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A PILOT STUDY TO DETERMINE PRESCHOOL CHILDREN’S LIKING AND INTAKE OF SEASONED VEGETABLES IN RELATION TO MATERNAL HERB AND SPICE EXPOSURE

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ABSTRACT

To design interventions targeted at improving children’s eating behaviors, we must first understand the biological and environmental factors that contribute to food choice. Exposure to flavors in the mother’s diet during pregnancy and in breastmilk plays a role in infant’s food acceptance during the weaning period, but research has not yet investigated if these effects persist into early childhood. If early exposure plays a strong role in children’s food acceptance through the preschool years, there is potential that it can be used to increase intake of nutritionally beneficial foods, like vegetables. A retrospective questionnaire was designed to assess mothers’ intake of 9 herbs and spices during pregnancy and lactation. Forty-two mothers and their preschool aged children attended two laboratory visits where mothers filled out the questionnaire and children rated their acceptance/liking of carrots prepared with seasoning blends of the herbs and spices (cinnamon-nutmeg-ginger, garlic-black pepper-oregano, cardamom-cumin-allspice). Children’s intake of the seasoned carrots was also measured during two multi-item ad libitum test meals. Mothers were able to report an answer (i.e. yes or no) when asked to recall their herb and spice intake more often than they selected the “I don’t know” option for all but one spice. When grouped by individual spice blends, no correlation was found between maternally reported intake of the herbs and spices and children’s liking or intake of the seasoned carrots ($P > 0.05$). However, when a combined score was calculated for total maternal herb and spice intake, there was a significant correlation with children’s overall liking of the seasoned carrots ($P = 0.03$) but not with intake of the carrots ($P > 0.05$). Overall, we did not find evidence that maternal intake of herbs and spices during pregnancy and breastfeeding influences children’s acceptance of these specific flavors in early childhood. However, the relationship between total herb and spice intake and children’s seasoned carrot liking may indicate that maternal dietary variety is a better indicator of children’s food acceptance in the preschool years. Once validated, retrospective dietary recall of herb and spice intake may be a fast and easy tool to assess the influence of maternal diet during pregnancy and breastfeeding on children’s food preference in future research.
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Chapter 1 - Introduction

Childhood Obesity

Prevalence and Risk.

Obesity and other diet related diseases are a major public health issue in the United States\(^1\). Obesity is associated with increased risk for hypertension, dyslipidemia, Type 2 diabetes, arthritis, and some forms of cancer\(^2,3\); it results in about $207.9 billion in additional health care costs per year\(^4\). Previously, obesity and associated health problems were seen primarily in adults, but childhood obesity has tripled in the last 40 years\(^5\). These statistics are of particular concern because earlier onset of overweight and obesity are associated with a greater lifelong health burden. It has been predicted that this generation of children will be the first in recent history to live shorter, less healthy lives than their parents\(^6,7\). Consequently, a large body of research has focused on how best to promote healthful eating behaviors in young children in order to prevent the onset of obesity and maximize the long-term benefits of a healthy diet.

Obesity and Taste Preferences.

Obesity is the result of weight gain due to imbalances in dietary intake versus energy expenditure\(^8\). Weight gain is often associated with consumption of large portions of high energy dense foods and inadequate intake of low energy dense foods, like fruit and vegetables. Given the obesogenic environment currently found in most industrialized nations, including the United States, access to highly palatable foods is positively associated with weight gain\(^9\). Children are especially susceptible to this type of eating pattern because the greatest predictor of children’s food intake is taste preference\(^10-12\), and humans have an inborn liking for sweet and high-fat foods.
Food acceptance and taste preferences develop over time from a combination of genetic and environmental influences. The “developmental systems perspective” approaches taste preference not as a clear debate of nature vs. nurture, but instead as an integrated system of interactions between genes, innate human taste responses, and learned factors. An understanding of these factors and the interactions between them can aid in identification of children most at risk and inform intervention programs to reduce the onset of obesity. One potentially beneficial intervention would be to increase children’s acceptance of vegetables, which are low in energy density and have been shown to displace higher calorie foods in the diet. Several factors contribute to children’s distaste for vegetables, but combined strategies can target both palatability and familiarity to bolster children’s vegetable intake.

Sensory Measures of Taste and Preference

What is Taste and Flavor?

Flavor, by definition, is a combined perception that results from taste, odor, and chemesthesis, although in much of the nutrition literature taste and flavor are used interchangeably. Basic taste includes those sensations that are detected by taste receptors on the tongue, such as sweet, salty, sour, bitter, and umami. There is also evidence for oral perception of metallic and fatty tastes. Odor is perceived retronasally as food is chewed and swallowed; the volatile odorants in foods are responsible for their characteristic flavor profiles and these are what allows us to determine the difference between various foods of similar macronutrient content, such as an apple and a potato. In case studies of patients with trauma-associated anosmia, flavor sensitivity and food enjoyment are drastically reduced without odor perception. Chemesthesis is a chemically induced touch sensation, such as the burn of chili peppers, the cooling of menthol, or the drying of red wine. Chemesthesis is out of the scope of this literature review, and the focus will be on the taste and odor components of flavor. To remain consistent with the nutrition literature
“taste preference” and “flavor preference” will be used interchangeably to refer to children’s integrated sensory preference for various foods.

**Acceptance vs. Preference.**

Acceptance and preference are key terms in understanding the hedonic reactions that humans have to foods and sensations. Both are affective sensory tests that aim to quantify someone’s degree of liking (or disliking) of a food based on its sensory characteristics, like appearance, flavor, and texture. Acceptance is an independent measure of some hedonic value. Preference is a comparison measure, where the most (or least) liked item is selected from a pair or group. Affective tests are useful because they are intuitive for participants to understand, easy to interpret, and rapid to perform.\(^{18}\)

Preference testing involves direct comparison of different alternatives. The simplest form of this test is paired comparison, where the preferred sample is chosen from a set of two. Best-worst scaling is a similar procedure, where samples are presented in small groups, typically triads or tetrads, and both the most preferred and least preferred are chosen from the set. If several pairs or groups are tested in succession, preference can be extrapolated for a larger set of samples. In most cases, these tests are forced choice, meaning that a most preferred sample must be selected, but in some cases a “no preference” option is included. Rank order testing is a preference procedure that directly compares the whole group at once, with the most liked selected first, and the following items chosen in order of preference. Preference testing is a great way to compare products, but a major issue is it does not give any information on the magnitude of the differences. For example, if all the samples in a set are disliked, then choosing the “most liked” sample is not a particularly helpful measurement.\(^{18}\)

Acceptance testing is an independent hedonic measure. Samples are rated using some form of scaling system that allows for expression of both liking and disliking. A 9-pt hedonic scale that ranges from
“Dislike extremely” to “Like extremely” with a neutral “Neither like nor dislike” center point is one of the most commonly used scales. Strictly speaking, these are categorical measures, and cannot be called a true scale, since perceptual intervals between points are not equal (i.e. a sample with a score of 6 is not necessarily liked twice as much as a sample with a score of 3). However, the 9-pt version invented by the US military in 1952 is considered to have almost equal intervals between points, and therefore if often treated as a continuous scale. Smaller versions, such as 3, 5, and 7 point hedonic scales do not have these properties, and can only be used in non-parametric tests.

Another acceptance test is the line scale, also known as a visual analog scale, where a value can be selected at any point along a continuum between extreme end points, such as “like” and “dislike.” The Labeled Affective Magnitude scale (LAM) is a line scale that ranges from “neutral” to “strongest imaginable liking of any kind.” In a two-sided LAM, “neutral” is the center point and negative values are also included, with an end point of “strongest imaginable disliking of any kind.” Compared to most line scales, the LAM is not subject to ceiling effects, and it can better distinguish acceptance values for products that are very strongly liked or very strongly disliked. Surveys and questionnaires that use scales to measure affective responses are often called preference tests, but more accurately they are measures of acceptance. In general, acceptance testing is helpful in quantifying liking for a food or flavor, but perception of foods can change in different contexts, so these results can only cautiously be compared across studies.

Sensory Testing in Children.

In children, sensory testing needs to be adapted to meet the cognitive abilities of the age group being tested. In infancy, acceptance is generally gauged by the child’s facial expression when presented with a flavor stimulus on the tongue or an odorant in front of the nose. In infancy, when a child is not capable of verbally identifying a favorite sample, preference can be inferred by comparison of the number
of positive to negative facial responses\textsuperscript{24,25}, or from intake data, where a formula or solution that is consumed in greater volume or at a greater rate is considered to be preferred to a less consumed solution\textsuperscript{22,26}.

In preschool aged children, acceptance is usually measured with an abbreviated hedonic scale and pictorial representations of the different categories, such as cartoon images, smiley faces, or actual photographs of different “good” and “bad” faces\textsuperscript{27-29}. Chen and Reserreccion identified the number of categories to use in children of various age groups\textsuperscript{27}. For preference testing, many of the methods used in adults can also be used in preschool aged children, such as forced choice paired comparisons, best-worst scaling, or rank orders. A protocol developed by Fisher and Birch (2002) combines acceptance and preference measures, with young children first giving the sample an acceptance rating on a 3-point categorical scale, and then ranking their preference from best to worst within each of the 3 hedonic categories, thus creating a full rank order for the samples\textsuperscript{30}.

**Development of Food Preferences in Children: Innate and Biological Factors**

**Innate Preferences.**

Children are born with unlearned or innate liking for foods that are high in fat and sugar, and a natural aversion to foods that are bitter or sour\textsuperscript{22,31,32}. These acceptance patterns are conferred by the mammalian genome. From an evolutionary standpoint, these innate taste preferences are beneficial traits to help toddlers maximize their caloric intake and minimize their contact with potential toxins\textsuperscript{13}. As early as the first few days of life, human infants can show aversion to bitter taste by displaying negative facial responses and turning away from a bitter stimulus placed on the tongue\textsuperscript{13,22,33}. Infants also show acceptance of sweet tastes immediately after birth, by displaying more positive facial responses and
consuming more of sweet solutions than water\textsuperscript{24,34}. This same reaction can be seen when comparing varying sugar concentrations, with sweeter solutions preferred to less sweet solutions\textsuperscript{35}. Additionally, while newborns do not initially show any reaction to salty solutions, a greater preference for moderate salt concentrations can be seen around the fourth month of life\textsuperscript{26}.

Food neophobia, the fear or avoidance of new foods, is another innate trait that is thought to protect children from accidentally consuming harmful substances. In the first months of life, children are particularly accepting of new foods and flavors\textsuperscript{36,37}, but neophobia begins to develop somewhere around 6 months and peaks between ages two to five\textsuperscript{38,39}. As the toddler gains newfound independence, the growing fear of novel ingestibles is thought to protect them from consuming something harmful or toxic. There is evidence that neophobia has a genetic component, with about 66-69\% estimated heritability\textsuperscript{40}. It has also been suggested that neophobia is not unique to humans, and that all animals respond to novel stimuli with fear or avoidance\textsuperscript{41}. Repeated exposure to a stimulus in the absence of negative consequences however, can reduce this fearful response. Rozin referred to this familiarity effect as the “learned safety” hypothesis\textsuperscript{41}; he proposed that when a novel food is consumed without negative post-ingestive consequences, that food is then associated with safety and liking can increase.

While these unlearned preferences and neophobic responses were once a beneficial part of human development, in today’s world of relative abundance, these preferences can drive overconsumption of fatty snack foods and sugar sweetened beverages\textsuperscript{42,43}, two factors that contribute to obesity. Similarly, they can also lead to lower acceptance and intake of micronutrient dense foods like vegetables, which tend to be bitter and low in fat and sugar. Fortunately, innate biology is not the sole influence on complex food preferences, choice, and dietary consumption. Genetic variation can influence individual differences in taste perception and preferences can be learned and modified over time as we experience food in many different contexts and stages of life.
Genes.

While innate taste preferences are encoded in the human genome, they do not explain the variation in basic taste preferences between individual humans. Genetic variation has been shown to account for somewhere around 30-50% of differences in human food choice. Twin studies in 3- and 4-year olds have found that preference for food categories, such as fruits and vegetables, proteins, desserts, and starches have significant heritable components, with heritability being higher for fruits, vegetables, and protein foods than that of snack or dessert foods. Similar studies in adolescents and adults have also shown genetic determinants of food intake patterns, indicating that genes have a significant effect throughout the lifespan.

Additionally, inherited variations in specific genes can influence flavor perception in individuals. Genetic sensitivity to the bitterness of thiourea moieties in food and drug compounds is associated with polymorphisms in the TAS2R38 gene. Individuals with a homozygous or heterozygous “taster” genotype are extremely sensitive to thiourea bitterness, while homozygous “nontasters” are much less sensitive, especially to low concentrations. The bitter taster phenotype can be measured by using solutions of phenylthiocarbamide (PTC) or 6-n-propylthiouracil (PROP), which both contain thiourea moieties and are perceived as bitter to tasters and neutral, or like water, to nontasters. These measures of heightened bitter perception in children have been associated with a greater acceptance of sweet foods and lower acceptance of raw cruciferous vegetables. In female children, nontasters have been shown to consume more discretion fats and to prefer higher fat milk products. These individual genetic differences again suggest that palatability is a major factor in designing nutritional interventions, and that, based on their genes, certain groups of children may respond differently to interventions involving high sugar or high fat items.
Development of Food Preferences in Children: Learned Factors and Associative Conditioning

Repeat Exposure.

In children, familiarity is one of the most salient factors in predicting food acceptance\textsuperscript{54,55}. Many experiments in both children and adults have shown that repeated exposure to a disliked food can increase preference for that food\textsuperscript{56-59}. In studies on initially disliked vegetables, repeated exposure is one of the most effective methods of increasing intake\textsuperscript{60-65} and in preschoolers, repeated exposure to vegetables has been shown to be an effective way to increase both self-reported liking scores and objective intake measures\textsuperscript{60,61,64,66}. However, encouraging exposure can be difficult in children because merely looking at a food does not increase acceptance or decrease the neophobic response; the food must actually be tasted\textsuperscript{57}. Depending on the food and the age of the child, somewhere between 5-15 exposures may be needed\textsuperscript{56,62,63,67}. Considering that children already have innate and genetic preferences for fat, salty, and sweet, and because these energy dense foods are generally associated with positive post-ingestive consequences, convincing them to vary their diets can be extremely difficult. Parents often give up before children have had enough exposure to increase liking\textsuperscript{68}. Promoting consumption of low energy dense foods like vegetables can be particularly difficult. However, there is a narrow window of opportunity for learned flavor associations to develop in the earliest stages of life, before neophobic responses take over and even before the introduction of solid foods.

Classic Conditioning.

Repeated exposure is one form of psychological conditioning that can promote acceptance of novel foods. Another strategy to increase vegetable intake and encourage children to taste new vegetables is flavor association. This technique relies on classic Pavlovian conditioning, where a response to a stimulus is consistently presented with another neutral stimulus until the neutral stimulus alone can stimulate the
response previously triggered by the initial stimulus. Two types of flavor learning have been shown to impact food preferences. Flavor-nutrient learning pairs a novel or neutral flavor with increased energy density (e.g. added sugar or fat) and liking for the novel/neutral stimulus increases due to the association with the positive post-ingestive effects of energy. Flavor-flavor learning pairs a novel or disliked flavor (Conditioned Stimulus) with a well-liked flavor (Unconditioned Stimulus), with the goal of increasing acceptance of the initially disliked flavor.

**Flavor-Nutrient Learning.**

Studies in both animals and humans have shown that flavor association can form quickly and lead to changes in subsequent preference for or intake of the conditioned stimulus. In an experiment by Birch and colleagues (1985), children were shown to respond to flavor cues when given puddings of varying energy density (high vs. low) and flavor (chocolate or vanilla) before an *ad libitum* snack period. Children initially responded by consuming less of their snack after a high energy dense pudding. After several conditioning trials, puddings were presented in isocaloric forms, but children continued to eat less at snack time when given a pudding flavor that had previously been paired with the higher energy density pudding. A later study of the same design found that using novel flavored preload drinks (bubble gum or chocolate-orange) of high and low energy densities also conditioned preferences and influenced children’s subsequent snack intake. After several exposures in the conditioning period, children were given the drinks in isocaloric forms, but they continued to adjust their post-drink snack intake, consuming more snack calories after a preload of the flavored drink that had previously been prepared in a low energy dense form and fewer snack calories after a preload of the flavored drink that had previously been high in energy density. These studies provide evidence of flavor nutrient learning. However, flavor nutrient learning may be difficult to achieve in vegetables because they are so low in energy density to begin with; even with added sugar or oil, a very large portion would need to be consumed to see significant changes in post-ingestive consequences. For this reason, adding small amounts of sugar or fat
to increase palatability is generally considered to be a form of flavor-flavor learning, whereas flavor-nutrient learning is only achieved when fat or sugar is added in sufficient quantities to significantly increase energy density.

**Flavor-Flavor Learning.**

Flavor-flavor learning has been used to increase vegetable intake in infants and children. Using a familiar and well-liked flavor can help to reduce the innate distaste for vegetables and also the neophobic response to novel vegetables. In true flavor-flavor learning, liking for the initially disliked vegetable is maintained, even after the added flavor is removed. For example, in one flavor-flavor learning experiment, sweetener added to pureed vegetable flavors increased preference for the unsweetened vegetable flavor after 6 exposures.

