Learning to Prefer the Familiar in Obesogenic Environments

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Abstract

What has become familiar tends to be preferred while the unfamiliar is avoided. Additionally, liking is impacted by associative learning processes where new stimuli become liked via repeated pairings with familiar, already-liked stimuli. In addition to the ability to learn to like new foods and flavors, infants bring genetic taste predispositions to the table, including an unlearned preference for sweet and salty tastes and a tendency to reject bitter and sour tastes. When diets were plant based, unlearned preferences for sweet and salty tastes promoted intake of foods that were relatively rare in nature but were good sources of essential nutrients; the presence of the preferred basic tastes in food no longer predicts scarce nutrients. Our ‘obesogenic’ dietary landscape is replete with sweet and salty foods that are energy dense, inexpensive, and exquisitely tuned to our genetic taste predispositions. In the current environment, early familiarization and associative learning can result in unhealthy diets and may promote obesity risk, but we suggest applying what we know about how food liking is learned to promote healthier diets. We review classic and current evidence demonstrating how familiarization and associative learning may be used to promote the intake of initially rejected foods like vegetables within an obesogenic context.

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Familiarization in Obesogenic Environments

Through experience, things become familiar; familiarity is a natural consequence of living [1]. Learning is the process of acquiring familiarity with objects, people, actions, and their consequences. Stimuli that are familiar provide a standard against which other stimuli seem unfamiliar. The distinction between the familiar and unfamiliar is particularly important because familiarity has a powerful evaluative component; what has become familiar
tends to be liked and preferred, while the unfamiliar is disliked, avoided, or even feared. In early life, the infant learns to prefer the people, objects, and activities that become familiar through experience: he develops an attachment to his mother, preferring her to others and begins to respond with fear to unfamiliar ‘strangers’. His familiar blanket provides comfort, and of particular relevance here, the milk he consumes also becomes familiar.

Initially, the infant diet consists exclusively of milk. When the transition to the adult diet begins at weaning, the child’s familiarity with the flavors of milk provides the standard for determining the extent to which new foods seem unfamiliar; the more unfamiliar they seem, the less likely it is that they will be readily accepted. Formula-fed and breastfed infants differ in what constitutes the domain of the familiar. The exclusively formula-fed infant only has experience with the flavor of formula; for the breastfed infant, the familiar is more broadly defined because a variety of flavors have already become familiar. Flavors of foods consumed by the mother flavor her breast milk [2], providing a ‘flavor bridge’ by making the flavors of the maternal diet familiar and easing the dramatic dietary transition that occurs in the first years of life. Relative to formula-fed infants, breastfed infants showed more rapid acceptance of pureed vegetables during weaning [3]. Very early experience with flavors defines the familiar and shapes food likes and dislikes during infancy and early childhood. The importance of liking in determining the intake of infants and young children is paramount; their preferences are especially powerful predictors of intake early in life [4, 5]. Blissfully ignorant of the importance of nutrition, young children eat what they like and leave the rest.

The effects of exposure are likely to be greatest during weaning, when all solid foods are new, and acceptance of some foods is essential to consuming a diet that supports growth and health. It appears that earlier in life, when nearly all foods are new, familiarization occurs rapidly, requiring few exposures. For example, infants who were just being introduced to pureed foods increased their intake of new fruits and vegetables significantly after a single exposure, and the effects of exposure generalized to other new pureed foods [6]. The first 2 years of life are characterized by relatively weak food ‘neophobia’ [7] that can often be changed to acceptance with relatively limited experience [8], providing a window of opportunity for promoting acceptance of new foods. Although evidence is limited, by defining the domain of the familiar, early experience with food forms the basis for how the individual will respond to new foods, flavors, and cuisines in subsequent encounters later in life. Neophobia, the fear and avoidance of novel foods and flavors, increases and peaks in early childhood, declining thereafter. It appears that by adulthood, the impact of repeated exposure on promoting acceptance is weak [9].

