CHILDREN'S RESPONSE TO FLAVOR VARIETY IN HERB AND SPICE SEASONED VEGETABLES SERVED WITHIN A MEAL

A Thesis in
Food Science
by

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Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science

May 2017
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Consumption of vegetables in preschool aged children is significantly lower than nutritional recommendations. Vegetables are an important source of vitamins and minerals, but they also may be able to combat the onset of obesity by displacing more energy dense foods in the diet. This intervention aimed to increase vegetable intake by creating flavor variety in vegetables served within a meal. Variety has previously been shown to delay sensory specific satiety and to increase food intake. Preschool aged (3-5 years-old) children attended two separate laboratories visit and were given a test-meal of common foods: pasta, applesauce, milk, water, and three servings of carrots. For the “No Variety” condition, all three servings of carrots were seasoned with the same herb and spice blend. For the “Variety” condition, the three servings of carrots were all seasoned with a different herb and spice blend. Children’s liking of the seasoned carrots was assessed on a hedonic scale, along with a salted control carrot. No differences were found in children’s individual acceptance ratings of the three types of seasoned carrots, or between the seasoned carrots and the salted carrot, but 41% of children selected the salted carrot as their favorite in a rank-order task. Children’s bitter sensitivity was assessed using a suprathreshold solution of 6-n-propylthiouracil (PROP). Children did not consume significantly more carrots in either the Variety or the No Variety condition (36.5 ± 40.5 g and 35.9 ± 43.7 g, respectively; T = 0.15, P = 0.88) when directly comparing differences in grams. Carrot intake at the two conditions was also adjusted into a proportion of total carrots consumed at both meals, in order scale significant differences relative to children’s individual intakes rather than the total weight of carrots served. The proportion of carrots consumed at each meal were not statistically different (P = 0.58), but there was a significant interaction between meal condition and PROP status (F_{1,40} = 5.16, P = 0.03). PROP tasters consumed relatively more carrots in the Variety condition, while PROP nontasters had the opposite response. It is possible that PROP tasters were better able to discriminate the differences between the seasoned carrots in the Variety condition. These findings suggest that seasoning vegetables with a variety of herbs and spices may be an effective strategy to increase vegetable intake in PROP tasters. Once replicated, this form of targeted intervention could be particularly helpful because PROP tasters tend to consume fewer vegetables than nontasters. These results also suggest that PROP status may influence sensory specific satiety and affect an individual’s response to flavor variety. More work is needed to clarify the role of individual herbs and spices on flavor perception and to determine what levels of spice can be used to optimize acceptance.
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ACKNOWLEDGEMENTS

I want thank Kathleen Keller for her continuous support and guidance. She has believed in my abilities even when I did not, and without her trust, I would never have been able to accomplish all that I have. I would also like to thank my academic advisor, Dr. Ziegler, for his help throughout my academic career and for pushing me to always take control of my own education. Thank you to my committee members, John Hayes and Josh Lambert, for your expertise and professional guidance. This wouldn’t have been possible without Wendy Stein; thank you for teaching me the ins and outs of writing and running a research study and for including me in this whole process. I especially want to thank our lab manager Terri Cravener for keeping the study running smoothly and for telling me I was doing a good job when I needed to hear it most.

Thank you to everyone who has been a part of the Children’s Metabolic Kitchen and Eating Behavior lab over the past 4 years, particularly Felicia, Sylvi, Yichi, and Nicole for all their work on meal preparation and data collection. I am grateful to Shana, Nicole, and Travis for their endless advice, not only on my project, but on life, career goals, and balance. Finally, and especially, I want to thank my parents and all of my family and friends for the years of emotional support and encouragement that stopped me from falling apart along the way. I can’t imagine this journey without any one of you!
Chapter 1: Introduction

Vegetable Intake and Health Benefits

Children’s Vegetable Intake.

Children in the United State consume 80% fewer vegetables than recommended\(^1\). Promoting vegetable intake in children is of particular importance because vegetable consumption has been associated with lower risk for diseases like cataracts, cancer, coronary heart disease, and stroke\(^2\). Additionally, due to their low energy density, vegetables have been shown to reduce energy intake by displacing higher calorie foods in the diet\(^3,4\). Thus, substituting vegetables for more energy dense foods is a potential intervention strategy for reducing childhood obesity.

Several government programs in the last two decades have aimed to increase fruit and vegetable intake by raising awareness for the “5-a-day” serving recommendation, but these have been largely unsuccessful, especially for vegetables\(^5\). One criticism of these programs is that they did not give children sufficient opportunity to taste the vegetables to overcome initial fear of the new foods\(^6\). As will be discussed below, children’s natural aversion to the bitter compounds found in some vegetables, combined with the lack of sugar, salt, and fat in most vegetables, contributes to low palatability and reduced intake. In some children, heightened bitter sensitivity may be another obstacle. Research has found several strategies for increasing vegetable intake in young children, most of which focus on increasing familiarity\(^7,9\) or altering/masking the taste of the vegetables to improve their palatability\(^11,14\). However, additional approaches are needed to increase children’s vegetable consumption to reach dietary recommendations.


Childhood Obesity.

In America, the prevalence of obesity has tripled over the last four decades\textsuperscript{15}. Obesity has been associated with higher incidence of hypertension, metabolic syndrome, Type 2 diabetes, respiratory problems, psychosocial problems, and all-cause mortality\textsuperscript{16}. Childhood obesity is a major public health concern because eating behaviors learned early in life tend to persist into adulthood\textsuperscript{17-19}. Children who enter the overweight category even once in the preschool years are more than five times as likely to be obese at the beginning of adolescence\textsuperscript{20}. While a recent plateau in the rate of childhood obesity suggests that current interventions may be starting to work\textsuperscript{15}, more strategies are needed to reverse this trend and prevent the development of new cases of obesity.

Biological Influences of Children’s Food Preference

Innate Preferences.

Encoded in the mammalian genome are inherent preferences for sweet and salty foods and a natural aversion to sour and bitter. These tastes are evolutionarily adaptive and can be seen across mammalian species\textsuperscript{21}. They are present in human newborns as early as the first few days after birth, and serve to maximize energy intake and minimize ingestion of potential toxins in times of food scarcity. However, these preferences may promote overconsumption of energy dense foods when high fat and high sugar items are regularly available\textsuperscript{22}. Similarly, they may drive down intake of nutritionally beneficial foods, like vegetables, that are lower in energy density and can taste bitter. Because the primary driver of children’s food intake is taste\textsuperscript{23-25}, children are particularly susceptible to eating patterns that include fewer vegetables and more fatty snack foods and sugar-sweetened beverages.
Genetic Variation.

While innate preferences are hardwired into the human genome, individual differences are present as well. Flavor perception results from integrated input of taste, odor, and chemesthesis\textsuperscript{26}. Taste and odor are recognized by receptors in mouth and retronasal passageway, respectively. Chemesthesis is a tactile response stimulated by certain compounds, such as the cooling effect of menthol or the burn of chili peppers. Polymorphisms in genes can affect which taste and odor receptors are expressed and the density of these receptors, and thus, polymorphisms can significantly influence flavor perception and food choice\textsuperscript{27}.

Odor receptors are coded for by over 1000 mammalian genes that allow us to recognize complex mixtures of volatile compounds\textsuperscript{28}. There is some degree of individual variation within these genes and receptor expression. An interesting case of receptor variation occurs in specific anosmia, in which a deficiency in a specific receptor makes an individual unable to perceive the smell of a particular volatile compound. Specific anosmias have been associated with sweaty\textsuperscript{29}, musky\textsuperscript{30}, minty\textsuperscript{31}, grassy\textsuperscript{32}, and fishy\textsuperscript{33} odors.

Polymorphisms have also been found in genes that code for specific taste receptors. Type 1 taste receptors are coded by \textit{TAS1R} genes and have been associated with differences in perception of umami\textsuperscript{34} and sweet\textsuperscript{35} tastes. Variation in the type 2 taste receptors, coded by \textit{TAS2R} genes, have been associated with bitter taste perception\textsuperscript{36}. Specifically, the \textit{TAS2R38} gene has been associated with perception of sulfur-containing thiourea compounds (N-C=S), which are found in cruciferous vegetables like broccoli, cabbage, and Brussels sprouts\textsuperscript{37}. Three single nucleotide polymorphisms in the \textit{TAS2R38} gene confer differences in functionality in the proteins that detect thiourea compounds on the tongue. Individuals with a homozygous PAV (proline-alanine-valine) haplotype have protein receptors that are more sensitive to the bitter taste of thiourea compounds, while individuals with a homozygous AVI (alanine-valine-isoleucine) haplotype have reduced thiourea sensitivity. Heterozygous PAV/AVI individuals also
experience greater perception of thiourea compounds, similar to that of PAV homozygotes\(^3\). Other polymorphic sequences in the \(TAS2R38\) genes exist in the population, but they are much less common than PAV or AVI sequences, and they will not be discussed here\(^3\).

**PROP Status, Taste Perception, and Food Choice.**

Genetic testing can reveal an individual’s \(TAS2R38\) genotype, but this is not always feasible in research or clinical settings. Alternatively, genotype can be inferred from phenotypic measurements of thiourea perception. Detection and threshold measurements can be assessed using solutions of phenylthiocarbamide (PTC) or 6-n-propylthiouracil (PROP), which both contain thiourea moieties. Individuals with a “taster” phenotype (PAV/PAV or PAV/AVI) perceive PTC and PROP solutions to be very bitter while “nontasters” (AVI/AVI) perceive the solutions as neutral, or like water\(^3\). PROP solutions are generally preferred in current studies, due to toxicity concerns of PTC\(^3\). More precise measures of sensitivity can be determined by varying the concentration of the tastant to assess specific thresholds\(^4\). These thresholds can also be used to further classify PROP tasters as “super tasters” or “medium tasters,” but these categories are not related to the \(TAS2R38\) genotype, suggesting that the ability to detect PROP may overlap with other genes and taste morphologies, but these mechanisms have not been completely elucidated\(^3\). Due to this overlap, PROP status (i.e. taster or nontaster) can only predict the correct genotype in about 55-85% of cases\(^3\). However, because PROP status is driven by multiple underlying mechanisms, it has also been associated with other differences in eating behaviors. One study by Feeney *et al.* found that PROP status is a better predictor of eating behavior than the underlying \(TAS2R38\) genotype\(^4\).