Flavored dips, like ketchup or ranch dressing, are commonly used to get children to consume disliked foods. The use of dips can be particularly effective in promoting vegetable liking and intake because they not only contribute to flavor-flavor learning, but also because the act of dipping the vegetables gives children more control over their food experience. In children, the use of sweeteners, peanut butter, and herb-flavored dips have all produced increases in children’s vegetable intake, but these increases in liking were not maintained after removal of the added flavor. One experiment found that in a subgroup of bitter-insensitive children, incorporating flavors into a dip was more effective than using the same ingredient combination as a sauce pre-mixed with the vegetables; however, in bitter sensitive children, regardless of condition, both treatments were effective. The main advantage of using dips is that they increased children’s willingness to try the vegetables, which can often be a challenge.

Herb dips, in particular, have been shown to significantly increase children’s vegetable intake. Low fat herb dips can be made so that they contribute a minimal amount of extra calories, although low fat
versions may be less effective than full-fat versions. Dips containing herbs and spices may provide an additional health benefits, since these tend to be rich in antioxidants. Research has not tested, however, if the flavor of herbs and spices can increase vegetable intake or willingness to try vegetables in preschool aged children when mixed directly with the vegetables, instead of being incorporated into a dip.

A key component of classical conditioning is that the two stimuli have to be paired together enough times for the child to form an association. Therefore, it is important to consider that flavor-flavor learning and flavor-nutrient learning are both forms of repeated exposure. A benefit to these techniques is that they can improve palatability of the disliked food in order to encourage eating it enough times to facilitate repeat exposure. Several studies, however, have found no advantage over repeat exposure, particularly for flavor-nutrient learning. More research is needed to determine which strategies are most effective for children of different ages, and what type of learning works best for different categories of vegetables.

**Flavor Learning from Maternal Flavor Transmission**

*In utero* exposure.

Human exposure to flavors and development of learned preferences via associative conditioning can begin as early as the prenatal period. A series of case studies from Israel first made the connection between spicy foods in the mother’s pre-delivery diet and odd smelling amniotic fluid during delivery. Since then, several studies have demonstrated that certain flavors from the mother’s diet can pass into amniotic fluid. These flavors include carrot, garlic, and anise, but likely many more flavors are transmitted.

In the uterine environment, human babies begin to swallow amniotic fluid around the 16th week of gestation. In the first few days after birth, newborns prefer the smell of their own amniotic fluid when
compared to that of another infant\textsuperscript{21,80}, clear evidence that both odor perception and learning occur. Several studies also show that flavor exposure \textit{in utero} increases acceptance of that flavor after birth\textsuperscript{76,82,83}. In a classic study of prenatal flavor transmission, children exposed to carrot flavors \textit{in utero} had increased acceptance of carrot flavored cereal 5-6 months after birth\textsuperscript{76}, suggesting that this type of flavor exposure could have a long-term impact on food intake.

\textbf{Breastmilk.}

Flavors in the mother’s diet are not only transmitted into amniotic fluid, but also into breastmilk. Flavor transmission in breastmilk has been a part of agricultural knowledge for centuries, when farmers noticed that the diet of cows could influence off flavors in their milk\textsuperscript{84}. In humans, research has focused on the negative effects of teratogens in breastmilk, including alcohol and nicotine. While exposure to the bioactive compounds from beer or cigarettes via breastmilk is fairly low, research has shown that the flavor of the milk is significantly altered by both substances\textsuperscript{85-87}.

These studies on potentially harmful transmission in breastmilk led to investigation of other forms of flavor transmission, and, like in amniotic fluid, it was determined that a great number of flavors from the mother’s diet are transmitted to the infant. Mothers who consume garlic produce breastmilk with a significant garlic odor; this and other novel flavors actually increased infant’s suckling\textsuperscript{88}. Chemical analysis has shown transmission of the characteristic flavor compounds found in peppermint, licorice, banana, and caraway seeds\textsuperscript{89}. Additionally, when the carrot experiment described above was done in lactating mothers, carrot exposure via breastmilk also increased infant’s acceptance of carrot flavored cereal at 5-6 months of age\textsuperscript{76}. 

**Early Flavor Exposure and Food Acceptance.**

Through the mother’s diet, prenatal exposure and breastfeeding can introduce infants to many different tastes and odors long before they can experience solid foods. Animal studies have suggested that the scent of amniotic fluids influences kin recognition\(^8\) and that the flavors in mother’s milk help to teach newborns what is safe to eat after weaning\(^5\). Familiarity of the flavor profile in mother’s milk can be so influential in food selection at weaning, that it has been used to aid in early weaning of piglets by exposing the sow to strong flavors like garlic and anise and then incorporating these into the first solid foods the piglets have access to\(^7\). In humans, the variety of flavors in breastmilk have been linked to greater acceptance of new foods during weaning when compared to formula fed infants. Unlike breastmilk, formula has no flavor variation and exposes the infant to the same sensory profile each time.

As previously described, Mennella *et al.* showed that specific flavor exposure to carrots can influence children’s flavor acceptance 5-6 months later\(^7\), while a study on rats exposed to peppermint odor in the first few days showed that preferences can persist into adulthood\(^9\). More work is needed to determine the long term impacts maternal flavor transmission has on human acceptance and preference.

**Critical Periods in Food Acceptance.**

Flavor exposure in newborns may be particularly important because the first few months of life serve as a critical period in taste development, during which infants accept novel flavors much more readily than at any other stage in development\(^3\)\(^6\)\(^,\)\(^3\)\(^7\). Evidence of a critical period was first discovered in rat pups exposed to peppermint odor, where rat exposed on days 1-8 of development displayed increased preference for the odor later in life, but those exposed after day 8 showed no preference\(^9\). In humans, acceptance of initially disliked flavors, like the bitter and sour taste of protein hydrolysate formula, occurs much more rapidly in the first 3 months of life, whereas at 5-6 months old, infants are
much more persistent in their rejection of hydrolysate formulas\textsuperscript{36}. This and other studies support the findings that this critical period in taste development ends somewhere between 5-6 months of age\textsuperscript{36,37}. Following the critical period, foods tried in the first year of life still need fewer exposures to increase acceptance\textsuperscript{92}. This window of flavor acceptance, combined with maternal flavor transmission, provides a unique opportunity to increase flavor acceptance for novel vegetables and other foods in children.

**Flavor Acceptance and the Benefits of Dietary Variety**

**Dietary Variety.**

Learning to accept new flavors is an important part of getting children to eat new foods. As omnivores, humans need to consume a variety of different foods to meet nutritional requirements\textsuperscript{93,94}. Diets lacking variety tend to be higher in energy density, with greater amounts of sweets and fats, whereas increased variety is associated with a healthier diet, particularly in regards to fruit and vegetable consumption\textsuperscript{94,95}. Because it is so difficult to change children’s eating habits after the preschool years, it is critical to introduce variety in to the diet as early as possible.

**Flavor Exposure and Increased Dietary Variety.**

As discussed above, specific flavor exposure in utero and via breastfeeding have both been shown to increase acceptance and intake of foods containing that flavor during weaning. Additionally, these results can generalize to other foods, and overall variety in flavor exposure during milk feedings can lead to increased acceptance of novel foods during weaning. For this reason, breastfed babies tend to be more accepting of novel flavors than formula fed babies\textsuperscript{96-98}. Less flavor exposure results in higher neophobic responses to new foods.
After the transition to solid foods, greater variety in food consumption also leads to greater acceptance of novel foods\textsuperscript{99,100}. For example, babies fed a variety of vegetable purees over the course of 9 days had greater acceptance and intake of a novel vegetable and a novel meat flavor than babies fed as single vegetable puree for those 9 days\textsuperscript{99}.

The impact of infant flavor exposure on future taste acceptance, preference, and intake is a compelling reason to study flavor transmission in the maternal diet. This developmental window provides a unique opportunity to promote consumption of healthful foods like vegetables, when novel flavors are most accepted and before the effects of neophobia set in. Additionally, targeting healthy behaviors in young children maximizes the lifelong benefits of these dietary habits\textsuperscript{101-103}, both in preventing obesity and achieving adequate micronutrient intake. Due to their overwhelmingly positive effects on child and adult health, increasing vegetable consumption is a promising strategy both in preventing and reducing obesity.

**Benefits of Herbs and Spices**

While the terms are commonly used interchangeably, herbs originate from leafy green part of the plant, while spices come from any other part of the plant, including bark, stems, bulbs, or roots. Several different herbs and spices may come from different parts of the same plant. “Seasonings” will also be used throughout this document as an umbrella term that includes both herbs and spices.

In adults, using herbs and spices has been shown to improve the palatability of and increase adherence to low-fat and low-sodium diets\textsuperscript{104-107}. Herbs and spices have also been associated with several positive health benefits, including reduced risk for neurodegenerative disease, cancer, and cardiovascular disease\textsuperscript{108,109}. Herbs and spices are good potentials candidate for flavor-flavor learning and increasing vegetable intake because they have distinct flavor profiles and can easily be added to many different
recipes. Additionally, seasoning vegetables may be a good way to improve palatability without adding large amounts of fat or sugar.
Purpose

Study Aims and Hypotheses.

The aim of this study was to investigate the role of pre- and postnatal herb and spice exposure on preschool aged children’s liking and intake of seasoned vegetables in a test meal intervention paradigm. The intervention paradigm was part of a larger study investigating the use of herb and spices on vegetables to create flavor variety as a way to increase vegetable intake within a meal in preschool aged children; these results will be reported elsewhere. The additional hypotheses were added to determine if maternal flavor transmission can influence the success of future dietary interventions.

A primary aim was to create a retrospective questionnaire to assess maternal herb and spice intake during pregnancy and, if the child was breastfed, lactation, as well as the mother and child’s current herb and spice use. We hypothesized that 3- to 5-years post-partum, mothers would be able to report their herb and spice intake more often than they would choose an “I don’t know” response.

A second aim of the study was to investigate the relationship between maternally reported herb and spice exposure and their preschool aged children’s liking and intake of vegetables prepared with these herbs and spices. We hypothesized that maternally reported intake of herb and spices during pregnancy and breastfeeding would positively correlate with children’s liking scores for carrots prepared with the same herbs and spices and children’s intake of these carrots during the Variety condition. We also hypothesized that greater maternal exposure to herbs and spices overall would correlate with higher liking scores for all the seasoned carrots.
Due to the combined impact of flavor transmission into amniotic fluid and into breastmilk, we hypothesized that breastfeeding status would moderate the relationship between maternally reported herb and spice exposure and children’s liking of the seasoning blends.

**My Role.**

I collaborated with graduate student Wendy Stein on the initial development of the experimental protocol, and I was specifically responsible for the design of the carrot and broccoli liking task, including the use of blinding codes and sample randomization. I wrote the maternal spice intake questionnaire to investigate the role of flavor transmission in children’s response to the seasoned vegetables. After the first year working together, I took over the project independently. I have been responsible for recruiting and scheduling participants, carrying out test meal visits, and analyzing the data.
Chapter 2 - Methods

Study Design

Laboratory Paradigm.

The study was a within-subject cross-over evaluating the effects of increased sensory variety on children’s vegetable intake within a meal. Herbs and spices were used to create flavor variety in cooked carrots. A retrospective questionnaire was used to ask mothers about prenatal, postnatal, and current herb and spice exposure to investigate the role of maternal flavor transmission on children’s liking and intake of vegetables seasoned with herbs and spices. Children came into the Metabolic Kitchen and Children’s Eating Behavior Laboratory with a parent for two test visits, scheduled at either lunch (between 11:00am – 2:00pm) or dinner (between 4:30pm – 7:00pm). One visit tested vegetables with only one spice blend (No Variety condition) while the other visit tested vegetables with three different spice blends (Variety condition). On the first visit, children also completed a liking task, where they rated broccoli and carrots prepared with the same herb and spice blends used in the test meal. Each visit was scheduled to take no more than two hours. Both visits were completed at the same time of day within two weeks, at least 1 week apart. A summary of each visit is shown in Table 1.
Parents gave written consent for their child, and children provided verbal assent. Children were given a few minutes to play in the waiting area in the presence of the research assistant to get comfortable before moving on to the test protocol. Anthropometrics were taken at the beginning of the first visit, with the aid of a parent if necessary. Afterward, all test procedures occurred in a private observation room, viewable to parents through a one-way mirror. Parents filled out questionnaires at a computer in an adjacent room.

Throughout each visit, children were offered breaks to play between tasks. Children could either color in the observation room or play with the toys in the waiting area, for up to 5 minutes, in the presence of the research assistant. Children could also refuse breaks and move on.

All protocols were approved by The Pennsylvania State University Institutional Review Board (IRB). Families received monetary compensation for their participation and children could select a prize at the end of each visit.

<table>
<thead>
<tr>
<th>Visit 1 (Week 1)</th>
<th>Visit 2 (Week 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Parental Consent and Child Assent</td>
<td>• Fullness: Peter Peter Pumpkin Eater Task</td>
</tr>
<tr>
<td>• Anthropometric Measurements</td>
<td>• Child’s Food Liking: Picture book Rating Task</td>
</tr>
<tr>
<td>• PROP Taster Status Assessment</td>
<td>• Pre-Meal Liking Task: Meal Tasting</td>
</tr>
<tr>
<td>• Fullness: Peter Peter Pumpkin Eater Task</td>
<td>• Intake Data: Test Meal</td>
</tr>
<tr>
<td>• Liking of Spice Blends: Vegetable Tasting</td>
<td>• Post-Meal Liking Task: Meal Tasting</td>
</tr>
<tr>
<td>• Pre-Meal Liking Task: Meal Tasting</td>
<td>• Parent Questionnaires</td>
</tr>
<tr>
<td>• Intake Data: Test Meal</td>
<td></td>
</tr>
<tr>
<td>• Post-Meal Liking Task: Meal Tasting</td>
<td></td>
</tr>
<tr>
<td>• Parent Questionnaires</td>
<td></td>
</tr>
</tbody>
</table>
Participant Recruitment.

Children were recruited from the areas surrounding the University using flyers, handouts, and online advertisements. Advertisements were distributed around campus, at local businesses and children’s events, and posted on local websites frequented by parents. We also utilized FIRST families, a University managed database of families interested in participating in research (http://firstfamilies.la.psu.edu/).

Interested parents contacted the lab by phone or email and were given a brief description of the study, including the purpose and duration. Parents were screened to determine eligibility over the phone by trained research assistants. Children were excluded if they did not like the test meal foods, had food allergies, medical conditions or were taking medications that could affect appetite, taste, or weight status. In addition, the parent primarily responsible for feeding had to be willing to escort the child to the visits and complete the study questionnaires. If this parent was not the biological mother, they were still eligible to participate in the overall variety study, but they were excluded from the flavor transmission data analysis.

Anthropometrics.

At the beginning of their first laboratory visit, children’s height and weight were measured after removing shoes, socks, and jackets. Weight was measured to the nearest tenth of a pound using a digital body scale (Tanita, Arlington Heights IL) and height was measured to the nearest tenth of a centimeter on a stadiometer (SECA, Chino CA). Height and weight were measured in duplicate and average values computed for data analysis.
PROP Taste Test.

Children were classified as PROP tasters or nontasters using a child-friendly method developed by Mennella et al.\textsuperscript{110}. Children were presented with Big Bird and Oscar the Grouch puppets and told that Big Bird likes to drink water while Oscar the Grouch likes to drink a special yucky/bitter drink, and we needed the child’s help to figure out who’s drink we had. They were then given a 10 mL sample of 56 $\mu$mol/L 6-n-propylthiouracil in distilled water to swish and spit. If the child said it tasted like water or pointed to the Big Bird puppet, they were classified as a nontaster; if they said it tasted yucky or pointed to the Oscar puppet, they were classified as a taster. Following the PROP taste test, children were given two mini vanilla wafers (Nilla Wafers, Mondelēz International, East Hanover NJ) to cleanse their palates.

Preparation of Seasoned Vegetables

Seasoning Blend Choices.

Flavor variety was created by using herb and spice blends to season the vegetables used in the study. Carrots were chosen as the target vegetable because they are generally familiar and well-liked by children\textsuperscript{64,111}. Broccoli was included as part of the self-reported liking task to help inform future studies on green vegetable intake, but was not served as part of the test meals.

Seasoning blends were developed from resources on complementary herbs and spices (http://adventuresinspice.com/flavormap/flavormap.html). Each blend incorporated three different herbs and/or spices to achieve a wide variety of flavors and a complex, but balanced sensory profile. Blends were chosen to be as different as possible, and included a sweet cinnamon blend (cinnamon-nutmeg-ginger) and two savory blends, a garlic blend predicted to be familiar (garlic-black pepper-oregano) and a cardamom blend predicted to be novel to most children (cardamom-cumin-allspice). All blends also
included baseline levels of salt. The ratios of recipe component are given in Table 2. Blends were premixed in larger batches and re-prepared every 3-4 months.

Table 2. Herb and spice blend recipes used to season vegetable samples.

<table>
<thead>
<tr>
<th>Cinnamon Blend</th>
<th>Garlic Blend</th>
<th>Cardamom Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 parts cinnamon</td>
<td>1 part garlic</td>
<td>2 parts cardamom</td>
</tr>
<tr>
<td>2 parts ginger</td>
<td>2 parts oregano</td>
<td>2 parts cumin</td>
</tr>
<tr>
<td>2 parts nutmeg</td>
<td>1 part black pepper</td>
<td>2 parts allspice</td>
</tr>
<tr>
<td>1 part salt</td>
<td>1 part salt</td>
<td>1 part salt</td>
</tr>
</tbody>
</table>

Seasoned Vegetable Preparation.

