THESIS

SENSORY PROCESSING CHARACTERISTICS AND EATING BEHAVIORS IN PRESCHOOL CHILDREN – AN OCCUPATIONAL THERAPY PERSPECTIVE

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ABSTRACT

SENSORY PROCESSING CHARACTERISTICS AND EATING BEHAVIORS IN PRESCHOOL CHILDREN – AN OCCUPATIONAL THERAPY PERSPECTIVE

Childhood obesity is a serious problem in the United States, and early childhood may be a critical time to implement obesity prevention efforts. Understanding a child's eating habits, such as picky-eating and food neophobia, is critical in intervention planning and helping a child develop healthful eating behaviors that lead to nutritionally adequate diets. Yet, to date, there is little research about a child's sensory processing characteristics and how it relates to their eating behaviors. There is currently a research study occurring in Colorado entitled, "A Longitudinal Study to Assess if the Effectiveness of a Preschool Nutrition and Physical Activity Program is sustained in Elementary School" and children's eating behaviors is just one area of data being collected through the means of a Tasting Panel and their parent's report. Through a partnership with this study, the purpose of this research was to understand the relationship on sensory processing characteristics and eating behaviors in preschool children, using caregiver surveys and data from an in-person Tasting Panel completed with preschoolers. This research study also examined the accuracy of a parent's report of their child's behavior in relation to their actual behavior, in addition to examining the reliability in certain sections of the *Sensory Profile Caregiver Questionnaire.* Finally, this study examined children's oral sensory processing in relationship to other areas of sensory behaviors.

Overall, there was a significant relationship between the number of children's food refusals, as measured by the in-person Tasting Panel and two specific sensory processing characteristics ("gags easily" and "craves certain foods"). There was a significant relationship

between children's food refusals and their parent's report of food neophobic or picky eating behaviors, demonstrating consistency in parent's report and confirming parental awareness of their child's eating difficulties. Test-retest reliability analyses of the total score for the oral sensory processing questions included in the *Sensory Profile Caregiver Questionnaire* were not significant, which may have been due to the different contexts that the questions were administered; for time one the questions were included in the Child Feeding Survey and for time two the questions were included in the full Sensory Profile Caregiver Questionnaire. In addition, there was a significant relationship between oral sensory processing and two other domains of sensory processing, the tactile domain and the multisensory domain. This is an important finding for healthcare professionals working with children with oral sensory processing difficulties, as other sensory evaluations may be needed to better treat the child. If parents and healthcare professionals can understand a child's sensory processing behaviors in greater detail, a child may be better served, which ultimately results in life long healthy eating behaviors.

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TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

The overall goal of this project was to further understand the relationship of sensory processing characteristics and eating behaviors in preschool children. This research project was done as part of the "A Longitudinal Study to Assess if the Effectiveness of a Preschool Nutrition and Physical Activity Program is sustained in Elementary School," study, which is a collaborative study between researchers at Colorado State University (CSU) and University of Colorado at Denver (UCD). Researchers at CSU and UCD were awarded a four-year grant from the United States Department of Agriculture (USDA) to examine the development of eating behaviors and physical activity patterns in children from preschool through first grade. Implemented in 2010 with an abbreviated title, the Colorado **L**ongitudinal **E**ating **A**nd **P**hysical activity (LEAP) study assesses the effectiveness of a preschool nutrition and physical activity program (*The Food Friends*®: *Fun with New Foods & Get Movin' With Mighty Moves*™). The researchers are interested in determining if healthy behaviors learned through preschool programming continue through young childhood. Research suggests that because children who try new foods tend to have better quality diets (Pelchat & Pliner, 1986; Galloway, Lee, & Birch, 2003) and children who have developed good motor skills participate in more physical activity (Williams, et. al., 2008; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006), understanding a child's eating behaviors and motor skills are two important avenues in preventing childhood obesity. The LEAP study has important data available in regards to the goal of this study, including data from a Tasting Panel, where children sampled new and/or familiar foods, and caregiver data, where caregiver's reported on their child's picky eating, food neophobia and oral sensory processing behaviors. These LEAP data were used for this research project, and

additional funding was graciously supplied through the Helen F. McHugh Graduate Fellowship, which supports graduate student research at Colorado State University. Therefore, new data were collected to support the goal of this research, and *The Sensory Profile Caregiver Questionnaire* (Dunn, 1999) was sent out to the parents within two cohorts of participants. The availability of critical data from LEAP, in conjunction with new data collected from parents, supported this study in further understanding the relationship of children's sensory processing and their eating behaviors.

Childhood Obesity

The prevalence of obesity among children in the United States is increasing at an alarming rate, and childhood obesity has more than tripled in the past 30 years. Specifically, one third of U.S. preschool-aged children are considered to be at risk for obesity (National Center for Health Statistics, 2011). Childhood obesity has negative short-term effects on health and well-being, such as the likelihood to develop type II diabetes, hypertension, high blood pressure, and the greater risk for bone and joint problems and sleep apnea (CDC, 2013). Besides suffering from physical illnesses, children may experience social stigmatization and discrimination, as well as psychological issues (Li, Ford, Zhao & Mokdad, 2009). Furthermore, obese children often become obese adults (Freedman et al., 2005), and some studies have found that infants with rapid weight gain are at an increased risk to be overweight in their young childhood (Stettler, Zemel, Kumanyika & Stallings, 2002). Thus, childhood obesity leads to long-term effects on health and well-being such as heart disease, stroke, some cancers and osteoarthritis (National Center for Health Statistics, 2011).

It has been suggested that early childhood is a critical time to implement obesity prevention efforts because it represents a time when a child is developing lifelong eating habits, such as eating behaviors and food preferences (Lytle, Seifert, Greenstein, & McGovern, 2000; Wardle, 1995; Crockett & Sims, 1995; Davis & Christoffel, 1994). There are a myriad of influences on children's eating behaviors and food preferences, such as their environments, their parents, and their willingness to try new foods. For example, schools have complex influences on a child's dietary practices (Wechsler, Devereaux, Davis, & Collins, 2000), and research shows that schools that offered fresh fruits and vegetables and nutrition education had children who ate more of these (Parmer, Salisbury-Glennon, Shannon, & Struempler 2009; Witt & Dunn, 2012). In addition, studies show that repeated exposure to novel foods in positive environments along with modeling increases a child's food acceptance (Fisher et al., 2005; Williams et al., 2008). Parents also play a critical role in shaping a child's eating habits and their environment, such as the parent's attitudes regarding what type of foods the child is given, when it's given, how much is given and the social context of meals and snacks (Birch & Fisher, 1995). Parents have many opportunities to affect a child's consumption of healthier foods, such as fruits and vegetables (Nicklas et al., 2001), and research also indicates that early eating habits may be predictive of eating habits in adulthood (Kelder, Perry, Klepp, & Lytle, 1994). Thus, a child's emerging food preferences can develop from their parent's feeding attitudes and practices (Birch, 1980; Birch, Marlin & Rotte, 1984; Birch, Mcphee, Shoba, Pirok & Steinberg, 1987).

Finally, a child's eating behavior and food preferences can influence their actual food choice and eating habits. For example, children who are more willing to try new foods have higher quality diets when compared to those children who reject new food (Galloway, Lee, & Birch, 2003). A child's recommended diet for healthy development requires necessary portions

of fruits, vegetables, dairy, grains, proteins, and limited added sugars, saturated fat, trans fatty acids, and cholesterol (USDA & HHS, 2010). Children may also have certain particular traits, such as sensitivity to taste and smell, which can impact their fruit and vegetable consumption (Coulthard & Blissett, 2009).

Developing and implementing healthy eating interventions in preschools is one way to influence a child's eating behaviors and food preferences. Childcare can be a positive environment and provide repeated exposure to new foods, helping children to develop good eating habits (Story, Kaphingst, & French, 2006). Some health education interventions that have been developed are measuring the outcomes related to the intervention programs, such as *Food Friends®,* a nutrition education program in preschools in Colorado that promotes healthful food choices (Young, Anderson, Beckstrom, Bellows, & Johnson, 2003). However, many of these outcomes are being measured by tools that use parent report, and it is not well understood how accurate parents' report of their child's eating behavior compares with their child's actual eating behavior. Thus, there is a possibility that parent's have a misunderstanding of their child's healthy eating habits, which can impact the child outside of school too.

Effective interventions need to target and measure child behaviors that are thought to lead to eating habits. One such behavior is a child not eating healthy foods due to dislike or sensitivity. However, there are also psychological barriers to a child's food preferences, such as food neophobia and picky eating, two eating behaviors that may lead to a child's inadequate diet.

Psychological Barriers Related to Food Preferences

There are certain psychological barriers that can impact a child's food preferences and influence their diet. Research suggests that nausea and/or vomiting are significant experiences

that cause humans to develop food and/or taste aversions (Pelchat & Rozin, 1982) and impact their overall food preferences. Other research states that humans might also experience Pavlovian conditioning when it comes to food behaviors, which means they might change their response to a certain food based on a contingent occurrence from another food and/or experience (Rozin & Zellner, 1985). However, there are other psychological barriers that impact a child's food preferences and healthy diets, such as food neophobia and picky-eating.

Food Neophobia

Food neophobia has been identified as an inherent adaptive personality trait and is defined as the rejection of foods that are new or completely unknown to the child (Dovey, Staples, Gibson, & Halford, 2008). Although there is a theory that all young children move through a developmental stage of food neophobia (Birch, 1998), food neophobia may become an issue if it extends to later childhood. For example, food neophobia in children has been found to be associated with decreased consumption of fruits and vegetables (Cooke, Carnell, & Wardle, 2006; Galloway et al., 2003), and on the onset of food neophobia, children were found to reject new fruits, vegetables and proteins more often than other food groups (Cooke et al., 2006; Jacobi, Agras, Bryson, & Hammer, 2003). Thus, food neophobia is associated with the likelihood of a child not eating foods that are healthy, rather than foods not associated with neophobia, such as sweets and fats and resulting in an inadequate diet (Birch, 1999).

Additionally, research shows that humans have food related emotions, such as disgust, which leads to food rejection of something that might be offensive or contaminating. This type of food rejection may be due to the belief that the food has negative sensory properties (such as

bad taste or odor), the anticipation of harm after ingesting it, or that the origin of the food is inappropriate (such as a rock, or a cockroach) (Rozin & Fallon, 1987).

Picky Eating

Research conducted by Pliner and Hobden (1992) state that "picky eating" is behaviorally different from food neophobia and that picky eating is usually defined as the child's rejection of familiar food or an unwillingness to eat a familiar food, thus resulting in an inadequate diet (Galloway et al., 2003). Milton (1993) found that picky eating resulted in a narrow diet of a low variety of food. However, research suggests that there might be a relationship between food neophobia and picky eating, in which the level of experimental factors, such as the child's level of innate neophobia and their parents' reactions to neophobia, may result in the child's development of picky eating (Galloway, Lee & Birch, 2003). More so, Galloway and team's research (2003) suggest that a child's intake of vegetables is limited by both neophobic behaviors and by also an unwillingness to eat familiar foods, which some nutrition specialists refer to as picky eating. Research regarding both food neophobia and picky eating indicate that early repeated exposure to foods and early food experiences influences children's eating behaviors (Galloway, Lee & Birch, 2003).

