al., 2021). Parents were asked to prepare an evening meal for the child as usual and have dinner together as part of the daily routine. The type and amount of food the child consumed was carefully assessed by obtaining a detailed description of the meal, weighing all food and drinks and taking photographs before and after the meal. The data were processed by trained dietitians to obtain total energy content of the meal. This was followed by an eight-minute free-play session of mother and child after which the researcher provided the child with a plate of two savory (two breadsticks and a handful of potato snack sticks) and two sweet (one slice of gingerbread, and two plain biscuits) age-appropriate palatable finger foods (total 275 kcal) for ten minutes. If the child was allergic to a food or parents disapproved of

a food, an alternative was offered, which was the case for 24 children. Mothers remained in the room but were asked not to interfere with the child's behavior, so the child had the opportunity to continue playing with the toys or eat the provided foods without interference. Finger foods were weighed before and after the free access procedure and the weight was multiplied by the energy content of each individual food to determine respectively the total weight (grams) and energy (kcal) consumed by the child. To measure self-regulation, children's finger food intake in kcal, corrected for energy intake during the evening meal, was used in subsequent analyses. Because a cut-off score of finger food intake could not be determined based on theoretical or empirical grounds, no success rate was established for this measure.

Mother-report. Mothers were asked to fill out the Baby Eating Behavior Questionnaire (BEBQ; (Llewellyn et al., 2011)) before starting the feeding schedule, and the Child Eating Behavior Questionnaire – Toddler (CEBQ-T; (Herle et al., 2016)) prior to the home visits at t18 and t24. The BEBQ and CEBQ-T assess several aspects of child eating behavior, including food responsiveness (FR) and satiety responsiveness (SR). Mothers reported on a 5-point Likert scale (from "1= never" to "5= always") how frequently they observed their child demonstrate several eating behavior characteristics on a typical day (e.g., *If (s)he was allowed, my child would overeat* (FR)*; My child cannot eat a meal if (s)he has had a snack just before* (SR)). The FR and SR scales are used as indicators of the child's self-regulation of energy-intake, where scoring lower on FR and higher on SR indicates better self-regulation skills (Sleddens et al., 2008). The original CEBQ scale has been shown to have good internal consistency (Cronbach's alphas ranging from 0.72 to 0.91; (Wardle et al., 2001b)), adequate two-week test-retest reliability (correlation coefficients ranging from 0.52 to 0.87; (Wardle et al., 2001)), and adequate construct validity (Carnell & Wardle, 2007). In our sample, internal consistency ranged from $\alpha = 0.73$ (t0) to $\alpha = 0.80$ (t18/24) for Food Responsiveness, and $\alpha = 0.68$ (t0) to $\alpha = 0.81$ (t18/24) for Satiety Responsiveness. Because a cut-off score of FR and SR could not be determined based on theoretical or empirical grounds, no success rate was established for this measure.

Secondary outcome: Anthropometrics

Child bodyweight was measured during each follow-up assessment at home using a calibrated digital scale (SECA robusta 813), in kilograms to the nearest 0.1 kg. Up until t18 the child's height was measured on an infant measuring mat to the nearest 0.5 cm. At t24 children's height was measured with a portable stadiometer (SECA 213, Chino, USA/Garant). Body Mass Index (BMI) was calculated and transformed into age and sex-standardized z-scores (BMI-z) using reference values from the WHO child growth standards (2019) (WHO, 2019) and the following formula: $BMI\text{-}z=[(BMI/M)^{L}-1]/(L\times S)$ (Cole, Bellizzi, Flegal, & Dietz 2000). As reported in earlier studies (Ezzahir et al., 2005; Olsen et al., 2021), change in BMI-z was calculated (t0 to t18, t0 to t24 and t18 to t24) as a measure of weight

gain. To establish the success rate in each condition, a cut-off for BMI-z of 2 (upper limit for normal weight) was used (Organization, 2006).

Secondary outcome: Maternal feeding behavior

Observed feeding behavior. Maternal feeding behavior was observed during mother-child feeding interactions in the home setting. Feeding interactions of t0, t18 and t24 were videotaped and coded from the beginning of the feed (first spoon offer until the moment the mother decided to end the meal) to measure, among others, responsiveness-to-stop signals of the child, maternal sensitivity during feeding and pressure to eat. After intensive training, a reliability set of 30 videos was coded by four coders, yielding intercoder reliabilities (intraclass correlations, single rater, absolute agreement) of > .70 for all scales between all individual coders (Cortina, 1993). The coders were not familiar with the families in the videos they were allocated, nor aware of these families' group status (experimental vs control).

Responsiveness to stop signals. The Responsiveness-To-Stop-Signals scale was based on the responsiveness-to-child-fullness-cues scale as described in the Responsiveness-To-Child-Feeding-Cues Scale coding instrument (Hodges et al., 2013). Adaptations made to the original scale are described elsewhere (Van Vliet et al., 2021). The responsiveness of the mother was based on her response to the fullness cues expressed by the child, taking into account the frequency and intensity of child fullness cues prior to the mother's decision to stop the feed. Maternal responsiveness was scored on a 5-point scale, ranging from highly unresponsive (1) to highly responsive (5). In case this maternal behavior could not be observed, for example when the child finished all the food without showing any stop signals, or the mother restricted the child from finishing all the food, mother was given a score of 9 (not applicable). Interrater reliability was good to excellent (ICC^{t0} = .75 - .87; ICC^{t18} = .77 - .94; ICC^{t24} = .78 - .97). To establish the success rate in each condition, a cut-off of ≥4 (often or always responsive) was used.

Sensitivity. To rate maternal sensitivity towards all child behavior shown during the feed, the Ainsworth sensitivity scale was used (Ainsworth et al., 1974). Mothers were scored on the original 9-point scale, ranging from highly insensitive (1) to highly sensitive (9). Interrater reliability was good to excellent (ICC^{t0} = .73 - .85; ICC^{t18} = .79 - .87; ICC^{t24} = .78 - .93). To establish the success rate in each condition, a cut-off of ≥6 (high sensitivity scores indicating the absence of behaviors clearly out of tune with the child's signals) on the Ainsworth scale was used.

Pressure to eat. Our observed pressure to eat scale was adapted from the "received pressure to eat scale" as designed by Camfferman and colleagues (Camfferman, 2017). Pressure to eat was defined as any encouragement, either physically or verbally, by the mother to

make the child eat more, and was coded on a 5-point scale (1 = no pressure at all, 5 = extreme pressure). Extreme pressure to eat could be defined either in terms of quantity (pressure throughout the entire interaction) or in terms of intensity (e.g. force feeding the child). Pressure to eat was only coded at t18 and t24. Internal consistency was good (ICC^{t18} = .71 - .83; ICC^{t24} = .77 - .86). To establish the success rate in each condition, a cut-off of ≤2 (never, or rarely use of pressure to eat) was used.

Self-reported feeding behavior. The Infant Feeding Style Questionnaire (IFSQ, (Thompson et al., 2009)) was used to measure responsive feeding and pressure to eat. Mothers reported on a 5-point Likert scale varying from never (1) to always (5), and were asked which answer was most applicable to their situation.

Responsive feeding. The original IFSQ Responsive-Feeding scale consists of 6 to 8 items, depending on the age and the diet of the infant (milk only versus including solid food). However, because some items show overlap with concepts other than responsive feeding (e.g., modeling, or child behavior instead of maternal behavior), we decided to select the three items of this scale that clearly represent responsive feeding (i.e., *I let C decide how much s/he eats; I pay attention when C seems to be telling me that s/he is full or hungry; I allow C to eat when s/he is hungry*). Internal consistency of the adapted responsive feeding scale was rather low (α^{t0} = .48, α^{t18} = .47, α^{t24} = .46), which reflects the fact that these behaviors do not necessarily have to occur simultaneously, but all represent different manifestations of responsive feeding. To establish the success rate in each condition, a cut-off of ≥4 (often or always responsive) was used.

Pressure to eat. The original pressure to eat scale consists of 5 to 7 items, depending on the age and the diet of the infant (milk only versus including solid food). However, because for some items it was ambiguous whether parents actually meant to pressure their child to eat by performing this behavior (e.g., the item "adding rice flour to the bottle"), we decided to use only 4 items that clearly defined pressure to eat (i.e., *I try to get C to finish his/her food; If C seems full, I encourage him/her to finish his/her food anyway; I try to get C to eat even if not hungry; I insist to retry new food refused at same meal*). Internal consistency of the adapted pressure scale was highest at later time-points (α^{t0} = .58, α^{t18} = .73, α^{t24} = .66). To establish the success rate in each condition, a cut-off of ≤2 (never, or rarely use of pressure to eat) was used.

Covariates

At t0 a baseline structured interview was conducted. This interview consisted of questions about perinatal characteristics, family situation, and parental characteristics such as education, health, job status and income, marital situation and information about type of milk feeding (e.g., duration of breastfeeding). In addition, prior to the home visits at t0,

t18 and t24, all mothers filled out online questionnaires, for assessing covariates such as child temperament, child food neophobia, maternal depression, or changes in the family's situation compared to t0 (e.g. educational level, marital status). Child temperament was assessed by the Infant Behavior Questionnaire-Revised short form at baseline t0 (Putnam et al., 2014), and the Early Childhood Behavioral Questionnaire at t18 (Putnam et al., 2006). Child food neophobia was assessed by the Child Food Neophobia Scale (Pliner, 1994; Pliner & Hobden, 1992), and maternal depression by the Center for Epidemiologic

Studies Depression Scale (Radloff, 1977). Furthermore, because pressure to eat was not coded at t0 and the related construct of maternal intrusiveness was (by means of Ainsworth's Interference vs. Cooperation scale; (Ainsworth et al., 1974)), the latter was used as a covariate. A similar baseline correction was performed for the self-report measures of maternal feeding behavior, by using the baseline data concerning type of milk feeding as a covariate. Maternal height (t0) and bodyweight were measured at all time points and used to calculate BMI in kg/m^2. Finally, children's dietary intake was assessed at t18 and t24 using the same three 24-hour dietary recalls as for assessing vegetable intake. Energy intake was calculated per recall day and an average daily energy intake was calculated per child for t18 and t24 separately. The data collected on days that a child was sick were excluded, therefore the average daily energy intake was based on one (4.4%), two (15.1%) or three (80.5%) recall days.

Statistical analysis

Detailed information about the inclusion phase and retention from initial contact with potential participants to randomization, as well as justification of the sample size are described elsewhere (Van der Veek et al., 2019).

Linear mixed model analysis (LMM) was used to test if the interventions differentially affected outcome measures over time. Because LMM facilitates an intention-to-treat analysis, all participants with data on at least one time point (t0, t18 or t24) were included in the analyses. Therefore, imputations were not considered necessary. As no baseline group differences were detected on relevant covariates (Table 1), adjustment for covariates was not undertaken, unless considered necessary based on other grounds (e.g. baseline correction). The covariance structure was determined for each outcome measure separately, by choosing the structure with the optimal fit (i.e. lowest AIC value, (Ngo & Brand, 1997)). Within LMM, pairwise comparisons that were relevant for our hypotheses were performed, at t18 and t24 separately. No posthoc-adjustments were undertaken, because only hypotheses-driven comparisons were performed (Baron, Perrodeau, Boutron, & Ravaud, 2013; Freidlin, Korn, Gray, & Martin, 2008). Effects of condition, time, and their interaction (comparing all groups simultaneously over time), were analyzed and reported as well, and considered exploratory analyses.

With respect to vegetable intake, a square root transformation was performed because of severe positive skewness. By means of planned pairwise comparisons in LMM, all three intervention groups were compared to the control group, and the COMBI group was compared to the VIPP-FI as well as the RVE group. Vegetable intake was related to average daily energy intake ($r(194) = .17$, $p = .02$ and $r(179) = .28$, $p < .001$) at t18 and t24, respectively. Therefore, the LMM analysis was run with and without correction for average daily energy intake to account for variations in appetite, which in turn may also influence vegetable intake. Because energy intake was not assessed at t0, baseline vegetable intake was expressed as grams per kilogram bodyweight.

To test differences in finger food intake between the conditions at t18 in order to measure self-regulation, an ANCOVA was performed. Planned pairwise analyses were performed, comparing the VIPP-FI and COMBI group to the RVE and AC group. Energy intake of the evening meal was added to the model as covariate. Regarding the FR and SR scales of the CEBQ-T, planned pairwise comparisons were performed in LMM, by comparing the VIPP-FI and COMBI group to the RVE and AC group. Data were analyzed at t18 and t24, corrected for pretest data concerning milk feeding.

Regarding child BMI-z scores, planned pairwise comparisons were performed in LMM, by comparing the VIPP-FI and COMBI group to the RVE and AC group. To test whether changes in child BMI-z scores (weight gain) differed between the intervention groups stated above (baseline to t18 and t24 and t18 to t24), ANOVA analyses were performed.