Frozen crinkle cut carrots (Wegman’s, Rochester NY) and frozen broccoli florets (Bird’s Eye, Pinnacle Foods, Parsippany NJ) were cooked and seasoned before each test meal visit. Carrots (2 cups) were steamed in the microwave for 5 minutes at power level 8 (General Electric, Louisville KY) with a half cup of tap water, drained and divided into half-cup portions. Each half cup portion was then mixed with 1/8 tsp. of canola oil and 1/16 tsp. of the appropriate seasoning blend. A control sample was mixed with only 1/16 tsp. of salt. Broccoli (1.5 cups) was steamed in the microwave for 4 minutes at power level 6 (General Electric, Louisville KY) and divided into one-third cup portions. Each third cup portion was then mixed with 1/8 tsp. of canola oil and 1/16 tsp. of a seasoning blend. Carrots and broccoli were both stirred to distribute the seasoning blends evenly.

Seasoned Vegetable Liking Task.

Prior to receiving any of the test meal foods, children were presented with bite-size (i.e. one carrot slice or one small broccoli floret) samples of the vegetables prepared with each of the three seasoning blends and
the salted carrot as a control Figure 1. Samples were served in a randomized block design, with either broccoli or carrots served first in a counterbalanced order and individual samples randomized within vegetable type. Children were asked to taste each vegetable, taking a small sip of water in between samples, and to rate their liking using a 5-pt child friendly hedonic scale ranging from 1-super bad to 5-super good. Trained research assistants used a pre-written script to explain how the scale worked and checked for understanding by having children rate their favorite and least favorite foods. If the child did not at least understand the difference between “good” and “bad” faces when asked to rate their favorite and least favorite foods, the scale was re-explained until they could demonstrate adequate understanding. In addition to rating each sample, children also selected their least and most preferred samples of both carrot and broccoli. The score children gave carrots on the 5-point scale is a measure of acceptance, also referred to as “liking”. The rank order task measures preference of one seasoned carrot over the others.

Figure 1. Seasoned vegetable liking task. Children used a 5-point hedonic scale to rate their liking of carrots and broccoli prepared with herb and spice blends. The sample order was randomized in block design by vegetable type.
**Test Meal Preparation**

**Test Meal Conditions.**

A “Variety” condition and a “No Variety” meal condition were presented in a randomized, within-participant crossover design at the two laboratory visits. For the Variety Condition, the child received the meal with three unique servings of carrots, each with one of the three spice blends. For the No Variety Condition, children received a meal with three servings of the same carrots, all prepared with the same spice blend, the cinnamon blend. In both meals, the three servings of carrots were presented in three identical bowls, as shown in Figure 2. The other meal items remained consistent between conditions. Intake of the seasoned carrots and other meal items were calculated from pre- and post-weighing.

The cinnamon blend was chosen for the No Variety condition, because it was hypothesized that children would be most familiar with these seasonings because they are used in many sweet bakery products. The blend was also used on the carrot for the pre- and post-meal liking task, regardless of meal condition.

![Figure 2](image-url) **Figure 2.** Test meal presentation, including macaroni and cheese, applesauce, milk, water and carrots. In the No Variety conditions, all carrots were seasoned with the cinnamon blend; in the Variety condition, one bowl of carrots each were seasoned with the cinnamon blend, the garlic blend, and the cardamom blend.
Test Meal Preparation.

On each visit, children were served a meal of Macaroni and Cheese (Stouffer’s, Nestle, Switzerland), Unsweetened Applesauce (Motts®, Dr. Pepper Snapple Group, Plano TX), 2% Milk (Galliker Dairy Company, Johnstown PA), water, and crinkle cut carrots (Wegman’s, Rochester NY). Age-appropriate portion sizes\(^{112}\) of each food served are listed below Table 3. Macaroni and Cheese was prepared in the oven according the package directions (50 minutes at 350˚F) immediately before meal visits. Because the duration of test visits varied from child to child depending on the number of breaks taken, the macaroni was covered in aluminum foil and kept warm in a toaster oven at the lowest “warm” setting, between 200-250˚F, (Oster. Sunbeam Products, Boca Raton FL) until needed. Applesauce, milk, and water were portioned out and kept refrigerated for up to an hour before the beginning of the visit. Carrots for each of the three spice blends were prepared as described above for the seasoned vegetable liking task and served in three separate bowls of identical color, shape, and size. If needed, carrots were reheated in the microwave for up to 30 seconds on high power. All foods were pre-weighed to the nearest tenth of a gram before leaving the kitchen.

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Weight (g)</th>
<th>Portion</th>
<th>Calories per Serving (kcal)**</th>
<th>Energy Density (kcal/g)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macaroni &amp; Cheese</td>
<td>175</td>
<td>3/4 cup</td>
<td>255</td>
<td>1.46</td>
</tr>
<tr>
<td>Applesauce</td>
<td>115</td>
<td>1/2 cup</td>
<td>59</td>
<td>0.51</td>
</tr>
<tr>
<td>Prepared Carrots*</td>
<td>120</td>
<td>3/4 cup</td>
<td>64</td>
<td>0.53</td>
</tr>
<tr>
<td>Milk</td>
<td>240</td>
<td>1 cup</td>
<td>130</td>
<td>0.54</td>
</tr>
<tr>
<td>Water</td>
<td>465</td>
<td>~2 cups</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

* A total of 120 grams of carrots were served in each meal, split into three 40 g servings for each flavor blend. Carrot calories and energy density were calculated based on preparation with seasonings and 1/8 tsp. of canola oil per 40 gram serving.
** Calories per serving and energy density were calculated using the nutritional information provided by the manufacturer.
Test Meal Procedure.

Prior the test-meal, children rated liking of all test-meal foods on the same 5-pt smiley face scale used for vegetable ratings. Children were presented with a tray of bite-size (~5 gram) servings of each of the test meal foods (macaroni and cheese, applesauce, carrots, milk) and asked to try the foods in order, with a sip of water in between, and to point to the face that matched their liking. A single seasoned carrot, the Cinnamon blend, was used for the meal tasting to minimize fatigue effects. Children were also asked to rank the foods from their favorite (rank=1) to their least favorite (rank=4).

Prior to receiving the test meal, children’s perception of their own hunger was measured using a protocol developed by Birch (2002) that allows them to choose from three pictures depicting a character that is “very hungry/not full at all,” “A little hungry/half full,” or “Not hungry/all the way filled up.”

Children were given a 30-minute ad libitum test meal (as described above) where they could eat as much or as little as they liked. Research assistants read a pre-screened, non-food-related story to the child while they ate, and were trained to keep discussions as neutral as possible to avoid undue distraction from the meal. The meal ended when the child said they were done or when 30 minutes had passed. Leftovers were returned to the kitchen and weighed to the nearest 0.1 g immediately following the test-meal.

Following the meal, the fullness task was re-administered and the test meal liking task was repeated as described above.
**Questionnaires**

**Parent Questionnaires.**

Parents filled out questionnaires using Qualtrics online software in a room adjacent to their child’s observation room during the two laboratory test visits. In the event that this parent was unavailable to attend a visit (i.e. the parent not primarily responsible for feeding the child brought them in) or if they could not fill out the questionnaire during the visit (i.e. they had multiple other children to attend to), the questionnaires were emailed to the parents and completed within one week of the visit. Surveys included questions on general demographics, food neophobia\(^\text{113}\), temperament\(^\text{114}\), clinical nutrition risk (http://www.nutristep.ca/), typical eating behaviors\(^\text{115}\), infant feeding practices, and caregiver feeding styles\(^\text{116}\).

The **Infant Feeding Questionnaire (IFQ)** was previously developed by our lab to measure maternal dietary habits and early infant feeding practices during pregnancy, lactation, and the child’s first year of life (e.g. maternal diet, initiation and duration of breastfeeding, choice of formula, introduction of solid foods).

**Spice Intake Questionnaires.**

The Spice Intake Questionnaire (SIQ) was developed specifically for this study to investigate the potential impact of maternal flavor transmission. Questions and answer choices were written to specifically ask about consumption of the 9 herb and spices used in the seasoning blends as well as salt. Mothers were first asked if they consumed that herb or spice during pregnancy as a yes/no question and then the frequency in which they consumed the spice during that period. For mothers who breastfed, the questions were asked again for the period of lactation. Additionally, mothers were asked how frequently both they
and their child currently consume that spice and how often their child rejects it. Questions were repeated individually for all 10 herbs and spices, including salt. For all retrospective questions, and “I don’t know/I don’t remember” answer choice was included to encourage mothers to only answer the question if they were confident in their answer.

The **home spice checklist (HSC)** was also developed specifically for this study. Parents were given a comprehensive checklist of 34 common herbs and spices (http://adventuresinspice.com/flavormap/flavormap.html) at the end of visit 1, and asked to return it on visit 2 after checking off all the options that they currently had in their home and used on a regular basis. Parents were instructed not to check any herb or spice that they had at home, but did not use on a regular basis (i.e. at least once a week in the past three months). While the SIQ was designed to assess specific intake of the herbs and spices used in the study, the HSC was designed to collect more information on the total variety of spices that children are exposed to at home.
Chapter 3 - Data Analysis

Data from 42 participants were included in the analysis. Two children were excluded from the data set because a parent other than their biological mother filled in the parent questionnaires. All statistics were run on SPSS Version 22.0 (SPSS Inc., Chicago, IL) with a critical $P$-value ≤ 0.05. Means and standard deviations (mean ± SD) are given for all continuous variables, while frequencies (%, $N$) are given for categorical variables.

Data Preparation

Characteristics and Demographics.

Children’s age was calculated in months from their date of birth to the date of their first visit to the lab. Body mass index (BMI) was calculated by dividing weight in kg by height in meters squared from the average values of duplicate measures for height and weight. BMI z-scores and BMI percentiles were calculated using the Baylor College of Medicine online calculator (https://www.bcm.edu/cnrc-apps/bodycomp/bmiz2.html). Children were considered normal weight if they had a BMI < 85th percentile, or overweight if they had a BMI ≥ 85th percentile.

Maternal BMI was calculated from self-reported height and weight. Moms were considered normal weight with a BMI < 25 kg/m$^2$, and overweight with a BMI ≥ 25 kg/m$^2$. Mom’s also self-reported their age, race/ethnicity, marital status, income, as well as their child’s race/ethnicity and if they chose to breastfeed.
Originally, we had hypothesized that breastfeeding status would moderate the relationship between maternal herb and spice intake and children’s liking of the seasoned carrots, but only two mothers in the study reported that they never breastfed their child, therefore this analysis was not pursued.

**Children’s Vegetable Liking.**

Children’s carrot and broccoli liking scores were assigned values of 1-5 with 1 being super bad and 5 being super good on a 5-point hedonic scale. Scores were also pooled to give children a combined liking score for all three seasoned carrots (range: 3-15) and a combined liking score for all three seasoned broccolis (range: 3-15). Children were considered to dislike carrots, regardless of seasoning blend, if they did not rate a single carrot, including the control carrot (salt and oil), in the top two categories (i.e. good or super good).

**Children’s Test Meal Intake.**

Children’s meal intake was calculated by subtracting the leftover meal items post-weight from the item’s pre-weight to the nearest 0.1 grams. Energy consumption was calculated from the child’s intake in grams multiplied by the food item’s energy density (kcal/gram) as reported on the manufacturer’s nutrition label. For the carrots, energy density was calculated for a recipe of ½ cup of carrots combined with 1/8 tsp. of canola oil. Herbs and spices were considered to add negligible calories and macronutrients. Total meal energy density (ED) was calculated from the total calories consumed divided by the total weight of food ingested. Because satiety is differentially influenced by solid foods than liquids \(^{117}\), ED was calculated separately for food items only (macaroni, applesauce, and carrots), for caloric items only (foods and milk), and for all meal items (foods and beverages). Meal intake and energy density calculations can be found in Table 4.
Table 4. Children’s intake of meal items by condition.

<table>
<thead>
<tr>
<th>Meal Item</th>
<th>No Variety Condition</th>
<th>Variety Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD (grams)</td>
<td>Mean ± SD (calories)</td>
</tr>
<tr>
<td>Macaroni and Cheese</td>
<td>100.27 ± 58.38</td>
<td>146.41 ± 85.24</td>
</tr>
<tr>
<td></td>
<td>101.41 ± 62.16</td>
<td>148.05 ± 90.75</td>
</tr>
<tr>
<td>Applesauce</td>
<td>76.33 ± 41.04</td>
<td>34.35 ± 18.47</td>
</tr>
<tr>
<td></td>
<td>77.14 ± 38.13</td>
<td>34.71 ± 17.16</td>
</tr>
<tr>
<td>Carrots</td>
<td>35.93 ± 44.15</td>
<td>14.05 ± 17.26</td>
</tr>
<tr>
<td></td>
<td>37.87 ± 40.96</td>
<td>14.81 ± 16.02</td>
</tr>
<tr>
<td>Milk</td>
<td>77.00 ± 78.86</td>
<td>41.73 ± 42.74</td>
</tr>
<tr>
<td></td>
<td>84.86 ± 74.70</td>
<td>45.99 ± 40.49</td>
</tr>
<tr>
<td>Water</td>
<td>26.30 ± 49.32</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>37.52 ± 63.70</td>
<td>N/A</td>
</tr>
<tr>
<td>Food Total (w/o beverages)</td>
<td>212.55 ± 111.42</td>
<td>194.80 ± 103.79</td>
</tr>
<tr>
<td>Meal Total (all items)</td>
<td>292.51 ± 142.98</td>
<td>263.54 ± 115.16</td>
</tr>
<tr>
<td></td>
<td>301.27 ± 148.39</td>
<td>243.57 ± 123.55</td>
</tr>
<tr>
<td>Energy Density (kcal/grams)*</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Energy Density (w/o beverages)</td>
<td>0.90 ± 0.20</td>
<td>0.89 ± 0.21</td>
</tr>
<tr>
<td>Energy Density (w/o water)</td>
<td>0.82 ± 0.18</td>
<td>0.79 ± 0.17</td>
</tr>
<tr>
<td>Energy Density (all items)</td>
<td>0.76 ± 0.21</td>
<td>0.73 ± 0.21</td>
</tr>
</tbody>
</table>

*Energy density was calculated by dividing the calories consumed by the weight of food consumed in grams.

Children’s Carrot Intake.

Children’s total carrot intake was calculated as the total carrot intake at both meals combined. Intake of carrots by seasoning blend was defined as intake of that seasoned carrot type at the Variety condition only. Children were considered non-carrot eaters if they consumed fewer than 5 grams of carrots between both visits (< 1 carrot per visit) and these children were removed from some analyses.

Maternal Spice Intake.

Maternal herb and spice intake was assessed to be the number of questions she responded “yes” to consuming that herb or spice during pregnancy and/or lactation. Scores were calculated for each individual spice blend (range: 0-3) and a combination score for all the herbs and spices used in the study (range: 0-9). For example, if a mom reported consuming garlic, black pepper, and cinnamon during pregnancy, she would have a score of 2 for the garlic blend, a score of 1 for the cinnamon blend, a score of 0 for the cardamom blend, and a total intake score of 3. Scores were calculated individually for
pregnancy and breastfeeding (ranges: 0-3 for spice blends; 0-9 for all spices used in the study), as well as a combined score for total maternal exposure during the flavor transmission period (ranges: 0-6 for spice blends; 0-18 for all spices used in the study).

**Statistical Analysis**

Spearman’s correlations were used to compare the relationship between maternally reported herb and spice intake and children’s reported liking and measured intake of the seasoned carrots. Spearman correlations were also used to check if age, sex, BMI z-score, or PROP taster status were correlated with the main outcomes. For correlations between maternal intake and child liking, data were analyzed with and without the children who did not report liking any of the carrots. For correlations between maternal intake and child carrot intake, data were analyzed with and without children who did not consume any carrots at the tests meals. Data was analyzed this way to isolate the effect of maternal flavor transmission on children’s seasoned vegetable liking/intake without the influence of children whose dislike for cooked carrots might have made them resistant to this form of intervention.

Differences between children’s liking of seasoned vegetables were compared with the Friedman test of differences for non-parametric, repeated measures. Analysis was followed by a post hoc comparison using Dunn’s test of multiple comparisons. Differences in children’s intake of the seasoned vegetables were compared with one-way repeated measures ANOVA with a Greenhouse-Geisser correction.
Chapter 4 - Results

Participants

Forty-two ($N = 42$) healthy children (mean age: $54.02 \pm 8.37$ months) participated in this study. Children were aged 3-5 years with the exception of one child who was tested just after their 6th birthday due to rescheduling problems. The data also included one set of siblings, tested about 1 year apart, and one set of twins, tested by separate researchers on the same days. The 6-year-old and the sibling sets were found not to significantly change the main outcome results, and were therefore included in the remainder of the data analysis.

