Photographs versus Food: Reliability of Young Children's Reported Taste Preferences Increase with Age and Familiar Foods

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Master of Science

with a

Major in Family and Consumer Sciences

in the

College of Graduate Studies

University of Idaho

by

Mackenzie Jayne Ferrante

Major Professor: Samantha Ramsay, Ph.D.

Committee Members: Ling Ling Tsao, Ph.D. & Katie Brown, Ph.D.

Department Administrator: Sonya Meyer, Ph.D.

April 2016

Authorization to Submit Thesis

This thesis of Mackenzie Jayne Ferrante, submitted for the degree of Master of Science with a major in Family and Consumer Sciences and titled "Photographs versus Food: Reliability of Young Children's Reported Taste Preferences Increase with Age and Familiar Foods," has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor _____ Date_____
Samantha Ramsay, Ph.D.

Committee Members

_____ Date_____
Ling-Ling Tsao, Ph.D.

_____ Date_____
Katie Brown, Ph.D.

Department Administrator

_____ Date_____
Sonya Meyer, Ph.D.

Abstract

Young children's taste preferences influence the quality of their diet. In consideration of the impact of preferences on children's food intake, it is important to have reliable methods for testing taste preferences. The purpose of this research was to investigate the reliability of food photographs versus real foods when conducting taste preference activities.

Twenty-six preschool aged children completed taste preference activities with nine food photographs and real foods. These activities were repeated twice (activity 1 & activity 2). Analysis included descriptive statistics, Cronbach's alpha, and Wilcoxon signed-rank tests. Reliability scores for food photographs versus real foods were $\alpha \geq 0.70$ during activity 1, and increased to $\alpha \geq 0.80$ during activity 2. Children three years of age had lower reliability than five-year-old children, and less familiar foods had lower reliability scores. Use of food photographs in taste preference activities is reliable; however, children's age and familiarity with foods should be considered.

Acknowledgements

I would first like to acknowledge my favorite ladies: my best friends, Stacy Jeremiah, Renee Herman, Liz Sugiura, and Jessica Soga, and my research cohort, Jennie Davis, Lauren Keeney, and Samantha Worden. I am so lucky to have such a strong group of people backing me up. To my family, Sherri, Joseph, and Alex Ferrante, thank you for your support and love during all of my phases of life, especially the ones that have mattered the most. I would like to acknowledge my committee members, Dr. Katie Brown for helping me with my statistics, and Dr. Ling Ling Tsao, for being the first person to tell me that I had a knack for research. My final acknowledgements will be to my husband, Michael Benedict, and my Major Professor, Dr. Samantha Ramsay, both of whom have been instrumental to my success. Michael, thank you for allowing me to grow and change, for being so supportive through this whole process, and for loving me. Dr. Ramsay, thank you for challenging me, giving me so many amazing opportunities, and for your incredible guidance and mentorship. I am truly lucky to have you all.

Table of Contents

List of Tables

List of Figures

Chapter One

Introduction

Optimizing health starts at a young age, and healthful living patterns in early childhood can reduce the risk for many diseases (World Health Organization, 2002; U.S. Department of Health and Human Services, 2012). What children prefer to eat has a large influence on their food consumption and future health status (Jaramillo, Yang, Hughes, Orlet Fisher, Morales, & Nicklas, 2006). Children are in a malleable developmental period, and there is ample opportunity to establish healthy habits and food preferences (Anzman, Rollins, & Birch, 2010). Young children's preferences and food choices directly relate to the amount and quality of nutrients children ingest (Casey & Rozin, 1989). For example, children's preferences for fruits and vegetables are directly related to their consumption of those foods (Domel, Thompson, Davis, Baranowski, T., Leonard, & Baranowski, J., 1996), and low intake of fruits and vegetables is associated with chronic diseases such as cardiovascular disease, cancers, diabetes, and osteoporosis (United States Department of Agriculture, 2010).

While many factors influence the intake patterns of adults (Drewnowski, 1997), children eat what they prefer (Birch, 1979). Taste preferences are the primary factor determining children's food intake (Birch, 1999; Calfas, Sallis, & Nader, 1991; Domel et al, 1996; Guthrie, Rapoport, & Wardle, 2000; Mielby, Edelenbos, & Thybo, 2012; Resnicow, Davis-Hearn, Smith, Baranowski, T., Lin, Baranowski, J., Doyle, & Wang, 1997). Children's taste preferences continue through adulthood (Branen & Fletcher, 1999; Jaramillo et al., 2006; Ramsay, Rudley, Tonnemaker, & Price, 2015) and many children form lasting taste preferences as early as two or three years of age (Skinner, Carruth, Bounds, & Ziegler, 2002). Supporting children to accept novel foods and previously rejected foods is an important part of establishing a healthy diet (Skinner et al., 2002).

In consideration of the role preferences have in children's food intake, it is important to have reliable and valid methods for testing young children's taste preferences (Guthrie et al., 2000).

Reliable methods for determining taste preferences in children have been reported, with the most recognized and standard method being the "taste and rate" (Birch, 1979; Birch & Sullivan, 1991). While the method has been tested for validity, reliability, and is consistently used in research, using real food can be impractical (Jaramillo et al., 2006). An alternative approach is to use photographs, a less expensive, efficient, and standardized approach (Calfas et al., 1991; Jaramillo et al., 2006). However, research on the reliability of using photographs to test young children's taste preferences has indicated a need to confirm these findings and address gaps (Calfas et al., 1991; Guthrie et al., 2000; Jaramillo et al., 2006).

Previous research has shown that photographs can be reliable indicators of children's taste preferences when using the "taste and rate" method depending on the age and type of foods presented (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen, Kildegaard, Gabrielsen, Thybo, & Moller, 2012). A few studies have examined the approach with three to five year old children (Guthrie et al., 2000; Jaramillo et al., 2006; Carraway-Stage et al., 2013), but a greater number of studies included older children (Calfas et al, 1991; Olsen, et al 2012; Vereecken, Vandervorst, Nicklas, Covents, & Maes, 2010). In addition, many of the studies used familiar fruits and vegetables (Carraway-Stage et al, 2013; Jaramillo et al, 2006; Vereecken et al., 2010;) but foods from all four food groups were used less frequently. Though few studies evaluated the use of food photographs to the use of real food in taste preference activities (Carraway-Stage et al., 2013; Guthrie et al., 2000), many studies tested food photographs to parent reported taste preferences (Vereecken et al., 2010), observed consumption of foods (Jaramillo et al., 2006; Olsen et al., 2012), and food models (Guthrie et al., 2000). The study results indicate moderate to low reliability for use of photographs (Guthrie et al., 2000; Olsen et al., 2012; Vereecken et al., 2010), indicating a need for further research. The purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences.

Problem Statement

The most common and reliable method to assess children's taste preferences requires precise production of food in a controlled, laboratory setting (Birch & Sullivan, 1991). Determining children's taste preferences without having to invest time and money in food preparation presents a simpler, more economic approach (Jaramillo et al., 2006). Previous research has shown photographs can be reliable indicators of children's taste preferences when using the "taste and rate" method (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012). However, the reliability of using photographs to test young children's taste preferences has not been consistent with young children, indicating a need for additional research to address this gap (Calfas et al., 1991; Guthrie et al., 2000; Jaramillo et al., 2006).

Photographs may be reliable tools to measure young children's taste preferences, but age, gender, and food type could impact the reliability and has not been fully explored (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Olsen et al., 2012; Jaramillo et al., 2006;). Previous research demonstrated reliability with older age groups, (7-13 years) (Calfas et al., 1991; Kildegaard et al., 2011; Olsen et al., 2012), but there is a need to confirm reliability with preschool aged children (Carraway-Stage et al, 2013; Guthrie et al., 2000; Jaramillo et al., 2006). Two previous studies showed differences in reliability between three, four, and five year olds (Calfas et al., 1991; Guthrie et al., 2000), and both studies reported a need for further testing. Familiar fruits and vegetables have been used to determine young children's taste preferences and have been shown to be reliable (Carraway-Stage et al., 2013; Jaramillo et al., 2006), but the reliability of using food photographs and foods from all four food groups has not been examined. Previous studies focused predominantly on the "taste and rate" methods, only assessing children's liking of the food using a three- or five-point, hedonic Likert scale (Calfas et al., 1991; Carraway-Stage et al., 2013; Jaramillo et al., 2006) while children's overall rankings of their preferences for the foods have been neglected (Guthrie et al, 2000). Therefore, studies assessing the reliability of food photographs versus real food

in taste preference testing using rankings, all four food groups, and young children are needed.

Statement of Purpose

The purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences. The primary objective was to assess the reliability of young children's taste preferences of nine different food items when being presented food photographs compared to the real foods. The secondary objective was to investigate whether the reliability changes with age (three, four, or five years) and between genders (male or female). The tertiary objective was to understand if a six-week period of time would influence the reliability of food photographs versus real food. The final objective was to determine whether a difference exists in the children's overall ranking of the food photographs versus real foods.

Research Question

The primary research questions was "is the use of food photographs versus real food reliable when conducting taste preference activities with young children to determine their taste preferences of nine food items?" Follow-up questions were "does the reliability change between food photographs and real foods with age (three, four, or five years) and/or between genders (male or female)," "does the reliability of food photographs versus real food change after a six-week time period," and, "does the children's overall ranking of the foods vary between food photographs and real foods?"

Significance of Study

Taste preferences are the primary factor determining children's food intake (Birch, 1999; Calfas et al., 1991; Guthrie et al., 2000; Mielby et al., 2012). Previous research indicates the use of photographs in testing young children's taste preferences can be reliable, but further assessment of the reliability is needed (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012). Carraway-Stage et al. (2013) express the need to study a

variety of foods from different food groups and Olsen et al. (2012) suggest children's rankings of foods may be a more accurate way to validate preference testing with photographs. Calfas et al. (1991) suggests that the images of foods be 'ready to eat.' In consideration the recommendation on the use of photographs to test children's taste preferences, this study sought to expand on the current literature and assess the reliability of photographs in preference testing with young children. In addition, this research sought to address the gaps in the literature by evaluating the reliability of children's rankings of real foods versus photographs, using a variety of foods from all food groups, and assessing differences among ages and between genders.

Definition of Terms

Young children:

Refers to children who are 2-years-old to 5-years-old (USDA, 2016).

Preferences:

Selection of one item over another, liking is the basis (Rozin, 1990; Birch, 1999).

Taste Preference:

To prefer a food is to choose that food over another (Rozin, 1990).

Neophobia:

Fear of the new (Birch & Fisher, 1998).

Food Neophobia:

Fear of new foods (Birch and Fisher, 1998).

Tasting:

Placing the food inside of the mouth and chewing (Carraway-Stage et al., 2013).

Early exposure:

Introductions to new flavors and foods at an early age, including in-utero, infancy, and childhood, which can enhance liking and acceptance of flavors (Mennella & Ventura, 2010).

Table Foods:

Foods that reflect the diets, (likes and dislikes) of the adult caregivers (Birch & Dietz, 2008).

Repeated Exposure:

Introduction to a flavor or to a variety of flavors within a particular food group (e.g., fruits or vegetables) following 8-10 days of continuous food introductions (Mennella & Ventura, 2010).

Limitations

This research study has several limitations. First, the study took place in the rural town of Moscow, Idaho. Participants were primarily Caucasian and from a moderately high socio-economic status (average household income ranged between $42,000 – $51,999 per year), which may not correspond to the demographic of the United States, but gives an accurate representation of the population of Moscow, Idaho (United States Census Bureau, 2010). A majority of caregivers had the minimum of a bachelor's degree. Thus, the results may not be generalizable to children throughout the country.

The photographs were standardized to a specific amount of food and specific setting, which could indicate the food photographs appeared different from the real foods presented to the children on testing day. However this study minimized this effect by standardizing recipes for both the photographs and presented foods. The photographs displayed appropriate Child and Adult Care Food Program (CACFP) portion sizes and appropriately sized food that would minimize potential choking hazards (American Academy of Pediatrics, 2010). The real food testing was offered in "three-bite" portions, which could influence how children perceived the food. The food photographs were shown to the children in a predetermined, randomized order that did not change from activity 1 to activity 2, which could present a potential limitation. However, previous studies followed the same procedure to randomly predetermine a consistent order for the food photographs and real food tasting portions (Carraway-Stage et al., 2013; Guthrie et al., 2000).

Exposure to the food outside of the study also may present a limitation. This study did not control for the environmental factors relating to exposure to the foods prior to testing or between activity 1 and activity 2. The possibility of exposure could have influenced the children's preferences, but the purpose of this study was to investigate the reliability of food photographs and the likelihood of reliability of food photographs being affected was minimal. The sample size of the study was small (n=26), which limited advanced statistical testing, but did not limit the ability to detect patterns in reliability. Test exhaustion also could have occurred as the children rated and ranked nine different food photographs and then nine real foods, however previous literature has tested over 30 different foods with young children (Jaramillo et al., 2006). Finally, the level of hunger was not assessed prior to the testing and previous research has shown that a child's level of hunger can affect preferences (Birch & Dietz, 2008).