With respect to the parenting measures, planned pairwise comparisons were performed in LMM, by comparing the VIPP-FI and COMBI group to the RVE and AC group. Observed pressure to eat (corrected for maternal intrusiveness at t0), as well as the self-report measures maternal responsive feeding and maternal pressure to eat (corrected for pretest data concerning milk feeding) were only analyzed at t18 and t24. The observational measures responsiveness-to-stop-signals and maternal sensitivity did include a pretest measure equal to the measures at t18 and t24.

Finally, differences in success rates between groups were analyzed by means of Generalized Linear Models with a binary outcome, correcting for pretest data. An overall Chi-square measure was reported, as well as *p*-values resulting from subsequent pairwise comparisons between relevant conditions.

Statistical significance was set at $p < .05$. Cohen's *d* effect sizes were obtained and reported regarding mean differences between conditions (Cohen, 1992). Values of .20, .50 and .80 were considered a small, moderate and large effect, respectively (Cohen, 1992). All analyses were performed with statistical software IBM SPSS version 25.

Results

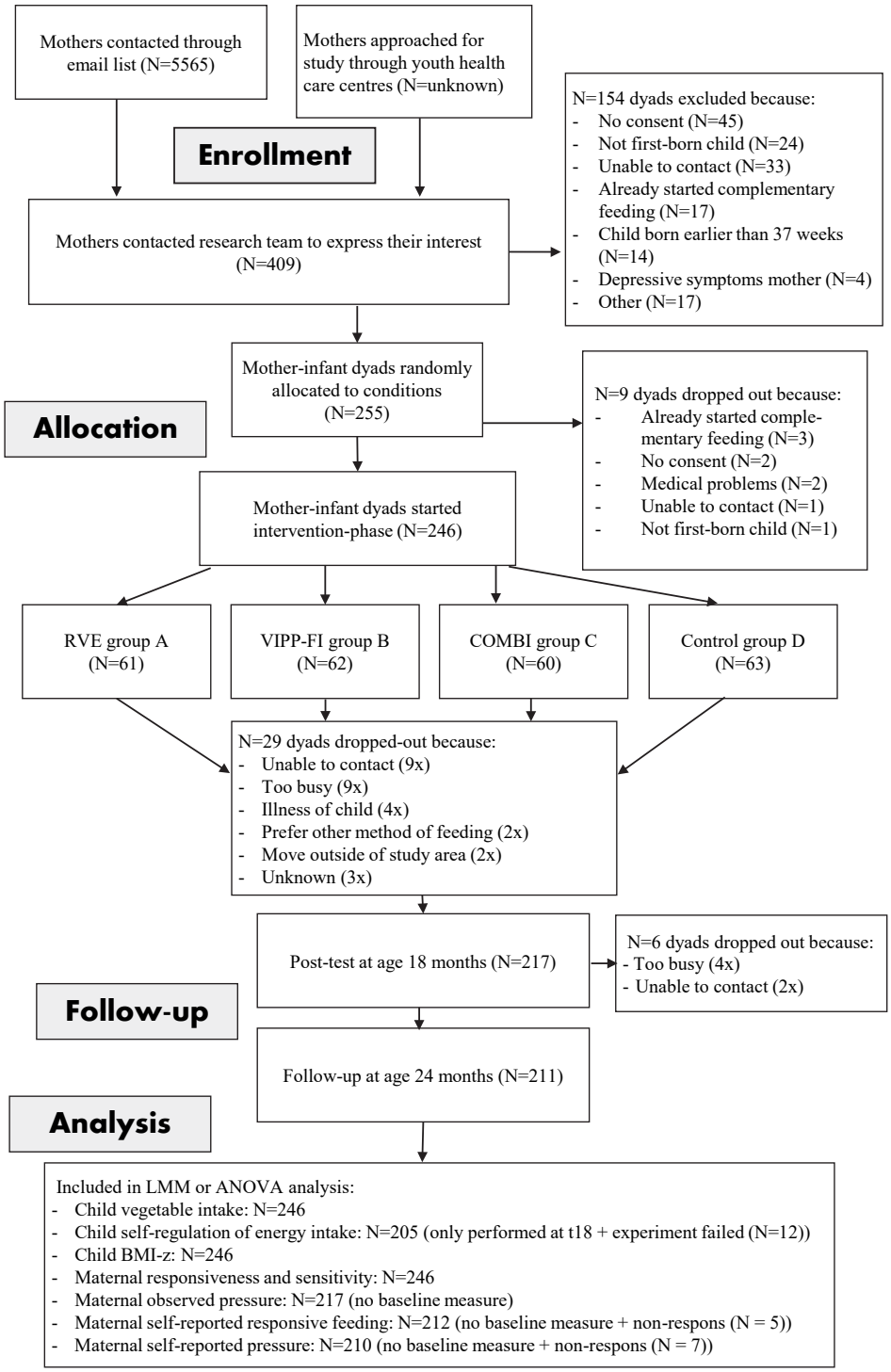
Participant characteristics

Participant flow throughout the study and baseline characteristics are depicted in Supplemental Figure 1 and Table 1, respectively. With respect to attrition, mothers who prematurely dropped out tended to have a lower educational level (2.6% of dropouts vs 22.2% of remaining participants had a university degree). Dropping out was not related to maternal BMI, maternal age, maternal vegetable intake, intervention group or household income. The only baseline difference found significant was vegetable intake at t0 ($p = .03$), with higher vegetable intake in the RVE condition than in the COMBI condition (Figure 1; Table 2).

Child outcomes

With respect to child vegetable intake, planned pairwise comparisons resulting from Linear Mixed Model analysis at t18 and t24 showed no significant differences between the RVE, VIPP-FI and COMBI groups compared to the AC group (p-values .11-.86; Figure 1A; Table 2). The COMBI group was also not superior to the RVE or VIPP-FI groups, as pairwise comparisons revealed no significant differences between these groups. The main effect of time was significant, with significant increases in vegetable intake in grams from t0 to t18 ($p < .001$) and t0 to t24 ($p < .001$) for all groups, and a significant decrease from t18 to t24, $p < .01$ (t0: 24 ± 23 g, t18: 87 ± 53 g, t24: 77 ± 54 g). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant). With respect to success rate, at t18 and t24, the majority of all children achieved the daily recommended intake of at least 50 grams. Corrected for vegetable intake at t0 and for daily energy intake, no main effect of condition was found at t18 ($X^2 = 2.82$, $p = .43$) or t24 ($X^2 = .43$, $p = .93$). In addition, planned pairwise comparisons did not reveal any group differences in achieving daily recommended vegetable intake at t18 or t24 ($p = .61$-$.92$; Table 2). Taken together, in contrast to our hypotheses, no differences between the three intervention groups compared to AC emerged in terms of vegetable consumption.

To examine the effects of the interventions on self-regulation, absolute intake of finger foods during the eating in the absence of hunger experiment was compared between conditions, corrected for energy intake of the meal consumed before the task (Table 2). At t18, a one-way ANCOVA analysis revealed no main effect of condition, indicating that children in the VIPP-FI and COMBI groups did not show better self-regulation skills than children in the RVE and AC group (Table 2). With respect to mother-reported self-regulation skills by means of the FR and SR scales of the CEBQ-T, t18 and t24 were examined with correction for mother-reported FR and SR concerning milk feeding at baseline. Planned pairwise comparisons revealed no significant differences between the VIPP-FI and COMBI groups on the one hand, and the RVE and AC group on the other hand, at t18 as well as t24



Supplemental Figure 1. Study flowchart.

(*p*-values FR: .07-.91; *p*-values SR: .17-.92; Table 2). The main effect of time was significant for FR as well as SR, with significant decreases in FR from t18 to t24 (t18: 2.6 ± 0.8, t24: 2.5 ± 0.8), and significant increases in SR from t18 to t24 (t18: 2.8 ± 0.6, t24: 3.1 ± 0.7). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant for both FR and SR (Table 2).

Regarding child BMI-z score, planned pairwise comparisons resulting from Linear Mixed Model analysis at t18 and t24 showed no significant differences between the VIPP-FI and COMBI groups compared to the RVE and AC group (*p*-values .29-.82; Table 2). The main effect of time was significant, with significant increases in BMI-z from t0 to t18 ($p < .001$), t0 to t24 ($p < .001$) and t18 to t24, $p < .001$ (t0: -0.2 ± 1.0, t18: 0.4 ± 1.1, t24: 1.0 ± 1.0). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant (Table 2). With respect to child weight gain, there were no group differences from t0 to t18 ($p = .79$), t0 to t24 ($p = .97$) or t18 to t24 ($p = .69$). However, with respect to success rate at t18, corrected for BMI-z at t0, the main effect of condition revealed a trend ($X^2 = 6.86$, $p = .07$). When examining planned pairwise comparisons, the COMBI group had a significantly lower proportion of children with overweight (2%) than the VIPP-FI group (16%; $p = .02$; Table 2). At t24, the main effect of condition showed a trend as well, $X^2 = 7.60$, $p = .06$. Planned pairwise comparisons revealed that the COMBI group had a lower proportion of children with overweight (7%) than the AC group (20%; $p = .02$; Table 2).

Maternal feeding behavior

Observed. With respect to maternal responsiveness to satiety cues, planned pairwise comparisons resulting from Linear Mixed Model analysis revealed higher levels of responsiveness in the COMBI and VIPP-FI group compared to AC at 18 months ($p = .02$, $d = 0.55$, and $p = .03$, $d = .47$, respectively; Table 3; Figure 1B). No differences in maternal responsiveness were present between COMBI and VIPP-FI compared to the RVE condition ($p = .14$, $p = .20$, respectively), and there were no group differences at 24 months ($p = .49$-$.98$). The main effect of time showed a marginally significant effect ($p = .052$), with a significant increase in responsiveness from t0 to t18, $p = .03$ (t0: 3.5 ± 1.1, t18: 3.8 ± 1.2, t24: 3.7 ± 1.2). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate at t18, corrected for t0, the main effect of condition was not significant, $X^2 = 5.88$, $p = .11$. However, planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI condition that was considered *(very) Responsive* (score ≥4) than in the AC condition ($p = .01$). Other groups did not differ in terms of success rate at t18 ($p = .12$-$.40$), and no significant main effect ($X^2 = 1.28$, $p = .73$) or significant planned pairwise comparisons were present at t24 ($p = .33$-$.96$; Table 3).

Regarding maternal sensitivity, planned pairwise comparisons resulting from Linear Mixed Model analysis revealed a marginally significant effect for more sensitive behavior during the meal in the VIPP-FI group compared to AC at t18 (p = .052; Table 3). The difference between VIPP-FI and RVE was not significant, p = .21. No differences in favor of the COMBI group compared to RVE and AC were found at t18 (p = .42, p = .14, respectively), and no differences in maternal sensitivity between any groups at t24 (p = .34-.91). The main effect of time was significant, with an increase in sensitive behavior from t0 to t18 (p < .001) and t0 to t24 (p = .03), and a decrease in sensitive behavior from t18 to t24, p = .04 (t0: 6.2 ± 1.5, t18: 6.8 ± 1.6, t24: 6.5 ± 1.7). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate (sensitivity score ≥6), the main effect of condition was not significant at t18 (X^2 = 2.71, p = .44), as well as t24 (X^2 = 0.34, p = .95). Planned pairwise comparisons revealed no differences between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (t18: p = .10-.83; t24: p = .67-.95).

With respect to observed maternal pressure to eat, t18 and t24 were examined with correction for intrusiveness during feeding at baseline. Resulting from Linear Mixed Model analysis, planned pairwise comparisons at t18 and t24 showed no significant differences between the VIPP-FI and COMBI groups compared to the RVE and AC group over time (p-values .17-.48; Table 3). The main effect of time was significant, indicating an increase in pressure to eat from t18 to t24 (t18: 2.4 ± 1.0, t24: 2.7 ± 1.0). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate at t18, the main effect of condition revealed a trend (X^2 = 6.68, p = .08). Planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI group that hardly used pressure to eat or did not use it at all (score ≤2), compared to the RVE and AC group (p = .04 and p = .04, respectively; Table 3). The VIPP-FI group did not significantly differ from RVE or AC (p = .10, p = .11, respectively). At t24, the main effect of condition was not significant (X^2 = 3.66, p = .30), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (p = .13-.85).