Children were 57% male ($N=24$), predominantly white (95.2%, $N=40$) and non-overweight (81%, $N=24$). Eighty-one percent ($N=34$) were classified as PROP tasters, and 19% ($N=8$) were nontasters. Mothers were also predominantly white (95.2%, $N=40$), married (95.1%, $N=39$), with a college degree (92.7%, $N=38$) and an average yearly household income greater than $50,000 (62.5%, $N=25$). A more detailed summary of demographic information is provided in Table 5 and Table 6. One mother failed to provide demographic information and was excluded from the demographic summary, although her spice intake questionnaire results were used in the remainder of data analysis. One additional mother did not provide income information.
Table 5. A summary of demographic information and anthropometric measurements for children in the study.

<table>
<thead>
<tr>
<th>Child Characteristics</th>
<th>% (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>57.0 (24)</td>
</tr>
<tr>
<td>Female</td>
<td>43.0 (18)</td>
</tr>
<tr>
<td>Race / Ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>92.8 (39)</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Asian</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Mixed Race</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Weight Classification</td>
<td></td>
</tr>
<tr>
<td>Non-overweight (BMI %ile 0-85th)</td>
<td>81.0 (34)</td>
</tr>
<tr>
<td>Overweight (BMI %ile &gt;85th)</td>
<td>19.0 (8)</td>
</tr>
<tr>
<td>PROP Status</td>
<td></td>
</tr>
<tr>
<td>Nontaster</td>
<td>19.0 (8)</td>
</tr>
<tr>
<td>Taster</td>
<td>81.0 (34)</td>
</tr>
<tr>
<td>Age</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Child age in months</td>
<td>54.02 ± 8.37</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td></td>
</tr>
<tr>
<td>BMI percentile</td>
<td>56.33 ± 29.56</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>0.21 ± 0.99</td>
</tr>
</tbody>
</table>
Table 6. A summary of demographic and anthropometric information self-reported by mothers in the study.

<table>
<thead>
<tr>
<th>Maternal Characteristics</th>
<th>% (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>95.2 (39)</td>
</tr>
<tr>
<td>Hispanic or Latina</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Mixed race</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Weight Class</td>
<td></td>
</tr>
<tr>
<td>Non-overweight (BMI &lt; 25)</td>
<td>45.0 (18)</td>
</tr>
<tr>
<td>Overweight (BMI ≥ 25)</td>
<td>55.0 (22)</td>
</tr>
<tr>
<td>Highest Education Achieved</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>7.3 (3)</td>
</tr>
<tr>
<td>College degree</td>
<td>46.4 (19)</td>
</tr>
<tr>
<td>Some graduate/professional school</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Graduate/professional degree</td>
<td>43.9 (18)</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
</tr>
<tr>
<td>Single (never married)</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Married</td>
<td>95.2 (39)</td>
</tr>
<tr>
<td>Separated</td>
<td>2.4 (1)</td>
</tr>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td>&lt; $20,000</td>
<td>0</td>
</tr>
<tr>
<td>$20,000-35,000</td>
<td>15.0 (6)</td>
</tr>
<tr>
<td>$36,000-50,000</td>
<td>22.5 (9)</td>
</tr>
<tr>
<td>$51,000-75,000</td>
<td>20.0 (8)</td>
</tr>
<tr>
<td>$76,000-100,000</td>
<td>20.0 (8)</td>
</tr>
<tr>
<td>&gt; $100,000</td>
<td>22.5 (9)</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>Age, in years</td>
<td>35.41 ± 4.46</td>
</tr>
<tr>
<td>Body Mass index</td>
<td>26.99 ± 7.45</td>
</tr>
</tbody>
</table>
Spice Intake Questionnaire (SIQ) Responses

Maternal self-reported intake of the herbs and spices used in the study is summarized in Table 7. Of 42 participants, 40 mothers reported breastfeeding and were also asked about herb and spice consumption during lactation. Salt, pepper, and garlic were the most commonly consumed spices, followed by oregano and cinnamon. A binomial test reveals that mothers were more likely to choose an answer (i.e. yes or no) as a response to herb and spice intake questions, as opposed to the “I don’t know” option \( (P < 0.001) \) with the single exception of consumption of allspice during breastfeeding \( (P = 0.08) \).

There was a trend for mothers to choose the “I don’t know” option more for questions about breastfeeding than those about pregnancy, however this was only significant for nutmeg \( (T = 2.08, P = 0.04) \) and allspice \( (T = 2.22, P = 0.03) \). Total intake scores on the SIQ are shown in Figure 3.

For all the herbs and spices used in the study, moms reported consuming an average of about 6 of the 9 total herbs and spices during pregnancy and/or breastfeeding (pregnancy: 6.38 ± 1.40, breastfeeding: 6.10 ± 1.61, both: 12.55 ± 2.84). For the individual blends, the herb and spices in the garlic blend (pregnancy: 2.95 ± 0.22, breastfeeding: 2.90 ± 0.38, both: 5.58 ± 0.53) were consumed the most and the herbs and spices in the cardamom blend (pregnancy: 1.17 ± 0.79, breastfeeding: 1.13 ± 0.79, both: 2.35 ± 1.44) were consumed the least, with the herbs and spices in the cinnamon blend falling in-between (pregnancy: 2.26 ± 0.83, breastfeeding: 2.08 ± 0.94, both: 2.35 ± 1.44). Using Dunn’s test for multiple comparisons, there was a significant difference in reported consumption of all three blends during all possible stages of maternal transmission (pregnancy: \( Q = 64.74, P < 0.05 \), breastfeeding: \( Q = 58.05, P < 0.005 \), both: \( Q = 62.47, P < 0.01 \)).
Table 7. Maternal Spice Intake Questionnaire responses for consumption of each herb/spice during pregnancy and breastfeeding.

<table>
<thead>
<tr>
<th>Herb/Spice</th>
<th>Pregnancy (N=42)</th>
<th>Breastfeeding (N=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (N)</td>
<td>No (N)</td>
</tr>
<tr>
<td>Allspice</td>
<td>33.3% (14)</td>
<td>47.6% (20)</td>
</tr>
<tr>
<td>Black Pepper</td>
<td>97.6% (41)</td>
<td>2.4% (1)</td>
</tr>
<tr>
<td>Cardamom</td>
<td>11.9% (5)</td>
<td>69% (29)</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>95.2% (40)</td>
<td>0%</td>
</tr>
<tr>
<td>Cumin</td>
<td>71.4% (30)</td>
<td>23.8% (10)</td>
</tr>
<tr>
<td>Garlic</td>
<td>100% (42)</td>
<td>0%</td>
</tr>
<tr>
<td>Ginger</td>
<td>61.9% (26)</td>
<td>33.3% (14)</td>
</tr>
<tr>
<td>Nutmeg</td>
<td>69% (29)</td>
<td>23.8% (10)</td>
</tr>
<tr>
<td>Oregano</td>
<td>97.6% (41)</td>
<td>2.4% (1)</td>
</tr>
<tr>
<td>Salt</td>
<td>97.6% (41)</td>
<td>2.4% (1)</td>
</tr>
</tbody>
</table>

Figure 3. Maternal Spice Intake Questionnaire scores for consumption of each herb and spice blend during pregnancy, breastfeeding, and a combination of them both.
Children’s Liking of Seasoning Blends

Children’s reported liking of the seasoned carrots and the seasoned broccoli is shown in Figure 4. Table 8 gives the percentage of children that chose each blend as their favorite. No significant differences were found in the mean liking ratings for any of the seasoned carrots ($\chi^2_{2, N=42} = 0.34, P = 0.85$) or the seasoned broccoli samples ($\chi^2_{2, N=40} = 0.20, P = 0.91$). Children liked the seasoned broccoli (combined liking score: $10.37 \pm 2.71$) more than the seasoned carrots ($8.52 \pm 3.35$) when compared with a paired t-test ($T = 3.18, P < 0.005$). Two children refused to try the broccoli samples and do not have liking data. Additionally, there was no significant difference in liking between the control carrot and the seasoned carrots ($\chi^2_{2, N=38} = 2.28, P = 0.52$), although the control carrot was selected as the most preferred sample in the rank-order task. The first four children were not given a control carrot sample, as this was a later addition to the study, however, mean liking score of the seasoned carrots was not significantly different for children who were not given the control carrot when compared to those who were.

![Figure 4](image_url)

**Figure 4.** Children’s self-reported liking of seasoned carrots (left) and broccoli (right). There were no significant differences in liking between any of the seasoning blends for both carrots ($\chi^2_{2, N=38} = 2.28, P = 0.52$) or broccoli ($\chi^2_{2, N=40} = 0.20, P = 0.91$).
Table 8. Children’s favorite seasoned vegetable sample, selected as their number 1 choice in the rank-order task. Children who did not select a favorite are not included.

<table>
<thead>
<tr>
<th>Favorite Carrot Sample</th>
<th>% (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Blend</td>
<td>15.6 (5)</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>25.0 (8)</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>18.8 (6)</td>
</tr>
<tr>
<td>Control (Salt and oil)</td>
<td>40.6 (13)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Favorite Broccoli Sample</th>
<th>% (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Blend</td>
<td>42.9 (15)</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>25.7 (9)</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>31.4 (11)</td>
</tr>
</tbody>
</table>

Children’s Carrot Intake

Children’s carrot intake is summarized in Table 9. There was no significant difference in intake between the seasoned carrots at the Variety meal (cinnamon: 12.72 ± 16.09, cardamom: 12.21 ± 15.20, garlic: 12.93 ± 16.68 grams, $F_{1.78,72.85} = 0.055, P = 0.93$). There were also no significant differences in carrot intake between the Variety and the No Variety condition ($T = -0.44, P = 0.66$), although this relationship is moderated by PROP taster status and will be discussed elsewhere. Total carrot intake at both meals had a mean value of 72.80 grams (SD ± 80.28), and did not correlate with gender ($P = 0.16$), age ($P = 0.61$), weight ($P = 0.53$), or BMI z-score ($P = 0.94$).
Table 9. Average carrot consumption by meal condition and within the Variety meal.

<table>
<thead>
<tr>
<th>Carrot Intake</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Blend</td>
<td>12.72 ± 16.09</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>12.21 ± 15.20</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>12.93 ± 16.58</td>
</tr>
<tr>
<td>Variety Meal</td>
<td>37.87 ± 40.96</td>
</tr>
<tr>
<td>No Variety Meal</td>
<td>35.93 ± 44.15</td>
</tr>
<tr>
<td>Both Meals</td>
<td>73.80 ± 80.28</td>
</tr>
</tbody>
</table>

**Correlation between SIQ and Carrot Liking**

Maternally reported intake of the herbs and spices used in individual blends and children’s liking of the seasoned carrots was not significantly correlated. The strongest correlations between maternal exposure and children’s liking was for exposure during breastfeeding, although they were not significant. For the breastfeeding data, the cardamom blend had the strongest correlation with children’s liking scores ($r = 0.25, P = 0.23$), followed by the cinnamon blend ($r = 0.19, P = 0.25$), and then the garlic blend ($r = 0.12, P = 0.47$). Figure 5 illustrates the relationship between children’s liking scores and maternally reported spice intake for the combination of breastfeeding and pregnancy. The full statistical results can be found in Table 10.
**Table 10.** Correlations between maternally reported intake of the seasoning blends used in the study and their child's reported liking of carrots prepared with that seasoning.

<table>
<thead>
<tr>
<th>Herb/Spice Blend</th>
<th>Maternally Reported Intake of the Herbs/Spices in a Seasoning Blend</th>
<th>Children’s Liking of Seasoned Carrots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maternally Reported Intake of the Herbs/Spices in a Seasoning Blend</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pregnancy (n=42)</td>
<td>Breastfeeding (n=40)</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
<td>p-value</td>
</tr>
<tr>
<td>Cinnamon Blend</td>
<td>-0.03</td>
<td>0.87</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>0.11</td>
<td>0.51</td>
</tr>
<tr>
<td>Garlic Blend*</td>
<td>0.16</td>
<td>0.31</td>
</tr>
<tr>
<td>All herbs and spices</td>
<td>0.19</td>
<td>0.24</td>
</tr>
</tbody>
</table>

*Correlation is limited by the high proportion of moms who had eaten all of the herbs and spices and the absence of data on the lower exposure end of the scale

**Figure 5.** Children’s self-reported liking of carrots seasoned with each herb and spice blend on a 5-point hedonic scale vs. their mothers reported consumption (i.e. “yes” on the SIQ) of the herb and spices used in that blend during a combination of pregnancy and breastfeeding. There were no significant correlations for any of the seasoning blends (p >0.05).
When children who did not report liking carrots were removed from the data \((N = 10\) child/mom dyads), the positive correlation trends of child’s liking and maternal exposure increased for the garlic blend and the cardamom blend. These results can be found in Table 11. Correlations between the child’s cardamom blend liking and maternally reported herb and spice exposure during breastfeeding \((\rho = 0.50, P = 0.01)\) and the combination of breastfeeding and pregnancy \((\rho = 0.38, P = 0.04)\) were significant. However, after removing the children that did not like carrots, there was no significant relationship between maternally reported exposure to spices in the cinnamon or the garlic blends and child’s reported liking for carrots seasoned with these spices.

Table 11. Correlations between maternally reported intake of the seasoning blends used in the study and their child’s reported liking of carrots. Data exclude children who did not report liking any of the carrots in the study, including the control.

<table>
<thead>
<tr>
<th>Herb/Spice Blend</th>
<th>Maternally Reported Intake of the Herbs/Spices in a Seasoning Blend</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maternally Reported Intake of the Herbs/Spices in a Seasoning Blend</td>
<td>Pregnancy (n=32)</td>
<td></td>
<td>Breastfeeding (n=30)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
<td>p-value</td>
<td>Correlation</td>
<td>p-value</td>
<td>Correlation</td>
</tr>
<tr>
<td>Children's Liking of Seasoned</td>
<td>Cinnamon Blend</td>
<td>-0.19</td>
<td>0.29</td>
<td>0.12</td>
<td>0.55</td>
</tr>
<tr>
<td>Carrots</td>
<td>Cardamom Blend</td>
<td>0.20</td>
<td>0.27</td>
<td>0.46</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Garlic Blend*</td>
<td>0.25</td>
<td>0.16</td>
<td>0.27</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>All herbs and spice</td>
<td>0.31</td>
<td>0.08</td>
<td>0.42</td>
<td>0.02</td>
</tr>
</tbody>
</table>

*Correlation is limited by the high proportion of moms who had eaten all of the herbs and spices and the absence of data on the lower exposure end of the scale.
When all herbs and spices in the study were combined into one maternal exposure score and a total score for children’s liking of all three seasoned carrots, there was a positive relationship between maternal exposure and child liking, but it was not significant (pregnancy: $r = 0.186$, $P = 0.24$, breastfeeding: $r = 0.24$, $P = 0.14$, both: $r = 0.23$, $P = 0.18$). When children who did not like carrots were removed, the correlation became stronger and was significant for breastfeeding and the combination of breastfeeding and pregnancy (pregnancy: $r = 0.31$, $P = 0.08$, breastfeeding: $r = 0.42$, $P = 0.02$, both: 0.40, $P = 0.03$) as shown in Figure 6.

**Figure 6.** Children’s combined liking score for all three seasoned carrots used in the study in relation to their mother’s reported intake of the 9 herbs and spices used in the blends during different stages of maternal flavor transmission: pregnancy, breastfeeding, and a combination of them both. Children who did not like carrots were removed from this analysis. There are significant correlations for breastfeeding ($\rho = 0.42$, $P = 0.02$) and a combination of pregnancy and breastfeeding ($\rho = 0.40$, $P = 0.03$), but not for pregnancy alone ($\rho = 0.31$, $P = 0.08$).
There were no significant correlations between maternally reported herb and spice exposure and children’s intake of the seasoned carrots. Individually, positive correlations were weak and not significant for the garlic blend (pregnancy: $\rho = 0.23$, $P = 0.15$, breastfeeding: $\rho = 0.06$, $P = 0.70$, both: $\rho = 0.07$, $P = 0.65$) and the cinnamon blend (pregnancy: $\rho = 0.14$, $P = 0.38$, breastfeeding: $\rho = 0.03$, $P = 0.84$, both: $\rho = 0.06$, $P = 0.72$). The cardamom blend had a negative correlation, but was not significant (pregnancy: $\rho = -0.10$, $P = 0.05$, breastfeeding: $\rho = 0.02$, $P = 0.91$, both: $\rho = -0.01$, $P = 0.97$). Full results are given in Table 12 and Table 13. When all the herbs and spices were grouped together into one total maternal intake score, there was no correlation between total maternal spice exposure and children’s overall intake of the seasoned carrots at the Variety meal. Removing the eight children that did not eat at least one carrot at either test meal did not significantly change the correlations for individual spice blends or total spice exposure.

### Table 12. Correlations between maternally reported intake of the seasoning blends used in the study and their child's intake of carrots prepared with that seasoning.

<table>
<thead>
<tr>
<th>Herb/Spice Blend</th>
<th>Maternally Reported Intake of the Herbs/Spices in a Seasoning Blend</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>fridge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pregnancy (n=42)</td>
<td>Breastfeeding (n=40)</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
<td>p-value</td>
</tr>
<tr>
<td>Cinnamon Blend</td>
<td>0.14</td>
<td>0.38</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>-0.10</td>
<td>0.53</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>0.23</td>
<td>0.15</td>
</tr>
<tr>
<td>All herbs and spices</td>
<td>0.06</td>
<td>0.70</td>
</tr>
</tbody>
</table>
Table 13. Correlations between maternally reported intake of the seasoning blends used in the study and their child's intake of carrots prepared with that seasoning. Data excluded children that consumed fewer than 5 grams of carrots total (< 1 carrot at each meal).