Being prepared to learn to prefer the familiar allows omnivores the flexibility to come to like and eat the foods available across a wide range of environments. Infants bring additional genetic predispositions to the table, including an unlearned preference for sweet and salty tastes and an initial rejection of
bitter and sour tastes [10]. When diets were more plant based, the unlearned preference for sweet and salty tastes promoted intake of foods that were relatively rare in nature but were good sources of essential nutrients: energy and micronutrients in the case of sweet taste and essential minerals in the case of salt [11]. These days, the presence of the preferred basic tastes in food no longer predicts scarce essential nutrients. A major reason that the current food environment is obesogenic is that our dietary landscape is replete with sweet and salty foods that are palatable, pervasive, energy dense, inexpensive, extensively marketed, and exquisitely tuned to our unlearned predispositions to like these tastes. These foods will be accepted without having to become familiar. Because these readily accepted energy-dense foods are ubiquitous, they become familiar to infants and young children, while fruits and vegetables have become scarce and unfamiliar; while research is lacking, a recent documentary revealed that children were unable to correctly identify common vegetables [12].

These days, it is challenging to promote liking and intake of foods that compose healthy diets. Take vegetables, which can bring the additional challenge of having bitter taste components, further reducing the likelihood that they will be initially accepted and consumed. Support for the view that vegetables are absent in the lives of many of today’s infants and toddlers comes from the results of the Feeding Infants and Toddlers Study, which showed that infants and toddlers are eating many of the same foods that characterize the broader obesogenic environment. Approximately one third of infants and toddlers consumed no vegetables and no fruits on an average day; French fries were the most commonly consumed vegetable among 15–18 month olds, and approximately half of infants and toddlers regularly consumed desserts and sweetened beverages [13]. These patterns of intake do not conform to current nutritional guidelines for young children and reveal that diet quality begins to decline as soon as the adult diet begins to be adopted [14].

Unfortunately, the majority of parents and caregivers are not aware of the power of familiarization in determining liking early in life. Parents may offer a new food once, and if the child rejects it (likely if it is unfamiliar and not sweet or salty), the parent concludes that the child dislikes the food and does not offer it again, providing no opportunity for familiarization to occur. This approach to introducing new foods is highly successful at producing ‘picky eaters’ who will only consume a few foods. Providing information to parents and caregivers that the rejection of new foods is normal and adaptive and giving guidelines on how to familiarize children with new foods could be effective in reducing the likelihood of children being labeled as ‘picky eaters’ and in promoting the acceptance of healthy foods. Although in the current obesogenic environment early familiarization may often result in diets that fail to meet dietary recommendations and may promote excessive weight gain and obesity risk, we could apply what we know about how food liking is learned to promote familiarity with foods that comprise healthy diets.
Learning Processes Influencing Food Liking: Familiarization through Repeated Exposure

Familiarization learning is the simplest of several types of learning affecting the acquisition of food preferences and eating behaviors and results from repeated ‘mere exposure’. Mennella and colleagues have demonstrated that familiarization begins prenatally; infants are more likely to accept flavors that they previously experienced in utero, during breastfeeding [2], or during formula feeding [15]. When Mennella et al. [2] provided early experience with carrot flavor either in utero or during lactation, this early familiarization affected infants' acceptance of the flavor when it was offered in infant cereal during weaning. In two experiments, Birch and Marlin [8] presented novel fruits or cheeses to 2-year-olds. The frequency with which children tasted 5 initially novel foods was varied within children, so that for each child, some foods were offered repeatedly and others remained novel. In both experiments, children's preferences for the foods increased as exposure frequency increased. Wardle et al. [16] have demonstrated that repeated exposure can also increase 2- to 6-year-olds’ acceptance of an initially disliked vegetable in the home context.

Learning Processes Influencing Food Liking: Associative Conditioning

Familiarization with food and eating does not occur in a vacuum but in the context of the child’s ongoing daily experiences, and other aspects of experience can become associated with foods, altering liking. Evidence for the impact of these associative learning processes on children's developing food and flavor preferences is reviewed below, organized by the stimuli that become associated with the food. These include flavor-nutrient learning, flavor-flavor learning, and flavor-context learning (table 1). Extensive research has provided evidence that these associative processes affect liking and intake in animal models [17], but the literature with humans is limited [18]. Below, we review the evidence for the familiarization and associative learning in infancy and early childhood. The common thread here is that young children learn to like (or dislike) new flavors via familiarization alone and through the formation of associations between foods and other aspects of the context of eating. These aspects include the postingestive consequences of eating the food, the addition of well-liked flavors to the food, or caregivers' feeding practices. The early learning of food likes and dislikes affects intake during key periods of early development, affecting not only growth trajectories, but also the familiar standard against which future flavor experiences are evaluated.