Summary

Optimizing health starts at a young age, and healthful living patterns in early childhood can reduce the risk for many diseases (WHO, 2002; HHS, 2012). What children prefer to eat influences their food consumption and future health status (Jaramillo et al., 2006). Young children's preferences and food choices relate to the amount and quality of nutrients they ingest (Casey & Rozin, 1989). As taste preferences are the primary factor determining children's food intake (Birch, 1999; Calfas et al., 1991; Guthrie et al., 2000; Mielby et al., 2012), reliable methods for assessing young children's taste preferences are needed (Guthrie et al., 2000).

Previous research indicates photographs can be reliable measures of young children's taste preferences, but whether photographs of foods continue to be reliable among young children of different ages, between genders, and with different food groups is not present in the literature (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012). Further research needs to include a variety of foods (Carraway-Stage et al., 2013), a standardized food display for the photographs (Olsen et al., 2012), and the use of children's rankings

of both photographs and foods in analysis.

The purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences. The first chapter provided an introduction, problem statement, purpose statement, research question, significance of study, definition of terms, and limitations of the study. The second chapter will review the literature on factors influencing children's taste preferences, current methods for assessing taste preferences, and the need to understand and study children's taste preferences. The third chapter is written as a manuscript and includes an introduction, the methodology, the results, the discussion, and implications from this research.

Chapter Two

Review of Literature

Children's taste preferences impact their food intake (Birch & Fisher, 1998; Birch, 1979; Guthrie et al., 2000; Resnicow et al., 1997), which can have important implications on health and disease state (Jaramillo et al., 2006). Many factors influence children's taste preferences (Birch & Fisher, 1998). Understanding children's taste preferences can allow for the identification and implementation of strategies that target behavior to improve their health (Birch & Fisher, 1998). Testing children's taste preferences should follow valid and reliable methods (Guthire et al., 2000). Several different methods for testing preferences are available, but "taste and rate" is the gold standard with children (Birch, 1979; Carraway-Stage et al, 2013; Jaramillo et al., 2006; Olsen et al., 2012). While this method has been used extensively, cost, time, and standardization present issues, and reinforce the need for innovative approaches to be considered in preference research (Guthrie et al., 2000). One innovative approach is the use of food photographs in lieu of real food (Carraway-Stage et al., 2013; Kildegaard, Olsen, Gabrielsen, Moller, & Thybo, 2011; Olsen et al., 2012). Whether images provide a reliable measure for young children to assess taste preferences has not been extensively studied. The purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences.

This literature review begins with the importance of the health of young children. Both the short-term consequences of poor health as well as the long-term consequences will be discussed. The importance of young children's taste preferences is then discussed, followed by the factors that influence young children's taste preferences. Internal factors (innate preferences and genetic factors) as well as external factors (repeated exposure, modeling, time of day, and cultural influences) will be reviewed. The final section will first discuss all general sensory evaluation methods used with young children and then finish by describing the literature on appropriate methods to determine young

children's taste preferences.

Importance of Nutrition and Health for Young Children

Addressing the health status and nutritional quality of children's diets is important (World Health Organization, 2013). Healthy children are better able to retain information and grow into healthy adults that contribute to the world socially and economically (WHO, 2013). Health begins at a young age and most risk factors for diseases such as diabetes, obesity, stroke, and cancer are related to lifestyle factors, particularly their food intake patterns (WHO, 2002). Early childhood malnutrition puts children at a heightened risk for some of these diseases and conditions, most notably obesity (HHS, 2012). For example, low intake of fruits and vegetables in young children is associated with many diseases, most prominently cardiovascular disease (United States Department of Agriculture, 2011), while high intake of fruits and vegetables is correlated with decreased risk for cardiovascular disease, obesity, and cancer (WHO, 2002; Miller, Moore, & Kral, 2011). Healthy living patterns in early childhood can help reduce the risk for these conditions (WHO, 2002; HHS, 2012).

Several objectives of the Healthy People 2020 are to improve the diet quality of young children, specifically through increased fruit and vegetable intake (HHS, 2012). The USDA recommends children consume three servings of vegetables and two servings of fruit a day for a total of five servings of fruit and vegetables combined (2011). However, studies have shown that young children are not getting their recommended amounts, with only 70% eating vegetables at least once per day as an individual food item (Fox et al., 2010). Within that 70%, the most commonly ingested vegetables are French fried potatoes and other fried potatoes (Fox et al., 2010). Though food consumption is influenced by a wide array of factors (Anzman, Rollins, & Birch, 2010; Birch, 1979, 1987; Birch & Fisher, 1998; Rozin, 1990), research has shown that preferences indicate intake, specifically for fruits and vegetables (Birch & Doub, 2014; Calfas et al., 1991; Carraway-Stage et al., 2013; Domel et al., 1996). Preferences, and therefore food choices, directly relate to the amount and

quality of nutrients the children ingest (Birch & Fisher, 1998; Casey & Rozin, 1989; Rozin, 1976). Understanding the factors that influence children's taste preferences is necessary for the future improvement of children's diets (Cooke, 2007), and having valid and reliable methods to test children's taste preferences will aid in this goal.

Short-Term Health Outcomes of Children's Intake

Short-term outcomes of adult feeding practices for children include influencing energy balance by affecting patterns of intake (Birch & Fisher, 1998), which has implications for disease state. Young children have high nutrient requirements relative to their energy needs (Fox et al., 2010), which leaves little room for low-nutrient, energy-dense foods. The Feeding Infants and Toddlers Study 2008 study showed that 80% of preschool children are consuming more low-nutrient, energy dense snacks and desserts than vegetables (Fox et al., 2010), and many children form lasting taste preferences as early as two or three years of age (Skinner et al., 2002). Supporting children to accept novel foods and previously rejected, nutrient dense foods is an important part of establishing a healthy diet (Skinner et al., 2002).

Many studies indicate that intake of healthful foods (fruits, vegetables, whole grains, and lean proteins) have implications for reduced risk of many disease states (WHO, 2002; Miller et al., 2011). Research on high intake of energy-dense foods has been linked to behavior related disease states (WHO, 2002; USDA, 2010). Endeavors to foster healthy eating patterns need to begin early in life (Fox et al., 2010). Early childhood is a critical stage in which young children transition from predominantly milk to predominantly table foods creating an opportunity to expose children to foods (Birch & Dietz, 2008). This is the stage where food becomes self-selected, which makes it especially important that children learn to prefer nutritious foods (Birch & Dietz, 2008).

Long Term Health Outcomes of Children's Preferences

What children prefer will influence their health status in the future (Jaramillo et al., 2006; Ramsay et al., 2015). Literature suggests a wide variety of flavor experiences in utero and in early

childhood can lead to better long-term dietary outcomes (Birch & Dietz, 2008; Cooke & Fildes, 2011). The World Cancer Research Fund (2015) states that diet and behavior changes are paramount in protecting against non-communicable diseases. An estimated 80% of deaths from non-communicable diseases are the result of one of four main disease states: cancer, cardiovascular disease, respiratory disease, and diabetes (WHO, 2013). These disease states are highly linked to poor diet and overweight/obesity (WCRF, 2015).

Children who are overweight or obese have long-term effects on a society (i.e. lost productivity, disability, and early death) (Seidel, 1998), and childhood overweight/obesity is more likely to be carried into adulthood (Birch & Dietz, 2008). Children who consume a greater amount of fruit and vegetables are more likely to have a healthy body weight, reducing their risk for diseases such as type 2 diabetes (Miller et al., 2011). Establishing healthy patterns early in life is important to reduce the risk of these disease states (Birch, 2008). Food preferences are in part learned, and fostering healthful preferences can lead to adults with healthier food patterns (Jaramillo et al., 2006) and decreased risk for mortality from preventable diseases (WHO, 2002).

The Importance of Young Children's Taste Preferences to Support Health

Children's taste preferences are an indicator of children's food choices (Birch, 1979; Guthrie et al., 2000; Resnicow et al., 1997). Preferences, and therefore food choices, directly relate to the amount and quality of nutrients children ingest (Birch & Fisher, 1998; Casey & Rozin, 1989). A child's greater preference for a food could increase the consumption of that food (Anzman-Frasca, Savage, Marini, Fischer, & Birch, 2012; Birch & Fisher, 1998). This preference is directly affected by their early food experiences including modeling, accessibility, and environment (Anzman et al., 2010; Birch, 1979, 1987; Birch & Fisher, 1998; Rozin, 1990). A tremendous amount of learning occurs during infancy and childhood, and much of this learning involves what and how to eat (Mennella & Ventura, 2010). Since young children are in a malleable developmental period, there is ample opportunity to establish healthy habits and preferences (Anzman et al., 2010).

Factors Influencing Young Children's Taste Preferences

Internal and external factors work in conjunction to influence children's food preferences (Birch, 1999; Ventura & Worobey, 2013). While many factors influence the intake patterns of adults (Drewnowski, 1997) taste is the primary indicator of consumption with children (Birch, 1999; Calfas et al., 1991; Guthrie et al., 2000; Mielby et al., 2012). Children with a range of taste preferences will often carry those preferences into adulthood (Branen & Fletcher, 1999; Jaramillo et al, 2006; Ramsay et al., 2015; Rozin, 1990). However, smaller contributions from genetic factors are reported with a larger contribution from environmental factors (Birch, 1999; Birch & Fisher, 1998). The factors are grouped into internal and external factors. Internal factors include heritable factors, prenatal development, innate responses (flavor exposure in amniotic fluid and evolutionary preferences), breastfeeding and bottle-feeding, early childhood development, and food neophobia. External factors include parent & peer models, culture, and experiences (repeated exposure, time of day, portion size). All factors are described in detail below.

Internal Factors Affecting Young Children's Taste Preferences

Internal factors begin with the ability to form taste preferences in utero as the gustatory and olfactory systems develop (Venture & Worobey, 2013). Heritable factors are, in part, responsible for the development of taste preferences (Breen, Plomin, & Wardle, 2006; Falciglia & Norton, 1994), but amniotic fluid and breast milk flavor exposure also play a role (Mennella & Ventura, 2003). Innate factors influence taste preferences through early childhood (Ventura & Worobey, 2013) and food neophobia can influence children's preference for foods (Birch & Fisher, 1998). Self-efficacy also impacts children's food preferences (Domel et al., 1996; Resnicow et al., 1997). Each internal factor is described in detail.

Internal Factors Influencing Taste Preferences: Heritable Factors. Heritable factors are a part of the development of taste preferences (Breen et al., 2006; Falciglia & Norton, 1994). Several

studies using dizygotous and monozygotous twins have shown a genetic component in taste preferences (Falciglia & Norton, 1994). This can be seen in children who have the bitter-sensitive gene, TAS2R38, which shows sensitivity to 6-n-propylthiouracil (PROP) substance (a bitter substance) (Mennella, Pepino, & Reed, 2005). Those with this gene have a higher preference for sweet flavors due to the ability to taste bitter flavors more strongly than those who do not have this specific gene (Mennella et al., 2005). Genetic influences may be more strongly represented in overall macronutrient intake versus specific food preference (Reed, Bachmanov, Beauchamp, Tordoff, & Price, 1997; Breen et al., 2006), as there are gene receptors for specific micro- and macronutrients (Breen et al., 2006). Even so, heritable factors influencing taste preferences are minimal, as repeated exposure can override a genetic predisposition (Rozin, 1990; Birch 1979).

Internal Factors Influencing Taste Preferences: In Utero Development. The ability to form taste preferences begins in utero with the development of the gustatory and olfactory systems (Venture & Worobey, 2013). Neonatal responses to bitter and sweet flavors provides evidence to the early ability of the olfactory processes of human fetuses and neonates (Soussignan, Schall, Marlier, and Jiang, 1997). The initial exposure of humans to flavors comes through three sequential mediums: amniotic fluid, breast milk/formula, and finally solid foods (Mennella & Ventura, 2010). Olfactory and gustatory systems begin developing in the first eight weeks, giving the fetus the capacity to be influenced by exposure to tastes and smells through amniotic fluid and upon birth and exposure to breast milk (Mennella, Jagnow, & Beauchamp, 2001; Ventura & Worobey, 2013). In the final trimester, the olfactory and gustatory systems are communicating with the central nervous systems (Ganchrow & Mennella, 2003) regarding the flavors experienced by the fetus through amniotic fluid (Ganchrow & Mennella, 2003). This chance for early learning is theorized to prepare the infant for exposure after birth (Ventura & Worobey, 2013; Mennella & Ventura, 2010) and literature suggests a wide variety of flavor experiences in utero can lead to better long-term dietary outcomes (Cooke & Fildes, 2011).

Internal Factors Influencing Taste Preferences: Flavor Exposure In Breast Milk. Transmission of flavors via breast milk is the next medium in early childhood taste preference development (Mennella & Ventura, 2010). Flavor memories created during prenatal amniotic fluid exposure are reinforced when infants are fed breast milk (Mennella & Ventura, 2010). Flavors of food ingested by mothers are transferred into human breast milk, though the amount and strength of the flavor compounds is individualized (Hausner, Bredie, Molgaard, Christian, Petersen, & Moller, 2008). The flavors transmitted via breast milk or flavors specific to formulas can influence children's taste preferences later in life (Mennella & Beauchamp, 2002). For example four and five year old children fed a protein hydrolysate formula during infancy were more accepting of the sensory attributes associated with the formula (sour flavor and aroma) than children who had not been fed this type of formula (Mennella & Beauchamp, 2002), and children whose mothers had consumed carrots and carrot juice during pregnancy and while breast feeding were more prone to accept the carrots during infancy (Mennella et al., 2001). Children, whose mothers consumed specific flavors during pregnancy and breast feeding, are more accepting of those flavors during early childhood (Mennella, Kennedy, & Beauchamp, 2006).