Self-report. Regarding self-reported maternal responsive feeding, t18 and t24 were examined with correction for self-reported responsive feeding concerning milk feeding at baseline. Resulting from Linear Mixed Model analysis, planned pairwise comparisons at t18 revealed that more responsive feeding behavior was reported in the COMBI group compared to RVE and AC group (p = .04, d = .45 and p = .02, d = .64, respectively; Table 3; Figure 1C). No differences in favor of the VIPP-FI group were found compared to RVE or AC at t18 (p = .16 and p = .32, respectively), nor any differences at t24, between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (p = .31-.82). The main effect of time was significant, indicating a significant decrease in responsive feeding behavior

from t18 to t24 (t18: 4.1 ± 0.5, t24: 3.9 ± 0.5). Main effects of condition and the interaction effect of time x condition, which both compare all conditions simultaneously, were not significant. With respect to success rate (sensitivity score ≥6), the main effect of condition was not significant at t18 (X^2 = 3.66, p = .30). Planned pairwise comparisons only revealed a marginally significant effect for the difference between COMBI and RVE (p = .054), with more responsive feeding behavior reported in the COMBI group. The difference between COMBI and AC at t18 was not significant (p = .33), nor differences between VIPP-FI and RVE or AC (p = .25, p = .90, respectively). At t24, the main effect of condition was not significant (X^2 = 1.55, p = .67), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (p = .30-.92).

With respect to self-reported maternal pressure to eat, t18 and t24 were examined with correction for self-reported pressure concerning milk feeding at baseline. Resulting from Linear Mixed Model analysis, at t18, planned pairwise comparisons indicated less pressure in the VIPP-FI group compared to the RVE group (p = .01, d = .35), and less pressure in the COMBI group compared to the RVE and AC group (p = .01, d = .47, and p = .04, d = .40, respectively; Table 3; Figure 1D). A trend was found for the difference between VIPP-FI and AC at t18 (p = .07). At t24, less pressure was reported in the COMBI group compared to the RVE group, and a trend was found for the difference with AC (p = .08). No differences were found in favor of the VIPP-FI group compared to RVE and AC (p = .21, p = .33, respectively). The main effect of time was not significant, but the main effect of condition, comparing all four conditions amongst each other, was. With respect to success rate, at t18, a significant main effect of condition was present (X^2 = 9.34, p = .03). Planned pairwise comparisons revealed a higher proportion of the mothers in the COMBI and VIPP-FI groups that reported to hardly use pressure to eat techniques (score ≤2), compared to both RVE (p = .02 and p = .04, respectively) and AC condition (p = .01 and p = .04, respectively; Table 3). At t24, the main effect of condition was not significant (X^2 = 3.84, p = .28), nor did any differences emerge between VIPP-FI and COMBI on the one hand, and RVE and AC on the other hand (p = .08-.56).

Table 2. Descriptives and analysis of child health outcomes comparing RVE, VIPP-FI, COMBI and AC at t0, t18 and t24.

	M ± SD	%	M ± SD	%	M ± SD	%	*p*T	*p*C	*p*TxC
Vegetable intake (grams; *n* = 246)	24 ± 23		87 ± 53	79	77 ± 54	67	< .001*	.48	.45
A – RVE (*n* = 61)	32 ± 30		90 ± 54	73	75 ± 61	63			
B – VIPP-FI (*n* = 62)	22 ± 20		95 ± 58	86	84 ± 62	67			
C – COMBI (*n* = 60)	19 ± 16		85 ± 56	77	80 ± 53	69			
D – AC (*n* = 63)	23 ± 20		79 ± 44	77	70 ± 40	68			
BMI-z[3] (*n* = 246)	-0.2 ± 1.0	99	0.4 ± 1.0	93	1.0 ± 1.1	85	< .001*	.89	.88
A – RVE (*n* = 61)	-0.2 ± 0.9	100	0.3 ± 1.4	94	0.9 ± 1.0	86			
B – VIPP-FI (*n* = 62)	-0.3 ± 1.1	98	0.5 ± 1.2	84*	1.0 ± 1.1	82			
C – COMBI (*n* = 60)	-0.1 ± 1.0	97	0.6 ± 1.0	98*	1.0 ± 1.1	93*			
D – AC (*n* = 63)	-0.1 ± 0.9	94	0.4 ± 0.9	94	0.9 ± 1.1	80*			
Self-regulation - finger food intake in kcal; (*n* = 205)	-	-	39 ± 36	-	-	-		.91[4]	
A – RVE (*n* = 48)			41 ± 34						
B – VIPP-FI (*n* = 51)			39 ± 38						
C – COMBI (*n* = 54)			37 ± 30						
D – AC (*n* = 52)			41 ± 43						
Self-regulation – FR[5] (*n* = 213)	-	-	2.6 ± 0.8	-	2.5 ± 0.8	-	< .001*	.20	.35
A – RVE (*n* = 50)			2.4 ± 0.8		2.3 ± 0.6				
B – VIPP-FI (*n* = 53)			2.7 ± 0.9		2.7 ± 1.0				
C – COMBI (*n* = 54)			2.6 ± 0.7		2.5 ± 0.6				
D – AC (*n* = 56)			2.8 ± 0.8		2.5 ± 0.7				
Self-regulation – SR[5] (*n* = 213)	-	-	2.8 ± 0.6	-	3.1 ± 0.7	-	<0.001*	.40	.47
A – RVE (*n* = 50)			3.0 ± 0.6		3.2 ± 0.6				
B – VIPP-FI (*n* = 53)			2.7 ± 0.7		3.0 ± 0.8				
C – COMBI (*n* = 54)			2.9 ± 0.6		3.2 ± 0.6				
D – AC (*n* = 56)			2.8 ± 0.7		3.0 ± 0.6				

1 Baseline and follow-up measurements at child age in months (mean ± SD) at each time point: t0 (4.6 ± 0.9) t18 (18.5 ± 0.7) t24 (24.4 ± 0.5). Values are means ± SDs or percentages. Per outcome measure, for each condition, the number of participants (*n* =) is reported. Differences in means were assessed using Linear Mixed Model (LMM) analysis, differences in percentages were assessed using Chi-square tests with subsequent pairwise comparisons, which are reported in the text. Regarding pairwise comparisons following from LMM, exact *P*-values and effect sizes are reported in the text. * Significant at $p < .05$. RVE= Repeated Vegetable Exposure Intervention, VIPP-FI = Video Intervention to Promote Positive Parenting Feeding Infants intervention, COMBI = Combined condition of RVE and VIPP-FI, AC= attention-control condition. FR = Food Responsiveness; SR = Satiety Responsiveness; % = Success rate: Vegetable intake – Daily recommended intake of ≥50gr achieved; BMI-z, normal weight between -2 and 2.

2 Overall effects resulting from Linear Mixed Model analysis. *P*T = time effect, *P*C = main effect condition, *P*TxC = interaction time x condition.

3 World Health Organization Standards

4 One-way ANCOVA analysis, $F(3, 199) = 0.181$

Table 3. Descriptives and analysis of maternal outcome measures comparing RVE, VIPP-FI, COMBI and AC at t0, t18 and t24.

Assessment[1]	t0		t18		t24		Overall[2]		
	M ± SD	%	M ± SD	%	M ± SD	%	*p*T	*p*C	*p*TxC
Responsiveness to satiety cues (Obs; *n* = 246)	3.5 ± 1.1	49	3.8 ± 1.2	68	3.7 ± 1.2	62	.06	.20	.60
A – RVE (*n* = 61)	3.5 ± 1.0	42	3.7± 1.4	68	3.8 ± 1.3	64			
B – VIPP-FI (*n* = 62)	3.5 ± 1.2	53	4.0* ± 1.1	70	3.7 ± 1.2	66			
C – COMBI (*n* = 60)	3.5 ± 1.1	52	4.0* ± 1.0	77*	3.7 ± 1.3	63			
D – AC (*n* = 63)	3.4 ± 1.1	47	3.4* ± 1.2	57*	3.6 ± 1.1	56			
Sensitivity (Obs; *n* = 246)	6.2 ± 1.5	40	6.8 ± 1.6	58	6.5 ± 1.7	47	.03*	.78	.34
A – RVE (*n* = 61)	6.1 ± 1.5	38	6.6 ± 1.8	57	6.3 ± 1.6	43			
B – VIPP-FI (*n* = 62)	6.1 ± 1.7	42	7.0 ± 1.7	65	6.5 ± 1.8	48			
C – COMBI (*n* = 60)	6.3 ± 1.6	47	6.9 ± 1.3	67	6.4 ± 1.7	53			
D – AC (*n* = 63)	6.2 ± 1.4	35	6.4 ± 1.7	52	6.7 ± 1.6	51			
Pressure (Obs; *n* = 220)	-	-	2.1 ± 1.0	56	2.7 ± 1.0	43	< .001*	.53	.27
A – RVE (*n* = 51)			2.6 ± 1.1	46*	2.8 ± 0.9	38			
B – VIPP-FI (*n* = 55)			2.3 ± 1.1	62	2.5 ± 1.1	54			
C – COMBI (*n* = 58)			2.3 ± 0.8	67*	2.9 ± 0.9	38			
D – AC (*n* = 56)			2.6 ± 1.0	47*	2.7 ± 0.9	41			
Responsive feeding (self-report; *n* = 212)	-	-	4.1 ± 0.5	73	3.9 ± 0.6	61	< .001*	.22	.49
A – RVE (*n* = 50)			4.0* ± 0.6	64	4.0 ± 0.6	66			
B – VIPP-FI (*n* = 52)			4.1 ± 0.5	76	4.0 ± 0.6	59			
C – COMBI (*n* = 54)			4.3* ± 0.5	84	4.0 ± 0.5	68			
D – AC (*n* = 56)			4.0* ± 0.5	69	3.8 ± 0.6	53			
Pressure (self-report; *n* = 210)	-	-	2.3 ± 0.8	45	2.2 ± 0.8	45	.26	.02*	.51
A – RVE (*n* = 48)			2.5* ± 0.9	36*	2.3* ± 0.9	46			
B – VIPP-FI (*n* = 52)			2.2* ± 0.8	53*	2.2 ± 0.8	51			
C – COMBI (*n* = 54)			2.1* ± 0.8	55*	2.1* ± 0.8	48			
D – AC (*n* = 56)			2.4* ± 0.7	35*	2.3 ± 0.8	36			

1 Baseline and follow-up measurements at child age in months (mean ± SD) at each time point: t0 (4.6 ± 0.9) t18 (18.5 ± 0.7) t24 (24.4 ± 0.5). Values are means ± SDs or percentages. Per outcome measure, for each condition, the number of participants (*n* =) is reported. Differences in means were assessed using Linear Mixed Model (LMM) analysis, differences in percentages were assessed using Chi-square tests with subsequent pairwise comparisons, which are reported in the text. Regarding pairwise comparisons following from LMM, exact *P*-values and effect sizes are reported in the text. * Significant at $p < .05$. RVE= Repeated Vegetable Exposure Intervention, VIPP-FI = Video Intervention to Promote Positive Parenting Feeding Infants intervention, COMBI = Combined condition of RVE and VIPP-FI, AC= attention-control condition. Obs = Observed outcome measure; % = Success rate: Responsiveness (observation and self-report) - score ≥4; Sensitivity - score ≥6; Pressure (observation and self-report) – score ≤2.
2 Overall effects resulting from Linear Mixed Model analysis. *P*T = time effect, *P*C = main effect condition, *P*TxC = interaction time x condition.