In associative conditioning, the individual's liking of an unfamiliar stimulus (the conditioned stimulus, or CS) changes after it is repeatedly paired with a
Table 1. Learning paradigms affecting children’s food preferences

<table>
<thead>
<tr>
<th>Paradigm</th>
<th>Definition</th>
<th>Example of effects</th>
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<tbody>
<tr>
<td>Familiarization</td>
<td>Repeated presentations of an unfamiliar stimulus on its own lead to increases in familiarity and liking.</td>
<td>When 2-year-old children were exposed to novel cheeses and fruits at different exposure frequencies, preferences increased with increased exposure frequency [8].</td>
</tr>
<tr>
<td>Flavor-consequence/nutrient learning</td>
<td>An unfamiliar flavor (CS) is repeatedly paired with an energy-rich substance like sugar or fat (US). The positive valence associated with the effects of ingesting energy becomes associated with the unfamiliar flavor; liking of this flavor on its own increases.</td>
<td>When 2- to 5-year-old children consumed novel-flavored yogurts that were high or low in fat and energy density, they increased their preference for the flavor that had been previously paired with a high energy density [20].</td>
</tr>
<tr>
<td>Flavor-flavor learning</td>
<td>An unfamiliar flavor (CS) is repeatedly paired with a familiar, liked flavor such as a sweet taste (US). The positive valence associated with the taste of the already-liked flavor becomes associated with the unfamiliar flavor, so that liking of this flavor on its own increases.</td>
<td>When 5-year-old children were provided with two new vegetable flavors, one sweetened and one unsweetened, they developed a preference for the previously sweetened vegetable flavor [22]. (The flavors were presented in pairs, so the authors argue that the results exemplify flavor-flavor learning and not flavor-nutrient learning as both flavors were technically paired with the post-ingestive consequences of dextrose.)</td>
</tr>
<tr>
<td>Flavor-context learning</td>
<td>An unfamiliar flavor (CS) is repeatedly paired with a positive, social experience, such as a birthday party or praise (US). The positive valence of these experiences becomes associated with the unfamiliar flavor, so that liking of this flavor on its own increases.</td>
<td>Pre-school children’s preferences increased for familiar snack foods repeatedly paired with adult attention or given as rewards [24].</td>
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The examples provided are those in which children learn to like healthy foods. In our current environment without intervention, it is likely that children are learning to like sweet, salty, energy-dense foods through similar processes.
familiar stimulus that already evokes a positive or negative hedonic valence (the unconditioned stimulus, or US). After repeated pairings with a positive US, the valence of the CS increases, such that presentation of the CS alone evokes greater liking than it did initially. In all of the specific paradigms that follow, the CS will be a new flavor and will be paired with a US that is liked and familiar.

**Flavor-Nutrient Learning**

In flavor-nutrient learning, the US is the positive consequence experienced after ingesting an energy-rich substance, such as sugar or fat. Sclafani and Nissenbaum [19] have conducted an extensive program of research to investigate flavor-nutrient learning in the rat. In the basic protocol, unfamiliar flavors (CSs) are provided. The CS flavor is paired with a US that produces a positive gastrointestinal consequence. In one series of experiments, this was an energy-rich concentrated starch solution, infused intragastrically, while another flavor was paired with infused water. When preference for the two flavors was tested after pairing with the infusions, the nutrient-paired flavor was preferred over the flavor that had been paired with water. This work inspired research in our laboratory to investigate flavor-nutrient conditioning in young children; when 2- to 5-year-old children consumed novel-flavored yogurts that were high or low in fat and energy density, they showed greater increases in liking for the high-energy-paired flavor [20]; similar findings were obtained when starch was used as the US [21]. Through most of human history, when food was scarce, learning to prefer flavors of foods that were good sources of energy was adaptive. However, in the current obesogenic context, our predisposition to learn to prefer energy-dense over energy-dilute foods may promote excessive intake, weight gain, and obesity.