Consumption of cruciferous vegetable and other thiourea containing foods can be lower in individuals with the taster phenotype\(^4\). Two different studies have found that nontaster children rate their liking of
raw broccoli higher than tasters, and another study found that nontaster children living in healthy food environments (i.e. close access to establishments selling fresh fruits and vegetables) reported liking more vegetables than tasters living in similar environments. In the study by Bell and Tepper (2006), nontaster children consumed more vegetables overall than taster children when vegetables were served as a snack in preschool. The literature, however, shows mixed results and other studies have not found an impact of taster status on children’s vegetable acceptance or intake, including raw and cooked cruciferous greens.

The TAS2R38 gene and taster phenotype have also been associated with other taste sensitivities that can affect food choice. PROP tasters perceive flavor sensations, like the burn from hot pepper or alcohol, more strongly than nontasters. Tasters can also better discriminate between high and low fat contents in products like cheese and salad dressing, although nontasters tend to prefer higher fat foods. In a study by Keller et al., nontaster girls consumed more discretionary fats and had greater preference for higher fat milk than girls who were tasters or boys of either phenotype. In adults, PROP tasters tend to dislike very sweet solutions, but in children the relationship is reversed. Children who are tasters show higher acceptance of sweeter sucrose solutions. Another study by Keller et al. found that when given a buffet of highly palatable food items, tasters consumed significantly more sweet items, like candy and fruit punch, than nontasters.

As a result of its influence on taste perception, heightened bitter perception can impact food selection patterns and overall dietary variety. In a 1961 study on tastant threshold, sensitivities to the bitterness of both quinine and PROP were associated with a greater number of disliked foods on a 118 item questionnaire, whereas no relationship was found between food liking/disliking and sweet, salty, or sour tastants. A similar study that also assessed both quinine and PROP thresholds found that PROP nontasters had more preferences for stronger tasting foods, like black coffee, sharp cheeses, and
horseradish, than PROP tasters on a self-reported questionnaire \(^{56}\). These results suggest that individuals with greater bitter sensitivity may have reduced dietary variety due to a higher proportion of food dislikes. A more recent study by Tepper’s group suggests that bitter perception only explains part of the variance in dietary variety and food dislikes. Temperament and personality differences in individuals that result in greater food adventurousness have been shown to interact with phenotype to increase dietary variety in PROP tasters. The relationship between food likes and dislikes in nontasters, however, is not related to food adventurousness\(^{57}\). Similarly, PROP phenotype can also interact with food neophobia. In a study of obese adolescents in weight loss treatment, PROP nontasters showed a greater decrease in food neophobia throughout the intervention, while PROP tasters were more resistant to accepting new foods\(^{58}\). Given the relationship between PROP status and food acceptance/rejection seen in adolescents and adults, it’s important to consider taster status, and ideally the underlying mechanisms, when looking at measures of food acceptance and intake in children.

**Learned Influences on Children’s Food Preferences**

**Food Acceptance and Preference.**

Acceptance and preferences testing are both used to quantify an individual’s hedonic response to a sensory stimulus. Acceptance is a measure in which a specific attribute (i.e. taste, texture, appearance) or the food as a whole is evaluated without a specific reference or comparison. Acceptance testing utilizes a scaling system that quantifies degree of liking (or disliking). Preference is a comparative measure in which two or more samples are evaluated together, and the most (or least) liked sample is selected from the group. Rank-order testing is a form of preference testing in which all the samples are ordered from most to least liked. Acceptance testing is useful because it provides information on the magnitude of the hedonic score, but it can be difficult to compare foods that are not evaluated at the same time or on the
same scale. Preference testing is better for direct comparison; however, it does not provide any information on the magnitude of difference\textsuperscript{59}. Versions of acceptance and preference testing have been adapted for children\textsuperscript{60}. For a more comprehensive overview of these measures, see Carney (2017)\textsuperscript{61}.

**Associative Conditioning.**

While biological factors play an important role in early food acceptance, humans also learn about food from daily experiences. In this way, we learn to like foods that are associated with positive post-ingestive consequences (i.e. satiety and satiation) or foods that are consumed in a positive social context\textsuperscript{62}. Conversely, if consumption of a particular food is associated with negative post-ingestive consequences (i.e. GI distress, nausea), or negative social experiences, a learned aversion can occur\textsuperscript{63}. In children, novel foods are typically introduced rapidly from the weaning period throughout early childhood. This period provides a unique window of opportunity to promote positive associations for healthy foods, but it presents challenges in overcoming children’s neophobia\textsuperscript{64}. Different methods of fostering positive food associations have been shown to increase children’s willingness to try new foods and to increase overall intake of those foods.

**Repeated Exposure.**

Tasting a novel food several times in the absence of negative post-ingestive consequences can increase liking and intake of that food in young children. Rozin referred to this as the “learned safety hypothesis” in which he suggested that all mammals are initially fearful of new foods, but once a food is consumed a sufficient number of times without negative consequences, an association is formed and the animal learns that it is safe to eat that food\textsuperscript{65}. In children, repeated exposure has been used to increase self-reported liking of specific vegetables. A difficulty in this approach is that 5-15 exposures may be needed to have a
significant effect on liking or intake of a new food, and the food must actually be tasted during these exposures. For parents, encouraging children’s willingness to try the vegetable in the first place is one of the greatest struggles with repeat exposure.

**Classical Conditioning.**

In classical or Pavlovian conditioning, an unconditioned stimulus that naturally elicits a certain biological response is paired with a conditioned stimulus enough times that a learned association forms and the conditioned stimulus alone begins to elicit the biological response formerly produced by the unconditioned stimulus. In the classic experiment on conditioning, Pavlov blew a whistle every time he fed his dogs. The presentation of food caused the dogs to salivate, but after several conditioning trials, the dogs began to salivate when the whistle blew, even when food was not present. Similarly, humans can form learned food associations from environmental and physiological cues.

Flavor-nutrient learning is a form of classical conditioning in which foods are paired with nutrients to stimulate positive post-ingestive consequences (i.e. satiation and satiety). In experiments with rats, either grape or cherry flavored water was paired with intragastric glucose infusions while the opposite flavor was paired with infusions of pure water. Rats increased both acceptance and preference of the flavor paired with the added nutrients over the flavor that was not, indicating the role of post-ingestive consequences in shaping food preferences. In vegetable studies in humans, added carbohydrate or fat can increase children’s acceptance of the vegetable over time, but the benefits do not offer a significant advantage over repeat exposure alone. Because vegetables are naturally low in energy density, flavor-nutrient learning may be difficult to achieve since a large amount of fat or sugar would need to be added to increase the energy content enough to significantly change post-ingestive signaling.
Conditioned taste aversions can be learned when foods become associated with negative-post ingestive consequences, such as bloating, nausea, or vomiting. Individuals can form a learned food aversion even if they know that the food itself was not the cause of the symptoms, as long as the food was consumed around the same time that symptoms occurred\(^6^3\). Food aversion is not limited to novel foods, but can also develop for familiar foods if a strong negative experience is associated with consumption of that item\(^7^4\).

Flavor-flavor learning occurs when a liked flavor is paired with a novel or disliked food or flavor in order to increase acceptance of the novel food. A common example of flavor-flavor learning often used by parents and caretakers is adding ketchup or ranch dressing to encourage a child’s consumption of a disliked or novel vegetable. Unlike flavor-nutrient learning, the flavor does not necessarily contribute additional energy. In true flavor-flavor learning, acceptance of the target food is maintained even after the flavor pair is removed. For vegetables, herb flavor dips have been a successful tool to increase intake in preschool aged children\(^1^1,1^2\). However, some studies fail to show sustained effects after the added flavor is removed or fail to find a benefit of flavor-flavor learning over repeat exposure alone\(^1^0,6^7,7^3,7^5\).

**Rewards and Modeling.**

Rewards and modeling are two extensions of associative conditioning that have been used as strategies to improve vegetable intake and increase children’s willingness to try novel or disliked vegetables. Rewarding children for eating healthy foods is a common practice among American parents, but it has been a controversial issue in scientific literature. Birch, Marlin, and Rotter (1984) found that offering a contingency (i.e. watching a movie) for eating certain foods decreased children’s intrinsic liking for that food\(^7^6\). Another study showed that using food as a reward for consuming another target food decreased children’s liking of the target food, even when the reward and the target food were initially equally liked\(^7^7\). These studies, however, used a palatable target food (sweetened milk drink and a moderately...
liked snack food, respectively), and may not apply to initially disliked or novel foods. Other studies have found that non-food rewards, like small prizes or stickers, can increase children’s willingness to try initially unfamiliar vegetables and praising children’s for consuming healthy foods has been associated with higher intake. Thus, for disliked or unfamiliar vegetables, rewards can be an effective option to increase children’s acceptance, especially when combined with repeated exposure or peer-modeling interventions.

Modeling, in which an adult, peer, or fictional character demonstrates eating the vegetable, is another strategy that can increase children’s acceptance of initially disliked vegetables. The type of modeling that is successful may be particularly susceptible to age effects, with younger children more responsive to maternal cues than older children. For children of school age, peers can be a strong influence. A study by Birch (1980) found that pairing a preschool student who disliked a certain vegetable with a table of peers who liked that vegetable increased vegetable preference in the target child over the course of several snack periods. Modeling can also work when a well-liked children’s character is depicted consuming vegetables.

All of these strategies discussed so far are intended to increase children’s acceptance of new and disliked vegetables, with the goal of increasing vegetable intake overall. A key concept in the usefulness of introducing novel items is that having a variety of vegetables in the diet is nutritionally advantageous. A greater variety of vegetables is beneficial both because of the unique micronutrient profiles that different vegetables provide, but also because variety can play a role in increasing overall quantity of intake. However, there is not always a positive correlation between liking and intake of foods and isolated measures of acceptance are not the only criteria in food selection and consumption. Intervention strategies should be mindful of this limitation and also focus on intake measures.
Dietary Variety and Sensory Specific Satiety

Sensory Specific Satiety.