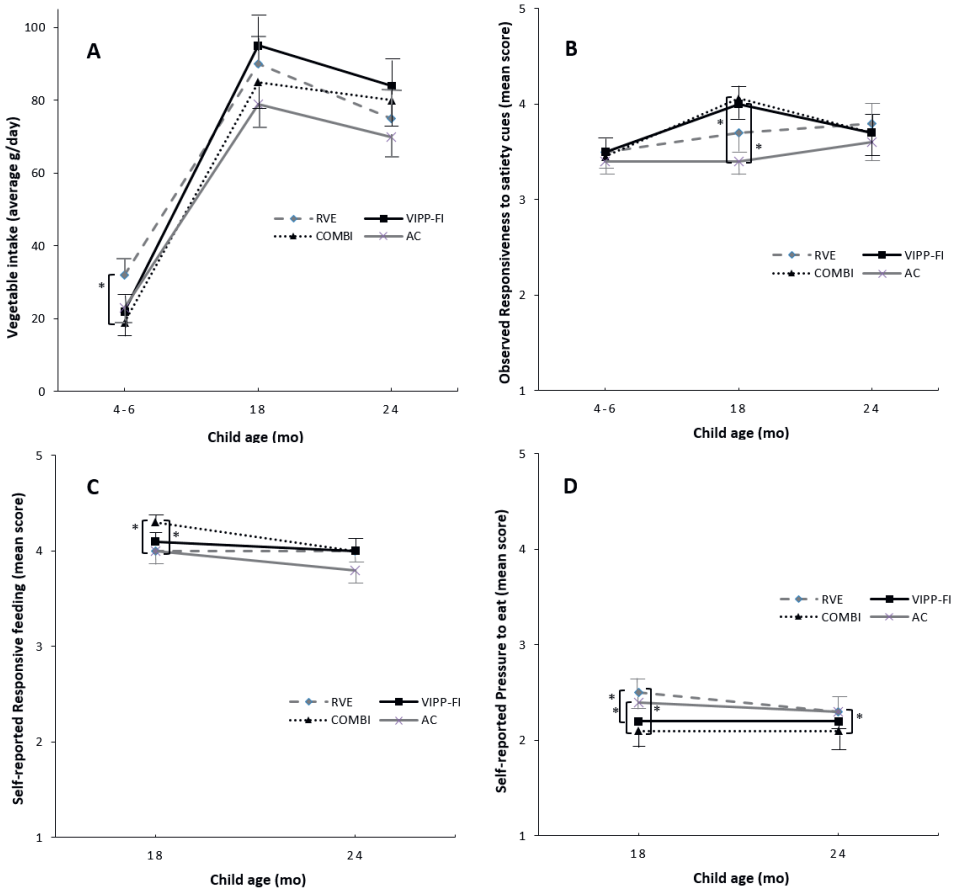


Figure 1. Analysis of outcome measures comparing RVE, VIPP-FI, COMBI and AC at t0, t18 and t24 on (A) child vegetable intake *(n* = 246), (B) maternal responsiveness to satiety cues (*n* = 246), (C) maternal self-reported responsive feeding *(n* = 212), and (D) maternal self-reported pressure to eat (*n* = 210). Means shown are absolute values. Linear Mixed Model analysis was used to identify main effects of treatment and time and their interaction (*p* < .05), followed by pairwise comparisons to identify mean differences between groups. Values are means ± SEs. Condition (*n*) per group in each figure: A and B – RVE (61), VIPP-FI (62), COMBI (60), AC (63); C - RVE (50), VIPP-FI (52), COMBI (54), AC (56); D - RVE (48), VIPP-FI (52), COMBI (54), AC (56).

Discussion

The present study reports on the post-test (18 months) and first follow-up (24 months) effects in the Baby's First Bites trial. No intervention effects were found on child vegetable intake and self-regulation of energy intake. There were fewer children with overweight

in the COMBI group compared to the VIPP-FI group at 18 months and the AC group at 24 months. However, this finding needs to be interpreted cautiously due to the small number of infants with overweight and the fact that differences between those groups were absent on the continuous measure of BMI-z. Finally, although effects of the interventions were not reflected in child outcomes, the VIPP Feeding Infants intervention was effective in enhancing sensitive maternal feeding behavior at 18 months - yet this effect disappeared at 24 months.

Despite the lack of effect of the interventions on vegetable intake in our study, overall vegetable intake of children (intervention and control) was relatively high. At 18 and 24 months, the average daily vegetable intake of our sample was 87 and 77 grams, respectively, compared to an average of 52 grams a day in the Dutch toddler population (age 12-36 months) as reported in the Dutch National Food Consumption Survey (2016). The overall high vegetable intake may have been related to sample characteristics. Although participants were recruited from the general Dutch population, recruitment was partly targeted at parents who had signed up for the 'Nutricia for parents' group, thereby showing special interest in information on child nutrition. As a consequence, the topic of our study may have attracted parents with an above average interest in infant food products and healthy eating practices (including vegetable consumption). Moreover, mere participation in an RCT like the current study may have increased parental awareness of the importance of healthy eating practices for their child, which may have had a positive effect on vegetable intake in all groups.

In addition, a large interindividual variation in vegetable intake was observed within all conditions (SDs 44-69 grams), which may have further complicated detection of an effect. This heterogeneity in intake may point to the existence of subgroups within our sample, which was found in another study as well (Caton et al., 2014). In this particular study of Caton and colleagues, different types of "eaters" were identified: "learners", who were defined as children who's intake increased over time; "plate-clearers", or children that consistently consumed a high amount; "non-eaters", that consistently consumed very little vegetables, or "others", which were children with a variable pattern (Caton et al., 2014). It is plausible that such subgroups are present in our sample as well, and that interventions affect certain types of eaters differently. Other possible moderators such as child picky eating or family factors such as socioeconomic status might be studied as well, in order to derive "what works for whom". In addition, future studies may need to focus on certain risk groups, such as caregivers that encounter difficulties feeding their child vegetables. Because in our sample vegetable intake was quite high in all study groups, for quite some children there was little need to improve their intake. In order to further test the effectiveness of our interventions, it would be fruitful to see if children with low intake would benefit from the intervention program.

The lack of an effect on absolute vegetable intake is in line with other RCTs studying this age group (Barends et al., 2014; Magarey et al., 2016; Maier-Nöth et al., 2016; Savage et al., 2018). One study only found short-term effects of repeated vegetable exposure in the first year of life and no longer at 24 months, suggesting that intervention effects might not be robust enough to have long lasting effects (Barends et al., 2013; 2014). Interestingly, another study did show a lasting effect of repeated exposure to a high vs. low variety of vegetables at the start of complementary feeding on vegetable intake and liking at age 3 and 6 years (Maier-Nöth et al., 2016; Maier et al., 2007). The absence of an effect at age 15 months in the same study might suggest that children may still benefit from exposure to vegetables at the start of complementary feeding later in life, but other studies to confirm this theory are lacking.

Although the VIPP-FI intervention effectively improved maternal sensitive feeding behavior at 18 months, we did not find children in those conditions to have better self-regulation skills. An explanation might be that a possible positive effect of sensitive feeding on self-regulation was not yet present or not large enough, and that it might evolve later on. Another possibility is that VIPP-FI did not lead to improved self-regulatory eating behavior. Although parents are known to have a key influence on their children's eating behaviors (Anzman et al., 2010; Savage, Fisher, & Birch, 2007; Schneider-Worthington, Berger, Goran, & Salvy, 2020), evidence that self-regulation of eating in toddlerhood can be influenced by improving maternal feeding practices is still lacking. Alternatively, it has been posed that heritability of appetitive traits of the child plays a role in both children's appetite regulation and their susceptibility to environments that stimulate overeating (Llewellyn, Van Jaarsveld, Johnson, Carnell, & Wardle, 2010; Llewellyn, Van Jaarsveld, Plomin, Fisher, & Wardle, 2012). In that case interventions may need to specifically target children's environment and behavioral traits rather than focus on maternal feeding alone. Finally, because our study included an evening meal, the EAH experiment was often conducted during the early evening. Because a toddler's appetite may be different during the evening than during the day, the timing of the experiment might have influenced the results. It would be interesting to repeat the experiment at a different time of day, for example around lunchtime.

With respect to anthropometrics, we did not find effects on BMI-z or rapid weight gain for any of the tested interventions, which is in contrast with other similar RCTs that found effects on rapid weight gain at 12-14 months (Daniels et al., 2012; Savage et al., 2016), and on BMI-z at 36 months; (Paul et al., 2018). However, those intervention programs included elements on a much broader level, such as avoiding unhealthy foods, portion sizes, and daily physical activity (Daniels et al., 2009; Paul et al., 2014). It is possible that solely focussing on the *what* and *how* is not enough to achieve effects on child weight (gain). Our findings regarding the proportion of healthy weight *do* provide some indication

that the combined advice on vegetable intake and sensitive feeding positively affected child weight. However, the prevalence of children with overweight was low. Moreover, children's average daily energy intake did not differ between intervention groups. Contrary to our expectations, a higher prevalence of overweight at 18 months was present in the VIPP-FI condition, compared to the COMBI condition. Although this finding needs to be interpreted with caution as well, it is plausible that feeding sensitively with more room for child autonomy in eating leads to greater enjoyment of food, a higher food intake and thereby a higher weight. Indeed, a study on Baby Led Weaning (BLW) found that children who were introduced to solid food with a BLW approach displayed more eating behavior characteristics associated with obesity risk (Taylor et al., 2017).

Taken together, our interventions were not effective in changing child outcomes. Our follow-up measurement at 36 months will reveal whether our intervention programs affect child health outcomes after a longer period of time.

The sensitive feeding intervention VIPP-FI was effective in promoting sensitive maternal feeding behavior. Other trials incorporating similar feeding advice as part of a broader prevention program also found positive effects (Daniels et al., 2012; Savage et al., 2018), however we are the first to show effects for *observed* maternal feeding behavior. Although we did find moderate effect sizes, absolute differences between groups on maternal behavior were small. Very insensitive behavior or extreme levels of pressure to eat were not often observed or reported, resulting in relatively high levels of positive behavior in all groups. Although this may have caused a ceiling effect, VIPP-FI was still effective in improving maternal sensitive feeding behavior.

However, most effects of VIPP-FI were only found at 18 months: at 24 months all differences between conditions, except for self-reported pressure to eat, disappeared. This might be explained by the onset of the so-called 'picky eating' phase: a phase of selectiveness in eating, present in about half of the children at some point between the age of 1.5 and 6 years (Dovey et al., 2008). Indeed, time effects from 18 to 24 months showed an overall decrease in vegetable intake, a decrease in observed maternal sensitivity and self-reported responsive feeding, and an increase in observed pressure to eat. This suggests that mealtimes are more challenging at 24 months, making it harder for all parents, including those in the intervention groups, to keep on showing positive feeding behavior. Therefore, it might be fruitful to offer more guidance on how to deal with the picky eating phase, for example by designing more VIPP-FI sessions around toddler age.

There are several limitations that should be noted. Our sample consisted mainly of well-educated Caucasian families and was not fully representative of the Dutch population (e.g., 57% obtained at least a bachelor's degree, compared to 41% in the general Dutch

population (Statistics Netherlands, 2021). Moreover, all families had to commit to participate in a highly intensive program. These sample characteristics may have led to a well performing control condition, and a ceiling effect among intervention groups in most outcome measures. In addition, mothers who prematurely dropped out tended to have a lower educational level. Another limitation is that our study focused solely on mothers and did not take other caregivers into account.

In summary, the present study tested whether three approaches to parental guidance in complementary feeding promote health outcomes in toddlers: advising parents on *what* to feed, *how* to feed or both. Although our intervention on how to feed effectively enhanced sensitive maternal feeding behavior, we did not prove effectiveness of our interventions regarding child health outcomes. To determine if child health outcomes can be influenced in the first years of life by advising parents on the *what* and/or *how* of complementary feeding, future research should aim to include a more heterogeneous sample or perhaps specifically focus on risk groups, such as picky eaters. Finally, intervention programs may need to pay more attention to toddlerhood, when new child behavior, such as food refusal during mealtimes, may challenge positive parental feeding practices as well as healthy child outcomes.

6

Chapter 6

General Discussion

General Discussion

Summary

The aim of the present dissertation was to examine the relation between sensitive parental feeding behavior and health outcomes in infants and toddlers up to 24 months. In the current chapter, the main findings are summarized and integrated, and future directions for research and practice are considered.

Mother-infant interaction during the very first bites

In the first empirical study described in **Chapter 3**, mother-infant interactions were studied during the start of complementary feeding. Observations of a feeding situation were performed on two consecutive days, during which infants received their very first bites of solid food. Results showed some stability of all measured constructs of both mother and child behavior from the first to the second feed. In addition, the study was the first to show that maternal behavior during feeding is associated with infant vegetable intake and liking of the very first bites of solid food. More specifically, sensitive and positive maternal feeding behavior was found to be positively associated with both infant vegetable intake and liking. Moreover, the fact that this was mostly the case during the second feed and not the first, suggests that the dyad was more attuned during the second feeding experience than during the first. In addition, infant vegetable liking during the first feed was found to predict maternal sensitive feeding during the second feed, while maternal sensitive feeding during the first feed was not found to predict vegetable intake or liking during the second feed. This underlines that it is important to consider that child behavior might as well influence parental behavior, and that it is of great importance to take bi-directionality into account when studying parent-infant interactions.

Maternal sensitivity during mealtime and free play

In **Chapter 4** we described the results of our second empirical study that examined whether observed maternal sensitivity towards 18-month-old children differed between mealtime and free-play. A second aim of the study was to explain possible differences between the two situations by studying moderating effects of children's eating behavior. Mothers were found to show lower levels of sensitivity during mealtime than during free play. In addition, observed child eating behavior was related to maternal sensitivity during mealtime, with more food enjoyment being associated with higher levels of sensitivity, and more challenging child behavior with lower levels of sensitivity. Finally, when children showed a high degree of challenging behavior during the meal, there was more discrepancy between sensitivity during mealtime and free play. Findings suggest that it is important to be aware of the challenges that parents might experience around mealtimes, especially during toddlerhood. Moreover, parental behavior might be

expressed differently across situations, which underlines the importance of taking context into account when observing parental sensitivity.