**Flavor-Flavor Learning**

In flavor-flavor learning, the CS is an unfamiliar flavor, and the US is a familiar, already liked flavor. Through repeated pairings of the two flavors, the unfamiliar flavor becomes associated with the familiar flavor, increasing the liking of the new flavor when it is presented alone. When 5-year-old children were provided with two new vegetable flavors in liquid form, one sweetened and one unsweetened, they developed a preference for the previously sweetened vegetable flavor [22].

We recently compared the effects of ‘mere exposure’ familiarization with flavor-flavor associative conditioning on 3- to 5-year-old children’s vegetable liking and intake. The 12-week procedure took place in children’s regular day-care center classrooms and involved pre-tests assessing liking and intake of vegetables, ten exposure trials, and post-tests assessing liking and intake. To assess liking, children tasted five cooked vegetables (broccoli, cauliflower, red peppers, sugar snap peas, and yellow squash) and rated them [4]. During the exposure trials, the children were asked to taste a very small sample (about
4 g) of a vegetable (yellow squash or red bell pepper) that was generally unfamiliar and rated as either ‘yucky’ or ‘just okay’ by most children. Children assigned to the repeated exposure condition tasted and rated the vegetable during each of the exposure trials. Children assigned to associative conditioning were given a small amount of a flavored dip that they thought was ‘yummy’ and dipped the vegetable into it prior to tasting during each exposure trial; dip options included ketchup, ranch, and cinnamon sugar [23].

Although we hypothesized that associating a liked flavor with the vegetable would produce greater increases in liking and intake, both familiarization and flavor-flavor associative conditioning produced the same significant increases in liking and intake, as shown in figure 1. Increases in liking occurred rapidly with a significant increase in vegetable liking between the first and second tasting exposures. In both conditions, liking for the vegetable that was repeatedly tasted, either with or without dip, was significantly greater than for the other vegetables that had not been tasted repeatedly. From before to after vegetable exposure, intake increased dramatically, more than doubling, from 15 to 33 g. These initial findings reveal that repeated exposure and associative conditioning had similar, positive effects on liking and intake of initially disliked vegetables, and that these effects occurred with only a few brief taste exposures [23].

**Fig. 1.** Repeated exposure and flavor-flavor associative conditioning increase vegetable liking. In both conditions, there was a significant difference between liking in the first and second tasting exposures (p < .05), and increases in liking were maintained throughout the experiment. Note: 30 children who found vegetable to be yummy during pre-exposure were excluded. Results were similar with the total sample.
Because this experiment was conducted in the context of children's preschool program, the findings suggest that such approaches could be readily adapted for use as part of ongoing activities in preschool settings.

**Social Influences**

Liking for an unfamiliar flavor can also increase when the flavor is repeatedly paired with positive social experiences. This type of conditioning can take many forms. For example, children's preferences increased when sweet and non-sweet snack foods were paired with positive adult attention or given as rewards [24]. There is also evidence that learned liking for foods served in positive social contexts can generalize to other, similar foods [25]. Overall, experimental studies demonstrate that young children learn to like flavors that become familiar through familiarization and through repeated association of foods with already-liked stimuli.