When a food is eaten to satiation, preference for that food declines, but preference for foods not eaten remains unchanged\(^8\). This phenomenon is referred to as sensory specific satiety (SSS), and there is evidence that it occurs in both humans and animals\(^8\)–\(^9\). In early SSS studies, adults were presented with a single food and allowed to consume it to satiation; when the same food was presented again immediately afterward, overall food intake did not significantly increase, but when a different food was presented, adults continued to eat more, despite being satiated on the first item\(^9\). Evidence of SSS persisted when several food options were presented in succession, with adults consuming significantly more than when a single option was presented multiple times\(^9\)\(^2\)\(^9\)\(^3\). These studies suggest that SSS is a major factor involved in meal cessation and total food intake during a meal.

Evidence has shown that a decrease in acceptance and consumption occurs in SSS because of habituation to the sensory properties of the food, and not the post-ingestive consequences\(^9\)\(^4\). When given a series of exposures to lemon-flavor gelatin, habituation patterns did not differ across low and high calorie versions, indicating a stronger response to flavor cues than energy consumption\(^9\)\(^4\). Additionally, declines in hedonic ratings can be seen 2 minutes after consumption of a food, before post-absorptive signals in the gut would have an effect, indicating it is a sensory phenomenon. Twenty minutes post-consumption, when post-absorptive signals would peak, hedonic scores rebound and sensory specific satiety is less pronounced\(^9\)\(^0\). The degree of sensory similarity between the foods has also been shown to moderate people’s responsiveness to variety. Greater changes in intake are seen more frequently in foods with more differences in several sensory attributes, such as appearance, flavor, texture and mouthfeel\(^9\)\(^3\). For example, one study found that savory foods decreased preferences for other savory foods but not for sweet foods, and vice versa\(^9\)\(^5\). Another classic study offered a series of sandwiches with flavored cream
cheese fillings in succession, and found that people consumed more when multiple flavors were presented instead of just one, even when the single flavor presented was the most preferred\textsuperscript{93}. Conversely, significant differences have not been observed when more similar foods are presented, such as different colored chocolate of the same flavor\textsuperscript{93}, or different flavored yogurts of the same color and texture\textsuperscript{92}. 

**Dietary Variety.**

In omnivores, high dietary variety is beneficial as a way to maximize intake of essential nutrients. In adults, greater variety does increase the likelihood that a diet is nutritionally adequate\textsuperscript{96}. The definition of dietary variety, however, can include variety between different food groups, variety within different food groups, or total variety of all food items and ingredients. The correlation between nutritional adequacy and food intake is higher for variety between food than for variety within groups\textsuperscript{96}. 

Dietary variety over the course of several days is important for overall nutrient balance, but dietary variety within a discrete eating period can also influence health outcomes. Increased variety within a meal can delay the onset of sensory specific satiety, which can lead to overconsumption. Exposure to a variety of high energy dense foods had been linked to weight gain and obesity\textsuperscript{97-99}. This occurs when multiple items from different food groups are offered, as well as when multiple flavors, sauces, or toppings are available with a food\textsuperscript{100}. 

**Vegetables Intake with Variety.**

Variety can have negative effects if exposure to a variety of highly palatable, energy dense foods leads to overconsumption and excessive energy intake. However, variety can be beneficial if exposure to a variety of low energy dense foods, like vegetables, increases consumption of these healthier food choices. In a
study of adults, vegetable intake was significantly increased when three different vegetables, as opposed to each of the vegetables individually, were offered alongside a pasta dish during laboratory controlled lunches. A school-based experiment with preschool children found that offering a variety of vegetables for snack increased intake when compared to any of the vegetables served individually. Alternatively, a study of Dutch children showed that offering two different kinds of vegetables at a restaurant meal did not increase vegetable consumption. Even in studies that were successful, changes in vegetable intake were not associated with a decrease in overall meal intake or energy density. More work needs to be done to determine what type of variety works to bolster vegetable intake in children and what environments might be conducive to this type of intervention. Further comparison is also needed to compare this strategy to other methods of increasing vegetable intake.

**Additional Strategies to Increase Vegetable Intake**

**Portion Size.**

Larger portion sizes lead to increased food consumption in both children and adults and across multiple food groups. While larger portions of high energy foods can result in excess consumption and weight gain, offering larger portions of low energy foods can encourage intake of healthier options and could potentially bring down the energy density of the meal. Two studies have shown that increasing the portion size of vegetables served as a snack or before a meal can increase overall vegetable intake in children. However, increasing the portion of vegetables served within the context of a meal has been shown to have mixed results. In one study where fruit and vegetable servings were both doubled within a meal at the same time, only fruit intake increased, whereas in another study that doubled fruit and vegetable portions both separately and together over the course of several meals, found that both fruit and vegetable intake increased independent of each other. The difficulty in increasing vegetable intake within a meal
is that the vegetable has to compete with other more palatable food options\textsuperscript{104}. Often in these situations, the vegetable loses out to more palatable, energy dense entrées and desserts.

**Vegetables by Stealth.**

Larger portions sizes are also limited to increasing intake of vegetables that children already like and are willing to consume\textsuperscript{105}. To overcome that limitation, increasing the portion size of vegetables incorporated into other food items, or “hiding vegetables by stealth,” can help increase intake of disliked vegetables by masking their taste and appearance\textsuperscript{13,14}. One study found that increasing the proportion of vegetables in dishes like spaghetti and casseroles significantly increased vegetable intake in children over the course of a day\textsuperscript{14}. Mother’s report that hiding vegetables in their children’s diets is an effective way to increase intake as early as the weaning period\textsuperscript{13}. Vegetables by stealth is a good strategy to increase intake and maximize the associated health benefits, as well as to reduce the energy density of a meal, but because children are not exposure to the vegetable in whole form, it may not affect children’s liking of the vegetables themselves or reduce their innate neophobic response.

**Benefits of Herbs and Spices**

Herbs and spices have been used throughout history to make food more palatable\textsuperscript{106}. By definition, herbs are generally the green, leafy parts of the plant while spices come from the seeds, bark, root, or stem. In culinary and nutritional literature, the terms are commonly used interchangeably. In this literature review and throughout this document, both will also be included in the umbrella term “seasonings”.

A 2014 survey showed that even low income families generally have herbs and spices on hand\textsuperscript{107}. In adults, studies have found the use of seasoning can increase acceptance of low fat\textsuperscript{108} and low sodium\textsuperscript{109}.
food items. For this reason, herbs and spices are recommended as a strategy to increase adherence to nutritional beneficial diets\textsuperscript{109,110}. On vegetables, herbs and spices may be good candidates for increasing palatability without the addition of significant amounts of sugar, fat, or salt.

In addition to their flavoring attributes, several health benefits have been attributed to many seasonings. Herbs and spices are rich sources of phenolic compounds and other antioxidants\textsuperscript{111,112}, which can protect cells from damage and reduce inflammation. Antioxidants and polyphenols have been associated with reduced risk for chronic and degenerative diseases, like cancer, cardiovascular disease, and Alzheimer’s\textsuperscript{113,114}. Spices high in antioxidants have also been shown to modulate post-meal insulin activity in adults and aid in weight management\textsuperscript{115}. The McCormick Spice Institute has funded many research reviews on the health benefits of commonly used spices, including black pepper\textsuperscript{116}, cinnamon\textsuperscript{117}, ginger\textsuperscript{118}, rosemary\textsuperscript{119}, and coriander\textsuperscript{120}. Because of their unique health benefits, it has been argued that the Dietary Guidelines for Americans should include recommendations for herb and spice intake\textsuperscript{121}.

While it is unlikely that adding small amount of seasonings to foods will contribute to long term health benefits in children, introducing them in childhood could be a strategy to increase acceptance of these flavors and work up to using them in larger amounts. Additionally, because seasonings can be used to increase palatability without adding energy, additional research in children is warranted.
Objectives and Aims.

Purpose.

The goal of this research was to investigate a potential intervention to increase vegetable intake in preschool aged children. Adding herbs and spices to create flavor variety in several smaller servings of the same vegetable is a novel strategy aimed at reducing sensory specific satiety to increase vegetable consumption within a meal. We aimed to test children’s acceptance of carrots prepared with three different seasoning blends, and to measure preference for the seasoned carrots compared to carrots prepared with salt but no other seasonings. The same herb and spice blends were used to seasoned the carrots as part of the flavor variety intervention. Herbs and spices are ideal options for creating flavor variety because they can improve palatability without adding large amounts of sugar, salt, and/or fat and they can be used in recipes that are easy to prepare. Additionally, herbs and spices are full of nutritionally beneficial antioxidants and they offer a huge array of diverse flavors.

A second aim of this study was to determine if PROP taster status moderates the influence of flavor variety on vegetable intake at a laboratory test-meal. Characterizing groups of children who may be more amenable to this intervention will inform the development of more effective, targeted approaches to increase vegetable intake in the future.
Specific Aims and Hypotheses.

The first aim of the study was to determine whether preschool children’s intake of vegetables within a meal can be increased by offering a greater variety of flavors achieved by using different herb and spice blends.

- We hypothesized that children would consume more seasoned vegetables when they were presented with a variety of seasoning options compared to a No Variety condition where only a single seasoning option was available.

A second aim was to investigate if children’s genetic sensitivity to the bitter taste of 6-n-prop thiouracil (PROP) moderates the impact of the variety intervention on children’s vegetable intake at the test-meal.

- We hypothesized that PROP nontasters would be more responsive to the Variety intervention than PROP tasters, due to the strong, bitter, or pungent nature of herbs and spices.

An exploratory aim was to create a list of common herbs and spices for parents to report which herbs and spices are frequently used in the home. This information will be used to inform recipe development for future studies.
Chapter 2: Methods

Study Design

Laboratory Paradigm.

The study was a within-subject cross-over design testing the effect of increased sensory variety on children’s vegetable intake across two test-meals. Children came to 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). 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.

Table 1. Summary of Study Design

<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 Test Foods Liking Task</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 Test Foods Liking Task</td>
</tr>
<tr>
<td>• Pre-Meal Test Foods Liking Task</td>
<td>• Parent Questionnaires</td>
</tr>
<tr>
<td>• Intake Data: Test Meal</td>
<td></td>
</tr>
<tr>
<td>• Post-Meal Test Foods Liking Task</td>
<td></td>
</tr>
<tr>
<td>• Parent Questionnaires</td>
<td></td>
</tr>
</tbody>
</table>

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 to the next task.

