

DOES MOM KNOW BEST? THE INFLUENCE OF BABY-LED WEANING
ON PICKY EATING AND SWEETENER USE

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Savanna Elizabeth Jean Westrom Jellison

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Savanna Elizabeth Jean Westrom Jellison

The Supervisory Committee certifies that this *disquisition* complies with North Dakota State University's regulations and meets the accepted standards for the degree of

DOCTOR OF PHILOSOPHY

SUPERVISORY COMMITTEE:

Rebecca J. Woods, Ph. D.

Chair

Sean Brotherson, Ph. D.

Elizabeth Blodgett Salafia, Ph. D.

Mary Larson Ph. D., MPH, RD, CHES

Approved:

May 14, 2021

Date

Joel Hektner, Ph. D.

Department Chair

ABSTRACT

Baby-led weaning, the process of an infant feeding themselves at the introduction of solid foods as opposed to being spoon-fed by a caregiver, is an under-researched area of infant development. There is a significant gap in knowledge regarding how baby-led weaning influences aspects of this critical period of development including picky eating and parental use of sweeteners or additives. The purpose of this research was to better understand the influence that feeding method has on optimal infant development. The central hypotheses were (1) that infants who baby-led weaned would have greater food acceptance and be less likely to be labelled a picky eater than parent-led weaned infants, and (2) parents who utilize baby-led weaning will be less likely to utilize sweeteners or additives with their infants compared to parents who choose parent-led weaning. Participants ($N = 412$) were given a link to a single questionnaire through an online survey software. The survey consisted of a variety of question types including Likert-type scales, yes/no, and short answer. Results of our first study showed that infants in both groups accepted most foods at similar rates at first introduction, indicating that initially infants from the two groups were similar in their food preferences. However, infants who had experienced baby-led weaning were less likely to be considered to be picky eaters by their parents than those who were parent-led weaned. These results support the hypothesis that feeding method may influence rates of picky eating. The results of our second study showed that there were no differences between parents who baby-led weaned and those who parent-led weaned in willingness to give sugar to increase food acceptance. For most of the sweeteners and additives surveyed, parents in both groups did not differ significantly in utilization. The exceptions were ranch dressing and honey. Parents who baby-led weaned were more likely to use both ranch and honey compared to their parent-led counterparts. Together, these studies

indicate that baby-led weaned infants differ from parent-led weaned infants in a variety of factors that contribute to the development of healthy eating habits.

Keywords: Infant nutrition; infant feeding methods; baby-led weaning; sweetener use; complementary feeding; picky eating

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DEDICATION

To those who believed I could: Thank you for believing in me and for all your support, love and encouragement along the way. To those who told me I couldn't: Thank you for the motivation and being a driving force.

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CHAPTER ONE. INTRODUCTION

In feeding infant children, the transition from breastmilk to complementary solid foods happens in a relatively short time frame (i.e., 6- to 10-months-old, D’Auria et al., 2020). However, during this time period, a child’s overall development is happening at a rapid pace (e.g., trunk control, pincher grasp, learning to chew and swallow). Prior to the availability of commercialized infant purees (i.e., “baby foods”), parents breastfed their infants until at least 12-months-old and solid food was not introduced until around this time (Bentley, 2014). When commercialized infant purees became more widely available in the mid-20th century, the most popular way of introducing solid foods in developed nations was through the method of parent-led weaning, where an infant is spoon-fed by a caregiver and the age of introduction declined from 11 months in 1880 to four to six weeks (starting with rice cereal in bottles before transitioning to fruit and vegetable purees) by 1950 (Bentley, 2014). Additionally, by this time, 90% of American infants were being fed mass-produced commercial baby food (Bentley, 2014).