Internal Factors Influencing Taste Preferences: Innate Factors. Innate taste preferences that can be seen in human fetuses and neonates continue through early childhood (Ventura & Worobey, 2013). Children are predisposed to prefer sweeter foods, possibly due to the physiological implications of their energy density (Birch & Fisher, 1998) as well as the implications of avoiding toxic or rancid foods, which are typically bitter (Rozin, 1990; Ventura & Worobey, 2013). As a result of these innate preferences, children prefer sweet and salty flavors to those that are bitter and sour (Birch, 1999; Birch & Fisher, 1998; Birch & Doub, 2014). Facial analysis of three-day-old neonates has shown hedonic preferences for sweet odors over bitter or sour (Soussignan et al., 1997). The initial rejection of bitter foods seems to be protective as young children are still learning what to

eat (Mennella & Ventura, 2010).

Internal Factors Influencing Taste Preferences: Food Neophobia. Children demonstrate greater food neophobia after solid food introduction, around the age of two (Ventura & Worobey, 2013), which can influence children's preference for foods (Birch & Fisher, 1998). As omnivores, humans have the flexibility to consume many different types of foods, but this could be dangerous since children could consume harmful, non-edible substances (Rozin, 1976). In evolutionary terms, novel foods may present a wanted source of nutrients but could also present illness or death (Rozin, 1976; Cooke, 2007). Food neophobia is thought to be an adaptive mechanism to help with selection of foods, and therefore food preferences (Pliner, Pelchat, & Grabski, 1993). Fortunately, food neophobia is a transitory phase, and does not have a lasting effect on children's eating habits (Cooke, 2007) if appropriate feeding practices are followed (Branen & Fletcher, 1999).

Internal Factors Influencing Taste Preferences: Early Sensory Development. The sensory ability of infants is on par with that of adults; and many infants at only 12 days old can distinguish the scents of their mothers (Feldman, 2009). In postnatal studies infants were able to show distinguished expressions of pleasure or disgust when olfactory stimuli was introduced (Soussignan et al, 1997). As children grow, their gustatory and olfactory systems develop and mature (Feldman, 2009). Evidence has shown that infants have a shift in developmental flavor perceptions in the first few months of life (Birch, 1999), which could be due to children's gustatory and olfactory system development dependency on maturing neural systems (Ganchrow & Mennella, 2003).

Internal Factors Influencing Taste Preferences: Cognitive Development. Children's development of emotional and cognitive skills may affect their food preferences (Reniscow et al., 1997). Children move through stages of behavior and cognitive development as they learn how and what to eat (Resnicow et al., 1997; Domel et al., 1996). Young children are in a preoperational thinking stage and symbolism is important at this stage (Piaget, 1964). This indicates that foods may become objects in which children associate a feeling or an idea (Feldman, 2009), which could affect

taste preferences. Self-efficacy also has a large role in children's food selection (Reniscow et al., 1997). Previous research examining seven- to eleven-year-old children's level of confidence in selection and preparation of vegetables and fruits for meals and snacks has shown that children who reported they are able to choose a vegetable will be more likely to prefer and eat that vegetable (Resnicow et al., 1997; Domel et al., 1996). Young children's food preferences will grow and mature as they grow and mature (Drewnowski, 1997).

Children's food preferences are, at least partially, a result of basic biology (Mennella & Ventura, 2010). However, the largest contributions to children's taste preferences come from external factors with smaller contributions from genetic factors (Birch, 1999; Birch & Fisher, 1998). Thus, it is important to understand the external factors affecting young children's preferences.

External Factors Influencing Taste Preferences

External factors impact young children's sustained preferences and the most influential external factor is exposure (Anzman et al., 2010; Birch, 1979, 1987; Birch & Fisher, 1998; Mennella & Ventura, 2003; Rozin, 1990). Parents are considered "gatekeepers" and can influence children's food preferences (Anzman et al., 2010). The social context in which children eat also can affect their preferences (Birch & Doub, 2014; Birch & Fisher, 1998; Rozin, 1990). Human beings are affected by their peers and social influence may be one of the strongest factors to increasing liking of foods (Rozin, 1990). Each external factor is discussed in detail.

External Factors Influencing Taste Preferences: Exposure. Young children's food preferences are, in large part, directly affected by their early exposure to food (Anzman et al., 2010; Birch, 1979, 1987; Birch & Fisher, 1998; Birch & Marlin, 1982; Mennella & Ventura, 2003; Rozin, 1990). The effects of early exposure continue throughout childhood (Mennella et al., 2001) and as children grow repeated exposure becomes one of the most effective factors in children's food preference development (Birch & Dietz, 2008). Familiarity of food is a necessary and universal concept seen in many different mammals (Rozin, 1976). Early learning and preferences are

dependent on parents providing ample opportunity to expose children to a wide array of tastes and flavors (Anzman et al., 2010; Anzman-Frasca et al., 2012; Birch & Doub, 2014;). Any predispositions children have with food can be readily changed through exposure (Birch, 1999; Anzman-Frasca et al., 2012; Birch & Doub, 2014). Therefore, exposure to foods builds acceptance of foods (Anzman-Frasca et al, 2012; Birch, 1987,1999; Birch & Fisher 1998; Birch & Doub, 2014; Rozin, 1990). Children need multiple exposures prior to liking a food (Birch & Marlin, 1982), indicating that foods should be offered an unlimited amount of times. Birch (1979) explains that exposure leads to familiarity, and that familiarity is displayed as increased liking. Repeated exposure to foods has the potential to offset food neophobia and previous dislike (Cooke, 2007).

External Factors Influencing Taste Preferences: Parents & Culture. Parents are considered "gatekeepers" and can influence children's food preferences (Anzman et al., 2010). Young children's diets are reflective of their food environments and the patterns of the household (Fox et al., 2010). Family members will likely prefer the same foods (Calfas et al., 1991). Parents and caregivers shape the eating environment for young children and influence the flavors that are familiar to the child (Birch, 1999; Birch & Doub, 2014; Birch & Fisher, 1998). Young children learn from the food experiences made available by their parents (Anzman et al., 2010), the behaviors parents model during mealtimes, and the interaction with children at mealtimes (Birch & Fisher, 1998). A parent's intention to control the eating patterns and food selection of their children also can influence the foods their children prefer (Birch & Fisher 1998).

Cultural influences from elders influence children's food acceptance (Birch, Billman, & Richards, 1984). Children learn about the rules of appropriateness of foods related to the cultural conceptions of foods (Birch et al., 1984). The social context in which children eat can affect their preferences (Birch & Fisher, 1998; Birch & Doub, 2014; Rozin, 1990) as social situations provide ample opportunity for knowledge transfer regarding foods (Rozin, 1976).

External Factors Influencing Taste Preferences: Peers. Young children's preferences will

be affected by observations of peers with foods (Birch & Fisher, 1998; Birch & Doub, 2014). Human beings are greatly affected by the influence of their peers, and social influence may be one of the strongest factors to increasing liking of foods (Rozin, 1990). Peer models' influence can be substantial and long lasting (Birch, 1987; Rozin, 1990). In fact, a child's chance of ingesting a disliked food increased when they saw another child eat that same food (Birch, 1980). This effect is increased with the age of the peer model (Birch, 1980) as older peer models are powerful influencers.

Other External Factors Influencing Taste Preferences. Many factors can influence children's taste preferences (Birch, 1999). Coercion and pressure negatively affect children's taste preferences (Galloway, Fiorito, Francis, & Birch, 2006). If a child has just ingested a particular food, his or her preference for that food may decrease slightly if he/she is exposed again too quickly (Birch, 1987). The caloric density of a food may also affect a child's preference for that food as young children may prefer flavor associated with higher energy-density (Birch, McPhee, Steinburg, & Sullivan, 1989). Time of day can be a factor in children's acceptance of foods, whereas certain beliefs about when foods should be eaten may influence a child's preference for that food if it is offered at the incorrect time (Birch, 1984). Sensory aspects of the food also can have an effect on preferences (Kildegaard et al., 2011). Varying brightness of colors as well as texture can influence children's preference for a given food (Kildegaard et al, 2011). In consideration of the impact taste preferences have in children's food intake, it is important to have reliable and valid methods for testing young children's taste preferences (Guthrie et al., 2000).

Previous Taste Preference Testing Methods

Many reliable methods have been established to gather and measure young children's taste preferences (Kildegaard et al., 2011). The sensory tests reported in the literature vary by sample size, population, and the product or goal of the testing (Mielby et al., 2012). Young children are limited in their cognitive ability, communication skills, and attention span (Piaget, 1964), which makes the type

of test used in taste preference testing important (Popper & Kroll, 2003). Sensory tests used for adults are not appropriate for children (Liem, Mars, de Graaf, 2004). Pictorial hedonic scales and Likert scales are effective in preference testing children because children can associate faces with different emotions rather than strictly using the word 'liking' to distinguish the preference for food (Popper & Kroll, 2003). Paired-comparison and rank-order testing has been widely used with young children (Birch, 1979, 1980; Guthrie et al., 2000). Three, five, seven, and nine point scales have been used with young children, though nine point scales become ambiguous with young children (Popper & Kroll, 2003). Best-worst testing is a newer method to discern taste preferences, but has limited testing with young children (Mielby et al., 2012). The paired comparison testing has shown very limited reliability with three and four year old children (Calfas et al., 1991). The simplest method to test preferences is by using a list of foods and asking the children to rate them (Guthrie et al., 2000). Although this method has not been evaluated with children less than five years of age (Guthrie et al., 2000). Parent reporting of children's taste preferences has been tested (Vereecken et al., 2010), while it is a cost effective and easy method, it is highly imperfect as parent knowledge of children's consumption and liking can be limited (Calfas et al., 1991; Vereecken et al., 2010), and biased. Of those methods, the gold standard is the "taste and rate" method (Birch, 1979; Birch & Sullivan, 1991).

Limitations to Taste Preference Testing with Young Children

Limitations are evident when conducting sensory taste preference tests with young children (Liem et al., 2004). Children's attention spans can be a limiting factor in taste preference testing (Guinard, 2001; Popper & Kroll, 2003). Group interviews are not an option with this age group, so one-on-one interviews must be conducted (Popper & Kroll, 2003). Children's limited verbal ability also eliminates many sensory applications, such as descriptive analysis (Guinard, 2001). Young children also have limited comprehension skills (Guinard, 2001; Piaget, 1964).

Young children typically evaluate food on one sensory characteristic at a time (i.e. color,

shape, size, etc.) (Guinard, 2001), which can influence their selections. Though children may be limited in their ability to classify many different types of foods (Nguyen, 2007) children are highly capable of expressing their liking of particular foods and their degree of liking (Guinard, 2001).

New Technologies in Taste Preference Testing

Many new technologies have made preference testing more feasible (Kildegaard et al., 2011; Olsen et al., 2012). Testing with computer images can be inexpensive and reach a wide array of people in a quick manner (Olsen et al., 2012). Photographs are a reasonable way to test children's taste preferences especially when asking children to use a hedonic scale to rate the foods; though it has not been extensively tested for reliability (Carraway-Stage et al., 2013; Olsen et al., 2012). The use of photographs has made preference testing more accessible to researchers (Kildegaard et al., 2011; Olsen et al., 2012).

Use of Images in Taste Preference Testing

Computerized pictures and pictorial methods could be quick and efficient ways to test children's taste preferences (Calfas et al., 1991; Carraway-Stage et al, 2013; Guthrie et al., 2000; Kildegaard et al., 2011; Olsen et al., 2012). Photographs also have helped to standardize preference testing (Calfas et al., 1991), ensuring that those who are being tested see the foods the same way at every test. This could lead to the advantage of testing a large number of foods at one time (Guthrie et al., 2000), and also lead to the ability to test larger populations of participants (Calfas et al., 1991; Olsen et al., 2012). Photographs are a promising way to assess young children's taste preferences due to their standardization and cost effective nature (Carraway-Stage et al., 2013; Kildegaard et al., 2011; Olsen et al., 2012). They are time efficient and economical (Jaramillo et al., 2006). However, the use of pictures is recommended to be paired with food to increase reliability (Guinard, 2001), and the foods pictured need to be the same as the foods being offered (Kildegaard et al., 2011).

Previous Literature on Testing Taste Preferences

Many studies assessed the reliability of different methods used to test children's taste

preferences (Guthrie et al., 2000). Though comparison of these studies is difficult due to the different testing methods have been used (Duo-trio, paired-comparison, ratings and rankings) (Guthrie et al., 2000), many of the studies confirmed photographs can be used reliably to test children's taste preferences (Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012).

