Abstract
Because infants are totally dependent upon parents (or other caregivers) for care and sustenance, parents’ feeding practices are a key feature of the family environments in which infants and young children learn about food and eating. Feeding practices include not only what the child is fed, but also the how, when, why and how much of feeding. Extensive evidence indicates that parenting behavior influences a variety of child outcomes, including cognitive and socioemotional development, as well as the development of self-regulatory skills. The focus of this chapter is on what is known about how parenting, particularly feeding practices, influences the early development of several aspects of children’s eating behavior, including the acquisition of food preferences, self-regulatory skills, children’s reactivity to food cues, satiety responsiveness and ‘picky eating’. It is argued that traditional feeding practices, which evolved to protect children from environmental threats and ensure adequate intake in the context of food scarcity, can be maladaptive in current environments. An evidence base is needed to inform public policy to reduce early obesity risk in current environments, where too much palatable food is a major threat to child health. Results of recent research provides evidence that promoting responsive feeding practices can alter the development of eating behavior, sleep patterns and early self-regulatory skills, as well as reduce early obesity risk.

Introduction
During the first years after birth, normally developing children reach important developmental milestones: they learn to sit, crawl, stand, walk, talk and sleep through the night. They also learn to eat, and by the end of the second year of life, their patterns of intake have been transformed from the exclusive milk diet
of early infancy to a modified adult diet, quite similar to the diets of other family members [1]. Of course, the eating behaviors of other family members are an important aspect of the early environment, affecting foods available to the infant and providing many opportunities for observational learning. Because infants are totally dependent upon parents (or other caregivers) for care and sustenance, parents’ feeding practices are a key feature of the family environments in which young children learn about food and eating. Feeding practices include not only what the child is fed, but also the how, when, why and how much of feeding.

Extensive evidence indicates that parenting behavior influences a variety of child outcomes, including cognitive and socioemotional development, as well as the development of self-regulatory skills [2]. The focus of this chapter is on what is known about how parenting, particularly feeding practices, influences the early development of several aspects of children’s eating behavior, including the acquisition of food preferences, self-regulatory skills, children’s reactivity to food cues, satiety responsiveness and ‘picky eating’. In this chapter, the evidence presented includes findings from both basic research and primary prevention trials focused on altering parenting and feeding practices hypothesized to affect the development of children’s eating behavior during the first years of life [3].

During the first years of life, plasticity is high, and children ‘come equipped’ to learn to like and eat the diet that is available to them. These genetic predispositions include unlearned biases to like and ingest sweet, salty and umami tastes, and to reject sour and bitter. Second, they have a conservative, potentially protective bias to be ‘neophobic’, initially rejecting unfamiliar flavors and bad tasting, potentially toxic sour or bitter foods. These predispositions evolved in a very different food environment, where food, and especially sweet- and salty-tasting food, was relatively scarce, and food safety risks relatively high. In the current obesogenic food environment, industry has designed foods to be so exquisitely tuned to these taste biases, that they are no longer adaptive. Unless feeding practices are in place that promote experience with new foods to reduce neophobia, the result is young children eat diets too high in added sugar, salt and fat, and too low in vegetables, which are dominated by bitter and more likely to be avoided.

It is argued below that many traditional feeding practices, which also evolved to protect children from environmental threats and ensure adequate intake in the context of food scarcity, are also maladaptive in current environments. Evidence-based policy is needed to inform how these traditional practices can be redesigned and adopted, serving to reduce obesity risk in current environments, where too much palatable food is a major threat to children’s health [4, 5].
Parents provide genes and also play a powerful role in shaping the environments for gene expression. Early postnatal environments differ across families in a variety of ways, including whether the infant is fed breast milk, formula or both, the timing of introducing solids and table foods, the foods made available to the child, and schedules and routines for eating. While the focus here is on eating behavior, it is important to note that during this early period, parents and other caregivers control children’s access to screen time, and opportunities for active play and sleep [6], which also affect energy balance and health. Because about two thirds of adults are currently overweight or obese [7], most infants and young children live in families in which at least one parent is overweight or obese. Having an obese parent increases a child’s obesity risk, and intergenerational transmission of obesity is well documented [8]. However, less attention has been given to systematic differences in the family environments in which parents are or are not obese [9, 10]. There are data from observational studies indicating that obese and normal-weight parents differ in their own eating and activity patterns, and that they tend to use different feeding practices [10–12]. Obese women are less likely to exclusively breastfeed for long durations, more likely to formula feed and are more likely to encourage their infant to finish the bottle [9]. Such feeding practices are associated with overfeeding and higher weight status, and may operate conjointly with genetic risk to produce an obese phenotype. Because early parenting and feeding strategies are potentially modifiable, they are obvious targets for primary prevention [3].