What vs. How: Intervention effects on maternal feeding behavior and child health outcomes

The results of the overarching RCT study testing interventions on vegetable exposure (*What*) and sensitive feeding (*How*) were described in **Chapter 5.** Our interventions, aimed at fostering healthy eating habits in children, showed no effects on child vegetable intake and child self-regulation. Although the proportion of children with overweight was significantly lower in the condition that received advice on both *what* and *how*, this finding needs to be cautiously interpreted due to the small number of infants with overweight and non-significant effects on the continuous measure of BMI-z. Finally, our sensitive-feeding intervention VIPP-FI was effective in enhancing sensitive maternal feeding behavior, mostly at 18 months. Our follow-up measurement at 36 months will shed more light on the longer-term effects of our interventions.

Integration of findings

Sensitive feeding and child health outcomes: theoretical framework

Parents are found to play a large role in their children's development, which is extensively described within attachment theory. This theory states that a parent's positive affect and behavior, including sensitivity and responsiveness, contributes to a child's adaptive development and emotion regulation (Bowlby 1988; Bretherton, 1991; Schore, 1994). The idea that the quality of interactions between parents and their children affect child outcomes, can be applied to the feeding context as well. The first evidence for this hypothesis was found by Bowlby's co-founder of attachment theory, Mary Ainsworth (Ainsworth and Bell, 1969). In her feeding observations during the first year of life, she observed that mothers who fed on demand, who adapted their feeding pace and who promptly responded to their infant during feeding had infants who cried less in early infancy and demonstrated greater attachment to their mothers at the end of the first year.

The assumption that parental responsiveness may contribute to child health outcomes such as vegetable intake and self-regulation of energy intake, is also underlined by another theory on child development closely related to attachment theory: the theory on compliance, developed by Kochanska and colleagues (Kochanska & Aksan, 1995; Kochanska et al., 2001). Kochanska proposed a motivational distinction between situational and committed compliance: children who show situational compliance are externally motivated to comply, and solely accept and follow caregivers' rules when they are closely monitored, while children who show committed compliance are internally motivated to comply. Parental responsiveness has been found to play a central role in the development of this committed compliance in children, because children who have

warm and sensitive parents would more easily embrace their parents goals and rules (Braungart-Rieker, Garwood, & Stifter, 1997; Crockenberg & Litman, 1990; Kochanska, Barry, Aksan, & Boldt, 2008; Kochanska, Woodard, Kim, Koenig, Yoon, & Barry, 2010). The sensitive discipline strategies we incorporated in our VIPP-FI intervention have been shown to promote a child's committed compliance (Feldman and Klein, 2003), and were therefore expected to benefit healthy child eating behavior in our trial.

Sensitive feeding and child health outcomes: present findings

However, contrary to these underlying theories and our expectations, in the present dissertation we did not find proof of a causal relation between sensitive maternal feeding behavior and healthier child outcomes. As described in **Chapter 5**, our VIPP-FI intervention did enhance sensitive maternal feeding behavior, but did not show effects on child health outcomes. Two other large longitudinal trials incorporating advice on parental responsive feeding behavior did find some positive effects on child health outcomes, i.e. child weight (Daniels et al., 2012; Savage et al., 2016). However, these trials did not find any effects on other health outcomes such as vegetable intake, and differences found on child weight were small and not consistently present over time. Moreover, in these trials advice on responsive feeding was embedded in a multicomponent intervention program, focusing on other topics as well, such as portion size, exercise, or sleep. Therefore, it is unclear if and in what way responsive feeding behavior contributed to the positive effects (Daniels et al., 2012; Savage et al., 2016). It should be noted, however, that we *did* find an effect in favor of our combined intervention group on child overweight. Although the effect at this point is too uncertain to interpret because of the small numbers of overweight children, it is promising, and may be supported through analysis of our data assessed at 36 months of age.

From child behavior to parental behavior?

In **Chapter 3,** we did not find maternal feeding behavior to predict child eating behavior the next day. In fact, the relations that we found pointed in the direction of child characteristics influencing parental feeding behavior, a direction of effects that is studied less often. Infant vegetable liking during the first day of complementary feeding was associated with maternal feeding behavior the next day, while we did not find this relation the other way around. Further, in **Chapter 4**, mothers were found to be less sensitive during mealtime than during free play, and this discrepancy was larger when children showed challenging behavior during the meal. Although causality cannot be confirmed in this study, this finding implies that challenging child behavior during the meal may impair sensitive parental responding.

Taken together, the present dissertation found some indications that child behavior may influence parental behavior, but no support for a causal relation from parental to child

behavior. In the feeding context, these findings are in line with the findings of a large twin study in the UK, where infant weight and infant appetite were found to be predictive of parental feeding behavior, but not the other way around (Fildes et al., 2015; Van Jaarsveld, Llewellyn, Johnson, & Wardle, 2011). Because feeding is such a goal-oriented task, it makes sense that a parent's responses are partly dependent on the child's eating behavior, such as appetite or food refusal. If this behavior does not match the parent's expectations, insensitive feeding behavior may arise. Moreover, parents are likely driven by long-term goals like optimizing or maintaining the child's health and growth, so some forms of insensitive feeding behavior such as mild pressure to eat is understandable. It is important for researchers as well as professionals to be aware that child behavior is not always a consequence of parental behavior, but that child behavior affects parental behavior as well.

Sensitive feeding and child health outcomes: explanation of findings

The fact that we were not able to show the influence of sensitive feeding on child health outcomes implied by attachment theory and the theory on committed compliance, does not necessarily mean this influence does not exist. Our sample had a relatively high vegetable intake, which may have left too little room for improvement. Therefore, it is plausible that our interventions are more effective regarding child health outcomes in a study population where improvements are actually needed. Examples of such populations are children who already have difficulties eating vegetables, or picky eaters in general. Parents who struggle with feeding their children might especially benefit from video-interaction training. This way, they can learn how to maintain a positive atmosphere despite the picky eating behavior, and how to deal with it in a positive and sensitive way, avoiding coercion. This in turn may increase the child's feelings of security at the table, his/her confidence, and positive associations with mealtimes, which might result in the child's willingness to try healthy foods somewhat more. With respect to the general population, it might also be that positive effects of VIPP-FI on maternal feeding behavior will indeed affect child health outcomes, but only in the longer term. Our follow-up measurement at 36 months will shed more light on this matter. Moreover, it would be interesting to have another follow-up at for example 6-7 years of age, when the food neophobia/picky eating phase has ended for most of the children that experienced it. With respect to vegetable intake, another study involving repeated exposure during the first year of life, found long-term effects at 3 and 6 years of age, yet no effects at 15 months (Maier-Nöth et al., 2016). This suggests that it is possible to lay a solid foundation at the beginning, which may only pay off at a later age. In addition, VIPP-FI might have contributed positively to child characteristics that are likely to be a consequence of a mother that is more attuned to the child's needs but that we did not analyze in the present dissertation, such as a child's positive affect during a meal or more specifically enjoyment of food. Finally, it is also

possible that VIPP-FI in the current form is not suitable to positively affect child behavior, and that adaptations to the protocol are needed.

Taken together, more research regarding the effects of VIPP-FI and sensitive feeding behavior in general is warranted. In addition, when studying feeding interactions, it is important to realize that the relation between parental behavior and child behavior is most often bidirectional, and that both directions need attention in research and practice.

Challenges around mealtime during toddlerhood

Picky eating, a phase of food fussiness and food rejection that emerges in many children between the ages of 1 and 6 years, may pose a daily challenge to parents and may in turn impact parental feeding behavior (Dovey et al., 2008; Taylor et al., 2015). In **Chapter 4**, we found some indications for such an effect. Maternal sensitivity towards 18-month-old children was found to be lower during mealtime than during free play, and this discrepancy was related to the level of challenging child behavior during mealtime, suggesting that challenging child behavior during the meal may impair parental sensitive responding. Moreover, in **Chapter 5** we found child vegetable intake to decline from 18 to 24 months, while we also found maternal sensitive feeding behavior to decline, and pressuring techniques to increase. These changes may be explained by the onset of picky eating and food neophobia in this age group. The fact that VIPP-FI was only found to be effective regarding outcomes at 18 months and not 24 months, might also be explained by mealtimes becoming more challenging for parents at age 24 months. This indicates that parents may need more support from the end of the second year onwards, by providing them with information on picky eating and more tools on how to deal with this behavior.

Indeed, as soon as children start showing more food-related fussy behavior by rejecting food they used to like before, chances increase that parents start using more negative and strict discipline strategies which may in turn result in increasingly difficult and challenging child behavior. Such cycles of negative parental and child behavior are defined as 'coercive cycles' according to Patterson's coercion theory (Patterson, 1982). This theory fits into social learning theory as first described by Bandura (1977), which states that parents who exhibit negative behavior socialize their children to exhibit similar behavior. Such coercive cycles are likely to occur more often during the picky eating phase, for example because parents start pressuring their child to eat. The theory states that instead of rewarding negative child reactions by giving (negative) attention to difficult child behavior, parents should reinforce children's positive behaviors and set rules and limits in adequate ways. The intervention VIPP-SD, which our intervention VIPP-FI is based on, uses this principle by teaching parents such positive disciplining techniques to deal with challenging behavior. Indeed, at 18 months, VIPP-FI effectively increased sensitive feeding behavior, and decreased pressuring techniques. However, although we informed parents on positive

disciplining techniques during our final two sessions at 13 and 16 months, most feeding interactions we videotaped and discussed during those sessions were not that negative. In addition, VIPP-FI contained some general information on the onset of the picky eating phase during the session at 16 months, when most parents had not yet experienced any picky eating behavior. In order to change parental as well as child behavior during the picky eating phase and prevent coercive cycles during mealtime, it might be more effective and desirable to intervene during the age of 2-4 years, so parents can be supported at the time when they actually have to deal with this more challenging eating behavior. Because our video-feedback intervention was effective in increasing sensitive feeding behavior at age 18 months, it is plausible that it might be effective during toddlerhood as well if sessions are more specifically aimed at the picky eating phase.

Practical challenges

Because of the complexity of longitudinal trials like BFB, we think it is useful to discuss some practical challenges that we encountered during the research process, with the aim to inform future research. Three major challenges we experienced were, a) the large number of home visits that had to be carried out for the purpose of data collection and interventions, b) the coding of a large amount of video material, and c) comparing two active interventions while making sure the advice given was unique for each intervention. With respect to the first challenge, home visits started when the child was offered its very first bite of solid food at 4-6 months and ended at the age of 36 months. All families started with a 19-day feeding schedule for their baby, with home visits that had to be planned on the first, second, eighteenth and nineteenth day of the schedule. This meant that we had to visit the families on four different days of the week, including weekends in most cases. Because most of the mothers had started working again during that period, and because life with a baby is busy, it was very challenging to conduct the home visits on these specific days within three weeks. Quite some home visits had to be planned after 5 PM, which typically is not the ideal time of day for an infant. In addition, the first bite had to be offered in between two regular milk feeds, so we had to adjust the home visit to the schedule of mother and baby, sometimes changing the order of tasks performed during the home visits.

Moreover, half of the families were randomized into a group receiving VIPP-FI, which meant that two extra home visits had to take place within those 19 days. For mothers receiving the intervention on vegetable intake, these two sessions were conducted through telephone calls, which was more flexible but these also had to be planned. To illustrate, a participant in the combined intervention group, had to a) follow the feeding schedule, b) have the researchers come over on four measurement days, c) have the VIPP-FI intervener come over for two more appointments, and d) have two more telephone calls with another intervener, all within 19 days. The study was designed this way, because we extended a

repeated exposure intervention that had been tested before, which included this 19-day feeding schedule as well (Barends et al., 2013). However, that particular study included lab visits and only concerned vegetable intake, while our study concerned sensitive feeding behavior as well, which we thought could more validly be assessed in a natural home setting. Although assessing and comparing both *What* and *How* within the same study was innovative, it was quite challenging to execute. Moreover, this intensive schedule in the first phase of the project has likely made some families decide not to participate in the study, which might have led to selection bias that possibly resulted in a somewhat higher educated sample. Future studies may need to make some other choices, making such multiple-arm RCT trajectories somewhat less time intensive to both researchers and participants. A possible solution, for home visits as well as video-feedback interventions such as VIPP-FI, could be to have participants videotape their own feeding interaction. Although this may come with some technical challenges and would ask more effort of participants, participants could plan the recording whenever convenient for them, and it might cause such observational studies to become more feasible. Finally, because of the time-demanding nature of the intervention, and because a 'well-functioning' sample such as ours did not seem to need an intervention, a video-feedback method might be more suitable for families that actually need assistance with feeding their child, and less suitable for families that do not encounter any problems.