<table>
<thead>
<tr>
<th>Herb/Spice Blend</th>
<th>Children's Intake of Seasoned Carrots</th>
<th>Maternally Reported Intake of the Herbs/Spices in a Seasoning Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pregnancy (n=34)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td>Cinnamon Blend</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td></td>
<td>-0.07</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td></td>
<td>0.17</td>
</tr>
<tr>
<td>All herbs and spices</td>
<td></td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Home Spice Checklist**

Mothers reported regular home use of 12-13 (mean: 12.68 ± 6.99, median: 12) of the 34 herbs and spices included in the home spice checklist, with a range from 2 to 33. Of the nine herbs and spices used in the study, mothers reported regular home use of about 5 of them (mean: 5.90 ± 1.84, median: 5.0), with a range of 1 to 9. The distributions of responses are given in Figure 8.

Home spice use of the nine herbs and spices used in the study did not correlate with children’s liking of the seasoned carrots (rho = -0.105, P = 0.52), nor did the home use of the full 34 listed herb and spices on checklist (rho = -0.06, P = 0.72). Additionally, home use of the herb and spices used in each individual seasoning blend did not correlate with children’s liking or intake of carrots prepared with those seasonings, as shown in Table 14.
Figure 7. The frequency distribution of the number of herbs and spices used regularly in the home as selected by mothers on the Home Spice Checklist, including all the herbs and spices on the checklist (left) and only those used in the seasoning blends (right).

Table 14. The correlations between children’s liking and intake of carrots prepared with each seasoning blend and the number of herbs and spices moms reported regularly using in the home.

<table>
<thead>
<tr>
<th>Herb/Spice Blend</th>
<th>Liking Correlation</th>
<th>Liking p-value</th>
<th>Intake Correlation</th>
<th>Intake p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Blend</td>
<td>0.05</td>
<td>0.75</td>
<td>-0.09</td>
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</tr>
<tr>
<td>Cardamom Blend</td>
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<td>0.75</td>
<td>-0.17</td>
<td>0.30</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>0.04</td>
<td>0.80</td>
<td>0.16</td>
<td>0.34</td>
</tr>
</tbody>
</table>
Chapter 5 - Discussion

Summary of Results

A primary aim of this study was to create a questionnaire for mothers to self-report herb and spice consumption during pregnancy and breastfeeding when asked 3- to 5- years postpartum. The results show that mothers did not select the “I don’t know” answer option more often than “yes/no,” indicating that mothers believed that they could accurately recall their pregnancy/breastfeeding diets. The second aim of the study was to investigate the relationship between maternally reported herb and spice intake on the spice intake questionnaire and children’s acceptance and/or intake of the seasoned carrots. We hypothesized that greater maternal exposure would correlate with greater acceptance and intake in the children. Based on the questionnaire results, maternally reported herb and spice intake did not correlate with children’s liking of carrots prepared with individual herb and spice blends, but maternally reported intake of all the herbs and spices used in the study did correlate with children’s combined acceptance of all the seasoned carrots. There was no relationship between maternally reported herb and spice use and children’s intake of seasoned carrots during the test meal. These results support the conclusion that maternal diet during pregnancy and breastfeeding may be associated with preschool aged children’s food acceptance, but longitudinal studies are needed to confirm this.

Explanation of Findings

The Spice Intake Questionnaire (SIQ) was able to successfully gather maternal data on herb and spice intake during pregnancy and lactation, as evidence by mothers’ ability to select “yes” or “no” when asked to recall their consumption of individual spices, as opposed to choosing the “I don’t know” response. If a majority of the mothers had chosen the “I don’t know” option, then we would have concluded that
A retrospective analysis is not a feasible way to collect this kind of data. A longitudinal study by Bunin et al. (2001) supported the hypothesis that mothers are able to accurately recall their diet from a previous pregnancy up to 7 years postpartum, however, the study analyzed the diet by macro- and micronutrient content, not by individual foods. It is not known whether this method is generalizable to the reporting of herb and spice intake. Mothers willingness to answer “yes” or “no” is not equivalent to longitudinal validation studies, but it is an important first step before longer term validation studies are worthwhile. For the purposes of this study, mother’s infrequent use of the “I don’t know” option provided confidence in moving forward to analyze the relationship between this self-reported herb and spice intake and children’s liking and intake of the seasoned vegetables.

When the cinnamon-nutmeg-ginger, cardamom-cumin-allspice, and the garlic-black pepper-oregano spice blends were all considered individually, there were no significant correlations between maternally reported intake of the herbs and spices used in the blends and children’s liking of carrots seasoned with that blend. While Mennella et al. (2001) found that maternal exposure to carrot juice during either pregnancy or breastfeeding increased children’s acceptance for carrot-flavored cereals during weaning, our results do not support that these effects persist into early childhood, at least when a self-reported measure is used for assessment. However, it is also not known if the transmission of flavor compounds found in carrots is similar to that of herbs and spices.

The significant correlation between maternally reported intake of all the herbs and spices used in the study and children’s combined liking of all three of the seasoned carrots indicates that maternal diet may still have a significant effect on children’s diet into the preschool years. It is important to note that mothers current home use did not have the same effect, as no correlations were found between responses on the home spice checklist and children’s liking of seasoned carrots. Research on critical periods in infancy shows that children are more accepting of novel flavors during a short window in the first 3 months after birth. However, the home spice checklist did not differentiate if herbs and spices were used
only in mothers’ diets or if they were currently used in the child’s food as well. Our data suggest that mothers’ diet during pregnancy and breastfeeding has a stronger impact on children’s acceptance of herbs and spices than mothers’ current use of herb and spices, but future studies should ask mothers to report which herbs and spices they currently use when preparing food for children in order to rule out influences of the child’s current diet on acceptance and intake of vegetables prepared with added herbs and spices.

A greater number of self-reported herbs and spices consumed during pregnancy and/or breastfeeding may also be indicative of greater variety overall in mothers’ diets. Studies have shown that children who consume a wider variety of foods are more accepting of novel foods\textsuperscript{99,100}. Therefore, the relationship between maternally reported herb and spice intake and children’s acceptance of differently seasoned carrots may be related to other dietary factors that were not measured in the current study.

Unlike children’s liking data, children’s intake of seasoned carrots was not related to any aspect of maternally reported herb and spice intake, either for individual seasoning blends or for the full list of herbs and spices used in the study. This is not the first study in our lab to show that children’s reported liking of a food does not necessarily correlate with intake of that food\textsuperscript{120}. Several other factors may also have contributed to low carrot intake. One was the use of a multi-item test meal. Another study that manipulated portion sizes to attempt to increase vegetable intake also found no effect, likely because even when larger portions of vegetables are served, they still cannot compete with other more palatable food options\textsuperscript{121}. Additionally, the cooked carrots in the study were not particularly well-liked. Even the salted control carrot did not have an average liking score in the “good” or “super good” category. Children self-reported greater liking for the seasoned broccoli samples. The relationship between maternal exposure to herbs and spices during pregnancy and breastfeeding and children’s acceptance of herbs and spices could have been obscured by children’s disliking of carrots regardless of how they were prepared. Indeed, correlations did improve when children who did not like any of the carrots were removed from the data analysis.
Strengths.

One key strength of this study was the higher percentage of mother’s who were able to recall their herb and spice during pregnancy and breastfeeding. Offering mothers an “I don’t know” option and avoiding a forced choice yes/no question was done to avoid errors in the data due to moms guessing or randomly selecting an option. If too many mothers had said that they could not recall their herb and spice intake, the rest of the data analysis would have been ineffective. Additionally, because we determined that mothers believe they can recall their herb and spice intake, we have data to support the development of longer term validation studies. Once validated, retrospective questionnaires are extremely useful in both research and clinical settings, because they can provide data on previous dietary exposures in an efficient and inexpensive manner.

Another strength of this study was the use of a laboratory controlled observational design. Children were tested in a child-friendly room away from the immediate influence of their parents or peers, both of which have been shown to influence children’s food choices. Data was collected using a validate liking scale and objective measures of intake data. Children were asked to rate their own liking after tasting the prepared foods, and we did not rely on parental reports of children’s liking. Vegetable were served within a meal, to mimic the way that they are traditionally served in American meals. While laboratory settings are always artificial, the environment was made as realistic and as comfortable as possible. Laboratory meal paradigms are beneficial because they help elucidate what is going on in real life, but they allow for some of the external confounding factors to be minimized. These tests are important in learning how strategies and interventions might work before they are developed for home or school use on a larger scale.

An additional benefit in the study design was the use of three different seasoning blends that were equally liked, as well as the inclusion of a salted control carrot in the liking task. While children’s liking scores
for all of the carrots were low and the control carrot was the most preferred in the rank-order task, it is important to note that the seasoned carrots had similar acceptance ratings as the control carrot on the smiley face assessment. These data should encourage future use of herb and spices in children’s meals, provided they are not served alongside a salt-only option, because children may prefer the more familiar option. Additionally, equivalent liking scores for the seasoning blends allows for better comparison of maternally reported herb and spice exposure and children’s liking of the seasoning blends. If one carrot clearly emerged at the favorite, it would have been difficult the discern if differences in liking were actually due to previous flavor exposure or if there were inherent differences in the palatability of the carrots.

Limitations.

This study had a few important limitations to discuss. First, the spice intake questionnaire is not a validated measure and therefore all results must be interpreted with caution and confirmed in future studies. The relationships between maternally reported herb and spice intake and children’s liking of seasoned carrots are best used to inform future studies on what areas may be worth closer examination.

The study was also limited by the use of herb and spice blends instead of individual herbs and spices. When multiple ingredients are combined together, the perceived flavor profile is not necessarily equal to the sum of the individual ingredients. One phenomenon is termed mixture suppression, and is defined as the decrease in the perceived intensity of a flavor when it is in a mixture as opposed to the perceive intensity when it is tasted alone. Conversely, some flavors can act synergistically, where their flavors are perceived more intensely when tasted together as opposed to when they are tasted alone. Because we did not test the herbs and spices individually, we can only draw conclusions about the blends themselves and children’s liking of the herbs and spices on the cooked carrots may have disproportionately been
affected by one of the component spices. For example, a child with a strong distaste for ginger may not have liked the cinnamon-nutmeg-ginger blend, even if they really liked cinnamon and nutmeg.

Another limitation is the use of cooked carrots as the target vegetable. Carrots were originally chosen because they have been shown to be familiar and well-liked by children of similar ages. However, children’s mean liking of the carrots, including the unseasoned control, were all low. The relationship between maternal exposure to herb and spices and children’s liking or intake of the seasoned vegetables was impacted by some children’s strong distaste for any kind of cooked carrots. This is supported by the experimental correlations, which improved when children who did not rate any of the carrots as “good” or “super good” were removed. Anecdotally, we had several parents tell us that their children were more familiar with raw carrots than cooked carrots. Previous research has shown that children’s acceptance of vegetables is very sensitive to the familiarity of the cooking method, and future studies should consider cooking method in addition to type of target vegetable.

Finally, the home spice checklist, which was used to collect data on mothers’ current use of herbs and spices in the home, did not specify whether the seasoning were used in preparation of the child’s meals or only in their own food. While it is valuable to know which seasonings moms use on a regular basis to compare current use with their reported use during pregnancy and breastfeeding, it also would have been informative to collect data on children’s current exposure to a wider variety of herbs and spices.

Conclusions

When asked to recall their consumption of herbs and spices during pregnancy and breastfeeding 3-5 years postpartum, mothers in our sample were able to give a yes/no answer more often than they reported not knowing the answer for all of the herbs and spices in the study but allspice. These results support the development of future studies to refine and validate retrospective measures of maternal diet as a tool to
predict and understand children’s acceptance of foods during the preschool years. The was a significant positive correlation between the number of herbs and spices that moms reported consuming during pregnancy and breastfeeding and their children’s liking of the three seasoned carrots used in the study. No correlation was found when comparing the total variety of herbs and spices that mothers currently use in their home and their children’s liking of the seasoned carrots. The disparity between the retrospective measure and current use data may reflect the significance of early flavor transmission of children’s food acceptance, but these results should be interpreted with caution until longitudinal data are available. Finally, no correlation was found between maternally reported intake of herbs and spices found in these individual seasoning blends and children’s liking or intake of carrots prepared with each blend. The lack of correlations for individual blends may be the result of changes in flavor perception of herbs and spices when they are combined instead of tasted alone, but it also shows that measuring overall spice variety in the mother’s diet is more predictive of preschool children’s acceptance of these flavors on vegetables.

**Future Directions**

Overall the study supports further investigation into the role of maternal diet on children’s food preferences, with the goal of understanding how these early flavor experience shape long term eating behaviors. In particular, the results support further exploration of maternal dietary variety on children’s food and flavor acceptance. Ideally, longitudinal studies should be used to measure variety in the mother’s diet during pregnancy, through breastfeeding, and into the children’s first few years of life. These studies can also be used to validate retrospective data collection measures.
Appendix A - Data Collection Scripts

PROP Script

Today, we have two guests with us.

(Pointing to Big Bird) This is Big Bird and this (pointing to Oscar) is Oscar the Grouch.

Do you know who they are? (Wait for a response. If the child is familiar with the Sesame Street characters, proceed forward. If he or she is not familiar with the characters, explain to the child that Big Bird and Oscar the Grouch are friends who live on Sesame Street.)

When Big Bird and Oscar are thirsty, they like to drink two different kinds of drinks. Big Bird prefers water but Oscar likes his special "yucky" drink. One day, they misplaced their water bottles and don't know which drink belongs to Big Bird or Oscar. They need your help.

I'm going to ask you to taste this drink and point to Big Bird if it tastes like water, and point to Oscar the Grouch if it tastes "yucky" or bitter? **IT IS VERY, VERY IMPORTANT THAT YOU SPIT THE DRINK OUT INTO THIS CUP** (show child empty cup for spitting; emphasize fact that the child is not to swallow PROP). Do you understand? (Wait for response.)

Before we start, I'm going to have you practice and rinse your mouth with water and spit it out into this cup right here. (Offer cup of water and empty cup to spit into.) Swirl the water around your mouth for 5-10 seconds and then spit it out.

Now you can try Big Bird or Oscar's drink (give child the PROP sample) Remember, point to Big Bird if it tastes like water, and Oscar if it tastes like his "yucky" bitter drink. (Wait for subject to point to character. Record response.)

**If child points to Oscar**, ask: What did Oscar's drink taste like? (Record child’s response.)
Peter Peter Pumpkin Eater Story and Script

(The child will be shown 3 figures (attached), each with the inside of their stomachs in view and at different levels of fullness.)

“This is Peter Peter Pumpkin Eater. He's a regular little boy just like you guys are regular little boys and girls, the only difference is that Peter can look inside of his tummy and see what's there!! This is what Peter's tummy looks like. We can see through his skin into his belly.”

The interviewer should show the child the hungry figure and point to the empty stomach.

“Now, Peter Peter Pumpkin Eater eats lots of different things, but, what do you think that he likes to eat the most? He likes to eat pumpkins!! When Peter Peter Pumpkin Eater eats pumpkins or any other kind of food, do you know where the food goes? It goes down into his belly!”

At this point, the interviewer will point out the empty stomach on the “hungry” figure.

“Now, one day, Peter Peter Pumpkin Eater was playing with some friends and guess what happened? His tummy grumbled and said Feed Me Peter! So, Peter Peter Pumpkin Eater thought, Wow! I wonder if I'm hungry? I haven't eaten for a while. I better go and check. So, Peter Peter Pumpkin Eater ran back to his house and went and looked in the mirror, and what do you think he saw?”

The interviewer should again show the child the picture of the “hungry” figure.

“THERE wasn't anything in his belly! So Peter thought to himself I haven't eaten anything, and my tummy is empty too! I must be hungry! So, Peter Peter Pumpkin Eater decided to go find some food. Where do you think he looked for food? Why in the pumpkin patch of course!! The first pumpkin patch that Peter found only had 2 pumpkins in it, and they weren't very big at all. But Peter was hungry so he ate them. Now, when he ate those pumpkins, where do you think the food went? It went down into his tummy! After eating those pumpkins Peter thought to himself, I ate 2 pumpkins and my tummy isn't really grumbling anymore, but I don't really feel full. I wonder if I'm done? So, Peter went back to his mirror and what do you think he saw? He saw this! The interviewer will show the child the “ate something” figure.

“There was some food in his tummy, but his tummy wasn't filled the whole way up! Peter thought to himself Hey! I ate something and the food went down into my tummy and now it isn't empty anymore! I'm not so very hungry anymore! But wait a minute, my tummy isn't full either. My tummy isn't empty so that means that I'm not so very hungry. But it's not filled all the way up yet either so I must not be full. I must be just a little hungry still! I need some more food! So, Peter Peter Pumpkin Eater ran off to find more food, and where do you think he went? Why to find another pumpkin patch of course. Now the next pumpkin patch that Peter came to had over 100 pumpkins in it and they were all very, very big! Peter ate a few more pumpkins and then all of a sudden, his tummy started to feel like he didn't want to eat anymore. So, Peter thought to himself I ate some more pumpkins, I better go and see how much food is in my tummy. So Peter ran back home and looked into his mirror, and what do you think he saw? He saw this!”