There are several child factors that contribute to individual differences, which lead to food neophobic and/or picky eating behaviors, such as sensory processing difficulties, temperament and parent feeding practices (Zuckerman, 1979; Galloway, Lee & Birch, 2003; Pliner & Melo, 1997; Pliner & Loewen, 1997; Carruth, Ziegler, Gordon, & Barr, 2004, Birch & Fisher, 1998). Certain individual traits, such as sensation seeking, which is a specific type of sensory processing difficulty, impact a child's acceptance of new foods (Zuckerman, 1979).

Those children who are more sensation seeking are likely to have lower levels of food neophobia (Galloway et al., 2003; Pliner & Melo, 1997). Another reason why children may have food neophobia is due to inherent individual differences, which can be attributed to a child's temperament (Pliner & Hobden, 1992; Pliner & Loewen, 1997) and environmental influences, such as exposure to new foods (Carruth, Ziegler, Gordon, & Barr, 2004), and parental child feeding practices (Birch & Fisher, 1998).

There may be a relationship between food neophobia and/or picky eaters and touch and smell sensitivities. Research suggests that children who may have behaviors of food neophobia and/or picky eating may also be tactilely defensive. Tactile defensiveness means that the child is overly sensitive to touch which may lead to the rejection of foods that have distinct or unusual textures (Smith, Roux, Naidoo, & Venter, 2005). Smith and colleagues (2005) report that the eating habits of tactilely defensive children and non-tactilely defensive children differed significantly, where tactilely defensive children were hesitant to eat unfamiliar foods and refused certain foods due to the smell or temperature. These children had a limited selection of foods within their diet and had an overall aversion to food's textures, temperatures, and smells, and a higher incidence of oral hypersensitivity. The conclusions from the study suggest that children who have food neophobia and/or picky eating behaviors may need a more thorough evaluation to determine other sensory processing issues, and to also consider interventions that treat the child's tactile defensiveness. This study suggests that there may be a relationship between a child's eating behavior and his/her sensory processing characteristics.

Sensory Processing and the *Sensory Profile*

As a natural part of typical development and a regulated sensory system, children process, interpret, and respond to sensory information, specifically sight, sound, smell, taste, touch, and perception of movement and position. However, some children do not develop a well-regulated sensory system and display problems with processing and integrating sensory information. It is hypothesized that a child who may have difficulties with sensory processing has a brain that is limited in its ability to process and integrate the sensory information, thus demonstrating alternative behaviors (Bundy, Lane, Murray, & Fisher, 2002). Sensory processing involves the registration, modulation, and organization of sensory input, so that humans can perform successful responses to situational demands, which allows them to engage in meaningful daily occupations (Humphry, 2002). For example, when a child with a sensory processing limitation engages in play or activities of daily living (ADLs), they may have increased difficulty in doing so, may have lack of control of certain behaviors or physical movements, or might overall be dissatisfied with their performance (Mulligan, 1996). Sensory processing has become an emerging field within occupational therapy, and with the development of new measurement tools, data have guided the understanding of a child's sensory processing. Some measurement tools and their respective models organize sensory information differently, and for the purpose of this study, sensory information will be categorized by using Winnie Dunn's standardized assessment, the *Sensory Profile* (Dunn, 1999).

Dunn organizes sensory processing characteristics into six categories that reflect particular types of sensory processing as part of daily life: auditory, visual, oral, vestibular, touch and multisensory (Dunn, 1999). Dunn's *Sensory Profile Caregiver Questionnaire* provides professionals a way to measure a child's sensory processing abilities (Dunn, 1999) and identifies

a child's sensory processing abilities and what impact it has on functional performance in the child's daily life. The *Sensory Profile Caregiver Questionnaire* was developed to contribute to diagnosis of sensory processing difficulties and guide intervention planning, and is most frequently used within the field of occupational therapy as occupational therapists have expertise in sensory processing (Dunn, 1999). The caregiver of the child, who most often is a parent, fills out a 125-item questionnaire by reporting frequency of which certain behaviors occur in response to sensory events in everyday activities. The healthcare professional scores the responses and reports certain patterns of performance that indicate difficulties with sensory processing and performance.

Specifically, there is a section that refers to a typical child's oral sensory processing and how the child responds to touch and taste stimuli to the mouth, and how they respond to smells. There are 12 questions within the *Sensory Profile Caregiver Questionnaire* that assess a child's oral sensory processing in regards to food textures, avoidance of foods, behaviors, food smells, and oral touch. It's interesting to note that both food neophobia and picky eating behaviors in children are sometimes associated with children's sensory processing characteristics, and the literature suggests that some children in a general population experience oral defensiveness, which is an avoidance of certain textures of food as well as being irritable with touch and activities associated with the mouth (Wilbarger, 2000). For example, children avoid textures and activities differently, as some will avoid food with rough textures, and others will avoid soft textures (Wilbarger, 2000). However, what is not understood is how a child's oral sensory processing relates to other sensory processing characteristics within a general population.

For this research project, whether or not oral sensitivity is unique or separate from other sensory processing behaviors within typical child population will be investigated. The stability

of Dunn's *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) and how reliable of an assessment it is in obtaining the same results, known as test-retest reliability (Portney & Watkins, 2009), will be critical in ensuring that accurate scores are being obtained during different times. More so, the oral sensory section within the *Sensory Profile Caregiver Questionnaire* may or may not be a reliable measure when it is used in isolation of other portions of the *Sensory Profile Caregiver Questionnaire*. Another option for health professionals desiring to use a shorter caregiver questionnaire is to utilize the *Short Sensory Profile*, which entails only 38 items and specifically four questions for oral sensitivity (Dunn, 1999). Since the *Short Sensory Profile* is an abridged version of the *Sensory Profile Caregiver Questionnaire,* it's important to ensure that it still yields reliable outcomes.

CHAPTER TWO: SENSORY PROCESSING AND EATING BEHAVIORS

Childhood obesity is a serious epidemic in the United States, and it has been suggested that early childhood is a critical time to implement obesity prevention efforts because it represents a time when a child is developing lifelong eating habits, such as eating behaviors and food preferences (Lytle, Seifert, Greenstein, & McGovern, 2000; Wardle, 1995; Crockett & Sims, 1995; Davis & Christoffel, 1994). Many different environments influence eating behaviors and food preferences, such as the physical environment (i.e., schools) and the social environment (i.e., parents and caregivers) (Wechsler, Devereaux, Davis, & Collins, 2000; Birch & Fisher, 1995). Childcare programming that focuses on healthy eating is one way to influence a child's eating behaviors and food preferences as childcare can be a positive environment to help children develop good eating habits (Story, Kaphingst, & French, 2006). Another way to influence a child's eating behaviors and food preferences is to understand parental behaviors and practices in the home, which could lead to services oriented toward modifying parental practices. Research suggests that children's emerging food preferences can develop from their parent's feeding attitudes and practices (Birch, 1980; Birch, Marlin & Rotte, 1984; Birch, Mcphee, Shoba, Pirok & Steinberg, 1987). More so, parents might not be aware of their child's actual developing eating behaviors and might have misconceptions about their child's diet. Since it is popular practice to gain information about children's habits and behaviors through parents' report and questionnaires, it is also critical that these measures be representative of their child's actual behaviors. However, there is a gap in the literature, and it is not well understood how accurate parent's report of their child's eating behavior is with their child's actual eating

behavior. Thus, there may be a possibility that parents have a misunderstanding or little accuracy in reporting their child's eating habits.

Finally, there are also certain individual characteristics of children that can influence their eating behaviors and food preferences. Some children may be picky eaters. Picky eating is defined as the rejection of familiar food or an unwillingness to eat a familiar food, thus resulting in an inadequate diet (Galloway et al., 2003). Other children may have food neophobia, which is the rejection of foods that are new or completely unknown to the child (Dovey, Staples, Gibson, & Halford, 2008). Both picky eating and food neophobia behaviors influence a child's food preferences and overall consumption of a healthy diet (Pliner & Hobden, 1992; Galloway, Lee & Birch, 2003). Furthermore, research suggests that picky eating and food neophobia behaviors in children are sometimes associated with children's sensory processing, such as sight, sound, smell, taste and touch. For example, in one experimental study with young children, it was discovered that children who have behaviors of food neophobia and/or picky eating may also be tactilely defensive, which means they were overly sensitive to touch. Hence the researchers implied that tactile defensiveness may lead to the rejection of foods that have distinct or unusual textures (Smith, Roux, Naidoo, & Venter, 2005), thus influencing a child's diet. Additionally, some children may have certain taste/smell sensitivities that influence their food choices. In another research study, children who were sensitive to taste and smell ate less fruits and vegetables, especially in comparison to their mother's fruit and vegetable consumption. The implications of this study highlighted that some children are less likely to model their parental feeding practices due to individual traits related to sensory processing, and specifically taste/smell (Coulthard & Blissett, 2009).

Although there is some research that examines the relationship between picky eating/food neophobia and sensory processing, there are no known studies that have directly observed child's eating behaviors and related them to their sensory processing characteristics. In addition, it is not well understood how a child's oral sensory processing relates to other sensory processing characteristics. Understanding a child's oral sensory processing may be critical to influencing their eating behavior and food preferences, in addition to understanding any other sensory processing issues. Within the field of occupational therapy sensory processing is often addressed and occupational therapists administer standardized assessments to measure a child's sensory processing. One assessment, the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) includes a section that measures a child's oral sensory processing. However, there is little research about how reliable this assessment is for measuring performance differences within oral sensory processing, and how this relates to other areas of sensory behaviors.

Purpose

The purpose of this study to is to further understand the relationship of oral sensory processing characteristics and eating behaviors in preschool children, using caregiver surveys and data from an in-person Tasting Panel completed on preschool children. Secondly, the accuracy of a parent's report of their child's behavior in relation to their child's actual behavior will also be addressed. Finally, the standardized assessment, the Sensory Profile Caregiver Questionnaire (Dunn, 1999), will be examined for its reliability in oral sensory processing, and whether or not oral sensory processing is separate from other areas of sensory processing. If parents and healthcare professionals can understand a child's eating behaviors in greater detail, and its relationship to sensory processing behaviors, parents and healthcare professionals will be

more prepared in creating interventions that support a child's healthy diet. Ultimately results from studies such as this may lead to adequate treatment and better solutions to address the child's formative eating behaviors, which are inextricably linked to their overall healthy weight.

Research Questions

This study will focus on exploring four research questions and respective hypothesis:

Question #1: Does a child's eating behavior relate to his/her oral sensory processing characteristics?

Hypothesis:

1. Children's food refusals from the Tasting Panel will have a relationship with their oral sensory processing behaviors, as measured by the 8 oral sensory processing questions on the LEAP Child Feeding Survey.
2. There will be a relationship between children's affective scores from the Tasting Panel and their oral sensory processing, as measured by the 8 oral sensory processing questions on the LEAP Child Feeding Survey.
3. Children's behaviors (touch, smell, lick, spit, swallow) as observed during the Tasting Panel session will be different depending on their overall scores on the oral sensory processing scale, as measured by the 8 oral sensory processing questions on the LEAP Child Feeding Survey.

Question #2: Does a child's behavioral response when trying new foods align with his/her parent's perceptions of their child's willingness to try new food?