A second challenge concerned the coding of the collected video material. Within the BFB study, almost 4,000 videos were collected, which all had to be coded. The majority of the videos concerned mealtimes, causing the video duration to be quite long in most cases (varying from 5 to 45 minutes). In total, we trained 35 students on coding either mealtime or free play, of whom 16 became a reliable coder after intense training. It was necessary to use this many coders, because most students only stayed with us for one year, and also because we wanted our data to be coded independently, which meant that we did not want the same coder to code a family on multiple time points during the study. However, although we monitored intercoder reliability within the time points, the large number of coders might have increased error in our measurements. For the mealtime videos, we coded many constructs at once, which meant the training process was quite demanding. As a consequence, only about half of the students became a reliable coder after intensive training, which is why the coders who did become reliable had to code many videos. In addition, we aimed to have 15% of the videos coded by two coders, in order to assess intercoder reliability and prevent coder drift. However, even though the coding-process is not without difficulty and is time-consuming, it is worth the effort because observed parent-child interactions represent such valuable information. In the future, it might be feasible to have some constructs coded automatically using certain algorithms, such as positive or negative affect. In addition, coding behavior on a micro level might also be possible to perform automatically. However, more global behavioral constructs, such as

parental sensitivity, will still have to be coded by human beings. In sum, with techniques getting more and more advanced, researchers may think of ways to have some of their behavioral coding work automatized in the future.

A third challenge was to make sure the two intervention programs, one focusing on vegetable intake (what), and the other on sensitive feeding practices (how), were indeed executed as two entirely different interventions, in order to measure a 'clean' effect when comparing their effectiveness. In practice, parents who received the intervention on vegetables often wanted to know for example how long they should persist when feeding their child, or what they should do when their child refused to eat anything. However, we were not allowed to answer these questions under the conditions of the treatment protocol because these questions concerned the 'how'. Similarly, parents who received the intervention on sensitive feeding regularly asked questions about what kind of vegetables they could offer their child at a certain age, or how they could increase their child's vegetable intake, which we could not answer because these questions concerned the 'what'. Although this procedure was inevitable for the purposes of our study, it made us realize that integrating the different types of advice into one program would probably be more effective and more helpful to parents. When we asked parents to evaluate the interventions, some parents in the combined intervention group indeed suggested to incorporate advice on vegetable intake within the VIPP-FI program. Moreover, such a more integrated program could use video-feedback to not only promote sensitive feeding, but could also be specifically aimed at the promotion of healthy food intake.

Future research directions

Samples 'at risk'

The first important implication of our study is that future studies should test parenting interventions in a sample that consists of families selected for needing assistance regarding their child's eating behavior and health. Examples are families with children with low vegetable intake, parents who show high levels of pressure to eat, or toddlers who show picky eating behavior. Our study suggests that there might be a considerable percentage of families in the general population that do not particularly need advice on healthy food intake, at least not during the first years of life. Moreover, unhealthy eating habits are mostly found to arise or at least increase after these first years of life. For example, food consumption studies show that sugar intake (based on food as well as beverages) substantially increases with age (e.g., Plaza-Díaz, Pastor-Villaescusa, Rueda-Robles, Abadia-Molina, & Ruiz-Ojeda, 2020; Wang, Guglielmo, and Welsh, 2018). Therefore, in the general population, intervention efforts might be more usefully targeted at somewhat older children. Severe eating problems during the first years of life may only concern a smaller, more specific group; this group perhaps *could* benefit from the interventions we tested in our trial. If one would focus on such families that already need guidance,

intervention efforts may benefit the child more. Several studies have already proven the effectiveness of such targeted secondary prevention programs for behavioral problems in young children (e.g. ADHD (Feil et al., 2016), or aggression (Mytton, DiGuiseppi, Gough, Taylor, & Logan 2007)). Moreover, VIPP-SD (the intervention that VIPP-FI was based on) has also been shown to be effective in improving child outcomes in risk groups, i.e. children with externalizing problems (Bakermans-Kranenburg et al., 2008; Juffer & Steele, 2014; Van Zeijl et al., 2006), so it seems fruitful for future studies to further examine the effectiveness of VIPP-FI on children with more severe eating problems.

However, before VIPP-FI is suitable to be tested in a sample with for example severe picky eaters, a few adaptations are suggested. First, additional sessions should be designed around toddlerhood, when picky eating behavior is likely to develop and increase. Second, because mealtimes with children who frequently show picky eating behavior can be challenging, it may be important to have sessions with less time in between than was the case in our study (e.g. 2-3 weeks, similar to VIPP-SD). Finally, parents should be provided with more tools on how to deal with things like food refusal. For example, the general advice through VIPP-FI is to avoid pressure, but for children that show severe pickiness, a certain level of positive stimulation could be beneficial. Moreover, because we wanted to separate the effects of *what* and *how*, VIPP-FI did not include advice on vegetable intake, while it could be fruitful to include such practical tips as well and maybe even videotape their implementation, such as offering multiple vegetables to choose from, involving the child when cooking the meal, or modeling consumption of healthy food. Parents who received the intervention on vegetable exposure, that was not found to be effective in improving child health outcomes, did receive such practical tips, but only on paper. It might be more powerful to actually practice these strategies with parents and to discuss their effect by means of video feedback. Finally, although we were not able to prove positive effects of VIPP-FI on child behavior at 18 and 24 months, video feedback may still be a powerful method in the first year of life. In the present dissertation, no effects were measured in the first year, but it would be fruitful to further examine its effects on parent and child during the infancy period. Through video feedback, parents can be taught how to sensitively feed their infant from the first bites onwards. To conclude, because in the current trial VIPP-FI promoted sensitive maternal feeding behavior, it is useful to further examine its effectiveness in other samples, such as infants with feeding problems, or toddlers with high levels of food fussiness. Video feedback seems a promising method to provide insight in a feeding interaction, to teach parents to correctly interpret the behavior of their child, and respond while respecting the child's wishes and needs, thereby increasing positive experiences in both parent and child.

Broader context

The fact that we did not find VIPP-FI to be effective in changing child health outcomes may also suggest that parental behavior is not the sole influencer of child behavior, but is only one pathway in a larger, complex system. This is in line with Bronfenbrenner's *social ecological model* (Bronfenbrenner, 1979). As described in **Chapter 1**, it is important to consider that several factors may influence the feeding process and child health outcomes, such as child factors (e.g., genetic taste capabilities, appetite, temperament), care by others (day care, grandparents), or the broader culture (e.g., the socio-economic context, food availability, food culture), and that these often result in a complex interplay that differs across dyads. Although there are many studies on these individual pieces of the puzzle, it would be interesting to design more overarching studies that include more of these elements, and to examine and compare their contribution to the feeding process. For example, there are studies that suggest little malleability in child eating behavior due to genetic influence (Llewellyn, Van Jaarsveld, Johnson, Carnell, & Wardle, 2010; Llewellyn et al., 2012), studies that indicate that child temperament is involved in the etiology of eating behavior (Steinsbekk, Bjørklund, Llewellyn, & Wichstrøm, 2020), or studies on how cultural attitudes and norms influence dietary patterns (Larson & Story, 2009). Unfortunately, studies looking at the bigger picture that examine and integrate parent and child correlates on individual level (e.g. genetics or temperament), interpersonal level (e.g. parent-child interaction) as well as socio-cultural level (e.g. socio-economic context) are lacking. Such insights are needed to determine what is required to improve dietary patterns, and what approaches to improving healthy eating behavior are likely to succeed. Consistent with ecologic models of behavior, improvements in eating behavior are probably most likely to result from interventions that succeed in making changes on more than one level, and it is important for researchers to think about how to achieve this (Booth et al., 2001; Bronfenbrenner & Morris, 2006).

Replication

Another recommendation for future studies is to include fathers as well. Because mothers are usually the ones who take care of feeding their child during the first year, it made sense for the BFB study to only focus on mothers to be able to optimally compare the families and the effectiveness of interventions. However, earlier studies imply that mothers and fathers may approach child feeding differently (Tan, Domoff, Pesch, Lumeng, & Miller, 2020). With respect to sensitive feeding behavior, some studies found fathers to use more insensitive feeding practices compared to mothers (Orrell-Valente et al., 2007; Tschann et al., 2013; Wendt et al., 2015), while others found fathers to report less insensitive feeding practices (Walton et al., 2019), or no differences at all (Haycraft & Blissett, 2008). More research involving the role of fathers regarding child feeding practices is needed. Moreover, interventions may be more likely to have positive effects on the child when both parents are actively involved in the process, instead of solely the mother. When performing video

feedback, videos could be discussed with both parents, to enhance their positive feeding strategies and align their approach towards the child.

Similarly, more research involving non-Western cultures is warranted. Studies have revealed several differences in feeding practices across cultures, such as the use of pressure to eat, restriction, modelling, or the parents perception of a healthy weight (Blissett & Bennett, 2013; Blissett & Jaylani, 2018; Gu, Warkentin, Mais, & Carnell , 2017; Van Eijsden, Meijers, Jansen, de Kroon, & Vrijkotte,, 2015). Moreover, there is evidence that several ethnic minority groups in Western countries are at higher risk of developing childhood overweight and obesity (Brug et al., 2012; Pollestad Kolsgaard et al., 2008; Saxena et al., 2004; Singh, Siahpush, & Kogan, 2010; Will, Zeeb, & Baune 2005). In the Netherlands, a recent study showed that 19.6% of nonwestern migrants were overweight, compared to 11.4% of the ethnic Dutch (Seidell & Halberstadt, 2020). Therefore, it is important to evaluate intervention programs in these particular groups.

Finally, to be able to compare advice on what and how and answer the main question of the present trial, it is important to replicate the present study. For our combined intervention group, one intervention containing the elements of what and how could be designed and evaluated, instead of two separate interventions. When replicating our study, researchers should aim to include a sample that represents the general population even better, for example in terms of socio-economic position or ethnicity, or by including fathers as well.

Implications for practice

One of the most important outcomes in the present dissertation is that VIPP-FI was effective in enhancing sensitive maternal feeding behavior, even in our generally already well-performing sample. When considering all positive effects of other VIPP modules so far, it is plausible that VIPP-FI is an effective method to at least promote a positive atmosphere during a very important daily routine activity - the family meal – even if it does not promote more healthy eating. Future studies should aim to replicate the positive findings on sensitive feeding behavior, further test effects on child health outcomes, and specifically evaluate VIPP-FI in samples at risk.

A second implication for practice that flows from this dissertation, is that when observing general parent-child interaction, it is important for practitioners to observe multiple situations that reflect the variety of behavior in daily family life. **Chapter 4** showed that when children show challenging behavior in a certain situation, it is more difficult for parents to respond in a sensitive way, which complicates the interaction. It is important for scientists, practitioners as well as parents to be aware that certain daily life situations are more challenging than others, and that parents are not alone when struggling with certain parenting situations. It is also important for practitioners to be aware that an

observation of parental behavior in a certain context is not necessarily generalizable to parental behavior in another context, let alone to the general quality of parental behavior. To better understand parent-child dynamics and to support parents more effectively, it is important for future studies to focus on how parent-child interaction can be expressed differently across situations.

A final suggestion for practice would be to start screening infants for more severe feeding problems during the first years of life, for example at child welfare centers, to be able to provide support to families that encounter difficulties at an early stage. For example, a Dutch study evaluated a screening instrument specifically designed to detect problems during the transition to solid food in the first year of life (Van der Heul, Lindeboom, & Haverkort, 2015). Such an instrument might be useful to detect feeding problems early.

Conclusion

Mealtimes are daily interactions that can be challenging to both parent and child, especially during toddlerhood. The present dissertation showed that video feedback can increase parental sensitive feeding behavior during the period of complementary feeding, although more research is needed to see if this method is beneficial to children's wellbeing as well. When positive experiences can be created during the first few years, they are likely to set the tone for future feeding interactions, enabling children to develop healthy eating habits and behaviors. However, positive feeding interactions are only one piece of the puzzle that needs to be solved to increase healthy eating habits and decrease the prevalence of obesity. Collaboration in research and practice, involving parents, children, daycare, schools, community and government is essential to ultimately create an even healthier society.

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Nederlandse samenvatting (Summary in Dutch)

De prevalentie van overgewicht en obesitas is gedurende de afgelopen decennia wereldwijd toegenomen (Dabas & Seth, 2018; Ebbeling et al., 2002; Kiefner-Burmeister & Hinman, 2020; Wang & Lobstein, 2006). Net als bij volwassenen, zijn de mogelijke fysieke en psychologische gevolgen van overgewicht ook in de kindertijd groot, en omvatten onder andere verhoogde kans op diabetes, hoge bloeddruk, laag zelfbeeld, gepest worden, en verdriet (Bray et al., 2017; Janssen et al., 2004; Strauss, 2000; Widhalm, 2018). Preventie in de vroege kindertijd wordt gezien als een belangrijk middel om de mondiale obesitasproblematiek terug te dringen (Widhalm, 2018). Om dit doel te bereiken, is het essentieel om gezonde eetgewoonten al vanaf de babytijd te stimuleren.