Not surprisingly, with the transition to table foods, children’s diets soon resemble those of their parents and of adults in general. These diets are too high in energy, saturated fat, sugar and salt, and too low in fruits, vegetables, fiber and complex carbohydrates. However, even in infancy, the poor nutritional quality of infants’ and young children’s diets [1, 13] is evident, and the prevalence of excessive weight gain and overweight among infants and toddlers [14] underscores the need to address this issue. Data from the 2008 Feeding Infants and Toddler Study (FITS) reveal that infants’ and toddlers’ intakes exceed estimated caloric needs. Unfortunately, FITS provided no data on feeding practices or weight status, so there is an absence of evidence regarding associations between feeding practices and children’s energy intakes and weight status. Recent NHANES data also indicate that children are consuming too many foods and drinks that are high in fat and sugar, including sugar-sweetened beverages, dairy and grain desserts, and pasta dishes, which are contributing to diets in which about 40% of energy is from added sugar and fat [13].
Do Traditional Feeding Practices Increase Obesity Risk in Current Environments?

Worldwide, the nutrition transition that has occurred in recent decades has created dramatic changes in the food supply and increased the availability of palatable, energy-dense, inexpensive foods [15]. We have argued previously that in the current environment, where too much food, not too little food, is a major risk to child health, traditional child feeding practices can actually exacerbate the adverse effects of our obesogenic environment on early obesity risk, promoting excessive intake and weight gain among infants, toddlers and preschoolers [16]. Traditional parenting and feeding practices evolved to protect and nurture children in the context of food scarcity, which, until recently, constituted the major environmental threat to infants and young children’s healthy growth and development. Traditional feeding practices include offering food as the default response to infant crying, feeding frequently when food is available, providing large portions, and pressuring or forcing children [17].

Recent research reveals that higher levels of ‘feeding to soothe’ (FTS) a fussy infant are related to high infant BMI z scores, but only for infants described by their mothers as high in temperamental negativity [18]; negative infants whose mothers did not report using higher levels of FTS did not have higher BMI z scores, suggesting the key role of feeding practices in early infant weight status. A recent review also reported that excessive weight gain and obesity reported among infants who are higher in negativity may result from the more frequent use of FTS [19]. Other traditional feeding practices, including pressuring children to ‘finish the bottle’ or ‘clean their plates’, can also foster both ‘picky eating’ and excessive energy intake in today’s food environment. In one experiment, pressuring preschool children to eat a ‘healthy’ food (puréed vegetable soup) increased dislike of that food [20], making it less likely that the food would be consumed, especially if other, more palatable foods are readily available. Parental use of pressure to eat ‘healthy’ foods has also been linked to greater consumption of energy-dense sweet and savory snacks in preschoolers [21].

Another traditional practice is serving large portions of palatable foods, and there is ample evidence that young children do eat more when given larger portions of palatable entrées [22]. A recent meta-analysis indicated that doubling the size of an entrée increased children’s intake by about 20%. In addition to increasing energy intake, offering 3- to 5-year-old children larger portions of a palatable entrée can actually reduce intake of other foods on the plate, reducing fruit and vegetable intake and dietary variety at the meal [23].

Although feeding practices are often used with the intent to promote healthy patterns of intake in children, some feeding practices may disrupt the
development of self-regulation of intake, in which eating is initiated by hunger and terminated in response to satiety cues. The use of FTS, discussed above, provides one example of feeding that is initiated in response to nonhunger cues. While evidence on the effects of feeding practices on infant intake is limited, infant ‘bottle finishing’ and FTS are commonly used with infants, and there is some evidence that such practices can promote greater consumption [9].