Hypothesis:

1. Children's affective rating of food on the Tasting Panel will be associated with their parent's report of their child's behaviors, as measured by the 10 food neophobia questions (section 7) on the LEAP Child Feeding Survey.
2. Children's affective rating of food on the Tasting Panel will be associated with their parent's report of their child's behaviors, as measured by the 5 picky eating questions (section 6) from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory on the LEAP Child Feeding Survey.
3. Children's number of refusals on the Tasting Panel will be associated with their parent's report of their child's behaviors, as measured by the 10 food neophobia questions (section 7) on the LEAP Child Feeding Survey.
4. Children's number of refusals on the Tasting Panel will be associated with their parent's report of their child's behaviors, as measured by the 5 picky eating questions (section 6) from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory on the LEAP Child Feeding Survey.

Question #3: Is the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) a reliable assessment for measuring performance differences in a child's oral sensory processing?

Hypothesis:

1. The reliability between the 8 oral sensory processing questions included within the LEAP Child Feeding Survey and the 8 questions within Section F (Oral Sensory Processing) in the *Sensory Profile Caregiver Questionnaire* collected from parents about one month apart will be moderate.

2. The four Taste/Smell Sensitivity items on *Short Sensory Profile* (Dunn, 1999) will be a reliable measure of the 8 oral sensory processing questions included within the LEAP Child Feeding Survey.

Question #4: Does a child's oral sensory processing relate to other areas of sensory behaviors?

Hypothesis:

1. The 8 questions within Section F (Oral Sensory Processing) in the *Sensory Profile Caregiver Questionnaire* will correlate with other areas of sensory processing measured in the Sensory Profile (i.e., auditory, visual, vestibular, touch, and multisensory).
2. Performance differences in the 8 questions within Section 4 (Oral Sensory Processing) in the *Sensory Profile Caregiver Questionnaire* will correlate with performance differences in the Section Summary for Behavior and Emotional Responses in the *Sensory Profile Caregiver Questionnaire.*

Methods

Participants

For research questions #1 and #2, there were a total of 214 preschool children, whom were between the ages of four and six years and their parent(s)/caregiver(s), in the state of Colorado, and previously recruited to participate in larger research project referred to as LEAP. LEAP's nutrition and physical activity research program spans over the course of three years. Participant inclusion criteria included all children and their caregivers within Cohort 1-Time 1 and Cohort 2-Time 1 of LEAP's pre-designed research study, which is only a subset of the

LEAP dataset. A total of 214 preschoolers completed the Tasting Panel. Of the 214 preschoolers included in this subset, only 160 of their parents returned the LEAP Child Feeding Survey (LEAP CFS), a 74.8% response rate. Data used for this study included measures from the LEAP CFS and an in-person Tasting Panel, and further information about these instruments is detailed in the Methods section.

For research questions #3 and #4, a total of 62 *Sensory Profile Caregiver Questionnaires* (Dunn, 1999) were sent out to parents of children in Cohort 1-Time 3 in spring 2012 and 25 completed questionnaires were returned by the parents, a 40.3% response rate. These data were utilized to exploring the aforementioned *Sensory Profile Caregiver Questionnaire* and *Short Sensory Profile* hypothesis questions (research questions #3 and #4), and more information about these instruments is also provided in the Methods section. The sensory profile data were combined with the parent LEAP Child Feeding Survey data only from Cohort 1-Time 3 to answer research question #3 regarding test-retest reliability to assure that no more than one month occurred between the two data collection time points. Overall, sample size varied per hypothesis question based on available data. Within the sample size of 214 children: 43.9% are male and 56.1% are female; 41.3% are Hispanic and 58.7% are non-Hispanic; the mean BMI is 16.4 with a standard deviation of 2.4; 66.6% have a normal weight, 15.9% are overweight, and 13.6% are obese. For all four research questions, the children were recruited from seven preschools and their associated elementary schools in rural communities in Colorado. Exclusion criteria for Research Questions #3 and #4 consisted of children and their caregivers whom moved out of the area, changed schools, or were no longer willing to participate.

Colorado State University's Research Integrity & Compliance Review Office (RICRO) and the Institutional Review Board (IRB) approved this study, which was part of the larger

research project, "Colorado **L**ongitudinal **E**ating **A**nd **P**hysical activity (LEAP)." Each primary caregiver provided informed consent.

Materials

Two questionnaires were used in this study to capture caregiver reported data: The LEAP Child Feeding Survey (LEAP CFS) and the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999). Within the *Sensory Profile Caregiver Questionnaire,* four items within the oral sensory processing section were used to represent the Taste/Smell section of the *Short Sensory Profile* (Dunn, 1999). Children's observed behaviors and their reported likability to new and familiar foods were captured through an in-person Tasting Panel.

The LEAP Child Feeding Survey (LEAP CFS)

The LEAP CFS is comprised of four valid and reliable measures: (1) the Child Feeding Questionnaire, which is a self-reported measure that assesses parental beliefs, attitudes, and practices regarding child feeding, with a focus on obesity proneness in children (Birch, et. al., 2001) (2) the 10 items from the Food Neophobia Scale that assesses parental report of their child's reluctance to eat and/or avoidance of novel foods (Pliner & Hobden, 1992) (3) the five items from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory, which measures parental beliefs of their child's picky eating habits and behaviors (Rowe & Plomin, 1977) and (4) the 12 items that comprise the oral processing section of the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999).

Specifically, the LEAP CFS was designed for use with parents of children ranging in age from two to 11 years of age, and for the purpose of this study, three sections of the LEAP CFS

were used: the Food Neophobia Scale (Pliner & Hobden, 1992); the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory (Rowe & Plomin, 1977), and the oral sensory processing section from the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999). For all three sections, caregivers indicated their level of agreement with the items using a five or seven point Likert type scale (see Appendix A). Below are details regarding scoring for each of the measures:

1. The score for the 10 items on the Food Neophobia Scale (Pliner & Hobden, 1992) was determined by totaling the responses and using a mean score. The following individual items were reversed in order to calculate the total score: "My child doesn't trust new foods; if my child doesn't know what is in a food, my child won't even try it; my child thinks ethnic food looks too weird to eat; my child is afraid to eat things he/she has never eaten before; my child is very particular about the food he/she will eat." The range of scores possible was from 10 to 70, and a higher score indicated increased levels of food neophobia.
2. The score for the five items from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory (Rowe & Plomin, 1977) was totaled and a total score was used. The range of scores possible was from five to 25, and a higher score indicated increased levels of picky eating behaviors.
3. The 12 oral sensory processing questions from the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) were examined to determine if all 12 items were a unitary construct. Results from both a Cronbach's alpha analysis and a cluster analysis indicated that that 8 of the 12 items represented a single construct. Both analyses indicated that the other 4 items were not included in this construct. Thus, only the 8 items representing the

single construct will be used for this study, and the items "routinely smells nonfood objects, shows strong preference for certain smells, chews/licks nonfood objects and mouths objects (for example, pencil, hand)" in the oral sensory processing section of the LEAP CFS (section 8) were not included in the analyses of this study. In addition, a multiple imputation procedure was used to complete missing data for participants that had no more than two missing values. The multiple imputation analysis was conducted using IBM SPSS Statistics software (version 21). Specifically, a custom fully conditional specification method with 5 imputations with a linear regression model for scale variables was implemented. Children missing more than two values were removed from the data analysis (n=28). Overall the score from the oral sensory processing section in the LEAP CFS was determined by a total score of the eight remaining items. The range of scores possible was from 5 to 40, and a lower score indicated likelihood of oral sensory processing issues.

The Sensory Profile Caregiver Questionnaire

The *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) is a 125 caregiver questionnaire designed to measure behaviors associated with responses to sensory stimuli in children three to 10 years of age. It is administered as a questionnaire in which the caregiver rates the child's typical responses to everyday events that involve sensory, modulation, behavior and emotional components on a five point Likert scale. This scale ranges from "never" responds in this manner to "always" respond in this manner (see Appendix B). Item scores cluster into patterns of sensory processing, such as oral sensory sensitivity, enabling the child's behavioral responses to be interpreted in each of these areas. The *Sensory Profile Caregiver Questionnaire*

was normed on more than 1,000 children without disabilities and 150 children with disabilities (Dunn, 1999). Dunn reports both internal consistency ratings (.47 to .97) and standard error of measurement (1.0-2.8). For research question #3, only the aforementioned eight of the 12 oral sensory processing questions that best represent eating behaviors were used. Total scores within the oral sensory processing section of the *Sensory Profile Caregiver Questionnaire* range from 12 to 60. Higher scores relate to typical performance in oral sensory processing and lower scores indicate that there are issues in oral processing.

There is an abridged version of the *Sensory Profile Caregiver Questionnaire*, titled the *Short Sensory Profile* (Dunn, 1999), and this instrument is reliable and administered for a quick screening of a child's sensory processing. Four items within the *Short Sensory Profile* comprise a section titled "Taste/Smell", and these four items are in the oral processing section of the full 125 item *Sensory Profile Caregiver Questionnaire.* These Taste/Smell items are: "avoids certain tastes or food smells that are typically part of children's diets, will only eat certain tastes, limits self to particular food textures/temperatures, and picky eater, especially regarding food textures." Total scores within the Taste/Smell section of the *Short Sensory Profile* range from 4 to 20. A higher score relates to typical performance expected from a child and a lower score indicate there are Taste/Smell issues in sensory processing.

The Tasting Panel

The Tasting Panel in this research study measured a child's liking for foods and the willingness to try new foods and was administered according to the procedure outlined in Sullivan and Birch's studies (Sullivan & Birch, 1990; Sullivan & Birch, 1994). The Tasting Panel consisted of familiar and new foods, and children were asked to try the following food in a

self-selected manner: beets, couscous, garbanzo beans, grapefruit, gouda cheese, jicama, pineapple, salmon and spinach (Figure 1). After the child tasted the food, he/she described how they thought the food tasted by pointing to one of three faces: "yummy" (smiley face), "just ok" (neutral face) or "yucky" (frown face), which are the same as affective ratings. If a child refused to taste a food, this was recorded, in addition to any other behaviors they demonstrated for trying each food: touch, smell, licked, spit, swallowed. For recording purposes, if a child smelled, licked, spit or swallowed a food, a refusal was not marked as it was deemed the child engaged in an oral sensory experience. However, if the child only touched the food and subsequently refused the item, this was recorded as a refusal. For the purpose of this study, the number of food refusals and summary of behavioral scores from the Tasting Panel (behaviors such as touch, smell, lick, spit, and swallow) were quantitative measuring criteria for the child's rating and behaviors. Also, affective scores were determined by counting the number of "yucky" per food that the child expressed, while "yummy" and "just okay" were combined for a total score. There were a total of nine foods and the children reported one affective score (either "yummy, yucky or just okay") for each of the nine foods.