Toward the end of the 20th century, parents began to reject commercialized baby food due to concerns over additives, sugar, and salt (Bentley, 2014). Parents began to make their own food at home or offered developmentally appropriate table foods. Due to the pushback on additives in commercialized foods, and new research findings and recommendations related to breastfeeding duration, there was an increase in the age of introduction to solid foods beginning to return closer to 6-months-old. Additionally, baby-led weaning, the process of allowing an infant to feed themselves, was beginning to emerge and is now becoming an alternative for many parents as more parents are going back to patterns that were common before commercialized baby foods became widely used. The short time frame of introducing solid foods to infants can have an impact on the development of lifelong dietary habits. This sensitive period of nutritional

development either positively or negatively influences physiology, overall functioning, health, and performance across the lifespan (Koleztko, 2011). Improper nutrition can lead to multiple health problems and ultimately a shortened lifespan, increased personal and economic costs and decrease the quality of life (Lightwood et al., 2009; Marsman et al., 2018).

Nutritional requirements of an infant are continuously changing as the infant ages; therefore, at 6 months, complementary foods must be added to an infant's diet of breastmilk (D'Auria et al., 2020). Not meeting nutritional requirements during infancy can impact infant growth and result in not meeting developmental milestones (Bandara et al., 2015). Proper nutrition plays a pivotal role in development, especially during the first few years of life. Improper nutrition due to poor dietary habits is linked to chronic diseases such as obesity, hypertension, diabetes, and allergies (D'Auria et al., 2020). Additionally, within infancy, poor nutrition can hinder infant development. For example, low vitamin D intake can lead to rickets, low iron can cause anemia but also pave the way for lead toxicity, and lack of essential fats can hinder brain and eye development (Chang et al., 2009; Hegazy et al., 2010; Holick, 2006).

Currently, there is limited research on the impact of baby-led weaning when compared to parent-led weaning with regards to various aspects of infant nutrition including food acceptance, picky eating, and overall behavioral and developmental differences. Understanding the impact of feeding methods employed during this critical period of child development would extend previous research on timing of food introduction and the impact on cognitive, behavioral, social, and nutritional development. Comparing feeding methods is the first step in building foundational knowledge on the impact of nutritional behaviors on development for children under the age of two. Nutritional behaviors can be described by the spontaneous and planned biological, anthropological, economic, psychological, socio-cultural and home economics of the

individual and those around them, that shape dietary choices, taste preferences, and mealtime behaviors related to the procurement, preparation and consumption of food (Department of Nutritional Behavior, 2010; Gedrich, 2003; Hummel & Hoffmann, 2016; Schnieder & Hoffman, 2011). In order to further research that could potentially prevent numerous negative health outcomes, it is essential to understand the building blocks of the development of taste preferences, dietary habits, and other nutrition decisions. This research study explores the influence of the weaning approach with infants on developing nutrition patterns in children, specifically food acceptance and picky eating among children, and also with parents and their utilization of sweeteners or additives in feeding young children.

Development of Eating Habits

Nutrition is one aspect of development that occurs daily, starting prenatally, and impacts all other areas of development across the lifespan (Herman et al., 2014). There is a wide range of impacts linked with nutrition and development including failure to thrive (i.e., undernutrition leading to inadequate growth), familiarity and comfort with differing foods, risk of obesity, and the comorbidity of other chronic health concerns (Black et al., 2007; Kaur et al., 2015; Taylor & Daniel, 1999; Zhang et al., 2017). The influence of nutrition is easily seen in child and adult research with findings that are translated into new policies and approaches each year, such as the National School Lunch Program targeting school nutrition and the Commodity Supplemental Food Program targeting low-income adults over the age of 60 (Douglas & Crespín, 2016; Geist Rutledge, 2015). While these programs target different groups, they both focus on improving health by providing nutritious food choices (Popkin, 2017; Wojcicki & Heyman, 2006). In addition to programing, the Dietary Guidelines for Americans are updated every five years based

on advances in nutrition research (United States Department of Health and Human Services [USDHHS] & United States Department of Agriculture [USDA], 2020).