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 small toy at the end of each visit.

**Participant Recruitment.**

Children were recruited from the areas surrounding The Pennsylvania State University campus (University Park, PA) 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.
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. 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 µmol/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, Mondelez International, East Hanover NJ) to cleanse their palates.

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. 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, while a salted carrot that was otherwise unseasoned served as the control. The ratios of recipe components 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 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 1/8 tsp of canola oil and 1/16 tsp. of table salt. Broccoli 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 meals 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, as shown in **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.
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 a block design by vegetable type.

Test Meal Conditions.

A “Variety” condition and a “No Variety” condition were presented in a counterbalanced, 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 presenting in three identical bowls, as shown in Figure 2. The other meal items remained consistent between conditions.

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. 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 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 3. Portion size of food items served in each test meal. Calories per serving and energy density were calculated using the nutritional information provided by the manufacturer.

<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.

Test Meal Procedure.

Prior to 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 Fisher and Birch 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 *Figure 2;* no additional servings were offered. 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 and rank-order tasks were repeated as described above with a new tray of the meal items in ~5 gram portions.

**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\(^{125}\), temperament\(^{126}\), clinical nutrition risk ([http://www.nutristep.ca/](http://www.nutristep.ca/)), typical eating behaviors\(^{127}\), infant feeding practices, and caregiver feeding styles\(^{128}\). These surveys are described in brief below, but the data for these instruments will be reported elsewhere.

**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).

The **Spice Intake Questionnaire (SIQ)** was developed specifically for this study. Questions and answer choices were written to specifically ask about consumption of the 9 herbs and spices used in the seasoning blends and 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 9 herbs and spices, and salt.

The **home spice checklist (HSC)** was also developed specifically for this study. Parents were given a checklist of 34 common herbs and spices ([http://adventuresinspice.com/flavormap/flavormap.html](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. The HSC will also serve as a reference for development of future studies involving herbs and spices in this or similar populations.
Data Preparation and Analyses

Data from 44 participants were included in the final analysis. All statistics were run on SPSS Version 22.0 (SPSS Inc., Chicago, IL) with a critical $P$-value $\leq 0.05$. Means and standard deviations (mean ± SD) are given for all continuous variables, while frequencies ($\%$, $N$) are given for categorical variables. Graphs are plotted with error bars displaying standard error of the mean.

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/cnre-apps/bodycomp/bmiz2.html). Children were considered normal weight if they had a BMI < 85th percentile, or overweight if they had a BMI $\geq$ 85th percentile.

Parents’ BMI scores were calculated in kg/m$^2$ from heights and weights reported by the parent that accompanied the child to the laboratory visits.

Children’s Test Meal Intake.

Children’s meal intake was calculated by subtracting the leftover meal item’s post-weight from the item’s pre-weight to the nearest 0.1 grams. Food that had fallen onto the tray or the table during the meal was placed back into its respective bowl before being post-weighted. Capped containers prevented any liquid spills. Calorie consumption was calculated from the child’s intake in grams multiplied by the food item’s energy density (g/kcal) as reported on the manufacturer’s nutrition label. For the carrots, energy density
was calculated for a recipe of $\frac{1}{2}$ 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 and liquids\textsuperscript{129}, 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).

**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’s Carrot Intake.**

Children’s total carrot intake was a combined score of their intake in grams over both test meals. Differences in the proportion of carrots eaten by condition was calculated by dividing the carrots eaten at each condition (Variety vs. No Variety) over the total carrots eaten at both meals. Using a proportion allowed for smaller differences to be detected in children who ate fewer carrots overall. Intake of the individually seasoned carrots was taken as the gram amount of carrot with that seasoning blend consumed in the Variety condition only.
Statistical Analyses

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. Because the first four children were not given a control carrot in the liking task, differences in liking of the three seasoned carrot blends were first compared for all participants ($N = 44$) and then were compared again with the control for those who received the control carrot ($N = 40$). Mean liking scores for the three seasoned carrots were not significantly different when the first four participants were removed. Differences in children’s intake of the seasoned vegetables were compared with one-way repeated measures ANOVA.

Children’s intake of individual food items and meal totals were calculated by condition (Variety vs. No Variety) and compared using paired t-tests.

General linear models with repeated measures were also used to compared differences specifically in carrot intake by condition. The Greenhouse-Geisser correction was used to adjust for unequal variances. Spearman correlations for categorical variables and Pearson correlations for continuous variables were used to find potential factors to include as covariates in the model. Meal condition and PROP status (taster vs. nontaster) were included as fixed factors in the model. Sex, age in months, BMI z-score, meal order, and pre-meal fullness were individually tested as covariates in the model, and were removed if they were not significant.
Chapter 3: Results

Participants

Seventy-nine child/parent dyads were screened based on responses to posted flyers and online advertisements. Fifteen children were excluded for not meeting eligibility criteria (i.e. wouldn’t eat the test meal foods, wouldn’t be comfortable in a room without their parent, medical condition or medication that can affect taste or appetite) and sixteen were excluded due to scheduling conflicts. Four more participants were excluded after their first visit because the child would not taste any of the carrots. Forty-four children ($N = 44$; mean age: $54.2 \pm 8.2$ months) were included in data analysis. Children were aged 3-5 years with the exception of one child who was tested just after his 6th birthday due to scheduling problems. The data also included one set of siblings, tested about 1 year apart, and two set of twins. Twins were tested by separate researchers in individual observation rooms 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 analyses.

Children were 57% male ($N=25$), predominantly white (93%, $N=41$) and non-overweight (79.5%, $N=35$). Eighty percent ($N=35$) were classified as PROP tasters, and 20% ($N=9$) were nontasters. Most children had a mother attend the visits and fill out the questionnaire ($N=42$) while two children were accompanied by their fathers. Forty-three parents provided information on all demographic questionnaires, while this information is missing for one parent. Parents who provided data were predominantly white ($N=41$) and college educated ($N=39$) with an annual household income greater than $50,000 ($N=27$). A more detailed summary of demographic information is provided in Table 4 and Table 5.
Table 4. Children’s anthropometric measurements and demographic information.

<table>
<thead>
<tr>
<th>Child Characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>% (N)</td>
</tr>
<tr>
<td>Male</td>
<td>56.8 (25)</td>
</tr>
<tr>
<td>Female</td>
<td>43.2 (19)</td>
</tr>
<tr>
<td>Race / Ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>93.2 (41)</td>
</tr>
<tr>
<td>Hispanic or Latinx</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td>Asian</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td>Mixed Race</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td>Weight Classification</td>
<td></td>
</tr>
<tr>
<td>Non-overweight (BMI %ile 0-85th)</td>
<td>79.5 (35)</td>
</tr>
<tr>
<td>Overweight (BMI %ile &gt;85th)</td>
<td>20.5 (9)</td>
</tr>
<tr>
<td>PROP Status</td>
<td></td>
</tr>
<tr>
<td>Nontaster</td>
<td>20.5 (9)</td>
</tr>
<tr>
<td>Taster</td>
<td>79.5 (35)</td>
</tr>
<tr>
<td>Age</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Child age in months</td>
<td>54.2 ± 8.2</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td></td>
</tr>
<tr>
<td>BMI percentile</td>
<td>56.8 ± 28.3</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>0.23 ± 0.98</td>
</tr>
</tbody>
</table>
Table 5. Parents’ self-reported demographic and anthropometric information.

<table>
<thead>
<tr>
<th>Parent Characteristics</th>
<th>% (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accompanying Parent</strong></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>95.5 (42)</td>
</tr>
<tr>
<td>Father</td>
<td>4.5 (2)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>95.4 (41)</td>
</tr>
<tr>
<td>Hispanic or Latinx</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td>Mixed race</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td><strong>Highest Education Achieved</strong></td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>9.3 (4)</td>
</tr>
<tr>
<td>College degree</td>
<td>44.2 (19)</td>
</tr>
<tr>
<td>Some graduate/professional school</td>
<td>4.6 (2)</td>
</tr>
<tr>
<td>Graduate/professional degree</td>
<td>41.9 (18)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
</tr>
<tr>
<td>Single (never married)</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td>Married</td>
<td>95.4 (41)</td>
</tr>
<tr>
<td>Separated</td>
<td>2.3 (1)</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
</tr>
<tr>
<td>&lt; $20,000</td>
<td>0</td>
</tr>
<tr>
<td>$20,000-35,000</td>
<td>14.4 (6)</td>
</tr>
<tr>
<td>$36,000-50,000</td>
<td>21.4 (9)</td>
</tr>
<tr>
<td>$51,000-75,000</td>
<td>23.8 (10)</td>
</tr>
<tr>
<td>$76,000-100,000</td>
<td>19.0 (8)</td>
</tr>
<tr>
<td>&gt; $100,000000</td>
<td>21.4 (9)</td>
</tr>
<tr>
<td><strong>Mean ± SD</strong></td>
<td></td>
</tr>
<tr>
<td>Age, in years</td>
<td>35.3 ± 4.5</td>
</tr>
<tr>
<td>Maternal BMI (kg/m2)</td>
<td>26.70 ± 7.4</td>
</tr>
<tr>
<td>Paternal BMI (kg/m2)</td>
<td>26.06 ± 3.67</td>
</tr>
</tbody>
</table>
Children’s Liking of Seasoned Vegetables

Using a Friedman’s test for nonparametric, repeated measures, no significant differences were found in children’s self-reported liking of each of the carrots prepared with each of the seasoning blends ($N = 44$, $Q = 0.63, P = 0.74$) or control carrot with just salt and oil ($N = 40$, $Q = 3.23, P = 0.36$). Mean liking scores are given in Figure 3 while Figure 4 gives the individual histograms for children’s liking responses to each of the seasoned carrots. Only 34-38% of children rated carrots with any of the seasoning blends in the “good” or “super good” category. Comparatively, 50% of children who received the control carrot rated their liking as “good” or “super good” and 41% of children selected the salted control carrot as their favorite carrot.
Table 6 summarizes children’s favorite vegetable as indicated by their first selection in the rank-order task. Similar to the carrots, no significant differences were found in self-reported liking scores of broccoli with each of the three seasoning blends (N = 42, Q = 0.19, P = 0.91).