Food	Order	Rating			Behavior					
	1-9	Yummy	Just OK	Yucky	Refused	Touch	Smell	Licked	Spit	Swallowed
Beets										
Couscous										
Garbanzo beans										
Grapefruit										
Gouda Cheese										
Jicama										
Pineapple										
Salmon										
Spinach										

Figure 1: The Tasting Panel rating scale

Procedure

In May 2011, 80 parent/caregivers out of a total of 95 (84.2% response rate) in Cohort 1-Time 1 completed the LEAP CFS. In May 2012, 80 parent/caregivers out of a total of 119 (67.2% response rate) in Cohort 2-Time 1 completed the LEAP CFS. Collectively, 160 parent/caregivers of a total of 214 completed the LEAP CFS, a 74.77 responses rate. The parents received the LEAP CFS through distribution at their children's school, filled it out at home, and returned it to the assigned administrator at their children's school. For the purpose of this study, the Food Neophobia Scale, the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory (picky eating), and the oral sensory processing questions from the *Sensory Profile* sections were used (see Appendix A).

The Tasting Panel data collected for this study were conducted in each child's preschool at the beginning of the LEAP project and was considered the baseline data for each child, within the larger LEAP project. Trained researchers administered the Tasting Panel from the LEAP project, and one trained researcher reviewed all scores from the Tasting Panel to ensure completion. A total of 214 children (Cohort 1 and Cohort 2) participated in the Tasting Panel. Parents were not present during the administration to avoid contamination or influence, with the exception of one mother who requested observance. Prior to the administration of the Tasting Panel the child received education about the ratings meaning and how the faces could be used to indicate their preference.

In addition, the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) was sent to Cohort 1-Time 3 participating caregivers' homes approximately one month after they received the LEAP CFS in schools. Only Cohort 1-Time 3 caregivers received the *Sensory Profile Caregiver Questionnaire*, due to importance of timing as the intention was to obtain data to

evaluate the test-retest reliability of the eight oral sensory processing questions that are in both tools (The oral sensory processing questions in the LEAP CFS and the oral sensory processing questions in the *Sensory Profile Caregiver Questionnaire*). The timing of the *Sensory Profile Caregiver Questionnaire* mailing limited age maturation influence on caregiver's response, thus only Time 3 data were used. Of the 62 packets sent out, 25 (43.4% response rate) caregivers completed the *Sensory Profile Caregiver Questionnaire* and returned it. The caregivers received a cash lottery incentive for completing the *Sensory Profile Caregiver Questionnaire* for their respective children. In addition, by having the parents fill out the full *Sensory Profile Caregiver Questionnaire*, the relationship of the oral sensory section and the other sensory modality sections within this questionnaire were examined.

Data Analysis

Children's Eating Behaviors and Oral Sensory Processing

For this research project, IBM SPSS Statistics software (version 21) was used to conduct all the analyses. Descriptive statistics were reviewed to determine type of analysis, and it was determined that many of the variables were not normally distributed, thus nonparametric statistics were computed based on the skewed data. The total number of participants was 214; however, sample sizes varied per questions based on the availability and validity of data.

To determine the relationship for the first research question, "does a child's eating behavior relate to his/her oral sensory processing characteristics," the eight oral sensory processing questions within the LEAP CFS were related to children's responses to the Tasting Panel. A Spearman Rank Order Correlation was used to relate the number of food refusals to the total oral sensory processing score (*Sensory Profile* items) from the LEAP CFS.

Children's Behaviors When Trying New Foods and their Parent's Perceptions

To answer the second research question, "does a child's behavioral response when trying new food align with his/her parent's perceptions of their child's willingness to try new foods," the Tasting Panel and caregiver responses to the 5 picky eating questions from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory and the 10 food neophobia questions on the LEAP CFS were used. A Spearman Rank Order Correlation was computed to relate the number of food refusals to their respective caregiver's report per the five picky eating questions from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory and the 10 food neophobia questions on the LEAP CFS.

Reliability of the Sensory Profile Caregiver Questionnaire in Measuring Oral Sensory Processing

To answer the third research question, "is the *Sensory Profile Caregiver Questionnaire* a reliable assessment for measuring performance differences in a child's oral sensory processing," eight of the 12 oral sensory processing questions within the LEAP CFS were compared to eight of the 12 oral sensory processing questions within the *Sensory Profile Caregiver Questionnaire.* Also, four of the 12 questions that are included in the abridged version of the *Sensory Profile Caregiver Questionnaire*, called the *Short Sensory Profile* (SSP), were assessed for reliability as they have previously been deemed reliable for a shorter assessment (Dunn, 1999). An Intraclass Correlation Coefficient (ICC), specifically a one-way random, was used to determine the reliability of the *Sensory Profile Caregiver Questionnaire*, and a Spearman Rank Correlation was used to determine the relationship between the between the four Taste/Smell items on the SSP with the eight oral sensory processing questions included within the LEAP CFS.

Relationship of Children's Oral Sensory Processing to Other Sensory Behaviors

Finally, to answer the fourth research question, "does a child's oral sensory processing relate to other areas of sensory behaviors," eight of the 12 oral sensory processing questions within the LEAP CFS were related to each of the sensory processing sections in the full *Sensory Profile Caregiver Questionnaire* (sections A – E: auditory processing, visual processing, vestibular processing, touch processing and multisensory processing). Finally, the eight of the 12 oral sensory processing questions from the *Sensory Profile Caregiver Questionnaire* were then related to the Behavior and Emotional Responses section summary in the *Sensory Profile Caregiver Questionnaire* (summary of sections L-N: emotional/social responses, behavioral outcomes of sensory processing, items indicating thresholds for response). For this question, a Spearman Rank Order Correlation was used to relate a child's oral sensory processing to other sensory behaviors.

Results

Descriptive Statistics for the Primary Variables

For the total scores of the three primary variables, the number of participants included, the median, mean, standard deviation (SD), and the range are reported in Table 1 below.

Table 1

Descriptive Statistics for the Sample of Participants that Completed both the Tasting Panel and the LEAP Child Feeding Survey

	n	Median	Mean	SD	Range
Total Picky Eating Score (5 questions)	125	14.00	13.82	5.23	5 - 25
Total Neophobia Score (10 questions)	124	33.00	33.63	12.45	11 - 70
Total Oral Sensory Processing Score (8 questions)	105	n/a	32.63	6.58	11 - 40

Children's Eating Behaviors and Oral Sensory Processing

For the first research question, a Spearman's Rank Order correlation was conducted to determine the relationship between children's food refusals from the Tasting Panel and the total score of the eight oral sensory processing questions in the LEAP CFS. The relationship for the summed total score was not significant ($r_s(124) = -.162$, $p = .71$). See Table 2 for frequency of total food refusals and Table 3 for number of children refusing specific foods in the tasting panel.

Table 2

Frequencies of Food Refusals for Children that Completed the Tasting Panel - Total Refusals (n = 214)

	Frequency	Percent
Children Who Refused All 9 Foods	4	1.9
Children Who Refused 8 Foods	8	3.7
Children Who Refused 7 Foods	8	3.7
Children Who Refused 6 Foods	3	1.4
Children Who Refused 5 Foods	9	4.2
Children Who Refused 4 Foods	8	3.7
Children Who Refused 3 Foods	11	5.2
Children Who Refused 2 Foods	9	4.2
Children Who Refused 1 Food	17	7.9
Children Who Refused No Foods	134	62.7
Missing Data	3	1.4

Table 3

Number of Children Refusing Specific Foods in the Tasting Panel (n = 214)

	Beets	Couscous	Garbanzo	Grapefruit	Gouda	Jicama	Pineapple	Salmon	Spinach
Refusal Frequency	42	32	25	48	29	40	31	38	34
Percent	19.6	14.9	11.7	22.4	13.5	18.7	14.5	17.8	15.8

However, when each sensory processing item was examined individually using a Spearman Rank Order correlation, two of the items significantly correlated with children's refusals ("gags easily with food textures or food utensils in mouth," r_s *(*124) = -.185, *p* =.038, and "craves certain foods," r_s *(*124) = -.185, *p* = .038). Overall, children with higher scores on the eight oral sensory processing questions on the LEAP CFS have a lower total number of refusals, and those with lower scores on the eight oral sensory processing questions on the LEAP CFS have higher total number of refusals.

A Spearman's Rank Order correlation was run to determine the relationship between children's affective scores ("yummy, yucky, and just okay") from the Tasting Panel and their oral sensory processing in the LEAP CFS. Specifically the variable "yucky" was related to oral sensory processing and then the combined "yummy" and "just okay" was related to oral sensory processing. Neither computations were significant: "yucky": r_s *(*77) = .027, *p* =0.817; and "yummy"/"just okay" r_s *(*77) = .002, *p* =.984. Overall, there is neither a positive or negative correlation when children's "yucky" scores and "yummy and just okay" scores were related to their oral sensory processing scores. See Table 4 for frequencies of "yummy," "yucky" and "just okay" ratings for each specific food, as well as food refusals and missing data. Finally, a Spearman's Rank Order correlation was computed between children's behaviors (touch, smell, lick, spit, swallow) from the Tasting Panel and their oral sensory processing, and the relationship was not significant (r_s *(*124) = .105, *p* =.241).

Table 4

Frequencies of the 3 Ratings for the Specific Foods by Children who Participated in the Tasting Panel
(n = 214)

Rating	Beets	Couscous	Garbanzo	Grapefruit	Gouda	Jicama	Pineapple	Salmon	Spinach
Yummy	62 29.0%	77 36.0%	78 36.4%	48 22.3%	96 44.8%	85 39.7%	120 56.0%	93 43.5%	94 43.9%
Just OK	23 10.8%	53 24.8%	33 15.4%	17 7.9%	47 22.0%	30 14.0%	41 19.2%	32 15.0%	41 19.2%
Yucky	82 38.3%	45 21.0%	70 32.8%	98 46.0%	30 14.0%	53 24.8%	13 6.1%	49 22.8%	40 18.7%
Refusals	42 19.6%	32 14.9	25 11.7%	48 22.4%	29 13.6%	40 18.7%	31 14.5%	38 17.8%	34 15.9%
Missing Data	5 2.3%	7 3.3%	8 3.7%	3 1.4%	12 5.6%	6 2.8%	9 4.2%	2 0.9%	5 2.3%

Children's Behaviors When Trying New Foods and their Parent's Perceptions

For the second research question, a Spearman's Rank Order correlation was used to determine the relationship between children's affective rating of food on the Tasting Panel and their parent's report of their child behaviors, as measured by the 10 food neophobia questions on the LEAP CFS. The relationships are not significant. This was true for affective rating scores of "yucky" (r_s *(*74) = -.074, *p* =0.528) and the affective rating score of combining "yummy and just ok" (r_s *(*74) = -.046, *p* =0.695). A Spearman's Rank Order correlation was used to determine the relationship between children's affective rating of food on the Tasting Panel and their parent's report of their child behaviors, as measured by the 5 picky eating questions (from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory) on the LEAP CFS, and this relationship is not significant. This was true for affective rating scores of "yucky" (r_s *(*74) = -.080, *p* =0.488) and the affective scores of combining "yummy and just ok" (r_s *(*75) = .04, *p* =0.728).

For the second research question pertaining to children's number of food refusals on the Tasting Panel and their parent's report of their child behaviors, as measured by the 10 food neophobia questions on the LEAP CFS, a Spearman's Rank Order correlation was conducted. This relationship is significant ($r_s(119) = .266$, $p = 0.003$). Therefore, children who have high number of refusals are more likely for their parents to report that they have food neophobic behaviors, as measured by the 10 items on the food neophobia scale. Children who are showing many food neophobia behaviors reflected by high total score were observed to have a high number of food refusals.