Until the most recent update, for the years spanning 2020-2025, the Dietary Guidelines for Americans did not include recommendations for children zero to two years of age and only the last two sets, for the years 2015-2020 and now 2020- 2025, do they include quantified daily values of added sugar consumption (Robinson, 2021; USDHSS & USDA, 2020; USDHSS & USDA, 2015). Nutrition behaviors, which are influenced by more than just the infant, that are developed in infancy evolve and become the established foundation for dietary habits across the lifespan are one of the major influences of whether developmental growth is typical or atypical (Lynch, 2011; Mccaffery et al, 2007).

Infancy is a critical period for the development of taste preferences which are a subjective experience and are developed largely through direct exposure to varying foods and their tastes (Duffy & Bartoshuk, 1996). Taste preferences will ultimately aid in determining eating habits and are a building block in the lifelong nutrition trajectory (Skinner et al., 2002), with a child's food preferences and overall dietary variety being a significant predictor of later food preferences (Lynch, 2011). Additionally, dietary diversity is a protective factor against the development of an allergic disease, decreasing the odds of developing a food allergy in the first decade of life by one third (Venter et al, 2017). Therefore, the establishment of healthy, nutritious, and diverse food preferences during infancy have been shown to predict the outcome of lifelong eating habits and can be linked to developmental outcomes across all domains including physical, socio-emotional and cognitive (Georgieff, 2014; Sigman, 1995; Trabulsi & Mennella, 2012; Turner et al., 2019). Nutrition is a vital contributor to multiple aspects of a child's development. For example, nutrition is a key influencer of physical development and is a

determinant of growth rate, body weight and ultimately height (Stuart et al., 1953). Nutrition also contributes to socio-emotional development and the development of self-regulation and organization, attachment and self-soothing behaviors, development of independence and autonomy, through the continued social components of eating as feeding and mealtime participation increases (Liu & Stein, 2013). Lastly, proper nutrition is essential for optimal cognitive development starting major brain formation occurring during pregnancy when the neural tube is developing and infancy, when the brain is rapidly developing (Pardo & Dewey, 2015). Furthermore, proper nutrition is predictive of cognitive abilities in later childhood and is predictive of later academic performance (Pardo & Dewey, 2015).

An infant's preferences are already developing through maternal choices during the prenatal period and can influence which foods are accepted postnatally (Cooke et al., 2003). Metabolic events (e.g., turning food into energy) are shaping nutritional development and are occurring constantly and during sensitive periods of development, both pre- and postnatally. The process of maternal food choices and the influence they have on metabolic events is referred to as metabolic programming, playing an essential role in the development of flavor preferences and behaviors (Koletzko, 2005). Metabolic programming is hypothesized to be one of the major influencers of growth patterns and overall development (Singhal & Lucas, 2004). Postnatally, the foundational nutrition choices for infants are made by parents based on their own preferences and the limited information or resources available to them. Additionally, parental behaviors can also influence a child's food preferences and eating behaviors which are encompassed within nutritional behaviors (Riley et al., 2018). Having unhealthy eating habits and nutritional behaviors can have lifelong consequences for health and are predictive of the risk of being overweight or obese, decreased cognitive functioning, poor physical performance, poor psycho-

social health and other chronic health problems (Brophy et al., 2009; DiGirolamo et al., 2020; Jokela et al., 2019; Marcellini et al., 2009; McClung & Murray-Kolb, 2013; Nicolas et al., 2001; Nurwanti et al., 2018; O’Dea & Amy, 2003). However, healthy eating habits improve overall cognitive, physical, and socio-emotional health starting in childhood (Helle et al., 2017; Lynch, 2011; Nyberg et al., 2011; Verstraeten et al., 2014). A variety of factors, including the choices made for an infant, determine whether the eating habits developed during infancy are healthy.

Bronfenbrenner’s Ecological Model and the Development of Eating Habits

As noted, the development of healthy eating habits during infancy can be influenced by multiple factors. Broadly, Bronfenbrenner’s ecological theory of human development can provide an overview of the interconnected systems that influence nutritional experiences, behaviors, and choices. Bronfenbrenner’s ecological theory of human development focuses on how an individual’s characteristics, contexts, and historical time mutually influence each other (Bronfenbrenner, 1977). This theory focuses on the relationships between the individual and each of the individual’s immediate environments (the microsystems), the interactions between the individual’s immediate environments (the mesosystem), the influence of the indirect environment (the exosystem), the influence of overarching beliefs and values (the macrosystem), and how these relationships change over time (the chronosystem; Bronfenbrenner, 1977).