The interviewer should show the child the “full” figure.
“His tummy was full of food! So Peter thought, Hey, I ate a lot of pumpkins and they went down into my belly and now, my belly is filled the whole way up with all of the food that I ate! I must not be hungry anymore! I must be full!! So Peter decided to go home and find someone to play with.

So, Peter Peter Pumpkin Eater thought of what he ate and how much food was in his belly to figure out how hungry he was. Can you point to the picture of Peter that shows what Peter Peter Pumpkin Eater looks like when he's hungry?"

(Wait for the child to point to the figures. If the child does not understand, or can't point to the right figure, tell them the Peter Peter Pumpkin Eater Story again. If the child points to the correct figure, reinforce him/her:)

"Good job remembering! OK can you point to the picture that shows what Peter looks like when he's full?"

Again, wait for the child to point. If the child does not understand, or can't point to the right figure, tell them the Peter Peter Pumpkin Eater Story again. If the child points to the correct figure, reinforce him/her:

"Way to remember! OK, can you point to the picture that shows what Peter looks like when he's not so very hungry, but he's really not full either, he's kind of in between?"

Again, wait for the child to point. If the child does not understand, or can't point to the right figure, tell them the Peter Peter Pumpkin Eater Story again. If the child points to the correct figure, reinforce him/her:

"Awesome job! Now, can you think about how much food it feels like is in your belly and tell me how hungry or full you are?"

The interviewer should point to each picture as they say:

"Is your belly empty so that you're very hungry (point to the figure with the empty belly), or is there lots of food in it and you're not hungry at all and you're feeling full (point to the figure with the full belly), or is there something in your tummy but it's not all the way full so you're not really so very hungry, but you're not really full either (point to the figure with the partly full belly)?"

The interviewer should wait for the child to point to a picture.

"OK! Good Job!"
Peter-Peter Pumpkin Eater
Smiley Face Scale and Training Script

Introduction: “Let’s play a fun food game, okay?

Part 1: Explanation of Five-point Scale

I am going to give you some fun foods to taste and I want you to taste each one and use these smiley faces to tell me how they taste, okay?

(Present Smiley face scale to the child)

I have this card with five little faces that we can use today. (Point to the face that says “super good”) Do you see this face? This guy is smiling a lot because he just tasted something that is “super good.” If you taste something that is “super good” point to this face.

(Point to the face that says “good”) Do you see this face? This guy is smiling, but not as much as this one (the “super good” face). He is smiling because he just tasted something that is “good.” If you taste something that is “good” point to this face.

(Point to the face that says “bad”) Do you see this face? This guy is frowning because he just tasted something that is “bad.” If you taste something that is “bad” point to this face.

(Point to the face that says “super bad”) Do you see this face? This guy is really frowning? He just tasted something that is “super bad.” If you taste something that is “super bad” point to this face.

(Point to the face in the middle, “maybe good, maybe bad”) This last face in the middle is for something that you taste that is not good, but not bad either. Use this face if something is in the middle, or if you just can’t decide.

Testing the child’s understanding of the scale.

What is your favorite food? So, if I gave you some (favorite food) to taste, which face would you point to? (Allow child to point to the face to make sure they understand. If the child points at “good” or “super good” the child’s response is correct and assume they understand).

What is your least favorite food, or a food you think is yucky? So, if I gave you some (least favorite food) to taste, which face would you point to? (Allow child to point to the face to make sure they understand. If the child points at “bad” or “super bad” the child’s response is correct and assume they understand).

Great work, now one more question and we will start our tasting game. What if I gave you something to taste and it you couldn’t decide if it was good or bad? What face would you point to? (Allow child to point to the face to make sure they understand. Most children will point to the middle face, but some children point to “bad” or “good” and give additional explanations why. We have counted these responses as correct, as long as they don’t pick “super good” or “super bad.”)

If the child does not understand, go through the explanation again.
Okay, let’s start the game. Ready?
Give child one food item at a time, allowing them to taste and rate each one. Have them sip water between each food.
Smiley Face Scale Refresher Script

For use when a child comes back after their first visit, to make sure they remember how to use the scale.

“It’s so great to see you again. Did you have fun last time? We are going to play another tasting game today. Do you remember our smiley faces? Can you remind me again how to use them? (Have child go through the explanation of each face. If they have trouble remembering, remind them what each face means. If the child does not remember, go through Parts 1 and 2 above again).
Appendix B - Parent Questionnaires

Family Demographics Questionnaire

We would like to know a bit more about you and your family. Please answer the following questions to the best of your ability. If you feel uncomfortable answering a question, you may leave it blank. All of your responses will be kept confidential.

1. What is your relationship to the child?
   - Mother
   - Father
   - Other (please describe) _______________  

2. What is your child's date of birth (MM/DD/YYYY)? __________________

3. What is your child's sex (M/F)?
   - Male
   - Female

4. How many people live in your household, including you? ________________

5. How many children live in your household? ________________

6. How many adults live in your household? ________________

7. What is your marital status?
   - Single (never married)
   - Married
   - Separated
   - Divorced
   - Widow
   - Remarried
   - Living together (but not married)
   - Other, please describe ________________
8. Please complete the following information as accurately as you can:

   Mother of child:  Age: _____  Height (ft’in’): _____  Weight (lbs): _____
   Father of child:  Age: _____  Height (ft’in’): _____  Weight (lbs): _____

9. What is the highest level of education you have completed?
   ☐ 8th grade or below
   ☐ Some high school
   ☐ Completed high school
   ☐ Some college
   ☐ Completed college
   ☐ Some graduate or professional school
   ☐ Completed graduate or professional school

10. If applicable, what is the highest level of education your spouse or live-in partner has completed?
    ☐ 8th grade or below
    ☐ Some high school
    ☐ Completed high school
    ☐ Some college
    ☐ Completed college
    ☐ Some graduate or professional school
    ☐ Completed graduate or professional school
    ☐ Not applicable

11. What is your current employment status?
    ☐ Working now
    ☐ Unemployed
    ☐ Retired
    ☐ On disability
    ☐ Sick/maternity leave
    ☐ Homemaker
    ☐ Student
    ☐ Other (please describe) ________________

12. What is your occupation? ________________

13. How many hours do you work each week?
14. Are you looking for work?
   ☐ Yes
   ☐ No

15. If applicable, what is your spouse or live-in partner's current employment status?
    ☐ Working now
    ☐ Unemployed
    ☐ Retired
    ☐ On disability
    ☐ Sick/maternity leave
    ☐ Homemaker
    ☐ Student
    ☐ Other (please describe) _________________
    ☐ Not applicable

16. What is your spouse or live-in partner's occupation? _________________

17. How many hours does your spouse or live-in partner work each week?
    ☐ More than 40
    ☐ 31-40
    ☐ 21-30
    ☐ 10-20
    ☐ Less than 10

18. Is your spouse or live-in partner looking for work?
    ☐ Yes
    ☐ No

19. What was your total or combined family income, before taxes, in 2013?
    ☐ Less than $20,000
20. Does your family own a functional automobile?
   - Yes
   - No

21. How many functional automobiles does your family own? _______________

22. Have you or anyone in your household used any of the following programs in the past 12 months? (Check all that apply.)
   - SNAP (formerly known as Food Stamps)
   - WIC
   - TANF (cash assistance)
   - Medicaid (medical assistance)
   - Home Energy Assistance (LIHEAP)
   - Free/Reduced School Meal Program
   - Other assistance programs ________________
   - None

23. Have you ever gotten food from a food pantry or soup kitchen?
   - Yes
   - No

24. How many times have you gotten food from a food pantry or soup kitchen in the past year? ________________

25. Does anyone in your household have a condition that affects the foods they eat?
   - Yes (please describe) ________________
   - No

26. Who is primarily responsible for feeding your child?
   - You
   - Your partner
   - Both
   - Other (please describe) ________________
27. Who is primarily responsible for buying food in your household?
   - You
   - Your partner
   - Both
   - Other (please describe) ________________

28. On average, how often does your family eat out or get delivery/take-out for dinner?
   - Once a month or less
   - Two times a month
   - Once a week
   - Two times a week
   - Three times week
   - Four or more times a week

29. On average, how many nights a week does your family eat dinner together as a group (with most family members present)?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7

30. Was your child breastfed?
   - Yes (for how long was he/she breastfed? ________________)
   - No

31. Was your child born pre-mature?
   - Yes (by how many weeks? ________________)
   - No

32. What was your child’s birth weight? ________________ Birth length? ________________

33. How many times has your child had an earache?
   - 0
   - 1-3
   - 4-6
34. For the times when your child had an earache, how many times did you take him or her to the doctor?
   - 0
   - 1-3
   - 4-6
   - 7-9
   - More than 9 times

35. Are you Hispanic or Latino?
   - Yes
   - No

36. Is your child Hispanic or Latino?
   - Yes
   - No

37. What is your race? (Select all those that apply.)
   - American Indian or Alaskan Native
   - Asian
   - Black or African American
   - Native Hawaiian or Pacific Islander
   - White
   - Other (please describe) ________________

38. What is your child's race? (Select all those that apply.)
   - American Indian or Alaskan Native
   - Asian
   - Black or African American
   - Native Hawaiian or Pacific Islander
   - White
   - Other (please describe) ________________

39. Do you primarily speak English at home?
   - Yes
   - No (What language do you usually speak? ________________ )
## Caregiver’s Feeding Styles Questionnaire

These questions deal with YOUR interactions with your preschool child during the dinner meal. Circle the best answer that describes how often these things happen. If you are not certain, make your best guess.

**How often during the dinner meal do YOU...**

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<th>Always</th>
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</tr>
<tr>
<td>5.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
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<td>---</td>
</tr>
<tr>
<td>12.</td>
<td>Warn the child that you will take away something <strong>other than food</strong> if he or she doesn’t eat (for example, “If you don’t finish your meat, there will be no play time after dinner”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13.</td>
<td>Tell the child to eat something on the plate (for example, “Eat your beans”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14.</td>
<td>Warn the child that you will take a food away if the child doesn’t eat (for example, “If you don’t finish your vegetables, you won’t get fruit”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15.</td>
<td>Say something positive about the food the child is eating during dinner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16.</td>
<td>Spoon-feed the child to get him or her to eat dinner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17.</td>
<td>Help the child to eat dinner (for example, cutting the food into smaller pieces).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18.</td>
<td>Encourage the child to eat something by using food as a reward (for example, “If you finish your vegetables, you will get some fruit”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19.</td>
<td>Beg the child to eat dinner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Child Feeding Questionnaire

**CHILD FEEDING QUESTIONNAIRE**

**INSTRUCTIONS:** Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study. Feel free to leave questions blank for any reason.

<table>
<thead>
<tr>
<th>ID #:</th>
<th>Date:</th>
<th>never</th>
<th>seldom</th>
<th>half of time</th>
<th>most of time</th>
<th>always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When your child is home, how often are you responsible for feeding him/her?</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. How often are you responsible for deciding what your child’s portion sizes are?</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. How often are you responsible for deciding if your child has eaten the right kind of foods?</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Using the scale below, please indicate how you would classify your own weight at each of these 4 time periods listed below (Please circle ONLY ONE number for each time period)

<table>
<thead>
<tr>
<th>Time Period</th>
<th>markedly underweight</th>
<th>underweight</th>
<th>average</th>
<th>overweight</th>
<th>markedly overweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Your Childhood (5 to 10 years old)</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Your adolescence</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Your 20’s</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Currently</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Using the scale below, please indicate how you would classify your child’s weight at each of these 6 time periods listed below. (Please circle only one number for each time period)

<table>
<thead>
<tr>
<th></th>
<th>markedly underweight</th>
<th>underweight</th>
<th>average</th>
<th>overweight</th>
<th>markedly overweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Your child during the first year of life</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Your child as a toddler</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Your child as a preschooler</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study.

<table>
<thead>
<tr>
<th></th>
<th>unconcerned</th>
<th>slightly unconcerned</th>
<th>neutral</th>
<th>slightly concerned</th>
<th>very concerned</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. How concerned are you about your child eating too much when you are not around him/her?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. How concerned are you about your child having to diet to maintain a desirable weight?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. How concerned are you about your child becoming overweight?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
**INSTRUCTIONS:**
Using the scale below, please circle one number for each question which best corresponds to your answer. Please answer about your child who is in our study.

<table>
<thead>
<tr>
<th></th>
<th>disagree</th>
<th>slightly disagree</th>
<th>neutral</th>
<th>slightly agree</th>
<th>agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. I have to be sure my child does not eat too many sweets (candy, ice cream, cake or pastries).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. I have to be sure my child does not eat too many high fat foods.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>16. I have to be sure my child does not eat too many of his/her favorite foods.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>17. I intentionally keep some foods out of my child’s reach.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>18. I offer sweets (candy, ice cream, cake or pastries) to my child as a reward for good behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>19. I offer my child his/her favorite foods in exchange for good behavior.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>20. If I did not regulate or guide my child’s eating, he/she would eat too many junk foods.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>21. If I did not regulate or guide my child’s eating, he/she would eat too many of his/her favorite foods.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>22. My child should always eat all of the food on his/her plate.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>23. I have to be especially careful to ensure my child eats enough.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>24. If my child says “I’m not hungry” I try to get him/her to eat anyway.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>25. If I did not guide or regulate my child’s eating, he/she would eat much less than he/she should.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
**INSTRUCTIONS:**
Using the scale below, please circle one number for each question which best corresponds to your answer. **Please answer about your child who is in our study.**

<table>
<thead>
<tr>
<th>Question</th>
<th>never</th>
<th>rarely</th>
<th>sometimes</th>
<th>mostly</th>
<th>always</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. How much do you keep track of the sweets (candy, ice cream, cake or pastries) that your child eats?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>27. How much do you keep track of the snack food (potato chips, Doritos, cheese puffs) that your child eats?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>28. How much do you keep track of the high fat foods that your child eats?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Children’s Behavior Questionnaire

Short Form Version I

Subject No. ___________ Date of Child’s Birth:

Today’s Date ___________ Month Day Year

Sex of Child ___________

Age of Child _____ _____ Years months

Instructions: Please read carefully before starting:

On the next pages you will see a set of statements that describe children’s reactions to a number of situations. We would like you to tell us what your child’s reaction is likely to be in those situations. There are of course no “correct” ways of reacting; children differ widely in their reactions, and it is these differences we are trying to learn about. Please read each statement and decide whether it is a “true” or “untrue” description of your child’s reaction within the past six months. Use the following scale to indicate how well a statement describes your child:

Circle # If the statement is:

1 extremely untrue of your child

2 quite untrue of your child

3 slightly untrue of your child

4 neither true nor false of your child

5 slightly true of your child

6 quite true of your child

7 extremely true of your child

If you cannot answer one of the items because you have never seen the child in that situation, for example, if the statement is about the child’s reaction to your singing and you have never sung to your child, then circle NA (not applicable).