An exploratory analysis was conducted of parent's reports of individual items within the food neophobia scales, and their children's total number of refusals. Those items with significant relationships were: "My child doesn't trust new foods" ($r_s(121) = .240$ $p = 0.007$); "If my child doesn't know what is in a food, my child won't even try it" ($r_s(121) = .256$, $p = 0.004$); "My child likes foods from different countries" ($r_s(122) = .182$, $p = 0.043$); "At dinner parties, my child will try new foods" ($r_s(121) = .209$, $p = 0.020$); "My child is afraid to eat things he/she has never eaten before" ($r_s(122) = .240$, $p = 0.007$); "My child is very particular about the foods he/she will eat" ($r_s(122) = .236$, $p = 0.008$); and "My child will eat almost anything" ($r_s(122) = .195$, $p = 0.030$). Those items on the food neophobia scale that did not have a significant relationship to the total number of refusals were: "My child is constantly sampling new and different foods": ($r_s(122) = .059$, $p = 0.515$); "My child thinks ethnic food looks too weird to eat" ($r_s(122) = .154$, $p = 0.087$); and "My child likes to try ethnic restaurants" ($r_s(122) = .126$, $p = 0.162$).

A Spearman's Rank Order correlation was used to determine the relationship between children's number of food refusals on the Tasting Panel and their parent's report of their child

behaviors, as measured by the five picky eating questions (from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory) on the LEAP CFS. The relationship is significant (r_s *(*120) = .203, *p* =0.025), thus children who have high number of refusals are more likely have parents that report that they have picky eating behaviors, as measured by the five picky eating questions (from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory) on the LEAP CFS. Children who are showing many picky eating behaviors reflected by high total score are likely to have more food refusals than children who have a low score on the picky eating scale.

An exploratory analysis was also conducted to learn more about parent's report of five picky eating questions (from the Negative Reactions to Food Scale from the Colorado Childhood Temperament Inventory) and each item's relationship to total number of refusals. The five picky eating questions that were significant with children's total refusals were: "My child tends to dislike many kinds of food" (r_s*(*121) = .197, *p* =0.028); "my child rarely likes new foods the first time he/she tries them" (r_s*(*121) = .330, *p* <.0005), and "my child tends to react negatively to new foods" (r_s*(*121) = .214, *p* =0.017). Those that did not have a significant relationship to total number of refusals were "once my child has decided he/she doesn't like a food, he/she won't even try it again" (r_s*(*122) = .029, *p* =0.750), and "my child has strong likes and dislikes in food" (r_s*(*120) = .145, *p* =0.111).

Reliability of the Sensory Profile Caregiver Questionnaire in Measuring Oral Sensory Processing

For the third research question, a one-way random Intraclass Correlation Coefficient (ICC) was used to determine the reliability of the eight oral sensory processing included within the LEAP CFS and the eight questions within the Oral Sensory Processing section in the *Sensory*

Profile Caregiver Questionnaire. This data were collected only in a subset of the participants included in the other sections based on how many parents in Cohort 1 returned the LEAP CFS and the *Sensory Profile Caregiver Questionnaire* at Time 3 (n = 18). Additionally, one participant was removed due to six missing responses within the Oral Sensory Processing in the *Sensory Profile Caregiver Questionnaire*. The reliability between the eight oral sensory processing questions included within the LEAP CFS and the eight questions within the Oral Sensory Processing section in the *Sensory Profile Caregiver Questionnaire* collected from parents about one month apart was not significant, ICC (1,1) = .158, p =.232 with 95% CI (-.266, .534).

In an exploratory analysis of individual items within the eight oral sensory processing questions within the LEAP CFS and the same eight items within the *Sensory Profile Caregiver Questionnaire,* there was moderate reliability found between items "gags easily with food textures or food utensils in mouth" (ICC (1,1) = .418, p =.022 with 95% CI (.014, .707); "limits self to particular food textures/temperatures" (ICC (1,1) = .468, p =.013 with 95% CI (.065, .742)); and "craves certain foods" (ICC (1,1) = .379, p =.047 with 95% CI (-.069, .702). Reliability for the following items is not significant: "avoids certain tastes or food smells that are typically part of children's diets," (ICC (1,1) = .216, p =.163 with 95% CI (-.220, .583)); "will only eat certain tastes" (ICC (1,1) = .236, p =.141 with 95% CI (-.200, .597))"; "picky eater, especially regarding food textures" (ICC (1,1) = .212, p =.162 with 95% CI (-.214, .573)); "shows strong preference for certain tastes" (ICC (1,1) = .039, p =.431 with 95% CI (-.393, .461); "seeks out certain tastes or smells" (ICC (1,1) = .127, p =.287 with 95% CI (-.315, .528)).

Additionally, a Spearman's Rank Order correlation was used for the four Taste/Smell Sensitivity items on the *Short Sensory Profile* and the eight oral sensory processing questions

within the LEAP CFS, and the reliability was not significant ($r_s(20) = .360$, $p = 0.207$).

In an exploratory analysis, and using a one-way random ICC statistical analysis, there was moderate reliability between the four Taste/Smell Sensitivity items included within the LEAP CFS and the four Taste/Smell Sensitivity items in the *Sensory Profile Caregiver Questionnaire* collected from parents about one month apart (The ICC (1,1) = .348, $p = .049$ with 95% CI (-.068, .664).

Relationship of Children's Oral Sensory Processing to Other Sensory Behaviors

For the last question, data from the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) were evaluated. The objective was to examine the relationship between the oral sensory section of the *Sensory Profile Caregiver Questionnaire* to the other sensory processing sections: auditory processing, visual processing, vestibular processing, touch processing and multisensory processing. Similar to research question #3, data were collected only in a subset of the participants included in the other sections based on how many parents in Cohort 1 returned the LEAP CFS and the *Sensory Profile Caregiver Questionnaire* at Time 3. Using a Spearman's Rank Order correlation, the relationship between oral sensory processing and touch processing is significant ($r_s(23) = .514$, $p = .009$), and the relationship between oral sensory processing and multisensory processing ($r_s(23) = .468$, $p = 0.018$) is also significant. The correlation between oral sensory processing in the *Sensory Profile Caregiver Questionnaire* and the auditory, visual, vestibular processing sections in the *Sensory Profile Caregiver Questionnaire* is not significant (auditory: $r_s(23) = .279$, $p = .177$; visual: $r_s(23) = .356$, $p = .080$; vestibular: $r_s(23) = .005$, $p = .981$). Finally, using a Spearman's Rank Order correlation, the relationship between oral sensory

processing and the section summary for behavior and emotional responses in the *Sensory Profile Caregiver Questionnaire* is not significant ($r_s(23) = .363$, $p = 0.074$).

Discussion

Children's Eating Behaviors and Oral Sensory Processing

The results of this study suggest that there is a significant relationship between children's food refusals during an in-person Tasting Panel and their oral sensory processing characteristics. Specifically, two items within the oral sensory processing section in the LEAP CFS were found to significantly relate to the children's total number of food refusals. Children's parents who reported that their child "gags easily with food textures or food utensils in mouth" were more likely to refuse foods on the Tasting Panel. Gagging can be induced by the somatic system, where there is a physical stimulation to the palate, base of tongue, or other areas in the mouth (Bassi, Humphris, & Longman, 2004). A child who gags easily may experience somatic gagging which is elicited by the physical stimulation of food of particular textures or by utensils. Thus, for a child with hypersensitivity in the mouth, the physical stimulation of food or utensil could cause gagging.

The relationship found in this study between gagging, which is an oral sensory behavior (Dunn, 1999), and food refusals, support other professionals' perspectives that gagging is a common behavior seen in children that have many food refusals (Chatoor and Ganiban, 2003). It is related to a sensory processing feeding issue that Chatoor and Ammaniti (2007) define as sensory food aversion. Sensory food aversion includes characteristics of hypersensitivity, gagging, negative reactions to food, reluctance to try new food, dietary deficiencies and no relationships to a post traumatic event or food allergies. Children whom have sensory food

aversions experience certain foods as strongly aversive in taste, texture or smell, and have reactions such as gagging. After an initial aversive reaction, children often refuse to try other foods that remind them of this unpleasant experience, thus generalizing many colors and textures of foods (Chatoor and Ammaniti, 2007). Also, children whom have characteristics of Sensory Food Aversions may have sensitivities in other sensory areas as well (Smith, Roux, Naidoo, & Venter, 2005). Therefore, the relationship in this study between parent's report of their child's "gags easily on food textures/utensils" and food refusals contributes to the validity of recent research that link food refusals to sensory processing feeding disorders.

The relationship between gagging on food textures/utensils and food refusals also demonstrates validity with parents' report of their child's behavior. If a parent reports that their child gags easily with food textures or food utensils, results of this study suggests that their child is likely to refuse foods. Since it is not well understood if gagging causes food refusals, or if food refusal behavior leads to gagging, parents and health care providers should address both avenues to encourage a child to eat a nutritionally adequate diet. Parents and health care providers can address a child's gagging through desensitization tactics (slow exposure to textures, brushing teeth, and offerings of smaller foods. Food refusals, and specifically sensory food aversions (Chatoor, 2009), can be addressed through strategies of repeated exposure of food within child's level of tolerance (including interaction, such as holding it with a fork), parent and peer modeling and scheduled snacks and meals so children are hungry at appropriate times. If these can be addressed, a child may be more likely to try new foods, because children who are more willing to try new foods have higher quality diets when compared to those children who reject new food (Galloway, Lee, & Birch, 2003). Recent research suggests that there are also certain populations, such as children with autism who are more likely to have food selectivity

than typically developing children, due to sensory processing issues (Cermak, Curtin, & Bandini, 2010). The relationship between sensory processing characteristics and refusals that was found in typically developing preschoolers may be useful in treatment planning with other populations whom may exhibit one of these characteristics.

Additionally, a child's parent who reported that her/his child "craves certain foods" was related to the child's likelihood of refusing foods during the Tasting Panel. From an occupational therapy perspective, "craves certain food" is one of several oral sensory processing characteristics that raises concern, and it is best understood when a child has a strong preference for certain foods (i.e., salty, spicy, sweet). In this current study, two parents listed "sweets" as a type of food that their child craves, while other parents listed various items (crackers, waffles, etc). Foods that are sweet, salty or spicy could be classified as foods that provide sensory stimulation, and research supports that children with oral sensory processing issues often crave certain food to get needed stimulation (Kranowitz, 2005).

If a child is particular about their food choices and craves certain foods, this study indicates that they are likely to refuse foods frequently. Thus, they may be classified as unwilling to try new or unfamiliar foods, demonstrating "picky eating," as defined previously by Pliner and Hobden (1992). Research states that picky eating behaviors in children result in a narrow diet of a low variety of food (Milton, 1993), thus parents and healthcare providers need to be aware of the child's certain cravings of food, which may indicate that their child is consuming an inadequate diet. Recent research supports that children with autism are more likely to have food selectivity than typically developing children, due to sensory processing issues (Cermak, Curtin, & Bandini, 2010), thus this relationship between "craves certain foods" and "food refusals" might also be present in children with autism. It is important to note that this relationship

between "craves certain foods" and food refusals was found in preschoolers from a general population, lending support that that oral sensory processing is linked to food selectivity and an inadequate diet, regardless of a disability.