Photographs may be reliable tools to measure young children's taste preferences, but age, gender, and food type could impact the reliability and has not been fully explored (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Olsen et al., 2012; Jaramillo et al., 2006). Previous research demonstrated reliability with older age groups, (7-13 years) (Calfas et al., 1991; Kildegaard et al., 2011; Olsen et al., 2012), but there is a need to confirm reliability with preschool aged children (Carraway-Stage et al, 2013; Guthrie et al., 2000; Jaramillo et al., 2006). Two previous studies illustrated the differences in reliability between three, four, and five year old children when using food photographs to test children's taste preferences (Calfas et al., 1991; Guthrie et al., 2000). Both studies showed that three-year-old children report the lowest reliability when using photographs and five-year-old children have the highest reliability of the young children, but both studies reported a need for further testing (Calfas et al., 1991; Guthrie et al., 2000). Use of familiar fruits and vegetables can be reliable in assessing children's taste preferences (Carraway-Stage et al., 2013; Jaramillo et al., 2006), but the reliability of using photographs and foods from all four food groups has not been examined. Previous studies also focused on the "taste and rate" methods, only assessing children's liking of the food using a three- or five-point, hedonic Likert scale (Calfas et al., 1991; Carraway-Stage et al., 2013; Jaramillo et al., 2006) while children's overall rankings of their preferences for the foods have been neglected (Guthrie et al, 2000). Therefore, studies assessing the reliability of food photographs versus real food in taste preference testing using rankings, all four food groups, and young children are needed.

Summary

Addressing the health status and nutritional quality of children's diets is important (WHO, 2013). What children prefer will influence their health status in the future (Jaramillo et al., 2006; Rudley & Ramsay, 2014) as taste preferences are the primary factor determining children's food intake (Birch, 1979; Guthrie et al., 2000; Resnicow et al., 1997). Many factors influence children's taste preferences (Birch, 1999; Ventura & Worobey, 2013), both internal and external (Birch, 1999). Reliable methods to determine children's taste preferences may be used to help foster strategies to increase liking of nutrient dense foods.

Many reliable methods have been established to gather and measure young children's taste preferences (Kildegaard et al., 2011), and new technologies have made preference testing more accessible (Kildegaard et al., 2011; Olsen et al., 2012). Computerized pictures and pictorial methods could be quick and efficient ways to test children's taste preferences (Calfas et al., 1991; Carraway-Stage et al, 2013; Guthrie et al., 2000; Kildegaard et al., 2011; Olsen et al., 2012). The reliability of different methods used to assess children's taste preferences using those new technologies have been studied (Guthrie et al., 2000), but gaps in the literature indicate a need for more research.

Previous research in children's taste preference testing has shown that photographs can be used as reliable measures when testing young children's taste preferences, but further validation of the reliability of this method is needed (Calfas et al., 1991; Carraway-Stage et al., 2013; Guinard et al., 2001; Guthrie et al., 2000; Jaramillo et al., 2006; Liem, Zandstra, & Thomas, 2010; Olsen et al, 2012). Gaps in the literature include reliability across age and gender, the variety of foods chosen (Carraway-Stage et al., 2013), the setting for the photographs (Olsen et al., 2012), and the analysis of children's rankings of both photographs and foods. Therefore, the purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences.

Chapter Three

Photographs versus Food: Reliability of Young Children's Reported Taste Preferences Increase with Age and Familiar Foods

Introduction

Healthful eating patterns in early childhood can reduce the risk for many diseases (WHO, 2002; HHS, 2012), and what children prefer to eat influences the food and nutrients consumed (Casey & Rozin, 1989; Domel et al., 1996), thus influencing their future health status (Jaramillo et al., 2006). Children are in a malleable developmental period, which presents an opportunity to establish healthy habits and preferences (Anzman et al., 2010). Taste preferences are the primary factor determining children's food intake (Birch, 1999; Calfas et al., 1991; Guthrie et al., 2000; Mielby et al., 2012). Taste preferences established in childhood often continue into adulthood (Branen & Fletcher, 1999; Jaramillo et al., 2006; Ramsay et al., 2015). Reinforcing children's taste preferences for nutrient dense foods has implications for disease prevention (Casey & Rozin, 1989; Skinner et al., 2002).

The method of assessing children's taste preferences can be useful to identify and develop strategies to reinforce healthful eating patterns, thus indicating a need for reliable and valid methods for testing young children's taste preferences (Birch, 1979; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012). However, the reliable methods for determining taste preferences in young children often rely on using real food, and such methods may be difficult without the tools and ease of a laboratory (Calfas et al., 2001; Guthrie et al., 2000; Olsen et al., 2012).

Methods to determine taste preferences without the use of food have been examined: parent reported preferences have been compared to children's reported preferences (Vereecken et al., 2010), food models have been used in lieu of food (Guthrie et al., 2000), as well as the use of photographs and computer images (Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen

et al., 2012). All of which have been shown to have moderate to low reliability (Guthrie et al., 2000; Olsen et al., 2012; Vereecken et al., 2010), although photographs have, thus far, shown higher reliability (Carraway-Stage et al, 2013; Jaramillo et al., 2006; Olsen et al., 2012). Use of photographs could provide a less expensive and efficient alternative in lieu of food for preference testing activities (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Kildegaard et al., 2011; Olsen et al., 2012).

Previous research has shown that photographs can be reliable indicators of children's taste preferences when using the "taste and rate" method (Calfas et al, 1991; Carraway-Stage et al, 2013; Guthrie et al, 2000; Jaramillo et al, 2006; Olsen et al, 2012). Some of this research examined the use of photographs with three- to five-year-old children (Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006), while other research was conducted with older children (Calfas et al., 1991; Olsen et al., 2012; Vereecken et al., 2010). In addition, many of the studies only tested familiar fruits and vegetables (Carraway-Stage et al., 2013; Jaramillo et al., 2006; Vereecken et al., 2010;) instead of using all four food groups. Though previous research compared the use of photographs to the use of real food in children's taste preference activities (Carraway-Stage et al., 2013; Guthrie et al., 2000), other studies tested against parent reported preferences (Vereecken et al., 2010), observed consumption of the foods (Jaramillo et al., 2006; Olsen et al., 2012), and food models (Guthrie et al., 2000). All of which have been shown to have moderate to low reliability (Guthrie et al., 2000; Olsen et al., 2012; Vereecken et al., 2010). Because reliable methods to determine children's taste preferences can be useful to identify and develop strategies to increase liking of nutrient dense foods, gaps in previous literature regarding age and gender, method of comparison, and familiarity of food need to be addressed.

The purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences. The primary objective was to assess the reliability of young children's

taste preferences of nine different food items when being presented food photographs compared to the real foods. The secondary objective was to investigate whether the reliability changes with age (three, four, or five years) and between genders (male or female). The tertiary objective was to identify whether reliability of food photographs versus real food would change after a six-week period of time. The final objective was to determine whether a difference exists in the children's overall ranking of the food photographs versus real foods.

Methods

To evaluate the reliability of assessing young children's taste preferences using food photographs versus real foods, twenty-six children, aged 38 to 71 months (μ=51), were recruited from the Child Development Lab at the University of Idaho in Moscow, Idaho as part of a larger study. Children participated in two taste preference activities (activity 1 and activity 2) scheduled six weeks apart. The activities were conducted by the first author and second author with a reliability score of 82%. Both taste preference activities followed the same procedure described below. This study was approved by the University of Idaho Institutional Review Board.

Recruitment. Participants were recruited using several approaches. The first was through the University of Idaho's Child Development Laboratory (CDL), a nationally accredited educational facility that serves three- to five-year-old children in Moscow, Idaho. Their goal is to provide developmentally appropriate and high quality education for children, and serve as an early childhood research setting. Parents of children at the CDL were given fliers (See Appendix F) with information about the study, contact information for the first author and second author, as well as an opportunity to ask the second author questions. Children also were recruited from the University of Idaho's Children's Center, a child care center located on the University of Idaho campus that serves families with children ages 6 weeks to 6 years of age. Fliers (See Appendix F) were placed at the front desk of the Children's Center.

Additional participants were recruited through the use of fliers (See Appendix F) posted

around the town of Moscow, Idaho. Fliers were distributed to locations such as grocery stores, children's consignment stores, and local elementary schools. Parents were then directed to the first author who completed a parent pre-screening to ensure the child was of the specified age, had no food allergies, and had no developmental concerns. Written parent consent was collected and child assent was obtained prior to each tasting activity.

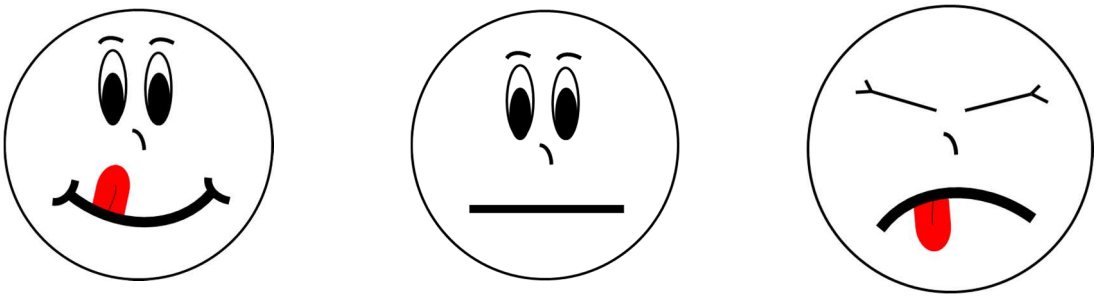
Food Selection for the Tasting Activities. At each taste preference activity, nine foods were presented to each child first as photographs and then in tasting portions. The nine foods selected were: boiled red potatoes, traditional hummus, hard boiled eggs, boiled broccoli, cooked quinoa, boiled lentils, whole wheat bread, diced tomatoes, and cooked brown rice. Each item was selected based on several qualities including palatability (a balance of palatable and non-palatable foods), familiarity, and macronutrient type in accordance with the food groups (USDA, 2015). Several experts, including two child feeding experts, a registered dietitian nutritionist, a child development expert, and the director of the child development lab, were consulted in the selection of the nine foods. The foods were prepared with no spices or flavorings (See Appendix E). The recipes and cooking methods were consistent throughout the study, and the food items were prepared by trained research assistants for both the photographs and the tasting portions. To minimize potential food safety issues, the prepared tasting portions were kept refrigerated. Twenty minutes prior to each tasting activity the foods were removed from the refrigerator and reached room temperature prior to serving.

Development of Food Photographs for the Tasting Activities. Once the recipes and cooking methods were standardized, the food was prepared and photographs were taken by a trained research assistant with a culinary background. The food was placed on child-sized plates in portions and sizes determined by Child and Adult Care Food Program (CACFP) (USDA, 2013) that were familiar to the children (See Appendix A). The size and amount varied by food due to the CACFP's recommended serving sizes and choking hazard avoidance (AAP, 2010). The photographs captured

the image of the food represented in the identical form (size, but not amount) to how the food was presented to the children during the taste preference activities. The photographs also were taken from a perspective (specific height and angle) that matched the children's view of the food when placed in front of them.

Taste Preference Activities. The tasting activities took place at the University of Idaho's Eating Laboratory designed and arranged with the intention of conducting feeding research with young children. The laboratory contained a child-sized table, two chairs, one for the researcher and one for the child as well as the necessary equipment for the tasting activity (See Appendix B). Arranged on the table was a three-point hedonic scale ("Yummy," "Just OK," and "Yucky,") (See Figure 1), water for the child, the nine photographs of the food, the nine tasting samples of the food (placed out of sight of the child), napkins, spoons, and a garbage can (placed on the floor near the child). Each child was brought into the University of Idaho's Eating Laboratory with his or her parent (the primary caregiver) who was seated in the back of the room, out of the child's direct vision to limit interactions. The first author obtained child assent by asking the question, "would you like to participate in a fun tasting activity with me?"

Figure 1: Hedonic Faces Used in Taste Preference Testing Activities



Yummy Just OK Yucky

*Faces developed by S. A. Ramsay, adapted from Birch, 1979.

To capture each child's taste preferences, a trained research assistant followed "taste and rate" protocols developed by Leanne Birch (1979), modified by Dr. Susan Johnson, and then modified again for the current study (See Appendix C). The script was not read verbatim but was

followed closely. Each face was presented to the child one at a time with a brief explanation (i.e. "This is the yummy face. This is the face that you choose when you really like a food," "This is the yucky face, this is the face you choose when you really dislike a food."). After all three faces were explained, they were mixed up and the child was asked to choose the faces that matched the descriptions ("Which face would you choose if you thought a food was really yucky?"). Children who demonstrated their understanding of the hedonic scale continued with the taste preference activity. All tasting activities were kept consistent through both activity 1 and activity 2.

Protocol to Present the Photographs During Taste Preference Activities. Once understanding of the hedonic scale was confirmed the faces were placed in order from left to right, "Yummy," "Just OK," and "Yucky." The photographs were randomized to a predetermined order (tomatoes, potatoes, quinoa, lentils, hummus, egg, rice, bread, broccoli) consistent in both activity 1 and 2. The food photographs were then presented to the child one at a time (See Appendix G). After each photograph was presented, the researcher would ask the child to identify the food by asking, "what do you see in this picture?" Once the child correctly identified the food in the picture, the child was asked to choose the face that matched their liking of the food pictured in the photograph. After the child chose the face representative to that of their taste preference, the researcher verified by asking the child, "What face is that?" and then, "does that mean you like the food and it is yummy, you think its just OK, or you think it's yucky?" When all nine photographs had been sorted into one of the three faces, each child was asked to rank the photographs of food by which food they thought was the "yummiest" and which food was the "most yucky". Starting with the "yummy" category the researcher would display the photographs the child placed in that category and asked the child to pick the food they thought was the yummiest. Once the child selected the "yummiest" photograph from the group, that photograph was removed and the question was asked again. This process continued until all nine photographs had been placed into a rank order from "most yummy" to "most yucky." Once all photographs were ranked, they were set out of the child's sight and the tasting

portions of the same foods were offered.