**Figure 3.** Children’s self-reported carrot liking (left) and broccoli liking (right) prepared with seasonings and rated on a 5-point hedonic scale. Using a Friedman test for non-parametric, repeated measures, no significant differences were found in liking for carrots (N = 40, Q = 3.23, P = 0.36) or broccoli (N = 42, Q = 0.19, P = 0.91).
Figure 4. Histogram distributions of children’s liking ratings for each of the seasoned carrot and the salted control.
Table 6. Children’s preferred seasoning blends, based on the number of children who chose each type of seasoned vegetable as their favorite when asked to rank them in preference order. 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>23.5 (8)</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>17.6 (6)</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>17.6 (6)</td>
</tr>
<tr>
<td>Control (Salt and oil)</td>
<td>41.2 (14)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Favorite Broccoli Sample</th>
<th>% (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Blend</td>
<td>20.5 (9)</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>40.5 (15)</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>29.5 (13)</td>
</tr>
</tbody>
</table>

Overall children’s mean liking score for seasoned broccoli was higher than that for seasoned carrots when the three individual liking scores for each vegetable were summed together ($T = 2.56, P = 0.01$).

Individually, only the broccoli with the cardamom blend was liked significantly more than carrots with the cardamom blend ($T = 2.17, P = 0.04$). The garlic blend broccoli ($T = 1.96 P = 0.06$) and the cinnamon blend broccoli ($T = 0.82, P = 0.41$) had higher mean liking scores than the carrots of the respective blends, but the relationship was not significant.

**Children’s Intake of Seasoned Carrots**

Children’s intake of carrots by condition and over the entire study are shown in Table 7. Using a one-way ANOVA, no significant differences were found in children’s intake of carrots with each seasoning blend during the variety condition ($F_{2,36} = 0.02, P = 0.98$), as seen in Figure 5. Children consumed an average of 36.54 ± 40.50 grams of carrots in the Variety condition, compared to 35.90 ± 43.72 grams of carrots in the No Variety condition. Individual variability was high. As a proportion of total intake, children consumed an average of 52% of total carrots in the Variety condition (grams of carrots consumed in the Variety condition / grams of carrots consumed in both conditions), and 48% of carrots in the No Variety condition.
condition. This analysis removed two children from the data set, because they did not eat any carrots at all and the denominator of the proportion became zero. When children who consumed fewer than 5 grams of carrots total (< 1 carrot per meal; \( N = 7 \)) were also removed from the analyses, the statistical significance of the models did not change, and the decision was made to keep these children in all reported statistics.

Table 7. Average carrot consumption of seasoned carrots in the variety meal and total carrot consumption by condition.

<table>
<thead>
<tr>
<th>Carrot Intake</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamon Blend</td>
<td>12.20 ± 15.90</td>
</tr>
<tr>
<td>Cardamom Blend</td>
<td>11.95 ± 15.05</td>
</tr>
<tr>
<td>Garlic Blend</td>
<td>12.40 ± 16.38</td>
</tr>
<tr>
<td>Variety Meal</td>
<td>36.54 ± 40.50</td>
</tr>
<tr>
<td>No Variety Meal</td>
<td>35.90 ± 43.72</td>
</tr>
<tr>
<td>Both Meals</td>
<td>72.44 ± 79.14</td>
</tr>
</tbody>
</table>

Figure 5. Mean intake of carrots prepared with each of the three seasoning blends at the Variety condition. A one-way, repeated measures ANOVA shows that there were no significant differences in seasoned carrot intake by seasoning blend \( F_{2,86} = 0.02, \ P = 0.98 \).
Differences in Meal Intake by Condition

Children’s intake of individual meal items by condition, the total meal consumption, calorie calculations and energy density are given in Table 8. Paired t-tests showed that there were no significant differences in consumption of any item by condition ($P > 0.05$). Additionally, there were no significant differences in total meal consumption, total calories consumed, or energy density ($P > 0.05$).

Table 8. Children’s intake of meal items by condition. Energy density was calculated by dividing the calories consumed by the food’s weight in grams. No significant differences were found for any of the meal intake variables by condition (Variety vs. No Variety) using a paired t-test ($P < 0.05$).

<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>102.13 ± 58.10</td>
<td>149.11 ± 84.83</td>
</tr>
<tr>
<td>Applesauce</td>
<td>76.31 ± 40.55</td>
<td>34.34 ± 18.25</td>
</tr>
<tr>
<td>Carrots</td>
<td>35.90 ± 43.72</td>
<td>14.04 ± 17.09</td>
</tr>
<tr>
<td>Milk</td>
<td>78.18 ± 80.31</td>
<td>42.37 ± 43.53</td>
</tr>
<tr>
<td>Water</td>
<td>25.94 ± 48.22</td>
<td>n/a</td>
</tr>
<tr>
<td>Food Total (w/o beverages)</td>
<td>214.33 ± 109.29</td>
<td>197.48 ± 102.65</td>
</tr>
<tr>
<td>Meal Total (all items)</td>
<td>292.51 ± 142.98</td>
<td>239.86 ± 115.71</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>0.91 ± 0.20</td>
<td>0.90 ± 0.22</td>
</tr>
<tr>
<td>Energy Density (w/o water)</td>
<td>0.83 ± 0.18</td>
<td>0.81 ± 0.17</td>
</tr>
<tr>
<td>Energy Density (all items)</td>
<td>0.77 ± 0.21</td>
<td>0.73 ± 0.21</td>
</tr>
</tbody>
</table>

A difference score between carrot intake during the two meal conditions (Variety – No Variety) was used to assess correlations with potential covariates. The same was done for the proportion of carrots eaten (Proportion\text{Variety} – Proportion\text{No Variety}). Spearman correlations were used to assess the relationship between non-parametric, categorical values and carrot intake, including sex, PROP status, meal order, and pre-meal fullness. Pearson correlations were used to assess the relationship between continuous variables and carrot intake, including age in months and BMI z-score. PROP status was not significantly correlated with
differences in grams of carrots eaten by condition (\( \rho = 0.29, P = 0.06 \)), but PROP status did significantly correlate with the proportion of carrots consumed in each meal (\( \rho = 0.33, P = 0.04 \)). In both cases, PROP taster status was associated with a tendency to consume more carrots in the Variety condition relative to the No Variety condition. There were no significant correlations between carrot intake and sex, age, BMI z-score, meal order, or pre-meal fullness (\( P > 0.05 \)).

Total meal intake of all foods was correlated with sex (\( \rho = 0.38, P = 0.01 \)) with males consuming larger amounts of food than females. BMI z-score and sex were also correlated (\( \rho = 0.30, P = 0.05 \)) with males in the study having a higher BMI z-score than females. No significant correlations were found between any of the other possible covariates.

**Carrot Intake by Condition and PROP status**

Linear models with repeated measures and the Greenhouse-Geisser correction were used to test the interaction between meal condition and PROP status on children’s consumption of carrots. Carrot intakes in grams at each condition were used as the dependent variable. Main effects (Condition, PROP status) and two-way interactions (Condition*PROP status) were included in the model. There were no effects of Condition (\( F_{1,42} = 0.23, P = 0.63 \)), PROP status (\( F_{1,42} = 0.03, P = 0.87 \)), or a PROP * Condition interaction (\( F_{1,42} = 1.04, P = 0.31 \)).

The proportion of carrots eaten at each meal was tested in a separate model as a dependent variable. There were no main effects of condition (\( F_{1,40} = 0.66, P = 0.42 \)), or PROP status (\( F_{1,40} = 0.0, P =1.00 \)), but there was a PROP*Condition interaction (\( F_{1,40} = 5.16, P = 0.03 \)) which can be seen in **Figure 6**. PROP tasters responded to the intervention by consuming more in the variety condition, but PROP nontasters did not. Sex, age, BMI z-score, meal order, and pre-meal fullness were added as covariates in the model, but they
were removed because they did not significantly affect the model or the significance of the meal condition by PROP interaction.

**Figure 6.** Carrot intake by condition and PROP taster status. Carrot intake is expressed in grams (left) and as a proportion of total carrot intake during both meals (right). PROP had a significant interaction with meal condition (Variety vs. No Variety) when using the proportion of carrots consumed at each meal ($F_{1,40} = 5.16, P = 0.03$), but not when comparing the gram amount of carrots eaten ($F_{1,42} = 1.04, P = 0.31$).

**Home Spice Checklist.**

Parent reports of what herbs and spices are used regularly in their homes are summarized **Figure 7.** Black pepper and salt were used most frequently, in 100% and 93% of homes respectively. The spices in the garlic blend were used most frequently in the home (pepper: 100%, garlic: 90%, oregano 69%) while the spices in the cardamom blend were used the least (cumin: 64%, allspice: 17%, cardamom: 5%) and the cinnamon blend fell in-between (cinnamon: 84%, ginger: 43%, nutmeg: 29%).
Figure 7. Self-reported herb and spice use on the Home Spice Checklist.
Chapter 4: Discussion

Summary of Results

The primary aim of this paper was to test if herbs and spices could be used to create flavor variety within a meal to increase vegetable intake in 3- to 5- year old children. Additionally, we hypothesized that children might respond differently to the variety intervention based on PROP status, specifically that the intervention would work better for nontasters because they may be less sensitive to any bitter or strong flavors in the seasonings. The results show that there was no difference in vegetable intake between the two meal conditions (Variety vs. No Variety) when comparing all of the children in the study. PROP tasters, however, did consume relatively more carrots in the Variety condition, while PROP nontasters had the opposite response. These results contradict our original hypothesis that PROP nontasters would be more responsive to the intervention strategy because they might be less sensitive to the bitter, strong, or pungent flavors of the spices. Instead, lower sensitivity to the flavor of the spices may have made it harder for nontasters to discriminate the differences between spice blends or between the two meal conditions.