Children's Behaviors When Trying New Foods and their Parent's Perceptions

The results from research question #2 suggest that there is consistency between a parent's report of their child's food neophobia and picky eating behaviors, and their child's actual food refusals. The results of research study suggest that parent's report of their child's differentiating food behaviors as measured by the picking eating questions (i.e., child's dislikes of foods, negative reactions to new foods and strong likes and dislikes in food overall), and food neophobia questions (i.e., doesn't trust new foods, is fearful to eat new foods, will not eat just anything, and is particular about the foods that he or she eats) within the LEAP CFS is validated because the parents' report relates to the children's refuels when trying foods in the Tasting Panel. This is an important finding because in practice, clinicians may only have parents' reports of children's picky eating and/or food neophobia behaviors when making clinical decisions about intervention. Given these findings, clinicians may be able to predict from a parent report of neophobia or picky eating behaviors that his/her child would more likely refuse foods when presented. In practice, when time is limited and valued, parent's report is critical in understanding children's profiles, and this study indicates that parents' reports provide some relationship to their children's actual eating behaviors. In particular, clinicians might be able to ask, "Does your child have strong dislikes in foods and is fearful to eat new foods," and the parent's response would be a dependable report to predict the child's behavior of familiar and new food acceptance.

Also, if a child has a high number of food refusals, it is likely that the parents would be able to accurately identify these aforementioned picky eating and food neophobia behaviors. In order for parents to help their children develop better eating behaviors, the first step is awareness and recognition of their picking eating and/or food neophobia behaviors, which may be expressed as a child continually refuses new foods. If parents don't accurately observe their child's behaviors, they may not realize their child was continually refusing food, thus potentially consuming a non-varietal diet that leads to adverse health impacts and preventing any early intervention services.

In addition, since the results of this research indicate that a child's affective ratings on the Tasting Panel do not relate to the parent's report of their picking eating and food neophobia behaviors, a child's rating of "yummy, yucky or just okay" may not be the best measure in identifying child's food choices and preferences and obtaining an overview of their diet. Otherwise, it is possible that the parent's report is not valid in this case, as parents reports are subjective. A child's affective scoring does not yield an understanding of why they refused food, and generally an affective score was not reported when the child refused. However, five children identified certain foods as "yummy", but refused to try the food, which may be due to measurement error. On the other hand, some children identified food as "yucky" while simultaneously refusing the food, which is an intuitive relationship. However it is not well understood *why* they refused the food. Some children may have had a previous negative experience with the food, justifying their "yucky" score and food refusal, and supporting a Pavlovian conditioning experience (Rozin & Zellner, 1985). Other children might have been fearful to try the food, which is a behavior that could be associated with picky-eating and/or food

neophobia. Therefore, a child's affective score does not indicate whether or not they've eaten the food before, and further inquiry is needed to understand why the child refused the food.

Reliability of the Sensory Profile Caregiver Questionnaire in Measuring Oral Sensory Processing

For research questions #3, there was significant moderate reliability found between specific items within the oral sensory processing questions included within the LEAP CFS and the oral sensory processing section in the *Sensory Profile Caregiver Questionnaire*. The items in this study "gags easily with food textures or food utensils in mouth, limits self to particular food textures/temperatures, and craves certain foods," were reported with reliability by parents. On two separate occasions, the parents answered the oral sensory processing questions: (1) in May 2012 within the LEAP CFS and (2) in June 2012 in the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999). These items might be more noticeable in children with sensory processing characteristics, such as a child gagging or demonstrating a preference for certain foods and/or textures. Additionally, this finding is consistent with results from research question #1, in which children that demonstrate "gagging" and "craving of certain foods" are likely to have a higher number of food refusals. The other 6 oral sensory processing items in the *Sensory Profile Caregiver Questionnaire* were not significantly reliable.

Overall, reliability within the *Sensory Profile Caregiver Questionnaire* was poor, as the total score of the eight items on the *Sensory Profile Caregiver Questionnaire* were not significantly related to the same 8 items on the LEAP CFS. Although, these findings should be interpreted cautiously as there was a small sample size of 25 participants in this study (thus a low statistical power). Additionally, reliability may be stronger when the questions are administered

in the same context. The oral sensory processing questions within the LEAP CFS were collected from parents within a questionnaire that related to child feeding practices. On the other hand, the oral sensory processing questions within the *Sensory Profile Caregiver Questionnaire* were collected in a questionnaire targeted at sensory processing. Thus, the context in which the parent/caregiver filled out the questionnaire varied and may not be an ideal for determining reliability. Based on the results of this study, researchers and clinicians should be cautious when extracting oral sensory items and placing them in questionnaires on other topics such as feeding behaviors or parent feeding practices, as the context may be influential. The results of such a constructed questionnaire may not yield the same information as provided when parents answer the same questions on the *Sensory Profile Caregiver Questionnaire.*

However, moderate reliability was discovered between the four Taste/Smell Sensitivity items included within the LEAP CFS and the four Taste/Smell Sensitivity items in the *Sensory Profile Caregiver Questionnaire* collected from parents ("Avoids certain tastes or food smells that are typically part of children's diets; will only eat certain tastes; limits self to particular food textures/temperature, and picky eater, especially regarding food textures"). These four items may be more reliable because they are easy to observe and to judge, thus the parents are able to consistently report on these. The 38 item *Short Sensory Profile* is more popular in studies measuring eating behaviors and sensory processing (Davis, et. al., 2013; Cermak, Curtin, & Bandini, 2010; Coulthard & Blissett, 2009; Paterson & Peck, 2011) than the full 125 item *Sensory Profile Caregiver Questionnaire*.

Relationship of Children's Oral Sensory Processing to Other Sensory Behaviors

For research question #4, children's oral sensory processing is related to touch processing as measured by the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999). These findings suggest that children whom have challenges with touch processing may also have difficulties in oral processing. Therefore one clinical implication for healthcare professionals, who work with children with touch sensory processing difficulties, is that they may also consider evaluating the child's oral sensory processing and not limit their evaluation to touch processing only. Also, there are certain touch-processing behaviors associated with eating, and a child with touch sensitivity may avoid getting "messy," which is a common occurrence during meals and snacks. Thus they may refuse certain foods, hesitate to eat unfamiliar foods and become a "picky eater" and/or "neophobic," limiting their selection of foods and consuming an inadequate diet. This finding is consistent with Smith et. al.'s (1995) conclusions that children with tactile defensiveness have different eating habits and food choices than children without tactile defensiveness. Thus, clinicians may want to take a more holistic approach when evaluating and treating children that are picky eaters and consider assessing sensory processing issues as well, especially touch processing.

The findings of this study also show a significant relationship between children's oral sensory processing and multi-sensory processing. Multi-sensory processing requires a child to respond adequately to activities that contain a combined sensory experience (Dunn, 1999). Within the *Sensory Profile Caregiver Questionnaire*, some of the items listed are "gets lost easily, has difficulty paying attention and looks away from tasks to notice all actions in the room (Dunn, 1999)". The results of this study indicate that if a child has oral processing difficulties, they may also have difficulties with multisensory processing and engaging in activities that

require using several senses at the same time. This overlap in sensory processing deficits may be likely because a preschool child usually eats their meals with others, such as in a busy school setting, or around a dinner table with their family. These environments are busy and require the ability to pay attention to the tasks of eating, and children with deficits in multisensory may not be able to focus and could be easily distracted, consuming an inadequate diet. Thus, overtime they may have underdeveloped oral sensory processing, which yields certain characteristics, such as gagging, avoidance of certain foods, and cravings of other foods.

Additionally, children's oral sensory processing is not related to their overall behavior and emotional responses, as measured by the *Sensory Profile Caregiver Questionnaire.* There are several sections within the *Sensory Profile Caregiver Questionnaire* that measure a parent's report of his/her child's behavior and emotional responses, and one on these sections entitled, "Items Indicating Thresholds for Response," had a significant relationship with oral sensory processing. This section measures a child's level of modulation, which is defined as the ability to monitor and regulate information to generate an appropriate response (Dunn, 1997). A clinical implication could be understood that a child with oral processing difficulties may have developed certain behaviors to understand and interpret his/her environment, such as purposefully smelling objects. As noted previously, it is the healthcare professional's responsibility to not solely address oral processing difficulties in children, but to look beyond and address other areas of sensory processing.

Study Limitations

There are a few study limitations. First, the sample size of the participants who filled out the *Sensory Profile Caregiver Questionnaire* (Dunn, 1999) for Research Questions 3 and 4 was

low, with a total of 25 participants that filled out questionnaires. Of these, only 17 were used in data analysis due to missing data within the LEAP CFS (some participants were missing significant data or had dropped out of the longitudinal study). For studies with a small sample size, the results need to be interpreted cautiously and may not be representative of the population. It is also unknown if the small sample size skewed the results.

Second, reliability within the *Sensory Profile Caregiver Questionnaire* assessment may be stronger when administered in the same context. The oral sensory processing questions within the CFS were collected from parents within a questionnaire that related to child feeding practices. Yet, the oral sensory processing questions within the *Sensory Profile Caregiver Questionnaire* were collected in a questionnaire targeted at sensory processing.

Finally, results should be interpreted cautiously because the test wise alpha levels were not adjusted for multiple tests. Since this is the first time some of these relationships have been examined, they were exploratory in nature and the alpha level was not adjusted.

Conclusion

The results of this study suggest that children's observed food refusals relates to parent's reports of certain characteristics of his/her child's oral sensory processing. Specifically, a child that refuses foods likely experiences certain sensory processing characteristics such as "gags easily with food textures or food utensils in mouth" and "craves certain foods." Children that experience these oral sensory processing behaviors are likely to refuse foods when presented to them. Additionally, certain items within the five picky eating questions and 10 food neophobia questions show consistency between a parent's report of their child's food neophobia and picky eating behaviors, and their child's actual food refusals, thus demonstrating validity in parent's

report. Also, it is recommended that future studies incorporate children's food experiences within the natural environment, such as their home or a preschool mealtime, rather than in a controlled trial. Although the Tasting Panel was designed to be as natural as possible, it is a controlled trial and we do not know if the controlled trial will relate to feeding behaviors in the natural environment. Finally, a child's oral sensory processing is related to the domains of touch processing and multi-processing, suggesting that holistic sensory assessments are necessary in order to provide the best interventions for a child. As more knowledge is gained about child's eating behaviors and their relationship to sensory processing, healthcare professionals can create enhanced interventions, in order to support a child's healthy diet and overall well-being.

CHAPTER THREE: DISCUSSION

Childhood obesity is a serious threat to the youngest generations, and one way to mitigate this health crisis is through implementing obesity prevention programming and interventions. It has been suggested that early childhood is a critical time to implement obesity prevention efforts because it represents a time when a child is developing lifelong eating habits, such as eating behaviors and food preferences (Lytle, Seifert, Greenstein, & McGovern, 2000; Wardle, 1995; Crockett & Sims, 1995; Davis & Christoffel, 1994). There are a myriad of influences on children's eating behaviors and food preferences, such as their environments (Wechsler, Devereaux, Davis, & Collins, 2000; Parmer, Salisbury-Glennon, Shannon, & Struempler 2009; Witt & Dunn, 2012), their parents (Birch & Fisher, 1995; Nicklas et al., 2001) and their willingness to try new foods (Galloway, Lee, & Birch, 2003). The findings of this study suggest that children's eating behaviors are also associated with their oral sensory characteristics. Additionally, the findings suggest that oral sensory processing is associated with other sensory modules, thus effective interventions may need to target children's sensory processing from a holistic perspective.