Protocol for Presenting the Food During the Taste Preference Activities. The nine foods were presented on a tray in two-ounce portion cups with three child-sized bites per portion cup. All foods were appropriately sized for the age group to avoid choking hazards and were prepared and presented in the method identical to the food photographs and served at room temperature. The foods were arranged on a tray in a previously assigned random order that was consistent through activity 1 and activity 2. The children were asked to self-select one of the foods to taste. They were encouraged to smell, lick, touch, or feel the food, and if they did not like it they were told it was OK to spit the food out into one of the napkins provided. The children were never forced or coerced to eat any of the foods. The order of the child's food selection was documented as well as their interaction with the foods. The children's preference for the foods followed the same procedure used for the food photographs. The children would choose a food, taste it, and then were asked to categorize it into "yummy," "just OK," or "yucky." The child's selection was verified and documented. After all foods were categorized, the child was asked to rank the foods in the same manner previously described. Once all foods were ranked, the taste preference activity was concluded and the children were offered a sticker for his/her participation. Each tasting session took approximately 15 minutes to complete. The taste preference activity was repeated using the same photographs and foods after six-weeks.

Data analysis

The purpose of this research was to investigate the reliability of food photographs versus real food when conducting taste preference activities to determine young children's taste preferences. The primary objective was to assess the reliability of young children's taste preferences of nine different food items when being presented food photographs compared to the real foods. The secondary objective was to investigate whether the reliability changes with age (three, four, or five years) and between genders (male or female). The tertiary objective was to identify whether

reliability of food photographs versus real food would change after a six-week period of time. The final objective was to determine whether a difference exists in the children's overall ranking of the food photographs versus real foods.

Descriptive statistics were completed with the demographic information and the children's reported preferences for photographs and food. A BMI Z-Score was used to account for age, sex, and growth of the children (CDC, 2000). Scores that fell between the 5th percentile and the 85th percentile indicated a child of normal or healthy weight for age (CDC, 2000). For boys 3-5 years old this range includes BMI scores from 13.96 to 18.04, for girls 3-5 years old this range includes scores from 13.64 to 17.99 (CDC, 2000). For the first objective, Cronbach's alpha was used to assess reliability between the photograph preferences and the food preferences. A reliability score greater than or equal to .70 indicated internal consistency within the preferences (0.70 is acceptable, 0.80 is good, 0.90 is high) (George & Mallery, 2003). Results of α less than .70 was considered low internal consistency (George & Mallery, 2003). Confidence intervals for all Cronbach's alpha scores also were reported at the 95% level. For the secondary objective, Cronbach's alpha was used to identify the reliability within the different age groups (3, 4, and 5 years) as well as gender (male and female). Descriptive statistics were used to report the differences between the reliability scores for age and gender as well as the differences between the overall Cronbach's for the two tasting activities. A Wilcoxon signed rank test was used for analysis to understand the differences between the rank orders of the photographs and the rank orders of the foods. Significance was $p \leq .05$ level. All analyses were conducted using IBM Statistical Package for the Social Sciences (SPSS version 23.0).

Results

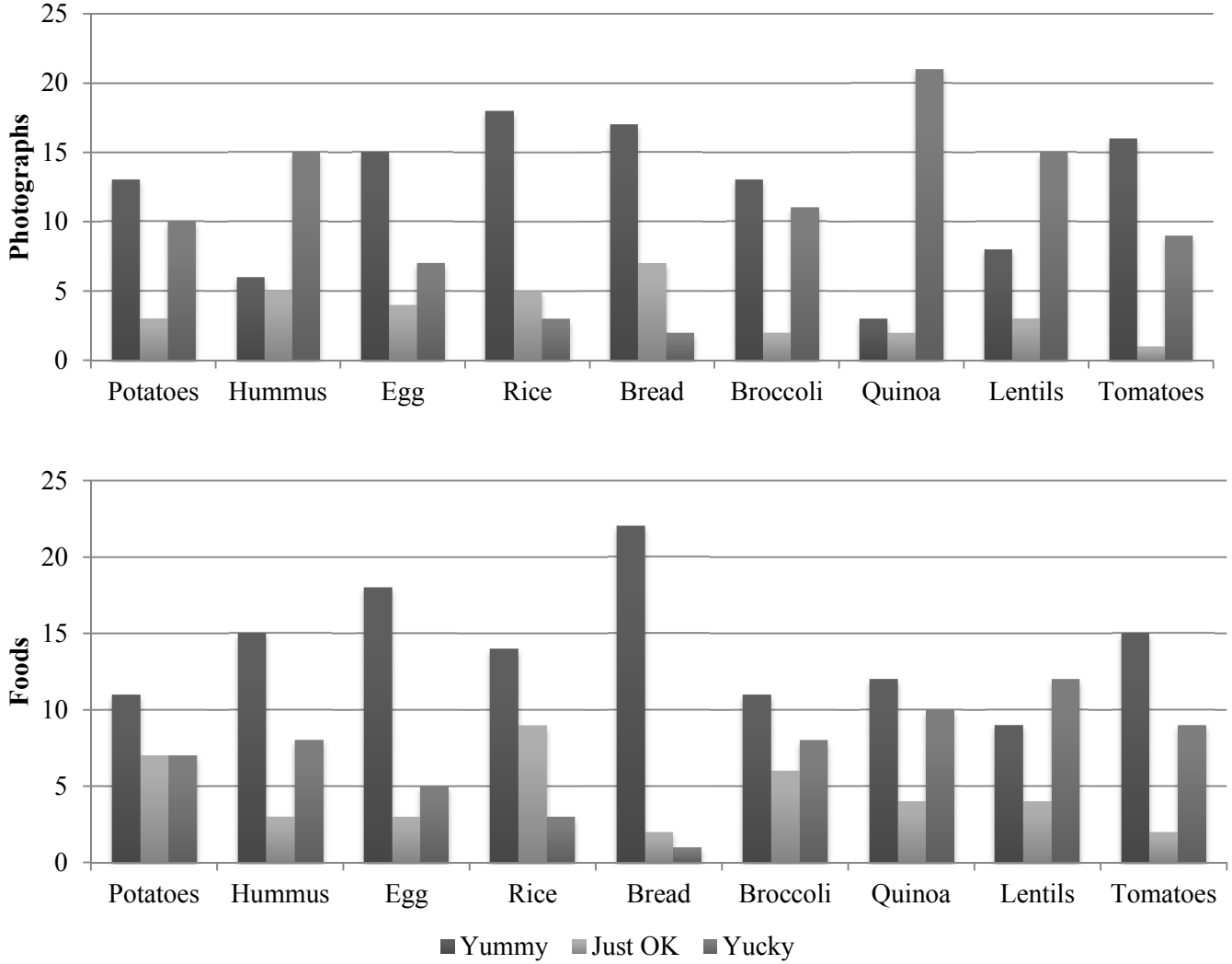
Demographics. Twenty-six children participated in taste preference activity 1 and activity 2. The children, ten boys (40%) and sixteen girls (60%), ranged in age from 38 to 71 months of age (μ=51). Ninety-six percent (n=25) of participants were non-Hispanic white and four percent (n=1) were Asian. BMIs for the children ranged from 14.6 to 21.3 (μ = 16.08) and Z-Scores for a majority

of the children ranged from -1 to 1 ($\mu = 0.10$) with two children who had a Z-Score of >2. Most children (n=10) were in preschool, while thirty-one percent (n=8) did not attend any form of child care or school. The remainder of the children were in varied child care settings (n=8).

A majority of the primary caregivers involved in the study were female (96%) and had an average Body Mass Index (BMI) of twenty-eight, and all of the primary caregivers had a minimum of a high school diploma. A majority of the primary caregivers of the children had completed at least four years of college (62.5%, n=16). Fifty percent of the primary caregivers (n=13) had no background in nutrition and thirty-five percent (n=9) had taken at least one college nutrition course. The population was predominantly high socio-economic status with the average household income ranging $42,000 – $51,999 per year.

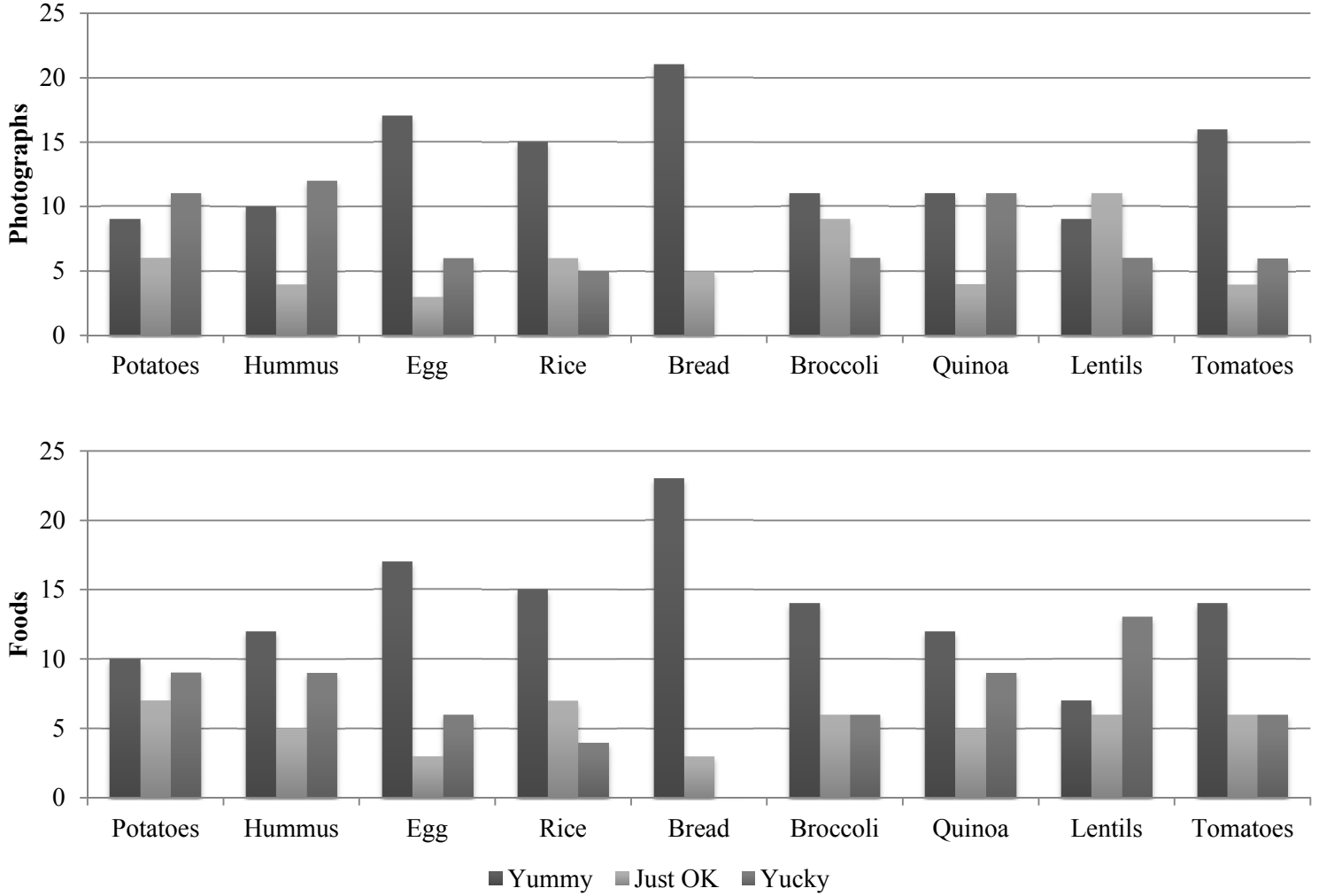
Children's Reported Taste Preferences for Photographs and Food. In the initial taste preference activity (activity 1) with photographs (See Figure 2) the children reported a preference ("yummy") for: brown rice (69% categorized as "yummy" and ranked 1st from 9 items), whole wheat bread (65% categorized as "yummy" and ranked 2nd from 9 items), and eggs (58% categorized as "yummy," and ranked 3rd of 9 items). The items consistently categorized as "yucky" were: quinoa (81% categorized as "yucky" and ranked 9th from 9 items), lentils (58% categorized as "yucky" and ranked 8th from 9 items), and hummus (58% categorized as yucky and ranked 7th form 9 items.) The other three foods showed a bi-modal distribution with children either reporting yummy or yucky (See Figure 2). Children's preferences for the real food were similar to the photographs for activity 1 (See Figure 2); However, the majority of children preferred whole wheat bread (85%, n=22, categorized as "yummy," ranked 1st from 9 items) and eggs (69%, n=18, categorized as "yummy," ranked 2nd from 9 items). During activity 1, when the children tried the real food, they showed a bimodal distribution for the remaining seven foods.