Please be sure to circle a number or NA for every item.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Seems always in a big hurry to get from one place to another.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Gets angry when told s/he has to go to bed.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Is not very bothered by pain.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Likes going down high slides or other adventurous activities.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Notices the smoothness or roughness of objects s/he touches.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Gets so worked up before an exciting event that s/he has trouble sitting still.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Usually rushes into an activity without thinking about it.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Cries sadly when a favorite toy gets lost or broken.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Becomes quite uncomfortable when cold and/or wet.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Likes to play so wild and recklessly that s/he might get hurt.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Seems to be at ease with almost any person.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Tends to run rather than walk from room to room.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Notices it when parents are wearing new clothing.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Has temper tantrums when s/he doesn't get what s/he wants.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Gets very enthusiastic about the things s/he does</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>When practicing an activity, has a hard time keeping her/his mind on it.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Is afraid of burglars or the &quot;boogie man.&quot;</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>When outside, often sits quietly.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Enjoys funny stories but usually doesn't laugh at them.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Tends to become sad if the family's plans don't work out.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Will move from one task to another without completing any of them.</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Moves about actively (runs, climbs, jumps) when playing in the house.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Is afraid of loud noises.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>Seems to listen to even quiet sounds.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>Has a hard time settling down after an exciting activity.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>Enjoys taking warm baths.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>Seems to feel depressed when unable to accomplish some task.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>Often rushes into new situations.</td>
<td>1</td>
<td>2</td>
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<td>7</td>
<td>NA</td>
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<tr>
<td>29.</td>
<td>Is quite upset by a little cut or bruise.</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>30.</td>
<td>Gets quite frustrated when prevented from doing something s/he wants to do.</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>31.</td>
<td>Becomes upset when loved relatives or friends are getting ready to leave following a visit.</td>
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<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>32.</td>
<td>Comments when a parent has changed his/her appearance.</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>33.</td>
<td>Enjoys activities such as being chased, spun around by the arms, etc.</td>
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<td>7</td>
<td>NA</td>
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<tr>
<td>34.</td>
<td>When angry about something, s/he tends to stay upset for ten minutes or longer.</td>
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<td>7</td>
<td>NA</td>
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<tr>
<td>35.</td>
<td>Is not afraid of the dark.</td>
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<td>3</td>
<td>4</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>36.</td>
<td>Takes a long time in approaching new situations.</td>
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<td>4</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>37.</td>
<td>Is sometimes shy even around people s/he has known a long time.</td>
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<td>NA</td>
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<tr>
<td>38.</td>
<td>Can wait before entering into new activities if s/he is asked to.</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>39.</td>
<td>Enjoys &quot;snuggling up&quot; next to a parent or babysitter.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>40.</td>
<td>Gets angry when s/he can't find something s/he wants to play with.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>41.</td>
<td>Is afraid of fire.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>42.</td>
<td>Sometimes seems nervous when talking to adults s/he has just met.</td>
<td>1</td>
<td>2</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>43.</td>
<td>Is slow and unhurried in deciding what to do next.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>44.</td>
<td>Changes from being upset to feeling much better within a few minutes.</td>
<td>1</td>
<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>45.</td>
<td>Prepares for trips and outings by planning things s/he will need.</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>46.</td>
<td>Becomes very excited while planning for trips.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>7</td>
<td>NA</td>
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<tr>
<td>47.</td>
<td>Is quickly aware of some new item in the living room.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>48.</td>
<td>Hardly ever laughs out loud during play with other children.</td>
<td>1</td>
<td>2</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>49.</td>
<td>Is not very upset at minor cuts or bruises.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>50.</td>
<td>Prefers quiet activities to active games.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>51.</td>
<td>Tends to say the first thing that comes to mind, without stopping to think about it.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>52.</td>
<td>Acts shy around new people.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>53.</td>
<td>Has trouble sitting still when s/he is told to (at movies, church, etc.).</td>
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<td>2</td>
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<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>54.</td>
<td>Rarely cries when s/he hears a sad story.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>55.</td>
<td>Sometimes smiles or giggles playing by her/himself.</td>
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<td>2</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>56.</td>
<td>Rarely becomes upset when watching a sad event in a TV show.</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>57.</td>
<td>Enjoys just being talked to.</td>
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<td>2</td>
<td>3</td>
<td>4</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>58.</td>
<td>Becomes very excited before an outing (e.g., picnic, party).</td>
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<td>59.</td>
<td>If upset, cheers up quickly when s/he thinks about something else.</td>
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<tr>
<td>60.</td>
<td>Is comfortable asking other children to play.</td>
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<td>7</td>
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<tr>
<td>61.</td>
<td>Rarely gets upset when told s/he has to go to bed.</td>
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<tr>
<td>62.</td>
<td>When drawing or coloring in a book, shows strong concentration.</td>
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<td>6</td>
<td>7</td>
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<tr>
<td>63.</td>
<td>Is afraid of the dark.</td>
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<tr>
<td>64.</td>
<td>Is likely to cry when even a little bit hurt.</td>
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<tr>
<td>65.</td>
<td>Enjoys looking at picture books.</td>
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<tr>
<td>66.</td>
<td>Is easy to soothe when s/he is upset.</td>
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<tr>
<td>67.</td>
<td>Is good at following instructions.</td>
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<td>68.</td>
<td>Is rarely frightened by &quot;monsters&quot; seen on TV or at movies.</td>
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<tr>
<td>69.</td>
<td>Likes to go high and fast when pushed on a swing.</td>
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<td>70.</td>
<td>Sometimes turns away shyly from new acquaintances.</td>
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<tr>
<td>71.</td>
<td>When building or putting something together, becomes very involved in what s/he is doing, and works for long periods.</td>
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<tr>
<td>72.</td>
<td>Likes being sung to.</td>
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<td>73.</td>
<td>Approaches places s/he has been told are dangerous slowly and cautiously.</td>
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<td>74.</td>
<td>Rarely becomes discouraged when s/he has trouble making something work.</td>
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<tr>
<td>75.</td>
<td>Is very difficult to soothe when s/he has become upset.</td>
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<tr>
<td>76.</td>
<td>Likes the sound of words, such as nursery rhymes.</td>
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<tr>
<td>77.</td>
<td>Smiles a lot at people s/he likes.</td>
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<tr>
<td>78.</td>
<td>Dislikes rough and rowdy games.</td>
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<tr>
<td>79.</td>
<td>Often laughs out loud in play with other children.</td>
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<tr>
<td>80.</td>
<td>Rarely laughs aloud while watching TV or movie comedies.</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>81.</td>
<td>Can easily stop an activity when s/he is told &quot;no.&quot;</td>
<td>1</td>
<td>2</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>82.</td>
<td>Is among the last children to try out a new activity.</td>
<td>1</td>
<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>83.</td>
<td>Doesn't usually notice odors such as perfume, smoke, cooking, etc.</td>
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<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>84.</td>
<td>Is easily distracted when listening to a story.</td>
<td>1</td>
<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>85.</td>
<td>Is full of energy, even in the evening.</td>
<td>1</td>
<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>86.</td>
<td>Enjoys sitting on parent's lap.</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>87.</td>
<td>Gets angry when called in from play before s/he is ready to quit.</td>
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<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>88.</td>
<td>Enjoys riding a tricycle or bicycle fast and recklessly.</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>89.</td>
<td>Sometimes becomes absorbed in a picture book and looks at it for a long time.</td>
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<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>90.</td>
<td>Remains pretty calm about upcoming desserts like ice cream.</td>
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<td>2</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>91.</td>
<td>Hardly ever complains when ill with a cold.</td>
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<td>2</td>
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<td>6</td>
<td>7</td>
<td>NA</td>
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<tr>
<td>92.</td>
<td>Looks forward to family outings, but does not get too excited about them.</td>
<td>1</td>
<td>2</td>
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<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
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</tr>
<tr>
<td>93.</td>
<td>Likes to sit quietly and watch people do things.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>94.</td>
<td>Enjoys gentle rhythmic activities, such as rocking or swaying.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Please check back to make sure you have completed all the pages of the questionnaire. Thank you very much for your help!
Children’s Eating Behavior Questionnaire

Child Eating Behaviour Questionnaire (CEBQ)
Please read the following statements and tick the boxes most appropriate to your child’s eating behaviour. If you cannot answer a question for any reason, feel free to leave it blank.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>My child loves food</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>My child eats more when worried</td>
<td></td>
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<tr>
<td>My child has a big appetite</td>
<td></td>
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<tr>
<td>My child finishes his/her meal quickly</td>
<td></td>
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</tr>
<tr>
<td>My child is interested in food</td>
<td></td>
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</tr>
<tr>
<td>My child is always asking for a drink</td>
<td></td>
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<tr>
<td>My child refuses new foods at first</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>My child eats slowly</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>My child eats less when angry</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>My child enjoys tasting new foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child eats less when s/he is tired</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child is always asking for food</td>
<td></td>
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<td></td>
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<tr>
<td>My child eats more when annoyed</td>
<td></td>
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</tr>
<tr>
<td>If allowed to, my child would eat too much</td>
<td></td>
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<tr>
<td>My child eats more when anxious</td>
<td></td>
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<tr>
<td>My child enjoys a wide variety of foods</td>
<td></td>
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<tr>
<td>My child leaves food on his/her plate at the end of a meal</td>
<td></td>
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<tr>
<td>My child takes more than 30 minutes to finish a meal</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Survey Question</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Given the choice, my child would eat most of the time</td>
<td></td>
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<tr>
<td>My child looks forward to mealtimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child gets full before his/her meal is finished</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>My child enjoys eating</td>
<td></td>
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</tr>
<tr>
<td>My child eats more when she is happy</td>
<td></td>
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</tr>
<tr>
<td>My child is difficult to please with meals</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child eats less when upset</td>
<td></td>
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<tr>
<td>My child gets full up easily</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>My child eats more when s/he has nothing else to do</td>
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</tr>
<tr>
<td>Even if my child is full up s/he finds room to eat his/her favourite food</td>
<td></td>
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</tr>
<tr>
<td>If given the chance, my child would drink continuously throughout the day</td>
<td></td>
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</tr>
<tr>
<td>My child cannot eat a meal if s/he has had a snack just before</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>If given the chance, my child would always be having a drink</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>My child is interested in tasting food s/he hasn’t tasted before</td>
<td></td>
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<tr>
<td>My child decides that s/he doesn’t like a food, even without tasting it</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>If given the chance, my child would always have food in his/her mouth</td>
<td></td>
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</tr>
<tr>
<td>My child eats more and more slowly during the course of a meal</td>
<td></td>
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</tr>
</tbody>
</table>
## Child Food Neophobia Scale

<table>
<thead>
<tr>
<th>ID#:</th>
<th>Date:</th>
</tr>
</thead>
</table>

### Child Food Neophobia Scale

<table>
<thead>
<tr>
<th></th>
<th>disagree</th>
<th>disagree</th>
<th>somewhat disagree</th>
<th>neither agree nor disagree</th>
<th>somewhat agree</th>
<th>agree</th>
<th>agree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>My child is constantly sampling new and different foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>My child doesn’t trust new foods</td>
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<tr>
<td>If my child doesn’t know what is in a food, he or she will not try it</td>
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<tr>
<td>My child likes foods from different countries</td>
<td></td>
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<td></td>
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<tr>
<td>My child thinks ethnic food looks too weird to eat</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>At dinner parties, my child will try a new food</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child is afraid to eat things she or he has never had before</td>
<td></td>
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</tr>
<tr>
<td>My child is very particular about the foods he or she will eat</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child will eat almost anything</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child likes to try new ethnic restaurants</td>
<td></td>
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</tr>
</tbody>
</table>
NutriStep Tool for Preschoolers

Nutrition Screening Tool for Every Preschooler

Instructions

Below are questions about your preschool child’s (3 to 5 year old) eating and other habits.

- Think about your child’s every day habits when answering. Check (✓) only one answer for each question.
- There is a number from 0 to 4 beside each answer. This number is a score for that question. At the bottom of each page is a box for the score for the page. For each page, add up the scores for each question.
- At the end of the questionnaire, you will add the page scores to get the total score.

1. My child usually eats grain products:
   *Examples are bread, bagel, bun, cereal, pasta, rice, roti and tortillas.*
   
   0 □ More than 5 times a day
   1 □ 4 to 5 times a day
   2 □ 2 to 3 times a day
   4 □ Less than 2 times a day

2. My child usually has milk products:
   *Examples are white or chocolate milk, cheese, yogurt, milk puddings or milk substitutes, such as fortified soy beverages.*

   0 □ More than 3 times a day
   1 □ 3 times a day
   2 □ 2 times a day
   4 □ Once a day or less

3. My child usually eats fruit:

   0 □ More than 3 times a day
   1 □ 3 times a day
   2 □ 2 times a day
   3 □ Once a day
   4 □ Not at all

Total Score for Page 1
4. My child usually eats vegetables:
   - 0️⃣ More than 2 times a day
   - 1️⃣ 2 times a day
   - 3️⃣ Once a day
   - 4️⃣ Not at all

5. My child usually eats meat, fish, poultry or alternatives:
   Alternatives can be eggs, peanut butter, tofu, nuts, or dried beans, peas and lentils.
   - 0️⃣ More than 2 times a day
   - 1️⃣ 2 times a day
   - 3️⃣ Once a day
   - 4️⃣ A few times a week
   - 5️⃣ Not at all

6. My child usually eats “fast food”:
   - 4️⃣ 4 or more times a week
   - 3️⃣ 2 to 3 times a week
   - 2️⃣ Once a week
   - 1️⃣ A few times a month
   - 0️⃣ Once a month or less

7. I have difficulty buying food to feed my child because food is expensive:
   - 4️⃣ Most of the time
   - 3️⃣ Sometimes
   - 2️⃣ Rarely
   - 1️⃣ Never

8. My child has problems chewing, swallowing, gagging or choking when eating:
   - 4️⃣ Most of the time
   - 3️⃣ Sometimes
   - 2️⃣ Rarely
   - 1️⃣ Never

9. My child is **not** hungry at mealtimes **because** he/she drinks all day:
   - 4️⃣ Most of the time
   - 3️⃣ Sometimes
   - 2️⃣ Rarely
   - 1️⃣ Never

☐  Total Score for Page 2
10. My child usually eats:
   □ Less than 2 times a day
   □ 2 times a day
   □ 3 to 4 times a day
   □ 5 times a day
   □ More than 5 times a day

11. I let my child decide how much to eat:
   □ Always
   □ Most of the time
   □ Sometimes
   □ Rarely
   □ Never

12. My child eats meals while watching TV:
   □ Always
   □ Most of the time
   □ Sometimes
   □ Rarely
   □ Never

13. My child usually takes supplements:
   Examples are multivitamins, iron drops, cod liver oil.
   □ Always
   □ Most of the time
   □ Sometimes
   □ Rarely
   □ Never

14. My child:
   □ Needs more physical activity
   □ Gets enough physical activity

15. My child usually watches TV, uses the computer, and plays video games:
   □ 5 or more hours a day
   □ 4 hours a day
   □ 3 hours a day
   □ 2 hours a day
   □ 1 hour or less a day

Total Score for Page 3
16. I am comfortable with how my child is growing:
   [ ] Yes
   [ ] No

17. My child:
   [ ] Should weigh more
   [ ] Is about the right weight
   [ ] Should weigh less

Total Score for Page 4

To get a total score, add the scores for each page.

Score for Page 1

+ Score for Page 2

+ Score for Page 3

+ Score for Page 4

Total Score

What does your NutriSTEP® score mean?

If the total score is 20 or less:
Your child’s eating and activity habits are good. There may be things that you want to work on; check out the educational material provided for tips and more information.

If the total score is 21 to 25:
Your child’s eating and activity habits can be improved by making some small changes. Check out the educational material provided or contact your local public health department for tips and more information.

If the total score is 26 and greater:
Your child’s eating and activity habits can be improved by making some changes. For suggestions, talk to a health professional such as a registered dietitian, your family doctor or paediatrician or contact your local public health department for more information.

May 2009.
Preschool Adjusted Liking Scale (PALS)

Please rate how much your child likes the following things.
Check the box to the right of the slider if your child doesn’t eat or drink that item or is never in that situation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dancing to music</td>
<td></td>
</tr>
<tr>
<td>Chicken nuggets</td>
<td></td>
</tr>
<tr>
<td>100% fruit juice (e.g., orange, apple, grape)</td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Green beans</td>
<td></td>
</tr>
<tr>
<td>Fruit flavored drinks (e.g., Hi-C, Kool-Aid)</td>
<td></td>
</tr>
<tr>
<td>ID: __________</td>
<td>Date: __________</td>
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<tr>
<td>--------------</td>
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</tr>
<tr>
<td><strong>Eggs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Playing on a playground</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Leafy greens (e.g., spinach)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Bologna</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Tomatoes</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Carrots</strong></td>
<td></td>
</tr>
<tr>
<td>ID: _______</td>
<td>Date: _______</td>
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<tr>
<td>------------</td>
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</tr>
<tr>
<td><img src="image1.png" alt="Potatoes" /> (not French fries)</td>
<td>______________</td>
</tr>
<tr>
<td><img src="image2.png" alt="Sweet potatoes" /></td>
<td>______________</td>
</tr>
<tr>
<td><img src="image3.png" alt="French fries" /></td>
<td>______________</td>
</tr>
<tr>
<td><img src="image4.png" alt="Lunch meat" /> (e.g., turkey, roast beef)</td>
<td>______________</td>
</tr>
<tr>
<td><img src="image5.png" alt="Reading books" /></td>
<td>______________</td>
</tr>
<tr>
<td><img src="image6.png" alt="Cheese" /></td>
<td>______________</td>
</tr>
<tr>
<td><img src="image7.png" alt="Pancakes or waffles" /></td>
<td>______________</td>
</tr>
<tr>
<td>ID: ________</td>
<td>Date: ________</td>
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<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Non-chocolate candy</td>
<td>______________</td>
</tr>
<tr>
<td>Chocolate candy</td>
<td>______________</td>
</tr>
<tr>
<td>Brussels sprouts</td>
<td>______________</td>
</tr>
<tr>
<td>Corn</td>
<td>______________</td>
</tr>
<tr>
<td>Taking a Bath</td>
<td>______________</td>
</tr>
<tr>
<td>White bread</td>
<td>______________</td>
</tr>
<tr>
<td>Whole grain bread</td>
<td>______________</td>
</tr>
<tr>
<td>ID: ______</td>
<td>Date: ______</td>
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<tr>
<td>------------</td>
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</tr>
<tr>
<td><img src="image" alt="Toaster pastries (e.g., Pop-Tarts)" /></td>
<td>__________________</td>
</tr>
<tr>
<td><img src="image" alt="White rice" /></td>
<td>__________________</td>
</tr>
<tr>
<td><img src="image" alt="Brown rice" /></td>
<td>__________________</td>
</tr>
<tr>
<td><img src="image" alt="Oranges" /></td>
<td>__________________</td>
</tr>
<tr>
<td><img src="image" alt="Bananas" /></td>
<td>__________________</td>
</tr>
<tr>
<td><img src="image" alt="Broccoli" /></td>
<td>__________________</td>
</tr>
<tr>
<td><img src="image" alt="Playing video games" /></td>
<td>__________________</td>
</tr>
<tr>
<td>ID: _______</td>
<td>Date: _______</td>
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<tr>
<td>------------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>Unsweetened cereal</strong> (e.g., Cheerios, corn flakes)</td>
<td>__________________</td>
</tr>
<tr>
<td><strong>Sweetened cereal</strong> (e.g., Froot Loops, Lucky Charms)</td>
<td>__________________</td>
</tr>
<tr>
<td><strong>Fried snacks</strong> (e.g., chips, Cheetos)</td>
<td>__________________</td>
</tr>
<tr>
<td><strong>Soup</strong></td>
<td>__________________</td>
</tr>
<tr>
<td><strong>Pizza</strong></td>
<td>__________________</td>
</tr>
<tr>
<td><strong>Beans, lentils, or chickpeas</strong></td>
<td>__________________</td>
</tr>
<tr>
<td><strong>Watching TV</strong></td>
<td>__________________</td>
</tr>
<tr>
<td>ID: _______</td>
<td>Date: _______</td>
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<tr>
<td>---------------------------------</td>
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</tr>
<tr>
<td><strong>Grilled cheese</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Asparagus</strong></td>
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<td></td>
<td></td>
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<tr>
<td><strong>Apples</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Burgers</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Getting dressed</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cake or cupcakes</strong></td>
<td></td>
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<tr>
<td>ID: _______</td>
<td>Date: _______</td>
</tr>
<tr>
<td>------------</td>
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</tr>
<tr>
<td>Peanut butter and jelly sandwiches</td>
<td></td>
</tr>
<tr>
<td>Macaroni and cheese</td>
<td></td>
</tr>
<tr>
<td>Cookies</td>
<td></td>
</tr>
<tr>
<td>Baked snacks (e.g., pretzels, Goldfish)</td>
<td></td>
</tr>
<tr>
<td>Ice cream</td>
<td></td>
</tr>
<tr>
<td>Riding a bike</td>
<td></td>
</tr>
<tr>
<td>ID: _____</td>
<td>Date: ________</td>
</tr>
<tr>
<td>-----------</td>
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</tr>
<tr>
<td>[Image] Garlic bread</td>
<td>[Image] ________________</td>
</tr>
<tr>
<td>[Image] Yogurt</td>
<td>[Image] ________________</td>
</tr>
<tr>
<td>[Image] Soda</td>
<td>[Image] ________________</td>
</tr>
</tbody>
</table>
Spice Intake Questionnaire

Please answer the following questions to the best of your ability. If you are uncomfortable answering a question, you may leave it blank.