Sensory processing is a realm in which occupational therapists are skilled in, and when occupational therapists respond to children who have sensory processing disorders, they consider sensory information from all the senses: sight, sound, smell, taste, touch, and perception of movement and position. Sensory processing disorders in children can pose a challenge to their occupational performance of their everyday activities in daily living, learning, playing and social skills (AOTA, 2008), including a child's eating behaviors and habits. More so, a child's eating behaviors, habits and their food preferences can influence the child's food choice, which is

implied through this study's results. This is also supported by previous research, and for example, children who are more willing to try new foods have higher quality diets when compared to those children who reject new food (Galloway, Lee, & Birch, 2003). In addition to experience and skills within sensory processing, many occupational therapists are also attentive to children's food behaviors (AOTA, 2008) and how this impacts their developmental outcomes and daily performance and participation. Specifically, it is not uncommon for occupational therapists to address a child's oral sensory processing in relation to their performance and participation in activities with interventions such as sensory diets (Wilbarger, 1995) and Sequential Oral Sensory SOS feeding approach (Toomey, 2002).

However, if an occupational therapist, or another healthcare practitioner, wants to accurately determine a child's oral sensory processing, this research suggests to explore alternative expressed behaviors and to not rely solely on children's behavioral reaction to foods or children's affective feelings. One might want to consider an assessment that considers the child's experience and reactions in their natural environments, which is deemed a reputable and popular practice within occupational therapy (Yerxa, 1990). On the other hand, the results from this study also provide strong support that both parental observations and report are valid, as the parent's report related to actual child refusals. Parents are often a relied upon resource for gathering detailed information about a child, and this research supports parent's creditability in their reporting. Parent's report should be relied upon particularly when children's food refusals are being observed in the home and/or school.

This research also provides evidence that oral sensory processing relates to touch processing and multisensory processing. Children with touch sensitivity may experience other tactile issues outside of mealtime and snacks, such as distress during self-care routines, (hair

brushing and brushing teeth) or they may be particular about clothing (prefer long-sleeved shirts when it's warm or becoming irritated by shoes or socks. The results of this study suggest that healthcare professionals should consider the child's touch and multisensory processing and its variety of behaviors, if they determine the child has differences in oral sensory processing.

Occupational therapists are often one of the first health professionals to be called upon if sensory processing issues in a child is suspected; however addressing a child's eating behavior should not be unilateral. Multi-disciplinary approaches should be practiced in order to successfully help a child develop and implement good eating habits. This may include other disciplines outside of occupational therapy, such as speech therapy, nutrition/dietetics, and psychology. It is also equally important to have multi-disciplinary involvement in tackling childhood obesity, considering the serious threat to societal health. Traditionally, nutrition and exercise/health sciences have significantly helped to combat childhood obesity, and it is undeniable that philosophies of good nutrition and physical activity should be incorporated as both are proven methods in decreasing body mass index (BMI) and achieving an optimal healthy weight (AHA, 2012). However, the means in how to get children to embrace the philosophy of healthy eating and physical activity may also be supported from the discipline of occupational therapy, through professional domains of the American Occupational Therapy Association (AOTA, 2008): self-efficacy, habits and routines and increased participation. Specifically, an occupational therapist can support a child's good nutrition and increased physical activity by increasing children's motivation, modifying/enhancing children's habits and routines and increasing participation to healthy environments. Occupational therapy offers a unique, holistic perspective, which can contribute to the promotion of children's healthy weight and overall well-being. Therefore, this research is not only important in understanding the critical relationship

between children's eating behaviors and sensory processing, but provides further evidence that childhood obesity needs attention from a multitude of disciplines in order to successfully address this public health crisis.

The results of this study suggest that children's observed food refusals is related to parent's report of certain characteristics of his/her child's oral sensory processing, which highlights the importance of health care providers in addressing a child's sensory domains if parent's report frequent food refusals. Additionally, the results demonstrated increased credibility in parent's report of their child's eating behaviors, indicating the validating of parent's observations to health care providers. Finally, a child's oral sensory processing is related to the domains of touch processing and multi-processing, suggesting that holistic sensory assessments are necessary in order to provide the best interventions for a child. This study has contributed to the overall knowledge about child's eating behaviors and their relationship to sensory processing, which will assist healthcare professionals in supporting a child's healthy diet and overall well-being.

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APPENDIX A: LEAP CHILD FEEDING SURVEY

ID: _____ Date: _____

Time point: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

Child Feeding Survey

First, we would like to ask you a few questions about mealtimes at your house

Sometimes it is challenging to get children to eat. Tell us how often you use the following strategies. (Please mark one box for each statement)

	Never	Rarely	Some of the Time	Most of the Time	Always
I serve my child only the foods that he/she likes	□	□	□	□	□
If my child says, "I'm not hungry," I try to get him/her to eat anyway	□	□	□	□	□
I have to be especially careful to make sure that my child eats enough	□	□	□	□	□

Young children can be reluctant to try new foods. Adults have different strategies for helping children try new foods. Tell us how often you use the following strategies.

(Please mark one box for each statement)

	Never	Rarely	Some of the Time	Most of the Time	Always
I teach my child about new foods	□	□	□	□	□
I offer my child new foods at mealtime	□	□	□	□	□
I offer my child new foods at snack	□	□	□	□	□
When I offer new foods, I have my child eat at least one bite	□	□	□	□	□
I have my child try a new food before he/she eats sweet foods	□	□	□	□	□
If my child refuses to at a new food, or a food he/she does not like, I continue to offer that food	□	□	□	□	□

Young children do not always want to eat what is "good for them" but would rather eat less nutritious foods.

(Please mark one box for each statement)

	Never	Rarely	Sometimes	Frequently	Always
Do you keep track of the sweets (candy, pastries) that your child eats?	□	□	□	□	□
Do you keep track of the snack foods (potato chips, cheese puffs) that your child eats?	□	□	□	□	□
Do you keep track of the high fat foods that your child eats?	□	□	□	□	□

ID: _____ Date: _____

Time point: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

Adults have different beliefs about how best to feed children. Please tell us whether you agree or disagree with the following statements.

4

	Disagree	Disagree a Little	Neutral	Agree a Little	Agree
My child should always eat all of the food on his/her plate	□	□	□	□	□
I have to make sure that my child does not eat too many sweets (candy, ice cream, pastries)	□	□	□	□	□
I have to make sure my child does not eat too many high fat foods	□	□	□	□	□
If I did not guide or regulate my child's eating, he/she would eat too many snack foods.	□	□	□	□	□
If I did not guide or regulate my child's eating, he/she would eat less than he/she should	□	□	□	□	□
I tell my child if he/she has not eaten enough	□	□	□	□	□

Please tell us your level of concern about your child's weight and eating. (Mark one)

5

	Unconcerned	A Little Concerned	Concerned	Fairly Concerned	Very Concerned
Are you concerned about your child *eating too much* when you are not with him/her?	□	□	□	□	□
Are you concerned about your child having to go on a diet to avoid being overweight?	□	□	□	□	□
Are you concerned about your child becoming overweight?	□	□	□	□	□
Are you concerned about your child eating enough?	□	□	□	□	□

ID: _____ Date: _____

Time point: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

Please read the following statements and check one box for each statement to show how YOUR child feels about trying new foods. It is important to remember that there are no right or wrong answers to these questions; we are interested in what parents really feel and do.

	Not at all like my child	Somewhat unlike my child	Neither like my child or unlike my child	Somewhat like my child	Very much like my child
Once my child has decided he/she doesn't like a food, he/she won't even try it again	□	□	□	□	□
My child rarely likes new foods the first time he/she tries them	□	□	□	□	□
My child tends to dislike many kinds of food	□	□	□	□	□
My child has strong likes and dislikes in food	□	□	□	□	□
My child tends to react negatively to new foods	□	□	□	□	□

	Disagree strongly	Disagree moderately	Disagree slightly	Neither agree or disagree	Agree slightly	Agree moderately	Agree strongly
My child is constantly sampling new and different foods	□	□	□	□	□	□	□
My child doesn't trust new foods	□	□	□	□	□	□	□
If my child doesn't know what is in a food, my child won't even try it	□	□	□	□	□	□	□
My child likes foods from different countries	□	□	□	□	□	□	□
My child thinks ethnic food looks too weird to eat	□	□	□	□	□	□	□
At dinner parties, my child will try new foods	□	□	□	□	□	□	□
My child is afraid to eat things he/she has never eaten before	□	□	□	□	□	□	□
My child is very particular about the foods he/she will eat	□	□	□	□	□	□	□
My child will eat almost anything	□	□	□	□	□	□	□
My child likes to try ethnic restaurants	□	□	□	□	□	□	□

ID: _____ Date: _____

Time point: □ 1 □ 2 □ 3 □ 4 □ 5 □ 6

Please check the box that best describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to comment because you have not observed the behavior or believe that it does not apply to your child, please check the 'Don't Know' box.

	Always (100% of the time)	Frequently (about 75% of the time)	Occasionally (about 50% of the time)	Seldom (about 25% of the time)	Never (0% of the time)	Don't Know
Gags easily with food textures or food utensils in mouth	□	□	□	□	□	□
Avoids certain tastes or food smells that are typically part of children's diets	□	□	□	□	□	□
Will only eat certain tastes list:_____	□	□	□	□	□	□
Limits self to particular food textures/temperatures list:_____	□	□	□	□	□	□
Picky eater, especially regarding food textures	□	□	□	□	□	□
Routinely smells nonfood objects	□	□	□	□	□	□
Shows strong preference for certain smells list:_____	□	□	□	□	□	□
Shows strong preference for certain tastes list:_____	□	□	□	□	□	□
Craves certain foods list:_____	□	□	□	□	□	□
Seeks out certain tastes or smells list:_____	□	□	□	□	□	□
Chews or licks nonfood objects	□	□	□	□	□	□
Mouths objects (for example, pencil, hand)	□	□	□	□	□	□

Thank you so much for taking the time to answer our questions. We sincerely appreciate your cooperation.