**Evidence for Persistent Effects of Early Familiarization**

We have argued that early experience is important because it defines the familiar, and the familiar tends to be liked, preferred, and consumed and shapes the child's subsequent responses to new foods. This is particularly important for children, who eat what they like and leave the rest. Mennella's work has revealed that flavor experience in utero, during lactation, and during formula feeding affects the infant's subsequent response to complementary foods. In a recent intervention we conducted to prevent excessive weight gain during the first year of life, a component of the intervention focused on the transition to solids. Intervention group mothers received guidance on promoting the acceptance of new complementary foods [26]. When mothers had begun to introduce infant cereal successfully and infants were 4–6 months old, four commercially available pureed vegetables were provided (Gerber pureed green beans, peas, squash, and carrots). One vegetable was offered each week for 6 consecutive days. Intake was measured before and after repeated exposure. Infants in this intervention group significantly increased their intake of green beans, peas, and squash from the first to the 6th day of exposure. Carrot intake was already high prior to exposure, probably due to carrots' sweeter taste and/or generalization from the other vegetables as carrots were offered last [26, 27]. We assessed the longer-term effects of this intervention on infants' acceptance of new foods when infants were one year old by having mothers offer their infant an unfamiliar food (hummus, cottage cheese, or yogurt); infants' responses were videotaped and coded. Fewer intervention infants rejected the unfamiliar food at one year (10%), compared to the control group (25%) [27]. This finding suggests long-term effects of early repeated exposure on subsequent acceptance of novel foods. Repeated exposure to healthy foods may also impact early growth and weight status given that our interventions affected infant weight status at one year [26].
Conclusions

Familiarization and associative conditioning processes can increase liking and intake of foods and flavors. By shaping what is familiar and preferred, these processes have lasting effects on intake and weight status. Early experience with food provides the initial basis for delineating the familiar from the unfamiliar. At weaning, all foods are new, and early experiences with food can either limit or expand the boundaries of the familiar. If early experience includes exposure to a variety of foods and flavors, then a wide range of foods and flavors will be accepted. However, in order for this to happen, caregivers need information: that the rejection of new foods is normal, and that familiarization can be used to promote children’s liking of healthy foods. Without this guidance, it is likely that their diets will be dominated by sweet or salty foods that are readily accepted without familiarization. In contexts of food scarcity, acceptance of only a few foods during weaning can result in inadequate growth, but in our obesogenic environment, limited variety can result in diets too high in added sugar, salt, and energy and too low in dietary variety, fruits and vegetables, fiber, and micronutrients [13].

The familiar continues to be redefined through our daily encounters with food and eating, although it appears that early experience is key in shaping our subsequent encounters with new foods and cuisines. Outside of the laboratory, eating episodes are complex and are accompanied by many positive and negative contextual stimuli that can be associated with food and can modify the effects of familiarization. Early experience provides a basis for food likes and dislikes, shaping subsequent patterns of dietary intake and obesity risk. The practical implication is that children should have frequent early experience with a variety of foods that comprise healthy diets. This experience may be most effective in promoting liking and acceptance if it occurs in association with already-liked flavors and foods, in positive social contexts.

References

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Discussion

Dr. Villalpando: I work with school children and adolescents who are obese, and we are sure that at least in Mexico these kids are not eating enough vegetables. Is there a decisive point during their growth that makes them reject later on certain types of foods or colors of food?

Dr. Birch: I think many of you who are parents would probably agree that adolescence is a time when kids are rejecting a lot of things that are connected with the adult establishment. Still, although evidence is limited, it appears that some of their negative reactions to 'healthy' foods are temporary and they will return to earlier patterns of preference later on. In addition, by the time children reach adolescence, they have established patterns of intake. Because it is easier to shape new behaviors than to alter existing ones, changing adolescents’ food intake patterns is particularly
challenging. There is research in the US looking at the effects of involving children and adolescents with gardening, growing, and cooking that has shown some positive effects. This requires a lot of effort, time and resources. Other approaches to making healthy foods available and more affordable have also shown promise.

Dr. Papadopoulou: We know from several studies that taste preferences of the children are established very early in life. You mentioned breastfeeding. I am thinking about the early weaning period. The usual practice is to introduce cereals with some sweet taste to infants as the first weaning foods. If we switch to vegetable puree as the first weaning food and introduce sweet foods after the infants have been exposed to a variety of vegetables and fruits, will this have an impact on children's taste preferences and dietary habits in the long term?

Dr. Birch: I think there might be as many different opinions as they are people in this room about that, but since you ask me I would say that again we don't have much of an evidence base for deciding this. Infants will like and eat sweet things no matter when they are introduced, and certainly I think your hypothesis is a reasonable one; namely if the infant first becomes familiar with sweet foods, this may make it less likely that most vegetables will be readily accepted, because they lack the familiar sweet taste. Dr. Mennella has done research that can speak to your question.