Figure 2: Children's reported taste preferences for food photographs and real food during activity 1



During activity 2, children's taste preferences using food photographs and real foods were similar to activity 1. Reported preferences of food photographs indicated the children generally categorized the following items as "yummy": whole wheat bread (81% categorized as "yummy" and ranked 1st from 9 items), eggs (65% categorized as "yummy" and ranked 2nd from 9 items), and brown rice (58% categorized as "yummy" and ranked 3rd from 9 items), with the addition of tomatoes (62% categorized as "yummy" and ranked 4th from 9 items) (See Figure 3). The other five foods either showed a bimodal distribution or were fairly evenly distributed among all three preference categories. Activity 2 reporting of taste preferences of real foods was similar to the food photographs of activity 2. Whole wheat bread (88%, ranked 1st from 9 items), eggs (65%, ranked 2nd from 9 items), and brown rice (58%, ranked 3rd from 9 items) were consistently ranked as "yummy" while the remaining six foods showed a bimodal distribution (See Figure 3).

Figure 3: Children's reported taste preferences for food photographs and real food during activity 2



Reliability of photographs versus real food

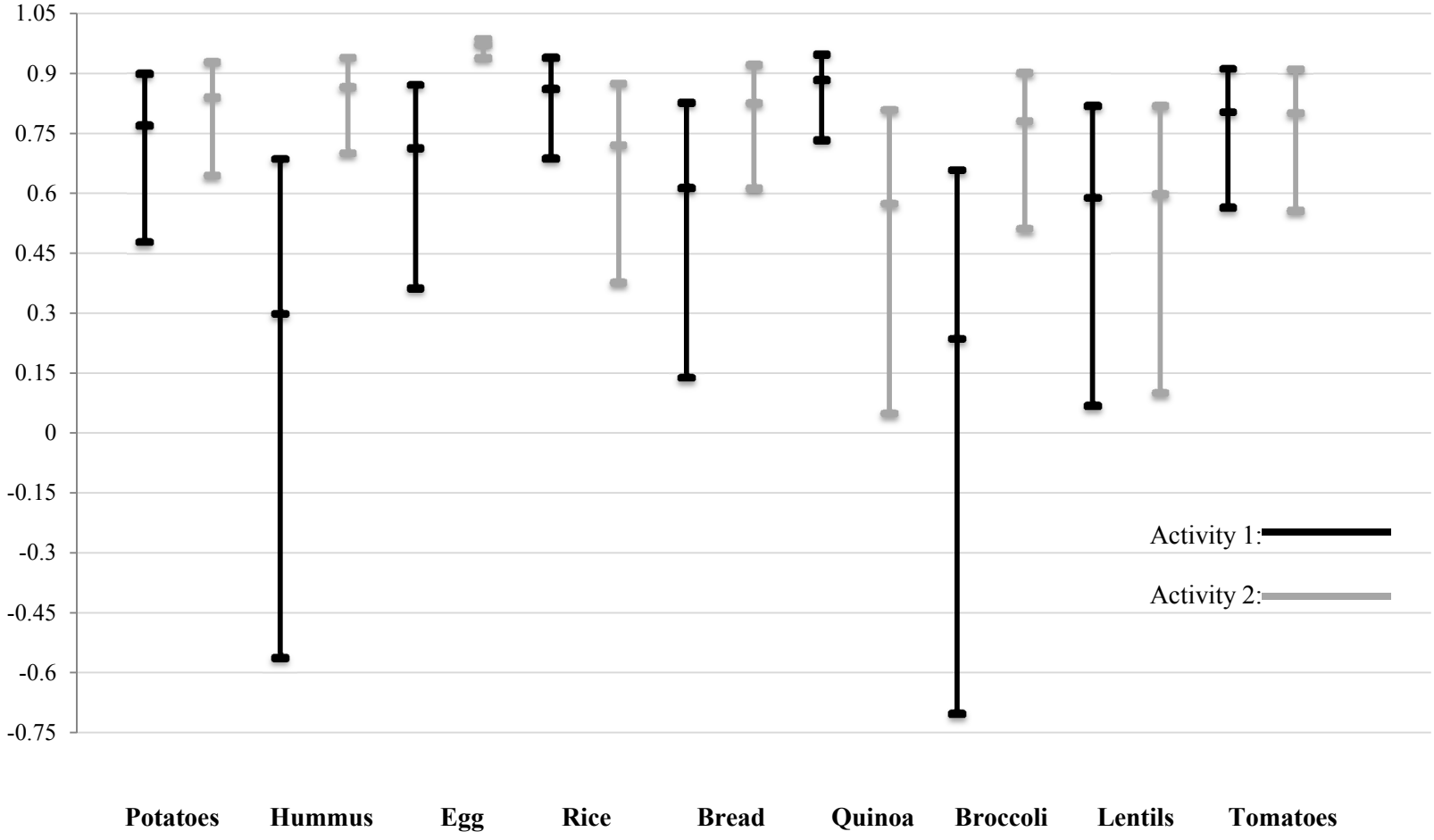
Cronbach's alpha was used to determine the reliability between the use of food photographs and real food presented in the taste preference activities (See Table 1). The reliability scores of the children's taste preferences were assessed using a 95% confidence interval (See Figure 4). A reliability score greater than or equal to .70 indicated internal consistency within the preferences (0.70 is acceptable, 0.80 is good, 0.90 is high) (George & Mallery, 2003); Results of α less than .70 was considered low internal consistency (George & Mallery, 2003). Children's reliability was high in both activity 1 and activity 2 for eggs, potatoes, tomatoes, and broccoli (See Table 1 and Figure 4).

Table 1: Reliability of food photographs versus real foods on children's taste preferences

Activity	Potatoes	Hummus	Egg	Rice	Bread	Quinoa	Broccoli	Lentils	Tomatoes	Mean (μ)
1 (α)	.77*	.30	.71*	.24	.59	.61	.86**	.88**	.80**	.64
2 (α)	.84**	.87**	.97***	.53	.60	.83**	.72*	.57	.80**	.75*
Both (α)	.88**	.76*	.88**	.64	.66	.67	.85**	.77*	.87**	

*Indicates α =0.70-0.79, ** indicates α =0.80-0.89, *** indicates α ≥0.90 (George & Mallery, 2003)

Figure 4: Confidence intervals for Cronbach's alpha scores of food photographs versus real foods for activity 1 and activity 2



Confidence Intervals measured at 95%

The greatest variations between the reliability of food photographs versus real foods from activity 1 to activity 2 were seen in hummus and brown rice (See Table 1 and Figure 4). Lentils and broccoli were the only foods that had a decrease in reliability from activity 1 to activity 2 (See Table 1). Average reliability of the food photographs versus the real foods in activity 1 was lower (mean α=.64) than activity 2 (mean α=.75) (See Table 1). A Cronbach's alpha of activity 1 and activity 2 combined showed high reliability for most foods except brown rice (α=.64), whole wheat bread (α=.66), and quinoa (α=.67) (See Table 1).

The reliability of children's preferences were analyzed by age (See Table 2). The age groups were separated by years: three years (38-47 months, n=11), four years (48-59 months, n=9), and five years (60+ months, n=6). The three year old group showed the highest average reliability for activity 1 (μ=.76), while the five year old group showed the highest reliability for activity 2 (μ=.96). The four year old group showed the largest variation between activity 1 and activity 2 (activity 1 μ=.36, activity 2 μ=.81). The three year old group showed a drop in reliability from activity 1 to activity 2 (activity 1 μ=.76, activity 2 μ=.56).

Reliability of the children's preferences were then analyzed by gender. This study had 17 female participants and 9 male participants. Males had higher average reliability scores (activity 1 μ=.73, activity 2 μ=.89) while the females showed low reliability for both activity 1 and activity 2 (activity 1 μ=.53, activity 2 μ=.67).

Table 2: Reliability scores of food photographs versus real foods for activity 1 and activity 2 separated by age and gender

Age/Gender	Potatoes	Hummus	Egg	Rice	Bread	Quinoa	Broccoli	Lentils	Tomatoes	Mean (μ)
3 y										
activity 1 (α)	.80	.69	.86	.15	1.0	.58	.90	.88	.97	.76
activity 2 (α)	.08	.71	1.0	.90	-.33	.75	.69	0.0	.49	.56
4 y										
activity 1 (α)	.58	-1.68	.01	.50	.81	.74	.74	.73	.68	.36
activity 2 (α)	.85	.96	.91	.63	1.0	.86	.62	.66	.75	.81
5 y										
activity 1 (α)	.89	.83	.96	-.38	.75	.46	.96	1.0	.77	.69
activity 2 (α)	.94	1.0	1.0	.88	1.0	.91	1.0	.88	1.0	.96
Males										
activity 1 (α)	.91	.35	.95	.40	.71	.51	.98	.92	.88	.73
activity 2 (α)	.97	.87	.98	.92	.78	.95	.67	.87	1.0	.89
Females										
activity 1 (α)	.65	.25	.31	.02	.52	.66	.74	.86	.76	.53
activity 2 (α)	.76	.86	.97	.61	.46	.75	.75	.33	.57	.67

Internal consistencies ranked by: α =0.70-0.79, acceptable reliability; α =0.80-0.89 good reliability; α ≥0.90 high reliability (George & Mallery, 2003)

Reliability of food photographs versus real food after six weeks

A comparison of the mean reported reliabilities identified the differences between activity 1 and activity 2. The mean Cronbach's alpha for activity 1 was not acceptable (μ=0.64) while the mean for the activity 2 was acceptable (μ=0.75) and can be considered to be reliable (George & Mallery, 2003). Seven of the nine food items displayed an increased reliability during activity 2 except broccoli (which dropped from α=0.86 to α=0.72, but remained reliable) and lentils (which displayed a decrease from α=0.88 to α=0.57 and was no longer considered to be reliable).

Rankings of photographs versus real food

A Wilcoxon signed rank test was used to compare the differences in the children's overall reported preference rankings of the food photographs versus as real foods (See Table 3). Statistically significant changes for the rankings of food versus photographs were identified in the first activity for potatoes (Z=0.026, $p \leq 0.05$), hummus (Z=0.023, $p \leq 0.05$), bread, (Z=0.032, $p \leq 0.05$), and quinoa, (Z=0.001, $p \leq 0.05$). No statistically significant differences in the rankings occurred in the second activity.

Table 3: Wilcoxon signed rank for food photographs versus real food comparison

	Potatoes	Hummus	Egg	Rice	Bread	Quinoa	Broccoli	Lentils	Tomatoes
Activity 1	.026	.023	.377	.082	.032	.001	.053	.561	.746
Activity 2	.221	.301	.870	.272	.279	.394	.287	.716	.214

Significance level $p \leq 0.05$

Discussion

Food photographs may be reliable tools to measure young children's taste preferences, but age, gender, and food type could impact the reliability and has not been fully explored (Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012). The purpose of this research was to investigate the reliability of food photographs versus real food using a variety of foods when conducting taste preference activities to determine young children's taste preferences.

Previous research has shown that food photographs can be reliable indicators of children's taste preferences when using the "taste and rate" method (Calfas et al., 1991; Carraway-Stage et al., 2013; Guthrie et al., 2000; Jaramillo et al., 2006; Olsen et al., 2012), yet few studies evaluated the use of food photographs to the use of real food when conducting taste preference activities with young children (Carraway-Stage et al., 2013; Guthrie et al., 2000). In this study, a majority (61%) of the food photographs tested displayed reliability during both tasting activities. In addition, the overall reliabilities of food photographs versus real foods in activity 1 and activity 2 were high. This suggests consistency with previous findings that food photographs can be reliable indicators of taste preferences when tested against real food using the "taste and rate" method (Carraway-Stage et al., 2013).

Previous studies have found that reliability increases with age (Calfas et al., 1991; Guthrie et al., 2000) and older children have been able to demonstrate reliability using food photographs (Olsen et al., 2012). This study demonstrated mixed results with age. During activity 1, three-year-old children (n=11) had the highest overall reliability, while four-year-old children (n=9) had the lowest reliability. During activity 2, five-year-old children (n=6) had the highest overall reliability, while three-year-old children had the lowest reliability. Older children may be at a higher cognitive level (Resnicow et al., 1997; Domel et al., 1996) and are able to demonstrate better understanding of the test, and therefore may complete the activity more consistently. While food photographs may be reliable indicators of three, four, and five-year old children's taste preferences, results from this study indicate age of the child should be considered prior to testing.

Reliability between genders was not significantly different in previous research (Calfas et al., 1991; Guthrie et al., 2000; Jaramillo et al., 2006), however this study indicated that males had a higher average reliability for both activity 1 and activity 2. There were fewer males participating in this study and they had a higher average age (μ=54 months, females μ=50 months), which could impact the reliability more so than gender. Further study of gender differences in taste preference testing using photographs is needed.

Children in this study demonstrated greater reliability in the taste preference activities using food photographs versus real foods from activity 1 to activity 2. Previous studies completed the activities in a smaller time frame (Carraway-Stage et al., 2013; Jaramillo et al., 2006). An increase in the overall reliability from activity 1 to activity 2 may be an indication that once children become accustomed to the protocol, they are more likely to have a higher reliability when using food photographs. Four food photographs were not reliable during activity 1 with scores below $\alpha \leq 0.70$ (hummus, brown rice, quinoa, and whole wheat bread). This decreased to three foods with $\alpha \leq 0.70$ during activity 2 (brown rice, whole wheat bread, and lentils). These results support the idea that acquainting children to the test may allow for more accurate reliability scores. In addition, when children become accustomed to the food through exposure to the foods as food photographs and in the tasting portions, a higher reliability score is more likely. Early learning and preferences are dependent on exposure to foods (Anzman et al., 2010; Anzman-Frasca et al., 2012; Birch & Doub, 2014) so the children's exposure to the foods in these forms during activity 1 could have led to the higher reliability scores during activity 2.