In an ongoing clinical trial, we are currently evaluating whether it is possible to reduce the use of traditional feeding practices, including use of FTS, serving large portions and feeding beyond satiety, by teaching new mothers more responsive feeding practices, including how to recognize and use hunger and satiety cues in feeding their infants, and also providing mothers with alternatives to FTS for a crying infant [3]. Mothers also received guidance on introducing solid foods, particularly on the use of familiarization, in combination with information on age-appropriate portion sizes and foods to offer and avoid. At this point, we are still in the data collection phase of this project, but results of a previous trial were promising [24].

Learned Likes and Dislikes: Familiarization in Obesogenic Environments

With experience, things in the environment become familiar to the infant. Familiarization is a very simple form of learning. It is a process of acquiring familiarity with objects, people, actions and their consequences [25]. The distinction between the familiar and unfamiliar is important due to the fact that familiarity has a very strong evaluative component: what becomes familiar tends to become preferred, and the unfamiliar tends to be avoided and disliked [15]. Infants learn to prefer people, objects, activities and foods that become familiar. Milk, as the single first food for infants, also becomes familiar.

When weaning begins, milk provides the standard against which all other new foods and flavors are evaluated. For formula-fed infants, only the flavor of formula is familiar, but because a variety of flavors from the mother’s diet are transferred to the mother’s milk, breastfed infants have already become familiar with a variety of food flavors in the maternal diet [26]. Research of Mennella and Trabulsi [27] has revealed that these familiar flavors provide a ‘flavor bridge’, easing the transition to the foods of the adult diet consumed by the mother. In one study, breastfed infants showed more rapid acceptance of puréed vegetables during weaning, and experience with specific flavors (e.g. carrot) in breast milk promoted acceptance of that same flavor during complementary feeding. Providing early experience with a variety of flavors in puréed foods also promoted acceptance of other unfamiliar flavors [5]. Early familiarization influences the
infants’ reactions to foods introduced at weaning and shapes the development of likes and dislikes for table foods. Unfortunately, many caregivers are not aware that familiarization is necessary to increase liking and intake of new foods. Interventions can help parents to see the ‘neophobic’ rejection response as a normal reaction to new foods, not ‘picky eating’, and research has shown that providing instructions on how to use repeated exposure to promote acceptance of new foods can have positive effects on infants’ responses to novel foods [24].

As mentioned above, infants also come equipped with predispositions to prefer or reject the basic tastes [28]. These predispositions include unlearned positive responses to sweet, salty and umami tastes, and rejection of bitter and sour tastes [26], although these initial responses to basic tastes can be modified through subsequent experience with food [29–31]. Our current food environment is tuned to our unlearned predispositions and characterized by the ready availability of inexpensive, energy-dense foods that are high in sugar and salt. Infants and young children will accept these foods and beverages the first time they are offered, even without repeated experience. It is, therefore, relatively easy to establish unhealthy dietary patterns, consisting primarily or exclusively of foods high in sugar and salt, while it takes more effort by caregivers to promote acceptance of a variety of healthy foods that lack these tastes and will only be accepted with repeated experience.

The effects of exposure on the development of food and flavor preferences may differ with age and be greatest as weaning begins [5], and preferences formed in this early period can affect preferences for foods later in childhood [32]. Relatively minimal exposure can promote flavor preferences during early infancy, which may prove to be a sensitive period for learning flavor preferences [33]. In a study from our laboratory, infants who were just beginning to be offered puréed foods increased their intake of new fruits and vegetables following only a single exposure, and the effects of exposure generalized to other, similar puréed foods [34].

Learned liking or disliking of foods can also occur through associative learning, which involves the association of the food or flavor (conditioned stimulus) with the emotional tone of the unconditioned stimulus. Extensive research has provided evidence that these associative processes affect liking and intake in animal models [35], and there is evidence that associative learning processes also play an important role in the acquisition of food likes and dislikes in young children [36]. They learn to associate foods with the emotional tone (either positive or negative) of social interactions during feeding, which affects food likes and dislikes. For example, liking for snack foods was increased when the food was either given as a reward or paired with positive adult attention [36]. In another experiment, children were served two different flavors of puréed vegetable soups at lunch in a preschool setting [20]. In the treatment condition, children were pressured by the
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adult at the table to ‘finish their soup,’ while no pressure to eat was applied in the control condition. Relative to control, children consumed less soup and made more negative comments about the soup they had been pressured to eat [20].