Dr. Mennella: We have done some work where we found that having prior experience with fruits didn't interfere with vegetable acceptance, but once the baby following from your own work has repeated exposure to vegetables will lead to increased acceptance of variety. But I think that one key point is that for those foods that taste bitter the experience has to be with bitter taste in food. So, you can give a variety of fruits, it's not going to impact on green vegetables. The baby has to become familiar with that bitter taste in order to learn to like it.

Dr. Birch: There is some generalization, there is no generalization across bitter.

Dr. Were: It is very interesting that we can observe and determine children's taste and how they move on to prefer those later. Let's get back to the children we are treating and obesity which is an issue that is concerning us, including me and the country I come from. Can we use this information to deliberately give foods that we know these babies don't like and reduce the foods that they like in order to influence their body mass accretion? It is probably an ethical dilemma whether we can deliberately remove a food that we know a child would like and observe the child eat less because they don't like what we are giving them. How do you see this experience?

Dr. Birch: I am suggesting that we could use what we know about how kids learn during this early period to promote acceptance and liking of foods that we think they should be eating. That would improve diet quality, foods that are lower in energy density that might be more consistent with diet so they are not going to promote obesity. However, as was pointed out by a previous speaker, it's often easy to understand what needs to happen, but it's much harder to know how to get it done. For example, we have noted that familiarization leads to increased acceptance and intake of foods by children, but when we have tried to conduct research to familiarize children with fruits and vegetables in child care settings, caregivers can be a major barrier: they often refuse to eat the food. So they are modeling the very behaviors we are trying to avoid in the children. Unfortunately, if we can't change the adults' diets we will have trouble changing children's diets. However, I think child care settings do provide many opportunities to familiarize children with healthy foods that they may not have access to, and may not be eating at home.

Dr. Stettler: What you presented about vegetables is consistent with the observation that kids don't eat enough vegetables. But I have more difficulty in reconciling your findings with children's fruit intakes because fruits are sweet so you would predict that kids would eat more rather than less than what is recommended. So why is
that not the case? Do fruits need to be combined with an energy-dense product to make them acceptable? And why is fruit intake not higher since they are sweet?

**Dr. Birch:** So why isn't fruit intake higher? I think fruit intake is less of a problem than vegetable intake. I think it still is, in many cases it's just a matter of availability and accessibility, at least for certain populations. We know that in many low-income areas, there are few supermarkets or other outlets available where you can buy fresh fruits and vegetables; they are expensive and have a short shelf life, and they don't tend to be offered in fast food places. So, I think it's more a problem of availability than potential acceptability of them.

**Dr. Siega-Riz:** I also think that it happens to do with the cost of fruits and vegetables and also the fact that mothers think that if they give juice to their children and they just drink all the juice, then in fact they are getting their fruits.

**Dr. Gottrand:** My question is related to the type of taste for the same food. For example, if you take a carrot, a manufactured product from the industry doesn't have the same taste than a carrot coming directly from the garden. Do you have any data comparing for the same fruit or vegetable if the taste is strong, sweet or acidic, if it can change something in the acceptance of the infant, or if it's better to start with smoother, more harmonized taste rather than strong, acidic or sweet for later acceptance of the same food?

**Dr. Birch:** I am not sure we know the answer to that one. I think that what we often see as subtle differences or trivial differences in food preparation can have a powerful impact on children's willingness to eat a familiar food, or to recognize a food as familiar. Dr. Mennella, do you have any comments about that in terms of your work?

**Dr. Mennella:** There has really been no good experimental research that looks at different quality of a vegetable and what the taste dimension is in acceptance. But what I would say is that the evidence seems to suggest that children will come to prefer that which they are fed, and so one way of thinking about it is we teach a child what it should taste like and so what children are offered is what they eat.