The phenomenon of children becoming accustomed to the test also was seen in the ranked scores, and was consistent with previous studies (Carraway-Stage et al., 2013). While some differences in children's ranking of the foods occurred during activity 1, there were no significant differences in the children's reported food rankings during activity 2. The increase in both the reliability scores from activity 1 to activity 2 as well as no differences in overall rankings during activity 2 indicates that food photographs may be used as reliable indicators of young children's taste preferences if the children are accustomed to the testing procedure.

When children have previous experiences with food they may have better recognition of the food as photographs, which could lead to more accurate representations of their taste preferences. Food photographs that did not show reliability during the first activity were reported as either "yummy" (brown rice and whole wheat bread) or "yucky" (hummus and quinoa). However, children reported all four foods to be "yummy" when tested as real food. This indicates children may not have

recognized the food photographs and assumed the food was "yucky." Pairing the food photographs with real foods during an initial taste preference activity may be preferred to gain reliable results (Guinard, 2000). This indicates that familiarity with the foods is necessary prior to using food photographs to test young children's taste preferences.

Sensory aspects can affect a child's preference for foods such as size, shape, and color (Kildegaard et al., 2011). Therefore, the colors and textures of the food photographs and real foods presented in this study should be considered. The foods with low reliability during both activities (whole wheat bread and brown rice) were reported as well liked foods when tasted, but in the food photographs visually they were a bland, tan color, which could have affected children's preferences. Photographs may not be able to properly display the sensory characteristics with which to judge foods. Young children will generally focus on one sensory attribute of food at a time (Guinard, 2001), thus use of food photographs that are uniformly bland in color (browns, creams, and tans) may be more difficult for children to evaluate without the association with real food. Brighter and more intense colors in certain foods may result in higher reported preferences with children (Kildegaard et al., 2011). This indicates a need to further study the sensory aspects (size, shape, and color) of food photographs when using them for taste preference testing.

Implications for Future Studies

Results from this study demonstrate that food photographs can be reliable indicators of young children's taste preferences, but several factors need to be addressed when using this method for testing young children. Future research should consider the age of the child as well as the gender. Use of food photographs in taste preference tests may be more reliable if the children are accustomed to the testing procedure and are familiar with the foods prior to testing. In addition, the sensory aspects of photographs could impact preferences and further research is needed to understand which sensory aspects of food photographs are influencing children's taste preferences. While continued research is needed on the use of food photographs with young children, results from this study show they can be a reliable tool for efficient and cost effective taste preference testing.

References

American Academy of Pediatrics (2010). Policy statement – prevention of choking among children. Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children. Retrieved from: http://pediatrics.aappublications.org/content/pediatrics/early/2010/02/22/peds.2009-2862.full.pdf

Anzman, S. L., Rollins, B. Y., & Birch, L. L. (2010). Parental influence on children's early eating environments and obesity risk: implications for prevention. *International Journal of Obesity*, 34, 1116-1124. doi:10.1038/ijo.2010.43

Anzman-Frasca, A., Savage, J. S., Marini, M. E., Fisher, J. O., & Birch, L. L. (2012). Repeated exposure and associative conditioning promote children's liking of vegetables. *Appetite*, 58, 543-553. doi:10.1016/j.appet.2011.11.012

Birch, L. L. (1979). Dimensions of preschool children's food preferences. *Journal of Nutrition Education*, 11(2), 91-95.

Birch, L. L. (1984). Time of day influences food acceptability. *Appetite*, 5(2), 109-116.

Birch, L. L. (1987). The role of experience in children's food acceptance patterns [Supplemental material]. *Journal of American Dietetic Association*, 87(9), S36-S40.

Birch, L. L. (1999). Development of food preferences. *Annual Reviews Nutrition*, 19, 41-62.

Birch, L. L., & Dietz, W. (2008). *Eating behaviors of the young child*. Elk Grove Village, IL: American Academy of Pediatrics.

Birch, L. L., & Doub, A. E. (2014). Learning to eat: birth to age 2 y [Supplemental material]. *American Journal of Clinical Nutrition*, 99, S723-S728.

Birch, L.L., & Fisher, J. O. (1998). Development of eating behaviors among children and adolescents [Supplemental material]. *Pediatrics*, 101, S539-S549.

Birch, L. L. & Marlin, D. W. (1982). I don't like it: I never tried it: effects of exposure on two-year old children's food preferences. *Appetite: Journal for Intake Research*, 3(4), 353-360.

Birch, L. L., McPhee, L., Steinberg, L., & Sullivan, S. (1990). Conditioned flavor preferences in young children. *Physiology & Behavior*, 47(3), 501-505.

Birch, L. L., Johnson, S. L., Andersen, G., Peters, J. C., & Schulte, M. C. (1991). The variability of young children's intake. *The New England Journal of Medicine*, 324(4), 232-235.

Branen, L. J., & Fletcher, J. (1999). Comparison of college students' current eating habits and recollections of their childhood food practices. *Journal of Nutrition Education*, 31(6), 303-374.

Breen, F. M., Plomin, R., & Wardle, J. (2006). Heritability of food preferences in young children. *Physiology of Behavior*, 88, 443-447.

Calfas, K. J., Sallis, J. F., & Nader, P. R. (1991). The development of scales to measure knowledge and preference for diet and physical activity behavior in 4- to 8- Year old children. *Developmental and Behavioral Pediatrics*, 12(3), 185-190.

Carraway-Stage,V., Spangler, H., Borges, M., & Goodell, L. S. (2013). Evaluation of a pictorial method to assess liking of familiar fruits and vegetables among preschool children. *Appetite*, 75, 11-20. doi.org/10.1016/j.appet.2013.12.011

Casey, R., & Rozin, P. (1989). Changing children's food preferences: parent opinions. *Appetite*, 12(3), 171 – 182.

Centers for Disease Control and Prevention (2010). National Center for Health Statistics, Data Tables. Retrieved from http://www.cdc.gov/growthcharts/data_tables.htm

Cooke, L. & Fildes, A. (2011). The impact of flavour exposure in utero and during milk feeding on food acceptance at weaning and beyond. *Appetite*, 57, 808-811. doi:10.1016/j.appet.2011.05.317

Domel, S. B., Thompson, W. O., Davis, H. C., Baranowski, T., Leonard, S. B., & Baranowski, J. (1996). Psychosocial predictors of fruit and vegetable consumption among elementary school children. *Health Education Research*, 11(3), 299-308.

Drewnowski, A. (1997). Taste preferences and food intake. *Annual Review of Nutrition*, 17, 237-253.

Falciglia, G. A., & Norton, P. A. (1994). Evidence for a genetic influence on preference for some foods. *Journal of the American Dietetics Association*, 94, 154-158. doi:10.1016/0002-8223(94)90239-9

Feldman, R. S. (2009). *Discovering the Lifespan*. Upper Saddle Lake, New Jersey: Pearson Education

Fox, M. K., Condon, E., Briefel, R. R., Reidy, K. C., & Deming, D. M. (2010). Food consumption patterns of young preschoolers: are they starting off on the right path [Supplemental material]? *Journal of the American Dietetic Association*, 9(2), S52-S59. doi: 10.1016/j.jada.2010.09.002

Galloway, A. T., Fiorito, L. M., Francis, L. A., & Birch, L. L. (2006). 'Finish your soup': counterproductive effects of pressuring children to eat on intake and affect. Appetite, 46, 318-23. doi:10.1016/j.appet.2006.01.019

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: a simple guide and reference.* 11.0 update (4th ed.). Boston: Allyn & Bacon. Retrieved from: http://wps.ablongman.com/wps/media/objects/385/394732/george4answers.pdf

Ganchrow, J. R., & Mennella, J. A. (2003). The ontogeny of human flavor perception. In: Doty, R. L. (2nd Eds.), *Handbook of Olfaction and Gustation* (pp. 823−846). New York: Marcel Dekker, Inc.

Guinard, J.-X. (2001). Sensory and consumer testing with children. *Trends in Food Science & Technology*, 11, 273-283.

Guthrie, C. A., Rapoport, L., & Wardle, J., (2000). Young children's food preferences: a comparison of three modalities of food stimuli. *Appetite*, 35, 73-77. doi:10.1006/appe.2000.0329

Hausner, H., Bredie, W. L. P., Molgaard, C., Petersen, M. A., & Moller, P. (2008). Differential transfer of dietary flavour compounds into human breast milk. *Physiology & Behavior*, 95, 118–124. doi:10.1016/j.physbeh.2008.05.007

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2010). *Healthy People 2020*. Retrieved from: http://www.healthypeople.gov/2020/topics-objectives/topic/early-and-middle-childhood/objectives

Jaramillo, S. J., Yang, S.-J., Hughes, S. O., Orlet-Fisher, J., Morales, M., & Nicklas, T. A. (2006). Interactive computerized fruit and vegetable preference measure for african-american and hispanic preschoolers. *Journal of Nutrition Education and Behavior*, 38, 352-459. doi: 10.1016/j.jneb.2006.06.003

Kildegaard, H., Olsen, A., Gabrielsen, G., Møller, P., & Thybo, A. K. (2011). A method to measure the effect of food appearance factors on children's visual preferences. *Food Quality and Preference*, 22, 763-771. doi:10.1016/j.foodqual.2011.06.009

Liem, D. G., Mars, M., de Graaf, C. (2004). Consistency of sensory testing with 4- and 5-year-old children. *Food Quality and Preference*, 15, 541-548.

Liem, D. J., Zandstra, L., & Thomas, A. (2010). Prediction of children's flavour preferences: effect of age and stability in reported preferences. *Appetite*, 55, 69-75. doi:10.1016/j.appet.2010.04.002

Mielby, L. H., Edelenbos, M., & Thybo, A. K. (2012). Comparison of rating, best-worst scaling, and adolescents' real choices of snacks. *Food Quality and Preference*, 25, 140-147. doi:10.1016/j.foodqual.2012.02.007

Mennella, J. A., & Beauchamp, G. K. (2002). Flavor experiences during formula feeding are related to preferences during childhood. *Early Human Development*, 68, 71-82.

Mennella, J. A., & Ventura, A. K. (2010). Understanding the basic biology underlying the flavor world of children. *Current Zoology*, 56(6), 834-841.

Mennella, J. A., Jagnow, C. P., & Beauchamp, G. K. (2001). Prenatal and postnatal flavor learning by human infants. *Pediatrics*, 107(6), NIH-PA Author Manuscript

Mennella, J. A., Kennedy, J. M., & Beauchamp, G. K. (2006). Vegetable acceptance by infants: effects of formula flavors. *Early Human Development*, 82, 463-468, doi:10.1016/j.earlhumdev.2005.12.001

Mennella, J. A., Pepino, Y., & Reed, D. R. (2005). Genetic and environmental determinants of bitter perception and sweet preferences. *Pediatrics*, 115(2), 216-222.

Miller, P., Moore, R.H., & Kral, T.V. (2011). Children's daily fruit and vegetable intake: associations with maternal intake and child weight status. *Journal of Nutrition Education and Behavior*, 43(5), 396-400.

Nguyen, S.P. (2007). An apple a day keeps the doctor away: children's evaluative categories of food. *Appetite*, 48, 114-118.

Olsen, A., Kildegaard, H., Gabrielsen, G., Thybo, A. K., & Moller, P. (2012). Measuring children's food preferences: using pictures in a computerized conjoint analysis. *Journal of Sensory Studies*, 27, 264-276. doi:10.1111/j.1745-459X.2012.00391.x

Olsen, A., Ritz, C., Kraaij, L., & Moller, P. (2012). Children's liking and intake of vegetables: a school-based intervention study. *Food Quality and Preference*, 23, 90-98.

Piaget, J. (1964). Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching*. 2(3), 176–186. doi:10.1002/tea.3660020306

Pliner, P., Pelchat, M., & Grabski, M. (1993). Reduction of neophobia in humans by exposure to novel foods. *Appetite*, 20(2), 111-123.

Popper, R., & Kroll, J. (2003). Conducting sensory research with children. *Food Technology*, 57(5), 60-65.

Reed, D. R., Bachmanov, A. A., Beauchamp, G. K., Tordoff, M. G., & Price, R. A. (1997). Heritable variation in food preferences and their contribution to obesity. *Behavior Genetics*, 27(4), 373-387.

Resnicow, K., Davis-Hearn, M., Smith, M., Baranowski, T., Lin, L. S., Baranowski, J., Doyle, C., & Wang, D. T. (1997). Social-cognitive predictors of fruits and vegetable intake in children. *Health Psychology*, 16(3), 272-276.

Rozin, P. (1976). The selection of foods by rats, humans, and other animals. *Advances in the Study of Behavior*, 6, 21-76

Rozin, P. (1990). Acquisition of stable food preferences. *Nutrition Reviews*, 48(2), 106-114.