Regardless of meal intake results, the use of herbs and spices appears to be a feasible strategy to increase flavor variety, at least in PROP tasters. Additionally, the seasoned carrots had similar acceptance ratings, even if the salted carrot was the most preferred. This suggests that carrots prepared with herbs and spices are accepted by children about the same as an unseasoned carrot with a greater amount of salt. The data from the Home Spice Checklist confirmed that some of the herbs and spices, particularly in the garlic blend, were more commonly used in the home, but this did not influence children’s liking scores.
Explanation of Findings

The lack of difference in carrot intake between the No Variety and the Variety conditions indicates that increasing flavor variety alone was not enough to increase carrot intake within a meal for all children. In early sensory specific satiety studies in adults, it was found that yogurts that differed only in fruit flavor, but not texture or color, did not reduce sensory specific satiety enough to increase consumption when compared to a single flavor of yogurt\textsuperscript{92}. Another study also found that differences in color or shape, but not flavor, did not increase food intake\textsuperscript{93}. However, in the same paper by Rolls et al. (1982), flavor variety did increase sandwich intake when flavored cream cheese sandwich fillings were designed to be as different as possible, including a salty, a sweet, and a curry flavor\textsuperscript{93}. Combined, these studies suggest that increased food consumption in response to variety is more salient when the differences in the foods are more pronounced, and when differences range across flavor, texture, and color. In the carrots used in the present study, the herb and spice blends may not have produced a varied enough sensory profile to increase intake by condition, at least for all children.

PROP taster status has been associated not only with ability to perceive bitter stimuli, but also with heightened sensitivity to other taste sensations, including sweet tastes\textsuperscript{52,53} and oral irritation\textsuperscript{49}. The fact that children who were PROP tasters increased carrot intake during the Variety condition relative to the No Variety condition may indicate a heightened ability to discriminate the flavor differences in the seasoned carrots. This further supports the work of Prescott et al. (2003) that showed that PROP tasters were better able to discriminate smaller differences in foods that had added concentrations of common tastants, such as citric acid (sour) or caffeine (bitter)\textsuperscript{130}. Another study by Hayes and Pickering (2011) found that PROP tasters were overrepresented in a sample of wine experts compared to average wine drinkers. The authors explain that heightened taste acuity and better ability to detect differences among wines could explain why PROP tasters are more likely to become wine experts than non-tasters\textsuperscript{131}. In the current study, if PROP tasters perceived the herb and spice blends more acutely, the differences could
increase intake by reducing sensory specific satiety. Conversely, if PROP nontasters were less able to perceive flavor differences in the carrots, then sensory specific satiety would occur more quickly and fewer carrots would be consumed.

Children’s acceptance ratings for seasoned carrots are another factor in the success of this type of intervention. Overall, children’s liking scores for all of the carrots, including the salted control, were low. The mean liking score for the seasoned carrots did not differ significantly from the salted control. This lack of difference in liking scores indicates that herbs and spices are a feasible option for adding flavor or creating flavor variety in children’s foods, at least in our sample population. They did not cause children to immediately reject the samples, even though many parents reported not using these spices at home.

Currently, the literature on children’s eating behaviors and vegetable intake only investigates the use of herbs and spices as a component of flavored dips\textsuperscript{12}. This study is the first to show that children can be accepting of seasoned carrots when the herbs and spices are mixed directly into the recipes. However, 41% of children chose the salted carrot as the most preferred. It is important to note that all the seasoned carrot had some salt in the seasoning recipes (18-25 mg of sodium per half cup serving), but the salted control had considerable more salt (125 mg). These results could indicate that herbs and spices improve acceptance of lower sodium vegetable preparations, even when the saltier version is the most preferred. Studies in adults have shown that herbs and spices can promote acceptance of lower sodium meals\textsuperscript{109}, but more data is needed before we can say if this generalizes to children or vegetables outside of an isolated liking task. Also, because we did not include a salted carrot test-meal condition, or a completely plain carrot in the liking task, we cannot make conclusions about the impact that adding herbs and spices had on children’s intake relative to consumption of unseasoned or unsalted carrots.

Children’s liking scores for seasoned broccoli also showed the three herb and spice blends to be equally accepted. Interestingly, children’s liking scores for broccoli were higher than they were for carrots. Many
studies have found that children’s liking for green vegetables is lower than for other groups of vegetables\textsuperscript{132}. Anecdotally, several mothers commented that their children were served raw carrots more often than cooked carrots, so the lower liking for carrots may stem from unfamiliarity with the preparation used in the study. A study by Poelman \textit{et al.} (2011) found that cooking method is a significant influence on children’s vegetable acceptance\textsuperscript{133}. Familiarity with cooking method, not just the target vegetable, should be considered for future studies.

Information on home spice use was collected as an exploratory aim of this study. Given the region-specific nature of food and flavor preferences, it was unclear how common the herbs and spices used in the study were to our sample. The spices in the garlic blend were reported as the most commonly used in the home, while the spices in the cardamom blend were reportedly used the least. A limitation of the home spice checklist is that it did not specify whether the seasonings were actually used in preparation of the child’s food, or if they were only used in adult meals.

\textbf{Strengths.}

Several strengths of the study are worth considering. The use of a between subjects, counter-balanced crossover design to test for differences in vegetable intake reduces variation due to individual differences in children when between groups comparison are made. The primary outcomes were also taken from objective measures, including meal intake data and a forced-choice PROP taste test. This reduced our reliance on children’s ability to communicate self-reported liking or rank orders. Another strength was that this type of flavor intervention did not significantly change the energy density of the carrots. The small amount of canola oil in each recipe contributed only 5 kcal per half cup serving of cooked carrots. Several other vegetable interventions recommend adding butter\textsuperscript{78} or sugar\textsuperscript{10,67,134} to vegetables or serving them with an energy dense dip\textsuperscript{66} to make vegetable more palatable for children.
Herbs and spices are also a rich source of antioxidants\textsuperscript{112} and have been associated with reduced risk of some diseases like cancer, cardiovascular problems, and neurodegenerative disorders\textsuperscript{113}. While the small amount of herbs and spices used in the vegetable recipes is unlikely to confer any long-term health benefits, the recipes can help introduce children to these flavors early in life. Using herbs and spices is a relatively fast and easy way for parents to increase flavor variety within a meal, especially compared to other variety interventions that require preparation of several different types of vegetables\textsuperscript{86,87}. Adding the seasonings directly to the vegetables also eliminates the need to prepare the seasonings into a dip first\textsuperscript{11,12}. Another benefit is that both oil and herbs and spices don’t require refrigeration and can be stored for long periods of time without significant changes in quality. Therefore, the ingredients needed for the recipes in this study are easy and convenient to keep on hand in the kitchen.

A final strength of the study was the collection of home herb and spice use data. The home spice checklist provides a broader source of information to determine if families have access to multiple types of seasonings beyond those used in the study, and to collect information for future recipe development.

**Limitations.**

Results should also be interpreted with some limitations in mind. First, the overall sample size was small ($N = 44$) and when subjects were divided by PROP status, the small number of PROP nontasters ($N = 9$) greatly limited the power of the analysis. The sample population was also well education and predominantly white, so caution should be used before generalizing these results to more diverse populations. Another limitation was children’s low liking scores overall for the cooked carrots. While carrots are commonly consumed and well like in children\textsuperscript{73,122}, familiarity with cooked carrots may have
been lower than other forms, such as raw baby carrots. It is difficult to tell if herb and spice interventions will work with other vegetables, especially those that are unfamiliar or strongly disliked. Using a multi-item test meal also could have limited the effectiveness of the vegetable intervention. Studies in portion size have shown that increasing vegetable intake is harder when more palatable entrée items are available\textsuperscript{104}, whereas interventions are more effective before a meal or at snack time when other options are not there to compete with vegetable intake\textsuperscript{87,103}. Children’s mean liking ratings of macaroni and cheese, applesauce, and milk were all higher than liking ratings for carrots.

Additionally, differences in meal intake were only seen when comparing relative proportions of carrot intake, not when comparing absolute intake of carrots by weight. Using a proportion is beneficial because it weighs smaller changes more significantly if children consume few carrots to begin with while minimizing the effect of larger changes in children who consume a greater number of carrots. However, if the intervention is targeted to help increase overall vegetable consumption in order to meet health guidelines, increasing intake by only a few carrots may not be significant, even if this is double or triple the typically consumed amount.

Availability of herbs and spices in the home is a limitation that may affect some populations more strongly than others. In this study, families had an average of 12-13 herbs/spices in the home that were used on a regular basis. For families of lower socioeconomic status, herbs and spices may be too costly to be an option. A 2014 study found that low-income households in New Jersey readily have herbs and spices available\textsuperscript{107}, however these results have yet to be replicated in other locations and may not be generalizable to all low-income populations.

Finally, the seasoning blends were developed \textit{a priori} from benchtop testing. It is unknown if certain blends altered the perception of other intrinsic taste properties of the carrot, such as sweetness or
bitterness. The cinnamon blend was chosen as the single blend used in the No Variety condition because it was hypothesized to be the most familiar, but there is no evidence that it was the preferred sample. Time limitations did not allow for each blend to be tested in three separate No Variety conditions.

**Conclusions**

Using herbs and spices to create flavor variety in vegetables served within a meal did not increase vegetable intake in preschool aged children. PROP status, however, had a significant role in moderating the amount of carrots children ate in Variety and No Variety conditions, with PROP tasters consuming relatively more carrots in the variety condition and PROP nontasters consuming relatively more in the No Variety condition. This research suggests that herbs and spices can be used to increase flavor variety in carrots and that flavor variety is a potential strategy for stimulating vegetable intake in PROP sensitive children. Because PROP tasters tend to have lower vegetable intake than non-tasters, targeting bitter sensitive children is a high priority. Additionally, children’s acceptance ratings for seasoned carrots did not differ from acceptance ratings for unseasoned carrots, indicating that herbs and spices were not aversive to most children and that encouraging parents to use herbs and spices in their children’s food may be advised, although additional studies are needed to determine this.
Future Directions

Future work is needed to replicate these experiments in larger numbers of children and more diverse samples. New studies should focus on the interaction of PROP status and sensory specific satiety, as this has not been well explored as a potential mediator of satiety and meal cessation. The impact of PROP status and sensory specific satiety should be explored in foods other than vegetables, such as highly palatable, energy dense foods. Additional work should also be done on children’s acceptance of seasoned vegetables, particularly focusing on the combinations and concentrations most acceptable to children of different age ranges. The home spice checklist could provide familiarity data for designing more balanced blends, at least in similar populations near central Pennsylvania. The home spice checklist could serve as a template to collect familiarity data for studies in new regions before pilot testing with actual children occurs.