Ongezonde eetgewoonten, zoals het eten van teveel calorierijk voedsel, eten terwijl er geen sprake is van honger, of lage groente-inname vergroten het risico op overgewicht en obesitas (Lansigan et al., 2015; Schwingshackl et al., 2015). Al vanaf de vroege peuterleeftijd eten kinderen teveel calorierijk voedsel, en te weinig groente en fruit (Denney et al., 2017; Emmett & Jones, 2015; Fox et al., 2004; Goldbohm et al., 2016; Ocké et al., 2008). Zo wijzen studies uit dat tussen de 40 en 80% van de Nederlandse kleuters dagelijks onvoldoende groente eten (Goldbohm et al., 2016; Ocké et al., 2008). Daarnaast vonden twee recente studies dat zo'n 40-70% van de kinderen tussen 1 en 4 jaar eten zonder honger te hebben en dus verminderde zelfregulatievaardigheden hebben, waarmee ze op deze jonge leeftijd al risico lopen op overeten en het ontwikkelen van overgewicht (Fogel et al., 2018; Schultink et al., 2021).

Eten is een immense ontwikkelingstaak tijdens de eerste levensjaren van een kind. Na een aantal maanden van louter melkvoeding, begint de transitie naar vaste voeding, die in Westerse landen meestal op de leeftijd van 4-6 maanden plaatsvindt. Dit proces wordt gezien als een kansrijke periode om eetgedrag te beïnvloeden, omdat het fundament voor de relatie van een kind met eten tijdens deze eerste ervaringen wordt gevormd (Van Dijk et al., 2012). In de vroege kindertijd zijn het de ouders die beslissingen nemen over het eetpatroon van hun kind. Elke dag beslissen zij *wat* er wordt aangeboden, *wanneer* dit wordt aangeboden, en *hoe* dit wordt aangeboden, waarmee zij de eerste ervaringen van het kind op allerlei manieren beïnvloeden. Om gezonde eetgewoonten vanaf de vroege kindertijd te bevorderen en overgewicht te voorkomen, is het van belang om te onderzoeken hoe ouders het voeden van hun kind het beste aan kunnen pakken. Hoewel vele studies tot nu toe het effect hebben bestudeerd van welk soort voeding wordt aangeboden (= wat), wordt het belang van *hoe* voeding wordt aangeboden, ofwel hoe ouders met hun kind omgaan tijdens eetmomenten, steeds meer onderstreept (Black & Aboud, 2011; DiSantis et al., 2011; Hurley et al., 2011). Zo lieten eerdere studies zien dat 25 tot 40% van de ouders problemen rapporteerden met het voeden van hun kind, zoals

het weigeren van eten en kieskeurigheid (Mitchell et al., 2013; Reau et al., 1996). Omdat ouders zo'n belangrijke rol spelen in het beïnvloeden van de ervaringen van hun kind met eten, en hiermee in de ontwikkeling van de gezondheid en het gewicht van hun kind, is het van belang dat ouders wetenschappelijk onderbouwde adviezen en richtlijnen ontvangen over *wat* ze het beste kunnen aanbieden, maar ook over *hoe* ze het beste met hun kind om kunnen gaan tijdens eetmomenten. Dit proefschrift, dat gebaseerd is op gegevens afkomstig uit het overkoepelende Baby's Eerste Hapjes onderzoek, bestudeert de interactie tussen ouder en kind tijdens eetmomenten (= hoe), en welke rol de kwaliteit van deze interactie speelt in het eetgedrag van baby's en peuters.

Het onderzoek Baby's Eerste Hapjes

In **Hoofdstuk 2** wordt de opzet van het onderzoek Baby's Eerste Hapjes uitvoerig beschreven. Het onderzoek werd ontworpen om meer te weten te komen over de effectiviteit van twee adviesprogramma's voor ouders ter bevordering van het eetgedrag van hun kinderen, zoals groente-inname en zelfregulatie met betrekking tot eten, ook wel *eten naar behoefte* genoemd. Ook werd gekeken naar het gewicht van de kinderen, en naar het voedingsgedrag van ouders. Het eerste adviesprogramma richtte zich op het dagelijks aanbieden van groente (*wat*). Deze interventie was gebaseerd op een interventie uitgevoerd in een eerdere studie (Barends et al., 2014; Barends et al., 2013), waarbij de baby vanaf de eerste hapjes vaste voeding dagelijks volgens een vaststaand schema groente aangeboden kreeg gedurende zo'n drie weken, ook wel de techniek van *herhaaldelijke blootstelling* genoemd. In de studie van Barends en collega's, werd een positief effect gevonden na drie weken, en ook nog rond de leeftijd van 12 maanden, maar was het effect met 21 maanden weer verdwenen (Barends et al., 2014; Barends et al., 2013). Om ervoor te zorgen dat kinderen ook na de leeftijd van 12 maanden meer groente bleven eten, hebben we binnen onze studie de interventie van Barends en collega's uitgebreid, door vijf telefoonsessies te houden met moeder verspreid over ongeveer een jaar, waarbij extra adviezen werden gegeven om de groente-inname van het kind te vergroten.

Het tweede adviesprogramma ging over hoe ouders het beste op hun kindje kunnen reageren tijdens voedingsmomenten, en had als doel om sensitief voedingsgedrag van moeder te bevorderen (*hoe*). De interventie heette Video-feedback Interventie to promote Positive Parenting – Feeding Infants (VIPP-FI), en was gebaseerd op de bewezen effectieve interventie VIPP – Sensitive Discipline (VIPP-SD) (Bakermans-Kranenburg et al., 2008; Juffer & Steele, 2014; Juffer et al., 2017; Mesman et al., 2008; Van Zeijl et al., 2006). Moeders die deze adviezen ontvingen werden vijf keer thuis bezocht, opnieuw verspreid over een periode van een jaar, om gemaakte video-opnames van moeder en kind tijdens voedingsmomenten te bespreken. Door middel van positieve feedback werd sensitief voedingsgedrag aangeleerd, bijvoorbeeld door moeders alert te maken op de signalen

van hun kind, en ze te leren om het voedingsmoment te beëindigen als hun kind aangaf genoeg te hebben.

Bij aanvang van de studie werden moeder en kind ingedeeld in één van de vier onderzoekscondities: de eerste groep ontving adviezen over groente, de tweede groep adviezen over sensitief voeden, de derde groep volgde beide adviesprogramma's, en de laatste groep was een controlegroep, die telefoongesprekken zonder gerichte adviezen ontving op dezelfde vijf momenten. Adviezen werden gegeven vanaf de eerste hapjes vaste voeding tot aan een leeftijd van 16 maanden, en werden geëvalueerd toen de kindjes 18 en 24 maanden oud waren. Het voornaamste doel van de studie was om te achterhalen welke aanpak ter bevordering van gezond eetgedrag nu het meest effectief is: een aanpak gericht op wat, hoe of wellicht allebei.

Moeder-baby interactie tijdens de allereerste hapjes

De eerste empirische studie van dit proefschrift staat beschreven in **Hoofdstuk 3**, en richtte zich op de interactie tussen moeder en baby tijdens de eerste hapjes vaste voeding. Positieve ervaringen met de introductie van vaste voeding in het eerste levensjaar, zouden positieve associaties met eten en voeden kunnen stimuleren bij zowel ouder als baby (Van Dijk et al., 2012). Het voedingsgedrag van ouders en het eetgedrag van de baby zouden elkaar hierbij positief kunnen beïnvloeden. Voeden op een sensitieve manier, waarbij de ouder prompt en adequaat inspeelt op de signalen van het kind tijdens het voedingsmoment, hangt samen met positief eetgedrag (DiSantis et al., 2011; Lindsay et al., 2017; Spill et al., 2019). Naast sensitief voeden, bekeken we in deze studie ook het affect van moeder, wat in de voedingscontext nog nooit eerder is onderzocht bij baby's. We maakten onderscheid tussen positief affect, gedefinieerd als een warme benadering door middel van bijvoorbeeld lachen of het geven van complimenten, en negatief affect, gedefinieerd als een meer negatieve benadering vanuit de ouder, zoals irritatie of een ruwe aanpak. Bij het bestuderen van de relatie tussen sensitief voeden en positief/negatief affect van moeder aan de ene kant, en eetgedrag van het kind aan de andere kant, hebben we gebruik gemaakt van een zogenoemd kruislings model, wat ons de mogelijkheid gaf om de relatie in beide richtingen te bekijken. Als je ouder-kind interactie bestudeert, is het immers van belang om ervan uit te gaan dat ouder en kind elkaar wederzijds kunnen beïnvloeden (Newton et al., 2014). Eerdere studies lieten al zulke bidirectionele effecten zien tussen voedingsgedrag van ouders en kindkenmerken als eetgedrag en BMI (Afonso et al., 2016; Fildes et al., 2015; Jansen et al., 2017; Webber et al., 2010), maar geen enkele studie onderzocht zulke relaties tijdens de allereerste hapjes vaste voeding.

Binnen onze studie werden twee voedingsmomenten geobserveerd op twee aaneengesloten dagen, waarbij de baby zijn/haar allereerste hapjes vaste voeding ontving. Uit de resultaten kwam ten eerste naar voren dat alle gemeten constructen

van zowel moeder als kind enige stabiliteit lieten zien van het eerste naar het tweede voedingsmoment, wat wil zeggen dat het voedingsgedrag dat moeder liet zien op Dag 1 samenhing met het voedingsgedrag op Dag 2, en dat de groente die de baby at en hoe lekker hij/zij deze vond op Dag 1 samenhing met deze maten op Dag 2. Ten tweede is onze studie de eerste die liet zien dat kinderen van moeders die sensitief en positief voedingsgedrag lieten zien tijdens de eerste hapjes, meer van de voeding aten en het eten meer waardeerden.. Wel werd dit verband met name tijdens het tweede voedingsmoment gevonden en niet altijd tijdens het eerste voedingsmoment, wat suggereert dat het ouder-kind paar tijdens het tweede voedingsmoment wellicht beter op elkaar afgestemd was dan tijdens het eerste voedingsmoment. Ten derde vonden we dat de mate waarin het kind de voeding waardeerde tijdens het eerste voedingsmoment, de mate van sensitiviteit van de moeder tijdens het tweede voedingsmoment voorspelde, terwijl moedergedrag tijdens het eerste voedingsmoment de inname of waardering van het kind tijdens het tweede voedingsmoment niet bleek te voorspellen. Deze bevinding onderstreept dat het van belang is om altijd rekening te houden met de mogelijkheid dat kindgedrag ook oudergedrag uitlokt, en niet alleen andersom. Samenvattend is het bij het bestuderen van voedingsinteracties van belang om er rekening mee te houden dat relaties twee kanten op werken.

Sensitiviteit van moeders tijdens maaltijden en spelsituaties

In **Hoofdstuk 4** staan de resultaten van onze tweede empirische studie beschreven, waarbij we onder andere onderzochten of sensitiviteit van moeders van kinderen van 18 maanden tijdens een spelsituatie verschilde van sensitiviteit van de moeder tijdens maaltijden. Sensitiviteit, of het vermogen om de signalen van het kind waar te nemen, correct te interpreteren, en prompt en adequaat te reageren, wordt gezien als een belangrijke indicator van de kwaliteit van ouder-kind interactie (Ainsworth et al., 1974). Vele onderzoeken hebben aangetoond dat sensitiviteit van ouders gerelateerd is aan positieve kinduitkomsten op verschillende domeinen (Bakermans-Kranenburg et al., 2003; De Wolff & van IJzendoorn, 1997; Kochanska, 2002; Van IJzendoorn et al., 2004). Tevens hebben studies aangetoond dat sensitiviteit van ouders situatie-specifiek kan zijn, en dus verschillend tot uiting kan komen afhankelijk van de context (Branger et al., 2019; Costanzo & Woody, 1985; Joosen et al., 2012; Seifer et al., 1992).

Een context waarin sensitiviteit tot nu toe nog weinig onderzocht is, is ouder-kind interactie tijdens de maaltijd, en ook is die context nog nooit vergeleken met sensitiviteit in een andere context. Omdat ouders veelal bepaalde doelen voor ogen hebben tijdens de maaltijd met hun kind, zoals groei en gezondheid, zou de maaltijd een setting kunnen zijn die gevoelig is voor conflict tussen ouder en kind, waarbij het moeilijker is voor ouders om sensitief te zijn. Bovendien zou de manier waarop een kind zich gedraagt tijdens de maaltijd de situatie voor ouders kunnen verergeren, of juist verzachten. Een tweede doel

van de studie was dan ook om te bekijken of, mocht er een verschil zijn in sensitiviteit tussen beide situaties, dit verschil verklaard zou kunnen worden door het eetgedrag van het kind.