Ramsay, S. A., Rudley, M., Tonnemaker, L., & Price, B. (2015). *A comparison of college stundets' reported fruit and vegetable liking and intake from childhood to adulthood*. Manuscript submitted for publication.

Seidel, J. (1998) Societal and Personal Costs of Obesity. Experimental Clinical Endocrinology and Diabetes, 106, 7-9.

Skinner, J. D., Carruth, B. R., Bounds, W., & Ziegler, P. (2002). Children's food preferences: a longitudinal analysis. *Journal of the American Dietetic Association*, 102(11), 1638-1647.

Soussignan, R., Schall, B., Marlier, L., & Jiang, T. (1997). Facial and autonomic responses to biological and aritfical olfactory stimuli in human neonates: re-examining early hedonic discrimination of odors. *Physiology and Behavior*, 62(4), 745-758.

U.S. Census Bureau. (2010). American fact finder. Washington, D.C.: Government Printing Office. Retrieved from http://www.census.gov/data/2010

United States Department of Agriculture, Choose MyPlate.gov. (2011). Why is it important to eat fruit? Retrieved from http://fnsweb01.edc.usda.gov/food-groups/vegetables-why.html

U. S. Department of Agriculture. (2013). Child care meal patterns. Retrieved from: http://www.fns.usda.gov/sites/default/files/Child_Meals.pdf

U. S. Department of Agriculture. (2015). Choose MyPlate. Retrieved from http://www.choosemyplate.gov/

U. S. Department of Agriculture. (2016). Nutrition and wellness tips for young children: Provider handbook for the child and adult care food program. Retrieved from: http://www.fns.usda.gov/sites/default/files/handbookintro.pdf

U. S. Department of Health and Human Services, U.S. Department of Agriculture, (December, 2010). Dietary Guidelines for Americans, 7th Edition, Washington, DC: U.S. Government Printing Office.

U. S. Department of Health and Human Services (HHS), 2012. Healthy People 2020. Retrieved from: http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=29.

Ventura, A. K. & Worobey, J. (2013). Early influences on the development of food preferences. *Current Biology*, 23(9), 401-408.

Vereecken, C. A., Vandervorst, S., Nicklas, T. Covents, M., & Maes, L. (2010).Test–retest reliability and comparison of children's reports with parents' reports of young children's fruit and vegetable preferences. *Appetite*, 55, 574-581.

World Health Organization (2002). 2002 World Health Report: Reducing risks, promoting healthy life. Retrieved from: http://www.who.int/whr/2002/en/whr02_en.pdf?ua=1,

World Health Organization, (2013). 2013 World Health Report. Retrieved from: http://apps.who.int/iris/bitstream/10665/85761/2/9789240690837_eng.pdf?ua=1,

Appendix A

Preparation before taste preference game:

Food items needed and details about specifics for cooking:

1) Fresh tomatoes (dice) – 3 "bites" per cup
2) Fresh broccoli (boiled and diced) – 3 "bites" per cup
3) Red potatoes (boiled and diced) – 3 "bites" per cup
4) Eggs (boiled and diced) – 3 "bites" per cup
5) Lentils (boiled/prepared) – 3 "bites" per cup
6) Hummus (pre-packaged plain) – 3 "bites" per cup
7) Whole wheat bread (sliced into ~1/2 inch pieces) – 3 "bites" per cup
8) Quinoa (boiled/prepared) – 3 "bites" per cup
9) Brown rice (boiled/prepared) – 3 "bites" per cup

All items can and generally have been purchased at WinCo, Rosauers, or Safeway. Home brand was purchased when available and brand was noted for consistency. Items can be purchased with University issued procurement card. All fresh items need to be washed thoroughly. All canned items should be drained of liquid. All items need to be cut into small pieces to prevent choking (for preschool aged children the recommended size is ½ an inch). Roughly 3 pieces ("bites") need to be included in each cup. All items should be refrigerated at all times and placed on a tray as needed with each child. Quinoa, lentils, and brown rice will need to be prepared following instructions on bag/box prior to preference activity. Potatoes and broccoli need to be boiled until fork-tender and eggs need to be hard-boiled until fully cooked. Foods should not be left at room temperature for more than 60 minutes.

Appendix B

Setting up the testing environment:

Tasting should be preformed in an area where distractions to the child being tested are minimal (University of Idaho's Eating Laboratory). Use tables and chairs that are friendly and comfortable to the children and are appropriately sized. Use of screens or walls may be necessary to keep distractions to a minimum when testing.

Prior to the child entering the room or space should be set up so that the testing can begin immediately. The specifics of the set up may vary by site and location.

Appendix C

Performing the test:

Welcome the child and gather assent by asking if he/she would like to play a game. NOTE ASSENT ON THE FORM. Any behavior from the child indicating discomfort (crying, statements that they want to leave) then the food preferences activity should be stopped and the parent should be brought to the Eating Laboratory to pick up her child. Each child should complete the activity individually if possible. If the child will not leave the parent this is OK but the parent must be told not to prompt the child. Then ask the parent about allergies.

ALWAYS CHECK FOR ALLERGIES BEFORE YOU BEGIN TESTING A CHILD!

Each child is asked to rate their preference for 3-bite samples of 3 grains, 3 meat alternatives, and 3 vegetables (listed above). The containers of all samples will be placed on a tray table out of the child's line of sight to prevent distraction. Keep the containers on one side of your chair. Begin with the Facial Images Dialogue.

FACIAL IMAGES DIALOGUE:

"I'd like to ask you to play the tasting game. In the tasting game, you get to taste some foods and then tell me how they taste to you."

[Present the three cartoon pictures one at a time- Figures 1-3]

"You will use these 3 pictures to tell me how you think the foods taste."

"This is a picture of a Yummy face. See how he/she is smiling. You choose this one when you like the food."

"This picture is of a Yucky face. See how he/she is frowning? You choose this picture when you don't like how a food tastes."

"If you taste a food and you think it tastes Just OK, you choose the Just OK face. See how he/she isn't smiling and isn't frowning? You choose the Just OK face when the food isn't yummy and it isn't yucky.

"This is the Yucky face (point to the face) this is the Yummy face (point) and this is the Just OK face (point)."

MIX UP FACES. (Child should match the faces.)

"If you tasted a food and you liked it, what face would you point to?" [The child needs to point to the Yummy face].

"If you tasted a food and it tasted Just OK, what face would you point to?" [The child needs to point to the Just OK face].
And if you tasted a food and it was Yucky, or you didn't like it, what face would you point to?" [The child needs to point to the Yucky face].
"Great! Now we are ready to play the tasting game! Let's look at some pictures of food."

If the child is not able to point to the correct faces, re-teach the task and ask them to identify the faces again. If the child still cannot identify the faces, discontinue the activity.

IMAGES TEST DIALOGUE:
Place all the images in front of you in their random, predetermined order. Pick up the first image, keeping the others behind you and out of sight and show it to the child. Say:
"What do you see in this picture?"
You may need to prompt the child. After they answer ask:
"Have you eaten it before?"
After the answer say:
"Put the picture in front of the face that looks like how it tastes to you."
You may need to prompt them with: "Is the food Yummy? Yucky? Or Just OK?" Always use a blank face expression when prompting them.
After they place it in front of a face, ask them for the name of the face?
"What face is that?'
And then verify by asking:
"Does that mean that you Like it? It's Just OK or that it's Yucky?
Make sure to record the appropriate "Rating" (face).
After each image has been shown, place it on the floor on the opposite side of your chair.

<u>Identify the Food Liked Best</u>: Once all the food images have been categorized, ask the child to rank order the foods by picking the one which was the "yummiest" food in the "yummy category." After that food is identified, remove it and ask the question again. Repeat this until all foods have been ranked for each category.

"Great! Now we are ready to try some foods."

TASTE TEST DIALOGUE:
Bring out the pre-set tray with the 9 taste cups (3 small bites of each food in each cup.)
Say, "Please take one food to try."

If the child takes the food out of the cup, but doesn't take the cup from the tray, encourage him or her to take the whole cup.
Record the foods the child tries in the "Order" column, assign a 1 to the first food the child chooses to try, and do so consecutively until the last food the child tries is number 9.
If the child refuses, encourage the child once. When encouraging a child, you can say something like:

"Go ahead and take a bite, and if you want you can spit it back out."
If they refuse, even after encouragement, check the Refusal box.
If the child decides to take a bite, check the appropriate boxes in the "Behavior" columns. Record if the child touched, smelled, licked, spit, and/or swallowed each food. See the Definitions on the next page.

If a child refuses with several foods left, the last food cup handled can be given an Order. The rest will only get marked as Refusal.
After the child takes a bite, say to the child:
"Put the cup in front of the face that looks like how it tastes to you."
You may need to prompt them with: "Is the food Yummy? Yucky? Or Just OK?" Always use a blank face expression when prompting them.
After they place it in front of a face, ask them for the name of the face?
"What face is that?'
And then verify by asking:
"Does that mean that you Like it? It's Just OK or that it's Yucky?
Make sure to record the appropriate "Rating" (face).
After each food has been tried, place it on the floor on the opposite side of your chair.
Identify the Food Liked Best
Once all the foods have been categorized, ask the child to rank order the foods by picking the one which was the "yummiest" food in the "yummy category." After that food is identified, remove it and ask the question again. Repeat this until all foods have been ranked for each category.
"Great! Maybe we can play it again sometime" Provide child with the sticker.

Reminder: The importance of writing notes after an assessment cannot be overemphasized. If any part of the assessment seems a bit unusual to, take the time to write a note before starting again with another child.

Between Testing Children

Double check your recording sheet or tablet. Did you record: Child ID, Assessor initials, Date and Time, Does every food have an order, rating, and behavior OR is "refused" marked.

Then, throw out the tasting foods and cups. Any cup that is opened, regardless or whether or not the child touched the food, must be disposed of. Foods can only be reused if the lid is not removed from the cup and the food has not been sitting at room temperature for more than 60 minutes. Wipe down trays and testing station with bleach and water solution. Prepare a tasting tray for the next child.

Appendix D

Taking down the testing stations:

Clean up station. Wipe down table and chairs with water and bleach solution. Wipe trays and faces with water/bleach solution after final testing. Clean up any spilled food. Dispose of all cups, lids, etc. Pack up all supplies in identified tubs and bags.

Appendix E

Standardized Recipes

Red Potatoes - The red potatoes were rinsed, cut into half inch pieces and boiled for twenty minutes. Once soft, they were drained and allowed to cool, then stored in airtight plastic containers in the refrigerator for no more than three days.

Hummus - The hummus was a store-bought brand that was measured out into one-tablespoon sized portions for each tasting. In between tasting the hummus was stored in its original container in the refrigerator.

Hard-boiled Eggs - The eggs were cooked in batches of ten, submerged in cool water and brought to a boil. Once the water was boiling they were left for one minute, then heat was turned off and they were left in the hot water for ten minutes. Then they were drained and submerged in ice water to stop the cooking process. After they cooled they were peeled and cut into appropriate sizes (quarters) and stored in airtight plastic containers in the refrigerator for no more than three days.

Broccoli - The broccoli was rinsed and then cut into large 4-6" florets and submerged in boiling water for fifteen minutes. Once soft, they were submerged in ice water to stop the cooking process and then cut into half or quarter inch pieces appropriate for young children. Finally they were stored in airtight plastic containers in the refrigerator for no more than three days.

Quinoa - The quinoa was cooked at a ratio of one cup grain to two cups water. The quinoa was rinsed prior to cooking. It was put in a large pot over medium heat and brought to a simmer. The pot was then covered and the simmer was maintained for fifteen minutes until the quinoa was cooked through. It was then allowed to cool for fifteen minutes and stored in airtight plastic containers in the refrigerator for not more than three days.

Lentils - The lentils were rinsed prior to cooking and cooked at a ratio of one cup lentils to three cups water. The lentils were brought to a simmer and partially covered with a lid and let boil

for 20 minutes. They were then drained and rinsed under cool water to stop the cooking process. The cooled lentils were then stored in airtight plastic containers in the refrigerator for not more than three days.

Whole Wheat Bread - The bread was a consistent brand of whole wheat bread that was weighed and cut into quarters, then stored in airtight plastic containers for no more than two days.

Tomatoes - The tomatoes were rinsed and diced into half or quarter inch pieces then put in airtight plastic containers and stored in the refrigerator for no more than three days.

Brown Rice - The brown rice was rinsed prior to cooking. A ratio of one-cup rice to one and a half cups water was used. The rice was brought to a boil over high heat and then the heat was reduced, the pot was covered, and the rice simmered for twenty minutes. The heat was turned off and the rice was let to cool at room temperature for fifteen minutes then stored in airtight plastic containers in the refrigerator for no more than three days.

Appendix F

University of Idaho

Are you the mother of a 3-5 year old child?

We are inviting you to participate in an 8 week study to learn about mealtime communication. You will be asked to attend an educational session of no longer than 1 hour the first week. Then attend a snack session (food provided) with your child once a week for six weeks.

Child care will be provided for the educational session. At the end of the study we are offering

a $50 gift card.

Snacks and parking vouchers will be provided at each weekly session.

To learn more PLEASE CALL, TEXT, OR E-MAIL:
Mackenzie Ferrante, Graduate Assistant
uofidahonutrition@gmail.com
323-577-5440
before February 7th, 2014

U of Idaho IRB has reviewed and approved this project for human subject particiation

Appendix G