**Dr. Birch:** Children begin to learn early in life about what is appropriate based on how foods are prepared and served to them. We did some research on children's acceptance of tofu years ago. Some of the children were served tofu with nothing added, some had it with sugar added, while a third group were served tofu with salt added. Results showed that children learned to prefer and eat it tofu the way it was served to them. If they had been given tofu without added sugar or salt, that was the way they preferred it, suggesting that they are learning some simple cuisine rules about whether is it 'appropriate' to add sugar or salt, and that these rules emerged from how the food was prepared and served to them.

**Dr. Klish:** I found your longitudinal studies interesting. When you stratified the children based on sugar intake or sweetened beverage intake, you saw differences in body mass index that persisted out to age 15 years. Have you analyzed your data on the intake of fruits and vegetables in the same way?

**Dr. Birch:** We haven't done that research.

**Dr. Klish:** The reason I ask the question is: there is much focus on fruits and vegetables, particularly in our schools, which puts a strain on school food budgets. I am not sure I have seen data that show a relationship to BMI over time.

**Dr. Birch:** I think the data are complicated and incomplete in adults.

**Dr. Agarwal:** In India, children who reached the age of 2.5 years go to playschool, and we tell the teachers what children should eat as right snacks. In turn, the teacher sends a message to the families to give green vegetables and mixed cereal snacks to kids (this goes on for 5 days in a week). School child nutrition message teaches the family about nutrition and dietetics.
Dr. Birch: Your example makes a very important point; the child's experience with food in out of home settings such as school or childcare provides opportunities for children to serve as change agents in the family. In the US, it is a major challenge to find effective ways to reach families in order to make dietary change.

Dr. Puri: The influence on food patterns in childhood is not only restricted to taste. There are so many other sociocultural issues to this; it is not just a direct simplistic relationship. Parenting styles have a strong influence. If the parents are more permissive, the preference for sodas and unhealthy foods is higher in these young children. If the parenting styles are more disciplinarian, the preferences for fruits and vegetables and healthier food options become greater.

Dr. Birch: I think you are absolutely right, and parenting styles and parents' feeding practices are really incredibly important. This is another area where parents need anticipatory guidance because childhood obesity can be viewed as a new threat to children's health, one that requires very different parenting responses than the challenges posed by food scarcity.

Dr. Madrazo: My comment goes in the same way. In my practice, I see parents who do not pay much attention to what their kids eat. They just buy what they consider the right food, put the food on the table and the kids will eat it. Those kids are the ones who do better. They don't have problems of obesity. Their problems are not related to food. Aren't we paying too much attention as parents or health professionals to those issues, and are we trying to force the kids to eat the right food? We were all children and we didn't like vegetables, and now we eat vegetables as adults. I understand now obesity and feeding disorders are important problems in pediatrics. Maybe by trying different strategies like in the past we would achieve better results.

Dr. Birch: I think that's a very important point. I haven't said much about this today, but we have done a lot of research on the effects of parents' feeding practices; for example, we find that parents who restrict access to palatable foods have children who tend to overeat those foods when they are available. One challenge is to find ways to help parents to deal effectively with their concerns, while helping them to promote their children's acceptance and liking of healthy foods.

Dr. Siega-Riz: You also can't deny the fact that we are now in an environment that has more food, has more processed foods and people are eating out more. So in the past when we used to eat out it was a treat, and now it's an every day occurrence. So, there is plenty of evidence that has actually shown that these dietary patterns over time are negatively influencing our health status. So we do need to retrain how we are eating

Dr. Guandalini: In longitudinal studies such as those on girls 5–15 years of age, other variables should perhaps be considered. I wonder, for instance, whether physical activity was taken into account as part of the lifestyle. Does physical activity play any role in dietary choices and in influencing eventual body mass index?

Dr. Birch: We do have accelerometry data on these girls, so the question you raise is one that we have tried to address. However, we haven't seen clear relations between accelerometry measures of physical activity and girls' weight status. But in our data, we did see that parents' eating and activity patterns were consistently related. That is, parents who were more physically active and had healthier diets tended to have daughters with lower weight status. In contrast, relative to this group, parents of heavier girls had lower levels of physical activity and consumed diets that were higher in energy. So the latter set of families could be characterized as 'obesogenic'. Unfortunately, it isn't possible to establish cause and effect or to tease apart effects of diet and activity on weight status in this observational study.