APPENDIX B: THE SENSORY PROFILE CAREGIVER QUESTIONNAIRE

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Sensory Processing

Item			A. Auditory Processing	Always	Frequently	Occasionally	Seldom	Never
	L	1	Responds negatively to unexpected or loud noises (for example, cries or hides at noise from vacuum cleaner, dog barking, hair dryer)	O	O	O	O	O
	L	2	Holds hands over ears to protect ears from sound	O	O	O	O	O
	L	3	Has trouble completing tasks when the radio is on	O	O	O	O	O
	L	4	Is distracted or has trouble functioning if there is a lot noise around	O	O	O	O	O
	L	5	Can't work with background noise (for example, fan, refrigerator)	O	O	O	O	O
	H	6	Appears to not hear what you say (for example, does not "tune-in" to what you say, appears to ignore you)	O	O	O	O	O
	H	7	Doesn't respond when name is called but you know the child's hearing is OK	O	O	O	O	O
	H	8	Enjoys strange noises/seeks to make noise for noise's sake	O	O	O	O	O
			Section Raw Score Total					

Comments

Item			B. Visual Processing	Always	Frequently	Occasionally	Seldom	Never
	L	9	Prefers to be in the dark	O	O	O	O	O
	L	10	Expresses discomfort with or avoids bright lights (for example, hides from sunlight through window in car)	O	O	O	O	O
	L	11	Happy to be in the dark	O	O	O	O	O
	L	12	Becomes frustrated when trying to find objects in competing backgrounds (for example, a cluttered drawer)	O	O	O	O	O
	L	13	Has difficulty putting puzzles together (as compared to same age children)	O	O	O	O	O
	L	14	Is bothered by bright lights after others have adapted to the light	O	O	O	O	O
	L	15	Covers eyes or squints to protect eyes from light	O	O	O	O	O
	L	16	Looks carefully or intensely at objects/people (for example, stares)	O	O	O	O	O
	L	17	Has a hard time finding objects in competing backgrounds (for example, shoes in a messy room, favorite toy in the "junk drawer")	O	O	O	O	O
			Section Raw Score Total					

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

	Item		C. Vestibular Processing	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
→	L	18	Becomes anxious or distressed when feet leave the ground	O	O	O	O	O
→	L	19	Dislikes activities where head is upside down (for example, somersaults, roughhousing)	O	O	O	O	O
→	L	20	Avoids playground equipment or moving toys (for example, swing set, merry-go-round)	O	O	O	O	O
→	L	21	Dislikes riding in a car	O	O	O	O	O
→	L	22	Holds head upright, even when bending over or leaning (for example, maintains a rigid position/posture during activity)	O	O	O	O	O
→	L	23	Becomes disoriented after bending over sink or table (for example, falls or gets dizzy)	O	O	O	O	O
→	H	24	Seeks all kinds of movements and this interferes with daily routines (for example, can't sit still, fidgets)	O	O	O	O	O
→	H	25	Seeks out all kinds of movement activities (for example, being whirled by adults, merry-go-rounds, playground equipment, moving toys)	O	O	O	O	O
→	H	26	Twirls/spins self frequently throughout the day (for example, likes dizzy feeling)	O	O	O	O	O
→	H	27	Rocks unconsciously (for example, while watching TV)	O	O	O	O	O
→	H	28	Rocks in desk/chair/on floor	O	O	O	O	O
			Section Raw Score Total					

Comments

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Item			D. Touch Processing	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	29	Avoids getting "messy" (for example, in paste, sand, finger-paint, glue, tape)	O	O	O	O	O
	L	30	Expresses distress during grooming (for example, fights or cries during haircutting, face washing, fingernail cutting)	O	O	O	O	O
	L	31	Prefers long-sleeved clothing when it is warm or short sleeves when it is cold	O	O	O	O	O
	L	32	Expressed discomfort at dental work or toothbrushing (for example, cries or fights)	O	O	O	O	O
	L	33	Is sensitive to certain fabrics (for example, is particular about certain clothes or bedsheets)	O	O	O	O	O
	L	34	Becomes irritated by shoes or socks	O	O	O	O	O
	L	35	Avoids going barefoot, especially in sand or grass	O	O	O	O	O
	L	36	Reacts emotionally or aggressively to touch	O	O	O	O	O
	L	37	Withdraws from splashing water	O	O	O	O	O
	L	38	Has difficulty standing in line or close to other people	O	O	O	O	O
	L	39	Rubs or scratches out a spot that has been touched	O	O	O	O	O
	H	40	Touches people and objects to the point of irritating others	O	O	O	O	O
	H	41	Displays unusual need for touching certain toys, surfaces, or textures (for example, constantly touching objects)	O	O	O	O	O
	H	42	Decreased awareness of pain and temperature	O	O	O	O	O
	H	43	Doesn't seem to notice when someone touches arm or back (for example, unaware)	O	O	O	O	O
	H	44	Avoids wearing shoes; loves to be barefoot	O	O	O	O	O
	H	45	Touches people and objects	O	O	O	O	O
	H	46	Doesn't seem to notice when face or hands are messy	O	O	O	O	O
			Section Raw Score Total					

Comments

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Item			E. Multisensory Processing	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		47	Gets lost easily (even in familiar places)	O	O	O	O	O
		48	Has difficulty paying attention	O	O	O	O	O
	L	49	Looks away from tasks to notice all actions in the room	O	O	O	O	O
	H	50	Seems oblivious within an active environment (for example, unaware of activity)	O	O	O	O	O
	H	51	Hangs on people, furniture, or objects, even in familiar situations	O	O	O	O	O
	H	52	Walks on toes	O	O	O	O	O
	H	53	Leaves clothing twisted on body	O	O	O	O	O
			Section Raw Score Total					

Comments

Item			F. Oral Sensory Processing	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	54	Gags easily with food textures or food utensils in mouth	O	O	O	O	O
	L	55	Avoids certain tastes or food smells that are typically part of children's diets	O	O	O	O	O
	L	56	Will only eat certain tastes (list: _____)	O	O	O	O	O
	L	57	Limits self to particular food textures/temperatures (list: _____)	O	O	O	O	O
	L	58	Picky eater, especially regarding food textures	O	O	O	O	O
	H	59	Routinely smells nonfood objects	O	O	O	O	O
	H	60	Shows strong preference for certain smells (list: _____)	O	O	O	O	O
	H	61	Shows strong preference for certain tastes (list: _____)	O	O	O	O	O
	H	62	Craves certain foods (list: _____)	O	O	O	O	O
	H	63	Seeks out certain tastes or smells (list: _____)	O	O	O	O	O
	H	64	Chews or licks on nonfood objects	O	O	O	O	O
	H	65	Mouths objects (for example, pencil, hands)	O	O	O	O	O
			Section Raw Score Total					

Comments

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Modulation

Item			G. Sensory Processing Related to Endurance/Tone	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		66	Moves stiffly	O	O	O	O	O
	H	67	Tires easily, especially when standing or holding particular body position	O	O	O	O	O
	H	68	Locks joints (for example, elbows, knees) for stability	O	O	O	O	O
	H	69	Seems to have weak muscles	O	O	O	O	O
	H	70	Has a weak grasp	O	O	O	O	O
	H	71	Can't lift heavy objects (for example, weak in comparison to same age children)	O	O	O	O	O
	H	72	Props to support self (even during activity)	O	O	O	O	O
→	H	73	Poor endurance/tires easily	O	O	O	O	O
→	H	74	Appears lethargic (for example, has no energy, is sluggish)	O	O	O	O	O
			Section Raw Score Total					

Comments

Item			H. Modulation Related to Body Position and Movement	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		75	Seems accident-prone	O	O	O	O	O
		76	Hesitates going up or down curbs or steps (for example, is cautious, stops before moving)	O	O	O	O	O
→	L	77	Fears falling or heights	O	O	O	O	O
→	L	78	Avoids climbing/jumping or avoids bumpy/uneven ground	O	O	O	O	O
→	L	79	Holds onto walls or banisters (for example, clings)	O	O	O	O	O
→	H	80	Takes excessive risks during play (for example, climbs high into a tree, jumps off a tall furniture)	O	O	O	O	O
→	H	81	Takes movement or climbing risks during play that compromise personal safety	O	O	O	O	O
→	H	82	Turns whole body to look at you	O	O	O	O	O
	H	83	Seeks opportunities to fall without regard to personal safety	O	O	O	O	O
	H	84	Appears to enjoy falling	O	O	O	O	O
			Section Raw Score Total					

Comments

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Item			I. Modulation of Movement Affecting Activity Level	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	85	Spends most of the day in sedentary play (for example, does quiet things)	O	O	O	O	O
	L	86	Prefers quiet, sedentary play (for example, watching TV, books, computers)	O	O	O	O	O
→	L	87	Seeks sedentary play options	O	O	O	O	O
→	L	88	Prefers sedentary activities	O	O	O	O	O
→	H	89	Becomes overly excitable during movement activity	O	O	O	O	O
	H	90	"On the go"	O	O	O	O	O
	H	91	Avoids quiet play activities	O	O	O	O	O
			Section Raw Score Total					

Comments

Item			J. Modulation of Sensory Input Affecting Emotional Responses	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		92	Needs more protection from life than other children (for example, defenseless physically or emotionally)	O	O	O	O	O
	L	93	Rigid rituals in personal hygiene	O	O	O	O	O
	H	94	Is overly affectionate with others	O	O	O	O	O
	H	95	Doesn't perceive body language or facial expressions (for example, unable to interpret)	O	O	O	O	O
			Section Raw Score Total					

Comments

Item			K. Modulation of Visual Input Affecting Emotional Responses and Activity Level	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
	L	96	Avoids eye contact	O	O	O	O	O
	H	97	Stares intensively at objects or people	O	O	O	O	O
	H	98	Watches everyone when they move around the room	O	O	O	O	O
	H	99	Doesn't notice when people come into the room	O	O	O	O	O
			Section Raw Score Total					

Comments

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Behavior and Emotional Responses

Item		L. Emotional/Social Responses	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
♡	100	Seems to have difficulty liking self (for example, low self-esteem)	O	O	O	O	O
♡	101	Has trouble "growing up" (for example, reacts immaturely to situations)	O	O	O	O	O
♡	102	Is sensitive to criticisms	O	O	O	O	O
♡	103	Has definite fears (for example, fears are predictable)	O	O	O	O	O
♡	104	Seems anxious	O	O	O	O	O
♡	105	Displays excessive emotional outbursts when unsuccessful at a task	O	O	O	O	O
♡	106	Expresses feeling like a failure	O	O	O	O	O
♡	107	Is stubborn or uncooperative	O	O	O	O	O
♡	108	Has temper tantrums	O	O	O	O	O
♡	109	Poor frustration tolerance	O	O	O	O	O
♡	110	Cries easily	O	O	O	O	O
♡	111	Overly serious	O	O	O	O	O
♡	112	Has difficulty making friends (for example, does not interact or participate in group play)	O	O	O	O	O
♡	113	Has nightmares	O	O	O	O	O
♡	114	Has fears that interfere with daily routine	O	O	O	O	O
♡	115	Doesn't have a sense of humor	O	O	O	O	O
♡	116	Doesn't express emotions	O	O	O	O	O
		Section Raw Score Total					

Comments

ID: 3 Date: _____

Time point: TIME 3

Cohort: 1 Please completely fill in your answer. Correct: ● Incorrect: ☑

Item			M. Behavioral Outcomes of Sensory Processing	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		117	Talks self through tasks	O	O	O	O	O
		118	Writing is illegible	O	O	O	O	O
		119	Has trouble staying between the lines when coloring or when writing	O	O	O	O	O
		120	Uses inefficient ways of doing things (for example, wastes time, moves slowly, does things a harder way than is needed)	O	O	O	O	O
	L	121	Has difficulty tolerating changes in plans and expectations	O	O	O	O	O
	L	122	Has difficulty tolerating changes in routines	O	O	O	O	O
			Section Raw Score Total					

Comments

Item			N. Items Indicating Thresholds for Response	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
		123	Jumps from one activity to another so that it interferes with play	O	O	O	O	O
	H	124	Deliberately smells objects	O	O	O	O	O
	H	125	Does not seem to smell strong odors	O	O	O	O	O
			Section Raw Score Total					

Comments