Because it is already so difficult to encourage vegetable intake in children, creating flavor variety with herbs and spices could be investigated in other model foods, such as dessert or entrée items, that may be more palatable to children. If herbs and spices increase intake in a more palatable system, then future work with vegetable is encouraged. If herbs and spices alone do not increase intake of more palatable foods, than more sensory attributes may need to change to achieve delays in sensory specific satiety. Other attributes, such as type of vegetable, shape of the cut, cooking method, and/or type of seasonings could all be investigated as potential ways to boost the effectiveness of variety based interventions, particularly in PROP non-tasters. Future studies should look to define the amount of variation needed to increase vegetable intake across taster and nontaster groups. If any of these variety methods continue to be successful in repeated studies, strategies should be developed to teach parents and schools about the effects of variety and help them adapt to using herbs and spices in children’s food.
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
   - Widowed
   - 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 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….*

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Most of the Time</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Physically struggle with the child to get him or her to eat (for example, physically putting the child in the chair so he or she will eat).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Promise the child something other than food if he or she eats (for example, “If you eat your beans, we can play ball after dinner”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Encourage the child to eat by arranging the food to make it more interesting (for example, making smiley faces on the pancakes).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Ask the child questions about the food during dinner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Tell the child to eat at least a little bit of food on his or her plate.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Reason with the child to get him or her to eat (for example, “Milk is good for your health because it will make you strong”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Say something to show your disapproval of the child for not eating dinner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Allow the child to choose the foods he or she wants to eat for dinner from foods already prepared.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Compliment the child for eating food (for example, “What a good boy! You’re eating your beans”).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. Suggest to the child that he or she eats dinner, for example by saying, “Your dinner is getting cold”.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. Say to the child “Hurry up and eat your food”.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>12. 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>
<td>5</td>
</tr>
<tr>
<td>13. 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>
<td>5</td>
</tr>
<tr>
<td>14. 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>
<td>5</td>
</tr>
<tr>
<td>15. 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>
<td>5</td>
</tr>
<tr>
<td>16. 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>
<td>5</td>
</tr>
<tr>
<td>17. 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>
<td>5</td>
</tr>
<tr>
<td>18. 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>
<td>5</td>
</tr>
<tr>
<td>19. Beg the child to eat dinner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</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.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>2.</td>
<td></td>
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<td>3</td>
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<tr>
<td>3.</td>
<td></td>
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<td>4</td>
<td>5</td>
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</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></th>
<th>markedly underweight</th>
<th>underweight</th>
<th>average</th>
<th>overweight</th>
<th>markedly overweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>5.</td>
<td></td>
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<td></td>
<td>1</td>
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<tr>
<td>6.</td>
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<td></td>
<td>1</td>
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<tr>
<td>7.</td>
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<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</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>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>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>Your child as a toddler</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>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>Question</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>
<tr>
<td></td>
<td></td>
<td>disagree</td>
<td>slightly disagree</td>
<td>neutral</td>
<td>slightly agree</td>
</tr>
<tr>
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</tr>
<tr>
<td>14. I have to be sure my child does not eat too many <strong>sweets (candy, ice cream, cake or pastries)</strong>.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I have to be sure my child does not eat too many <strong>high fat foods</strong>.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. I have to be sure my child does not eat too many of his/her <strong>favorite foods</strong>.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. I intentionally keep some foods out of my child’s reach.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. I offer <strong>sweets (candy, ice cream, cake or pastries)</strong> to my child as a reward for good behavior.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. I offer my child his/her <strong>favorite foods</strong> in exchange for good behavior.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. If I did not regulate or guide my child’s eating, he/she would eat too many <strong>junk foods</strong>.</td>
<td></td>
<td>1</td>
<td>2</td>
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<td>4</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 <strong>favorite foods</strong>.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22. My child should always eat all of the food on his/her plate.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23. I have to be especially careful to ensure my child eats enough.</td>
<td></td>
<td>1</td>
<td>2</td>
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<td>4</td>
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<tr>
<td>24. If my child says “I’m not hungry” I try to get him/her to eat anyway.</td>
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<td>2</td>
<td>3</td>
<td>4</td>
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<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>
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<td>1</td>
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</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>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 <strong>sweets</strong> <em>(candy, ice cream, cake or pastries)</em> 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 <strong>snack food</strong> <em>(potato chips, Doritos, cheese puffs)</em> that your child eats?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>28. How much do you keep track of the <strong>high fat foods</strong> that your child eats?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>
Children’s Behavior Questionnaire

Short Form Version 1

Subject No. ____________ Date of Child’s Birth: 

Today’s Date ____________ Month __ Day __ Year __

Sex of Child ____________ Age of Child _______ 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.
1. Seems always in a big hurry to get from one place to another.
   1 2 3 4 5 6 7 NA
2. Gets angry when told s/he has to go to bed.
   1 2 3 4 5 6 7 NA
3. Is not very bothered by pain.
   1 2 3 4 5 6 7 NA
4. Likes going down high slides or other adventurous activities.
   1 2 3 4 5 6 7 NA
5. Notices the smoothness or roughness of objects s/he touches.
   1 2 3 4 5 6 7 NA
6. Gets so worked up before an exciting event that s/he has trouble sitting still.
   1 2 3 4 5 6 7 NA
7. Usually rushes into an activity without thinking about it.
   1 2 3 4 5 6 7 NA
8. Cries sadly when a favorite toy gets lost or broken.
   1 2 3 4 5 6 7 NA
9. Becomes quite uncomfortable when cold and/or wet.
   1 2 3 4 5 6 7 NA
10. Likes to play so wild and recklessly that s/he might get hurt.
    1 2 3 4 5 6 7 NA
11. Seems to be at ease with almost any person.
    1 2 3 4 5 6 7 NA
12. Tends to run rather than walk from room to room.
    1 2 3 4 5 6 7 NA
13. Notices it when parents are wearing new clothing.
    1 2 3 4 5 6 7 NA
14. Has temper tantrums when s/he doesn't get what s/he wants.
    1 2 3 4 5 6 7 NA
15. Gets very enthusiastic about the things s/he does.
    1 2 3 4 5 6 7 NA
16. When practicing an activity, has a hard time keeping her/his mind on it.
    1 2 3 4 5 6 7 NA
17. Is afraid of burglars or the "boogie man."
    1 2 3 4 5 6 7 NA
18. When outside, often sits quietly.
    1 2 3 4 5 6 7 NA
19. Enjoys funny stories but usually doesn't laugh at them.
    1 2 3 4 5 6 7 NA
20. Tends to become sad if the family's plans don't work out.
    1 2 3 4 5 6 7 NA
21. Will move from one task to another without completing any of them.
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>NA</th>
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<tbody>
<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>
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<tr>
<td>23.</td>
<td>Is afraid of loud noises.</td>
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<tr>
<td>24.</td>
<td>Seems to listen to even quiet sounds.</td>
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<td>2</td>
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<tr>
<td>25.</td>
<td>Has a hard time settling down after an exciting activity.</td>
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<td>2</td>
<td>3</td>
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<td>6</td>
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<tr>
<td>26.</td>
<td>Enjoys taking warm baths.</td>
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<td>2</td>
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<td>27.</td>
<td>Seems to feel depressed when unable to accomplish some task.</td>
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<tr>
<td>28.</td>
<td>Often rushes into new situations.</td>
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<td>29.</td>
<td>Is quite upset by a little cut or bruise.</td>
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<td>30.</td>
<td>Gets quite frustrated when prevented from doing something s/he wants to do.</td>
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<td>2</td>
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<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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<tr>
<td>32.</td>
<td>Comments when a parent has changed his/her appearance.</td>
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<td>2</td>
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<td>33.</td>
<td>Enjoys activities such as being chased, spun around by the arms, etc.</td>
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<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>35.</td>
<td>Is not afraid of the dark.</td>
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<td>36.</td>
<td>Takes a long time in approaching new situations.</td>
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<td>37.</td>
<td>Is sometimes shy even around people s/he has known a long time.</td>
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<tbody>
<tr>
<td>38.</td>
<td>Can wait before entering into new activities if s/he is asked to.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>39.</td>
<td>Enjoys &quot;snuggling up&quot; next to a parent or babysitter.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>40.</td>
<td>Gets angry when s/he can't find something s/he wants to play with.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>41.</td>
<td>Is afraid of fire.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>42.</td>
<td>Sometimes seems nervous when talking to adults s/he has just met.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>43.</td>
<td>Is slow and unhurried in deciding what to do next.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>44.</td>
<td>Changes from being upset to feeling much better within a few minutes.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>45.</td>
<td>Prepares for trips and outings by planning things s/he will need.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>46.</td>
<td>Becomes very excited while planning for trips.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>47.</td>
<td>Is quickly aware of some new item in the living room.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>48.</td>
<td>Hardly ever laughs out loud during play with other children.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<tr>
<td>49.</td>
<td>Is not very upset at minor cuts or bruises.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>50.</td>
<td>Prefers quiet activities to active games.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>51.</td>
<td>Tends to say the first thing that comes to mind, without stopping to think about it.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>52.</td>
<td>Acts shy around new people.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>53.</td>
<td>Has trouble sitting still when s/he is told to (at movies, church, etc.).</td>
<td>1 2 3 4 5 6 7 NA</td>
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<tr>
<td>54.</td>
<td>Rarely cries when s/he hears a sad story.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<td>55.</td>
<td>Sometimes smiles or giggles playing by her/himself.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<tr>
<td>56.</td>
<td>Rarely becomes upset when watching a sad event in a TV show.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<tr>
<td>57.</td>
<td>Enjoys just being talked to.</td>
<td>1 2 3 4 5 6 7 NA</td>
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<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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<td>I</td>
<td>2 3 4 5 6 7 NA</td>
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<tr>
<td>60.</td>
<td>Is comfortable asking other children to play.</td>
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<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</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>I</td>
<td>2 3 4 5 6 7 NA</td>
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<td>62.</td>
<td>When drawing or coloring in a book, shows strong concentration.</td>
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<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</td>
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<td>63.</td>
<td>Is afraid of the dark.</td>
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<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</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>I</td>
<td>2 3 4 5 6 7 NA</td>
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<tr>
<td>65.</td>
<td>Enjoys looking at picture books.</td>
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<td>I</td>
<td>2 3 4 5 6 7 NA</td>
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<tr>
<td>66.</td>
<td>Is easy to soothe when s/he is upset.</td>
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<td>67.</td>
<td>Is good at following instructions.</td>
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<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</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>I</td>
<td>2 3 4 5 6 7 NA</td>
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<td>69.</td>
<td>Likes to go high and fast when pushed on a swing.</td>
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<td>I</td>
<td>2 3 4 5 6 7 NA</td>
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<td>70.</td>
<td>Sometimes turns away shyly from new acquaintances.</td>
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<td>I</td>
<td>2 3 4 5 6 7 NA</td>
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<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>I</td>
<td>2 3 4 5 6 7 NA</td>
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<td>72.</td>
<td>Likes being sung to.</td>
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<td>I</td>
<td>2 3 4 5 6 7 NA</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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<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</td>
<td></td>
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<tr>
<td>74.</td>
<td>Rarely becomes discouraged when s/he has trouble making something work.</td>
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<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</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>I</td>
<td>2 3 4 5 6 7 NA</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>I</td>
<td>2 3 4 5 6 7 NA</td>
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<tr>
<td>77.</td>
<td>Smiles a lot at people s/he likes.</td>
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</tr>
<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</td>
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<tr>
<td>78.</td>
<td>Dislikes rough and rowdy games.</td>
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</tr>
<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</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>
<tr>
<td>I</td>
<td>2 3 4 5 6 7 NA</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
80. Rarely laughs aloud while watching TV or movie comedies.
   1 2 3 4 5 6 7 NA