Eating has positive postingestive consequences, including feelings of satiety, which can increase liking for the foods eaten. There is extensive evidence on flavor-postingestive consequence learning from research with animal models, revealing that flavors paired with ingestion of foods with higher energy density are preferred to those associated with lower energy density [see ref. 35 for a review]. There is some evidence for such conditioning in young children; when 2- to 5-year-old children repeatedly consumed two different novel-flavored yogurts as snacks on alternate days, which were either high or low in energy density, greater increases in liking were obtained for flavors associated with higher energy density than those paired with low energy density yogurts [37].

Finally, in flavor-flavor learning, the conditioned stimulus is an unfamiliar flavor and the unconditioned stimulus is a familiar, preferred flavor. Following repeated pairing of the two during a series of tasting trials, in which the two are consumed together, the unfamiliar flavor can become associated with the preferred flavor, increasing liking of the new flavor, even when it is subsequently consumed alone, without the preferred unconditioned stimulus flavor. A recent study compared the effects of ‘mere exposure’ familiarization and flavor-flavor conditioning on 2- to 5-year-old children’s vegetable liking and intake [38]. Flavor-flavor learning consisted of trials in which an initially disliked vegetable was tasted either alone or with a preferred sauce the child could use as a ‘dip’ for the vegetable. We hypothesized that flavor-flavor learning would produce greater increases in liking and intake compared to familiarization, but the findings indicated that both familiarization and flavor-flavor conditioning resulted in significant increases in liking and intake after the test [38]. A challenge in familiarizing children with new foods and flavors is that tasting the food is necessary to alter preference and intake [39]. However, inducing children who are reluctant to taste a novel, disliked food can be difficult [39]. One of the benefits of pairing disliked vegetables with familiar, preferred dips was that it increased the likelihood that children would actually taste the vegetable, so that familiarization and associative processes come into play [38].

**Observational Learning: Using Social Influence to Facilitate Tasting, Liking and Intake**

Social influence provides another powerful tool for promoting tasting, liking and intake of foods. Children are more likely to taste unfamiliar foods if they observe adults eating them than if the food is merely offered to the child [40].
Peer modeling can also be effective; observers who watched peer models eating a food the observer disliked increased the observer’s willingness to choose and eat that food subsequently [41, 42]. Social influence affects even very young children; toddlers (14–20 months old) were more likely to try a new food after seeing it consumed by a familiar adult. We assessed young children’s (2–5 years old) responses to novel foods when an adult model (a) was not eating the food; (b) was eating a food of a different color, or (c) was eating a food of the same color as that offered to the child [43]. Children accepted and ate more of the novel food in the ‘same’ color condition, providing evidence that in young children food acceptance is promoted by specific social influence [43]. More research is necessary to understand what infants and toddlers are learning about food and eating through observation.

**Summary and Conclusions**

The transition to the adult diet begins in infancy, and by their 2nd birthday, children are consuming diets not very different from those of their parents. Children are born with a bias to prefer sweet and salty tastes, and to reject new foods and flavors; predispositions evolved which could have served a protective function in times of food scarcity, but in today’s world can foster unhealthy diets that are too high in sweet and salty foods. Children also learn an enormous amount about food and eating early in life, and much of this learning occurs in the family environment. Although preferences and eating behaviors continue to develop throughout the lifespan, patterns learned early tend to persist to shape both concurrent and subsequent dietary patterns, health and weight status.

Parents’ feeding practices are an important feature of early environments in which infants and young children are learning about food and eating. Traditional feeding practices, developed in response to the threat of food scarcity, still tend to be the default, despite dramatic changes in the food environment. These traditional practices can be maladaptive by exacerbating the effects of obesogenic environments, characterized by large portions of palatable, inexpensive food. Changes in the food environment are essential to addressing the obesity epidemic, but evidence-based alternatives to traditional feeding practices are also needed. Responsive parenting that is contingent, prompt and developmentally appropriate and fosters self-regulatory skills is an attractive alternative. Emerging evidence suggests that components of responsive parenting can also promote self-regulatory skills in feeding, which are likely to be beneficial as children are learning to eat in our obesogenic environment.
Disclosure Statement

The author declares that no financial or other conflict of interest exists in relation to the contents of the chapter.

References