Resultaten van de studie lieten zien dat moeders inderdaad minder sensitief waren tijdens maaltijden dan tijdens vrij spel. Ook vonden we dat geobserveerd eetgedrag van het kind, namelijk uitdagend gedrag en genieten van de maaltijd, gerelateerd was aan sensitiviteit van moeder tijdens de maaltijd. Kinderen van meer sensitieve moeders lieten minder uitdagend gedrag zien, en genoten volgens moeder ook meer van het eten. Tot slot vonden we dat het gevonden verschil in sensitiviteit tussen maaltijd en vrij spel verklaard werd door geobserveerd uitdagend gedrag van het kind tijdens de maaltijd: hoe meer uitdagend gedrag het kind liet zien, hoe groter het verschil tussen sensitiviteit tijdens de maaltijd en vrij spel. Deze bevindingen onderstrepen dat de maaltijd tijdens de (vroege) peuterleeftijd een uitdagende situatie kan zijn voor ouders. Daarnaast is een belangrijke conclusie dat gedrag van ouders per opvoedsituatie verschillend tot uiting kan komen. Indien men sensitiviteit observeert, binnen onderzoek of in de praktijk, is het dus van belang om rekening te houden met de context die men observeert, en indien mogelijk om diverse contexten te observeren om een beeld te vormen dat zo goed mogelijk de werkelijkheid reflecteert.

Wat versus Hoe: effectiviteit van interventies op de gezondheid van kinderen en het voedingsgedrag van moeders

De resultaten van onze studie naar effectiviteit van de interventies gericht op blootstelling aan groente (*wat*) en sensitief voedingsgedrag (*hoe*), staan beschreven in **Hoofdstuk 5**. Het voornaamste doel van het project Baby's Eerste Hapjes was om gezonde eetgewoonten van kinderen te bevorderen, maar onze interventies lieten rond de leeftijd van 18 en 24 maanden geen effect zien op groente-inname van het kind en eten naar behoefte. Wel vonden we dat het percentage kinderen met overgewicht het laagst was in de onderzoeksconditie waarin ouders beide adviesprogramma's over *wat* en *hoe* hadden gevolgd, zowel rond de leeftijd van 18 als 24 maanden. Deze bevinding moet echter met voorzichtigheid geïnterpreteerd worden, omdat het aantal kinderen met overgewicht in alle groepen nog relatief klein was, en omdat we geen effect vonden op andere maten met betrekking tot het gewicht van het kind. Tot slot was onze interventie gericht op sensitief voeden (VIPP-FI) effectief in het verbeteren van sensitief voedingsgedrag bij moeders rond de leeftijd van 18 maanden. Rond 24 maanden waren interventie-effecten nagenoeg verdwenen en deden alle vier de groepen het dus weer ongeveer even goed. Het verdwijnen van interventie-effecten, is mogelijk te wijten aan de opkomst van de fase van kieskeurig eetgedrag, die rond deze leeftijdsperiode bij veel kinderen intreedt. Andere bevindingen waren in lijn met deze gedachte, zoals minder groente-inname rond

24 maanden dan rond 18 maanden, en meer druk vanuit moeders om kinderen te laten eten.

Een belangrijke verklaring voor het uitblijven van verschillen daar waar we ze wel verwacht hadden, is het feit dat alle groepen op de meeste uitkomstmaten hoog scoorden. Zo aten kinderen in alle vier de groepen gemiddeld veel meer dan de Aanbevolen Dagelijkse Hoeveelheid voor groente, en lieten moeders in alle groepen gemiddeld al een hoge mate van positief voedingsgedrag zien. Vanwege deze sterk presterende steekproef, was het lastig om positieve effecten van de interventies aan te tonen. Een andere verklaring zou kunnen zijn, dat gunstige effecten voor het kind wat later alsnog op zouden kunnen treden. Zo zou het kunnen dat het nog te vroeg was om een positief effect te zien van sensitief voedingsgedrag op de zelfregulatievaardigheid van het kind. De nameting rond 36 maanden, die nog geanalyseerd moet worden, zal weer meer informatie geven over de effecten van de twee interventies, zodat de hoofdvraag binnen onze studie over de effectiviteit van *Wat* versus *Hoe* beantwoord kan worden.

Aanbevelingen voor toekomstig onderzoek

De eerste aanbeveling die voortkomt uit ons onderzoek, is dat toekomstige studies interventies zoals deze zouden kunnen toetsen in een steekproef die bestaat uit gezinnen die bij voorbaat al ondersteuning kunnen gebruiken met betrekking tot het eetgedrag van hun kind. Voorbeelden zijn gezinnen met kinderen die moeizaam groente eten, of peuters die in het algemeen veel kieskeurig eetgedrag laten zien. Omdat onze video-feedback interventie effectief was in het verbeteren van sensitief voedingsgedrag, zou het nuttig zijn om deze methode, voorzien van relevante aanpassingen, toe te passen in gezinnen zoals hierboven beschreven.

Een tweede aanbeveling betreft het ontwerpen van studies die meerdere factoren onderzoeken die invloed kunnen hebben op het eetgedrag van een kind. Oudergedrag is niet het enige wat invloed heeft, maar is slechts één factor binnen een groter, complex systeem. Het is van belang om te bedenken dat er vele factoren zijn die het voedingsproces en kinduitkomsten kunnen beïnvloeden, zoals kindfactoren (bijvoorbeeld genetica of temperament), opvang door anderen (kinderdagverblijf, grootouders), of de bredere cultuur (bijvoorbeeld de sociaaleconomische context, beschikbaarheid van voedsel), en dat deze vaak resulteren in een complexe interactie die voor elk ouder-kind paar verschilt. Het zou dan ook interessant zijn om meer overkoepelende studies te ontwerpen waarin meerdere van deze elementen worden onderzocht, en hun bijdrage aan het voedingsproces en het eetpatroon te vergelijken. Er bestaan genoeg studies die kijken naar deze elementen op een individueel niveau, maar er zijn nog geen studies die deze elementen binnen één studie integreren. Zulke nieuwe inzichten kunnen gebruikt

worden om meer inzicht te krijgen in wat er nodig is om de eetgewoonten van kinderen te verbeteren.

Een derde en laatste aanbeveling is om het onderzoek binnen dit proefschrift te repliceren, zowel in een vergelijkbare steekproef, als in steekproeven met een andere samenstelling. Zo is van belang om ook vaders te betrekken binnen onderzoek naar voedingsinteracties. Omdat moeders doorgaans degenen zijn die de grootste rol spelen in het voeden van hun baby tijdens het eerste levensjaar, kozen we ervoor om ons binnen onze studie te focussen op moeders, zodat we gezinnen en de effectiviteit van interventies optimaal konden vergelijken. Omdat er studies zijn die laten zien dat moeders en vaders het voeden van kinderen verschillend benaderen (Tan et al., 2020), is van belang hier meer onderzoek naar te doen. Ook zou het zo kunnen zijn dat interventies effectiever zijn als ze actief op beide ouders worden gericht, in plaats van op één van beiden. Daarnaast is van belang om meer onderzoek te doen naar voedingsinteracties in niet-Westerse culturen, zowel binnen als buiten Nederland. Diverse onderzoeken hebben culturele verschillen aangetoond in voedingsgedrag (Blissett & Bennett, 2013; Blissett & Jaylani, 2018; Gu et al., 2017; van Eijsden et al., 2015). Daarnaast hebben bepaalde minderheidsgroepen in Westerse landen een groter risico om overgewicht te ontwikkelen, wat maakt dat het van belang is om interventies te toetsen in deze groepen (Brug et al., 2012; Pollestad Kolsgaard et al., 2008; Saxena et al., 2004; Singh et al., 2010; Will et al., 2005).

Aanbevelingen voor de praktijk

Een van de belangrijkste bevindingen van dit proefschrift, is dat VIPP-FI effectief was in het verbeteren van sensitief voedingsgedrag, ondanks onze sterk presterende steekproef. Als je de bewezen effectiviteit van andere VIPP modules samen met ons resultaat in ogenschouw neemt, is het waarschijnlijk dat de VIPP-FI een effectieve methode kan zijn om in elk geval een positieve sfeer te bevorderen tijdens een belangrijke dagelijkse routine: de gezinsmaaltijd. Voordat de methode geïmplementeerd kan worden in de praktijk is het echter nodig dat toekomstige studies de effectiviteit repliceren, en VIPP-FI toetsen in steekproeven die bestaan uit gezinnen die al problemen ondervinden met het voeden van hun kind.

Een tweede implicatie voor de praktijk is dat het van belang is om bij het observeren van ouder-kind interacties meerdere situaties te observeren die een diversiteit aan gedrag in het dagelijkse gezinsleven laten zien. Het is van belang voor wetenschappers, praktijkbeoefenaars en ouders om zich ervan bewust te zijn dat sommige dagelijkse opvoedsituaties uitdagender zijn dan andere. Ook is van belang om oudergedrag in een bepaalde situatie niet zomaar te generaliseren naar oudergedrag in een andere situatie, of naar de algemene opvoedkwaliteit van ouders. Om de dynamiek tussen ouders en kinderen beter te begrijpen en ouders effectiever te kunnen ondersteunen, is meer

kennis nodig over hoe oudergedrag verschillend tot uiting kan komen afhankelijk van de opvoedsituatie.

Tot slot is van belang om jonge kinderen te screenen op voedingsproblemen, zodat ernstigere problemen tijdiger aan het licht komen. Zo werd binnen een studie in Nederland een screeningsinstrument ontwikkeld om problemen te achterhalen tijdens de overgang naar vaste voeding (Van der Heul et al., 2015). Een instrument als deze zou gebruikt kunnen worden op consultatiebureaus, om voedingsproblemen in een vroeg stadium te signaleren om vervolgens tijdig hulp te kunnen bieden.

Conclusie

Maaltijden zijn dagelijkse interacties die uitdagend kunnen zijn voor zowel ouder als kind, met name tijdens de peuterleeftijd. Dit proefschrift liet zien dat video feedback sensitiviteit van ouders tijdens maaltijden kan vergroten, hoewel meer onderzoek nodig is om na te gaan of het welzijn van kinderen ook positief beïnvloed wordt. Als positieve ervaringen al tijdens de eerste levensjaren gecreëerd kunnen worden, leggen ze mogelijk de basis voor positieve ervaringen in de toekomst, waardoor kinderen gezonde eetgewoonten kunnen ontwikkelen. Toch zijn positieve voedingsinteracties slechts één stuk van de complexe puzzel die opgelost dient te worden om ongezonde eetgewoontes, overgewicht en obesitas terug te dringen. Samenwerking tussen onderzoekers en praktijkbeoefenaars, met betrokkenheid van ouders, kinderen, kinderdagverblijven, scholen, gemeenten, en overheid, is essentieel om uiteindelijk een gezondere maatschappij te creëren.

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Curriculum Vitae

Merel van Vliet werd geboren op 17 december 1986 te Tuitjenhorn (NH). In 2005 behaalde ze haar gymnasiumdiploma aan de Gemeentelijke Scholen Gemeenschap te Schagen. Aansluitend volgde zij de opleiding Docent Muziek aan het Koninklijk Conservatorium te Den Haag (hoofdvak klassiek piano), en studeerde in 2009 cum laude af. Vervolgens volgde zij de bacheloropleiding Pedagogische Wetenschappen aan de Universiteit Leiden en aansluitend de research master *Developmental Psychopathology in Education and Child Studies* (specialisatie Orthopedagogiek). Gedurende haar masteropleiding volgde Merel een klinische stage op het spreekuur Ontwikkelingsstoornissen aan het Ambulatorium van de Universiteit Leiden. Naast haar studie werkte ze als muziekdocent in het primair onderwijs, en als woonbegeleider op een woongroep voor ernstig verstandelijk beperkte volwassenen. Na het behalen van haar masterdiploma in 2014, werkte Merel voor korte tijd als onderwijs- en onderzoeksassistent op de afdeling Orthopedagogiek van de Universiteit Leiden. Daaropvolgend startte zij haar promotietraject in 2015 bij de programmagroep Opvoeding en Ontwikkeling aan de Universiteit Leiden, bij het onderzoeksproject *Baby's Eerste Hapjes* dat zich richtte op het bevorderen van gezond eetgedrag bij baby's en peuters. Merel heeft binnen dit project onderzocht hoe sensitief voedingsgedrag van ouders positief bij kan dragen aan het eetgedrag van baby's en peuters. De resultaten hiervan staan beschreven binnen dit proefschrift. Gedurende de duur van haar promotietraject was Merel tevens werkzaam als docent Pedagogische Wetenschappen. Momenteel is Merel wederom werkzaam als docent Pedagogische Wetenschappen aan de Universiteit Leiden, en geeft daarnaast video-interactie training (VIPP-SD) aan gezinnen in Rotterdam.

List of Publications

Van Vliet, M., Mesman, J., Schultink, J., Vereijken, C., Martens, V., & Van der Veek, S. (in press). Maternal sensitivity during mealtime and free play: differences and explanatory factors. *Infancy,* doi: 10.1111/infa.12465.

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