81. Can easily stop an activity when s/he is told "no."
   1 2 3 4 5 6 7 NA

82. Is among the last children to try out a new activity.
   1 2 3 4 5 6 7 NA

83. Doesn’t usually notice odors such as perfume, smoke, cooking, etc.
   1 2 3 4 5 6 7 NA

84. Is easily distracted when listening to a story.
   1 2 3 4 5 6 7 NA

85. Is full of energy, even in the evening.
   1 2 3 4 5 6 7 NA

86. Enjoys sitting on parent’s lap.
   1 2 3 4 5 6 7 NA

87. Gets angry when called in from play before s/he is ready to quit.
   1 2 3 4 5 6 7 NA

88. Enjoys riding a tricycle or bicycle fast and recklessly.
   1 2 3 4 5 6 7 NA

89. Sometimes becomes absorbed in a picture book and looks at it for a long time.
   1 2 3 4 5 6 7 NA

90. Remains pretty calm about upcoming desserts like ice cream.
   1 2 3 4 5 6 7 NA

91. Hardly ever complains when ill with a cold.
   1 2 3 4 5 6 7 NA

92. Looks forward to family outings, but does not get too excited about them.
   1 2 3 4 5 6 7 NA

93. Likes to sit quietly and watch people do things.
   1 2 3 4 5 6 7 NA

94. Enjoys gentle rhythmic activities, such as rocking or swaying.
   1 2 3 4 5 6 7 NA

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>
<td></td>
<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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<td></td>
</tr>
<tr>
<td>My child finishes his/her meal quickly</td>
<td></td>
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<tr>
<td>My child is interested in food</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child is always asking for a drink</td>
<td></td>
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</tr>
<tr>
<td>My child refuses new foods at first</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child eats slowly</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>My child eats less when angry</td>
<td></td>
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<tr>
<td>My child enjoys tasting new foods</td>
<td></td>
<td></td>
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<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>
<td></td>
</tr>
<tr>
<td>My child is always asking for food</td>
<td></td>
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<td></td>
<td></td>
</tr>
<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>
<tr>
<td>My child leaves food on his/her plate at the end of a meal</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>My child takes more than 30 minutes to finish a meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
</tr>
<tr>
<td>-----------------------------------------------------------------</td>
<td>-------</td>
<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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<td></td>
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</tr>
<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>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>My child enjoys eating</td>
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<td></td>
</tr>
<tr>
<td>My child eats more when she is happy</td>
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<tr>
<td>My child is difficult to please with meals</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>My child eats less when upset</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>My child gets full up easily</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My child eats more when s/he has nothing else to do</td>
<td></td>
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<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>
<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>
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<tr>
<td>If given the chance, my child would always be having a drink</td>
<td></td>
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<tr>
<td>My child is interested in tasting food s/he hasn’t tasted before</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>
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</tr>
<tr>
<td>If given the chance, my child would always have food in his/her mouth</td>
<td></td>
<td></td>
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<tr>
<td>My child eats more and more slowly during the course of a meal</td>
<td></td>
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</tbody>
</table>
Child Food Neophobia Scale

<table>
<thead>
<tr>
<th>Description</th>
<th>disagree strongly</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>
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<tr>
<td>My child doesn’t trust new foods</td>
<td></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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<tr>
<td>My child thinks ethnic food looks too weird to eat</td>
<td></td>
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<tr>
<td>At dinner parties, my child will try a new food</td>
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<tr>
<td>My child is afraid to eat things she or he has never had before</td>
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<tr>
<td>My child is very particular about the foods he or she will eat</td>
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<td></td>
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<tr>
<td>My child will eat almost anything</td>
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<td></td>
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<tr>
<td>My child likes to try new ethnic restaurants</td>
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</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:
   - [ ] More than 2 times a day
   - [ ] 2 times a day
   - [ ] Once a day
   - [ ] 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.
   - [ ] More than 2 times a day
   - [ ] 2 times a day
   - [ ] Once a day
   - [ ] A few times a week
   - [ ] Not at all

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

7. I have difficulty buying food to feed my child because food is expensive:
   - [ ] Most of the time
   - [ ] Sometimes
   - [ ] Rarely
   - [ ] Never

8. My child has problems chewing, swallowing, gagging or choking when eating:
   - [ ] Most of the time
   - [ ] Sometimes
   - [ ] Rarely
   - [ ] Never

9. My child is not hungry at mealtimes because he/she drinks all day:
   - [ ] Most of the time
   - [ ] Sometimes
   - [ ] Rarely
   - [ ] 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>
</tr>
<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>
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<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="Potatoes" /> (not French fries)</td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image" alt="Sweet potatoes" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image" alt="French fries" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image" alt="Lunch meat" /> (e.g., turkey, roast beef)</td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image" alt="Reading books" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image" alt="Cheese" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image" alt="Pancakes or waffles" /></td>
<td>__________________________</td>
</tr>
<tr>
<td>ID: _______</td>
<td>Date: ________</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
</tr>
<tr>
<td><img src="image1.png" alt="Non-chocolate candy" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image2.png" alt="Chocolate candy" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image3.png" alt="Brussels sprouts" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image4.png" alt="Corn" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image5.png" alt="Taking a Bath" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image6.png" alt="White bread" /></td>
<td>__________________________</td>
</tr>
<tr>
<td><img src="image7.png" alt="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>Unsweetened cereal (e.g., Cheerios, corn flakes)</td>
<td>___________________</td>
</tr>
<tr>
<td>Sweetened cereal (e.g., Froot Loops, Lucky Charms)</td>
<td>___________________</td>
</tr>
<tr>
<td>Fried snacks (e.g., chips, Cheetos)</td>
<td>___________________</td>
</tr>
<tr>
<td>Soup</td>
<td>___________________</td>
</tr>
<tr>
<td>Pizza</td>
<td>___________________</td>
</tr>
<tr>
<td>Beans, lentils, or chickpeas</td>
<td>___________________</td>
</tr>
<tr>
<td>Watching TV</td>
<td>___________________</td>
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<tr>
<td>ID: _______</td>
<td>Date: _______</td>
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<td>-------------</td>
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<tr>
<td>Grilled cheese</td>
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<tr>
<td>Asparagus</td>
<td></td>
</tr>
<tr>
<td>Apples</td>
<td></td>
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<tr>
<td>Burgers</td>
<td></td>
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<tr>
<td>Getting dressed</td>
<td></td>
</tr>
<tr>
<td>Cake or cupcakes</td>
<td></td>
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<tr>
<td>ID: ______</td>
<td>Date: ______</td>
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</tr>
<tr>
<td><strong>Peanut butter and jelly sandwiches</strong></td>
<td>___________________</td>
</tr>
<tr>
<td><strong>Macaroni and cheese</strong></td>
<td>___________________</td>
</tr>
<tr>
<td><strong>Cookies</strong></td>
<td>___________________</td>
</tr>
<tr>
<td><strong>Baked snacks</strong> <em>(e.g., pretzels, Goldfish)</em></td>
<td>___________________</td>
</tr>
<tr>
<td><strong>Ice cream</strong></td>
<td>___________________</td>
</tr>
<tr>
<td><strong>Riding a bike</strong></td>
<td>___________________</td>
</tr>
<tr>
<td>ID: ______</td>
<td>Date: ______</td>
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<tr>
<td><img src="image" alt="Garlic bread" /></td>
<td><img src="image" alt="Garlic bread" /></td>
</tr>
<tr>
<td><img src="image" alt="Yogurt" /></td>
<td><img src="image" alt="Yogurt" /></td>
</tr>
<tr>
<td><img src="image" alt="Soda" /></td>
<td><img src="image" alt="Soda" /></td>
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</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:

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

_______
References

2. Liu RH. Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals. Am J Clin Nutr 2003;78:517S-20S.
42. Keller KL, Steinmann L, Nurse RJ, Tepper BJ. Genetic taste sensitivity to 6-n-propylthiouracil influences food preference and reported intake in preschool children. Appetite 2002;38:3-12.


132. Hiza H, Guenther PM, Rihane C. Diet Quality of Children Age 2-17 Years as Measured by the Healthy Eating Index-2010. In: Promotion UCINPa, ed.: USDA; 2013.