1. Currently, how willing is your child to try foods prepared with spices?
   - Very unwilling to try foods with spices
   - Moderately unwilling to try foods with spices
   - Neither willing nor unwilling to try foods with spices
   - Moderately willing to try foods with spices
   - Very willing to try foods with spices
   - I don’t know / they have never been given spices

2. How often does your child complain that foods are bland?
   - Never
   - Rarely
   - Sometimes
   - Often
   - Always

3. How often does your child ask to add spices to their food?
   - Never
   - Rarely
   - Sometimes
   - Often
   - Always

4a. Did you eat foods prepared with allspice while you were pregnant?
   - Yes
   - No
   - I don’t know / I don’t remember
4b. On average, how often did you eat foods prepared with allspice while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

5a. Did you eat foods prepared with allspice while breastfeeding?

- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

5b. On average, how often did you eat foods prepared with allspice while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

6a. On average, how often do you currently eat foods prepared with allspice?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
6b. Currently, what foods do you commonly eat with allspice?

_____________________________________________________________________________________
___________________________________________________________________________________

7a. On average, how often does your child currently eat foods prepared with allspice?

☑ Never
☑ Once a month or less
☑ 2-3 times per month
☑ 1-3 times per week
☑ 4-6 times per week
☑ Daily

7b. Currently, what foods does your child commonly eat with allspice?

_____________________________________________________________________________________
___________________________________________________________________________________

8. How often does your child currently reject foods prepared with allspice?

☑ Never
☑ Rarely
☑ Sometimes
☑ Often
☑ Always
☑ I don’t know/they have never been given this spice

9a. Did you eat foods prepared with black pepper while you were pregnant?

☑ Yes
☑ No
☑ I don’t know / I don’t remember
9b. On average, how often did you eat foods prepared with black pepper while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

10a. Did you eat foods prepared with black pepper while breastfeeding?

- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

10b. On average, how often did you eat foods prepared with black pepper while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

11a. On average, how often do you currently eat foods prepared with black pepper?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
11b. Currently, what foods do you commonly eat with black pepper?

_____________________________________________________________________________________
___________________________________________________________________________________

12a. On average, how often does your child currently eat foods prepared with black pepper?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily

12b. Currently, what foods does your child commonly eat with black pepper?

_____________________________________________________________________________________
___________________________________________________________________________________

13. How often does your child currently reject foods prepared with black pepper?

☐ Never
☐ Rarely
☐ Sometimes
☐ Often
☐ Always
☐ I don’t know/they have never been given this spice

14a. Did you eat foods prepared with cardamom while you were pregnant?

☐ Yes
☐ No
☐ I don’t know / I don’t remember
14b. On average, how often did you eat foods prepared with **cardamom** while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

15a. Did you eat foods prepared with **cardamom** while breastfeeding?

- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

15b. On average, how often did you eat foods prepared with **cardamom** while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

16a. On average, how often do you currently eat foods prepared with **cardamom**?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
16b. Currently, what foods do you commonly eat with cardamom?

____________________________________________________________________________________

17a. On average, how often does your child currently eat foods prepared with cardamom?

☑️ Never
☑️ Once a month or less
☑️ 2-3 times per month
☑️ 1-3 times per week
☑️ 4-6 times per week
☑️ Daily

17b. Currently, what foods does your child commonly eat with cardamom?

____________________________________________________________________________________

____________________________________________________________________________________

18. How often does your child currently reject foods prepared with cardamom?

☑️ Never
☑️ Rarely
☑️ Sometimes
☑️ Often
☑️ Always
☑️ I don’t know/they have never been given this spice

19a. Did you eat foods prepared with cinnamon while you were pregnant?

☑️ Yes
☑️ No
☑️ I don’t know / I don’t remember
19b. On average, how often did you eat foods prepared with *cinnamon* while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

20a. Did you eat foods prepared with *cinnamon* while breastfeeding?

- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

20b. On average, how often did you eat foods prepared with *cinnamon* while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

21a. On average, how often do you currently eat foods prepared with *cinnamon*?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
21b. Currently, what foods do you commonly eat with cinnamon?


22a. On average, how often does your child currently eat foods prepared with cinnamon?

☑ Never
☑ Once a month or less
☑ 2-3 times per month
☑ 1-3 times per week
☑ 4-6 times per week
☑ Daily

22b. Currently, what foods does your child commonly eat with cinnamon?


23. How often does your child currently reject foods prepared with cinnamon?

☑ Never
☑ Rarely
☑ Sometimes
☑ Often
☑ Always
☑ I don’t know/they have never been given this spice

24a. Did you eat foods prepared with cumin while you were pregnant?

☑ Yes
☑ No
☑ I don’t know / I don’t remember
24b. On average, how often did you eat foods prepared with **cumin** while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

25a. Did you eat foods prepared with **cumin** while breastfeeding?

- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

25b. On average, how often did you eat foods prepared with **cumin** while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

26a. On average, how often do you currently eat foods prepared with **cumin**?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
26b. Currently, what foods do you commonly eat with cumin?

___________________________________________________________________________
___________________________________________________________________________

27a. On average, how often does your child currently eat foods prepared with cumin?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily

27b. Currently, what foods does your child commonly eat with cumin?

___________________________________________________________________________
___________________________________________________________________________

28. How often does your child currently reject foods prepared with cumin?

☐ Never
☐ Rarely
☐ Sometimes
☐ Often
☐ Always
☐ I don’t know/they have never been given this spice

29a. Did you eat foods prepared with garlic while you were pregnant?

☐ Yes
☐ No
☐ I don’t know / I don’t remember
29b. On average, how often did you eat foods prepared with garlic while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

30a. Did you eat foods prepared with garlic while breastfeeding?

- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

30b. On average, how often did you eat foods prepared with garlic while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

31a. On average, how often do you currently eat foods prepared with garlic?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily

31b. Currently, what foods do you commonly eat with garlic?

____________________________________________________________________________________
____________________________________________________________________________________
32a. On average, how often does your child currently eat foods prepared with garlic?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily

32b. Currently, what foods does your child commonly eat with garlic?

___________________________________________________________________________________

___________________________________________________________________________________

33. How often does your child currently reject foods prepared with garlic?

☐ Never
☐ Rarely
☐ Sometimes
☐ Often
☐ Always
☐ I don’t know/they have never been given this spice

34a. Did you eat foods prepared with ginger while you were pregnant?

☐ Yes
☐ No
☐ I don’t know / I don’t remember

34b. On average, how often did you eat foods prepared with ginger while you were pregnant?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
☐ I don’t know / I don’t remember
35a. Did you eat foods prepared with ginger while breastfeeding?

- Yes
- No
- I don't know / I don't remember
- I didn’t breastfeed my child

35b. On average, how often did you eat foods prepared with ginger while breastfeeding?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

36a. On average, how often do you currently eat foods prepared with ginger?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily

36b. Currently, what foods do you commonly eat with ginger?

___________________________________________________________________________________

___________________________________________________________________________________
37a. On average, how often does your child currently eat foods prepared with *ginger*?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily

37b. Currently, what foods does your child commonly eat with *ginger*?

____________________________________________________________________________________

____________________________________________________________________________________

38. How often does your child currently reject foods prepared with *ginger*?

- Never
- Rarely
- Sometimes
- Often
- Always
- I don’t know/they have never been given this spice

39a. Did you eat foods prepared with *nutmeg* while you were pregnant?

- Yes
- No
- I don’t know / I don’t remember

39b. On average, how often did you eat foods prepared with *nutmeg* while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember
40a. Did you eat foods prepared with nutmeg while breastfeeding?
- Yes
- No
- I don’t know / I don’t remember
- I didn’t breastfeed my child

40b. On average, how often did you eat foods prepared with nutmeg while breastfeeding?
- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember

41a. On average, how often do you currently eat foods prepared with nutmeg?
- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily

41b. Currently, what foods do you commonly eat with nutmeg?

_____________________________________________________________________________________
_____________________________________________________________________________________

_____________________________________________________________________________________
_____________________________________________________________________________________
42a. On average, how often does your child currently eat foods prepared with nutmeg?
- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily

42b. Currently, what foods does your child commonly eat with nutmeg?

____________________________________________________

____________________________________________________

43. How often does your child currently reject foods prepared with nutmeg?
- Never
- Rarely
- Sometimes
- Often
- Always
- I don’t know/they have never been given this spice

44a. Did you eat foods prepared with oregano while you were pregnant?
- Yes
- No
- I don’t know / I don’t remember

44b. On average, how often did you eat foods prepared with oregano while you were pregnant?
- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember
45a. Did you eat foods prepared with oregano while breastfeeding?

☐ Yes
☐ No
☐ I don’t know / I don’t remember
☐ I didn’t breastfeed my child

45b. On average, how often did you eat foods prepared with oregano while breastfeeding?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
☐ I don’t know / I don’t remember

46a. On average, how often do you currently eat foods prepared with oregano?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily

46b. Currently, what foods do you commonly eat with oregano?

________________________________________________________________________

________________________________________________________________________
47a. On average, how often does your child currently eat foods prepared with oregano?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily

47b. Currently, what foods does your child commonly eat with oregano?

____________________________________________________________________________________
____________________________________________________________________________________

48. How often does your child currently reject foods prepared with oregano?

- Never
- Rarely
- Sometimes
- Often
- Always
- I don’t know / they have never been given this spice

49a. Did you eat foods prepared with salt while you were pregnant?

- Yes
- No
- I don’t know / I don’t remember

49b. On average, how often did you eat foods prepared with salt while you were pregnant?

- Never
- Once a month or less
- 2-3 times per month
- 1-3 times per week
- 4-6 times per week
- Daily
- I don’t know / I don’t remember
50a. Did you eat foods prepared with salt while breastfeeding?

☐ Yes
☐ No
☐ I don’t know / I don’t remember
☐ I didn’t breastfeed my child

50b. On average, how often did you eat foods prepared with salt while breastfeeding?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
☐ I don’t know / I don’t remember

51a. On average, how often do you currently eat foods prepared with salt?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily

51b. Currently, what foods do you commonly eat with salt?

_____________________________________________________________________________________
___________________________________________________________________________________

52a. On average, how often does your child currently eat foods prepared with salt?

☐ Never
☐ Once a month or less
☐ 2-3 times per month
☐ 1-3 times per week
☐ 4-6 times per week
☐ Daily
52b. Currently, what foods does your child commonly eat with salt?

____________________________________________________________________________________

53. How often does your currently child reject foods prepared with salt?

☐ Never
☐ Rarely
☐ Sometimes
☐ Often
☐ Always
☐ I don’t know/they have never been given this spice

54. Do you have any additional comments on your intake or your child’s intake of spices?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
Home Spice Checklist

Please check the following spices/herbs in your home that you add to food on a regular basis (i.e., used in the past 3 months on a weekly basis).

**Please remember to return this checklist to us at your second visit**

on __________________ at ______________.

- Anise
- Allspice
- Basil
- Bay leaves
- Black pepper
- Caraway seeds
- Cardamom
- Cayenne pepper
- Chili powder
- Chives
- Cilantro
- Cinnamon
- Cloves
- Coriander
- Cumin
- Curry powder
- Dill
- Fennel seed
- Garlic powder
- Ginger
- Marjoram
- Mint
- Nutmeg
- Oregano
- Paprika
- Parsley
- Red pepper flakes
- Rosemary
- Saffron
- Sage
- Salt
- Tarragon
- Thyme
- Turmeric

Are there any other spices in your home you use on a regular basis that are not listed? Please list them here:

_____________________________________
_____________________________________
_____________________________________
_____________________________________
_____________________________________
_____________________________________
65. de Wild VW, de Graaf C, Jager G. Effectiveness of flavour nutrient learning and mere exposure as mechanisms to increase toddler's intake and preference for green vegetables. Appetite 2013;64:89-96.


121. Kral TV, Kabay AC, Roe LS, Rolls BJ. Effects of doubling the portion size of fruit and vegetable side dishes on children's intake at a meal. Obesity (Silver Spring) 2010;18:521-7.
ACADEMIC VITA

Elizabeth Carney
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Education

The Pennsylvania State University
Master of Science, Food Science
Bachelor of Science, Food Science
Bachelor of Science, Nutritional Sciences
Schreyer Honors College, Integrated Undergraduate Graduate Program
Expected Graduation: May 2017

Master’s Thesis: Children’s response to flavor variety in herb and spice seasoned vegetables served within a meal.

Undergraduate Thesis: A pilot study to determine preschool children’s liking and intake of seasoned vegetables in relation to maternal herb and spice exposure.

Minors: Microbiology, Human Development, Entrepreneurship: Food and Bio-innovation

Research Awards
- Speizer Award for Undergraduate Research in Food Science: $750 | 2016
- Sharkasi Family Award for Undergraduate Research in Food Science: $750 | 2015
- Speizer Award for Undergraduate Research in Food Science: $500 | 2014

Professional Memberships
- Association of Chemoreception Scientists
- Institute of Food Technologists

Internships

Mondelēz International; East Hanover, NJ
RD&Q Summer Intern; Product Development – Global Biscuit | Summer 2015
- Developed savory, filled snack products for future testing in Brazil, Russia, and China
- Investigated ingredient functionality in low water activity, fat-based filling systems
- Created a sensory ballot to evaluate filling attributes and to facilitate small group sensory analysis
- Built relationships with seasoning suppliers to co-develop regionally accepted taste profiles

Sensory Evaluation Center; University Park, PA
Sensory Lab Intern | Summer 2014
- Gained experience in all aspects of company-contracted consumer sensory tests
- Used Compusense® five software to build sensory tests, collect data, and prepare summary reports
- Assisted in coordinating a trained consumer panel evaluating attributes of Pennsylvania wines
- Prepared various chemical tastant solutions (PROP, sugar, salt, alum, quinine, citric acid, etc.)
**Research Experience**

**The Metabolic Kitchen and Children’s Eating Behavior Laboratory;** University Park, PA  
Advisor: Kathleen Keller, PhD

Children's Taste Study (Spice Study)  
*Project Leader | Jan. 2014 – Present*  
- Utilized test meal paradigms to investigate the use of herbs and spices on increasing vegetable intake in preschoolers  
- Mentored a team of 3 undergraduate research assistants, promoting engagement in research and individual growth  
- Collaborated on preparing original project grant and Institutional Review Board application  
- Developed vegetable recipes, technical instructions, and data collection procedures  
- Analyzed data using SPSS software and Microsoft Excel

Branding Familiarity fMRI Study  
- Ran fMRI protocols to investigate neural responses to brand images in 7-10 year old children  
- Improved data entry procedures by digitizing paper surveys with Qualtrics online survey software  
- Prepared weekly test meals, measured body composition, and recruited participants

The Green Smoothie Pilot Study  
*Research Assistant | Feb. 2014 – April 2014*  
- Investigated the addition of leafy vegetables to fruit smoothies as a potential way to increase vegetable intake  
- Developed green smoothie recipes as part of a team using benchtop tests and small group sensory discussion  
- Recorded preschool-aged children’s liking and intake of smoothies in a classroom setting

**Presentations**

“Herbs and spices create flavor variety in a meal to increase carrot intake among PROP taster children.” Poster abstract accepted to the annual meeting for the Association of Chemoreception Scientists. Bonita Springs, FL. Schedule for April 2017.

“A pilot study to test preschool children’s intake of vegetables prepared with herbs and spices to create a variety of flavor options” Poster presentation at The Penn State Life Sciences Graduate Symposium. University Park, PA. 2016.