The individual is positioned at the center of Bronfenbrenner’s systemic models and affects their own developmental trajectory through behaviors driven by personal preferences. For example, food experiences and preferences drive eating behaviors, which affect health throughout the lifespan. Infancy is a sensitive time period for developing healthy eating preferences through taste development (Black & Aboud, 2011; Cole et al., 2017; Komininou et al., 2019). For example, food choices during this period have the power to influence later food

preferences and eating behavior throughout the lifespan, including dietary patterns as well as growth and health outcomes (Boak et al., 2016; Chai et al., 2016). The taste preferences developed during infancy are, to a large extent, acquired through direct exposure to flavors, but can be determined by multiple factors (e.g., genetic predisposition, physiological characteristics, and experience; Skinner et al., 2002). Taste preferences describe the subjective experiences each individual has with food through the balance of the five basic taste properties (i.e., sweetness, saltiness, bitterness, sourness, and umami; Duffy & Bartoshuk, 1996).

During infancy, there is limited control that the individual has over each system due to developmental inability. For example, the microsystem (e.g., immediate environment) of the infant at any given time is most frequently controlled by a parent or guardian, and infants are dependent on such caregivers for their daily nutrition and survival. The diet of infants can consist of healthy food and food preferences if that is learned from influential older individuals such as an older sibling, parent, or guardian (DeJesus et al., 2019). During this time of limited control, infants are learning about food and developing their preferences based on the decisions, experiences, and resources of household members. The influence of dietary choices on infant preferences and development begins prenatally and continues throughout the lifespan (Gale et al., 2009; Martins, 2006). However, the choices that parents make regarding food are influenced by the broader, outer levels of the environment in Bronfenbrenner's systemic model, ultimately influencing how infants are exposed to foods, learn about them by observation and experience and develop a variety of nutritional behaviors.

The family setting is one of the primary elements influencing a child at the microsystem level in Bronfenbrenner's ecological model. Parents and others in the home model behaviors both consciously and unconsciously, shaping the nutritional experiences and behaviors of

younger, more impressionable members of the household. Social cognitive theory provides one way to understand how those in the home influence nutritional behaviors of infants. Social cognitive theory, an extension of Bandura's social learning theory, focuses on individuals learning through the observation of others (Bandura, 1997; Bandura, 1989).

A major component of the development of eating preferences is learned from other individuals and the impact of others' nutritional behaviors, an aspect found in both Bandura's and Bronfenbrenner's theories. In applying social cognitive theory to eating behaviors, infants watch and learn from the behaviors of the individuals in the home and develop food preferences from there. Infants are learning what, when, how to eat, how much to eat and other aspects of meal time behaviors from observing those around them (Savage et al., 2007). If a parent or sibling expresses disgust for a food item, learning through observation has likely occurred and the infant may refuse it. If a parent suffers from low dietary variety, strong likes and dislikes or frequent unhealthy food choices, all common continued influences of having been a picky eater in childhood, the food, taste and flavors being offered is likely to be strongly influenced by the parents' preferences thus –limiting nutritional learning opportunities. If a parent dislikes a food or quickly rejects it, that food may not be offered, and therefore learning about that food, taste or flavor cannot occur. On the other hand, if enjoyment is expressed by others, the infant may accept a food that would otherwise be refused. Additionally, if parents are eating a wide variety of foods and making them available for food experiences, the observing infant may also be at an increased likelihood to sample foods more openly, as this is perceived as normal behavior in the home as seen through parental role modeling.

There are numerous aspects of overlap between social cognitive theory and the ecological systems theory, including the power of parental influence and the multidimensional approach

applied to influencing factors. Social cognitive theory includes consideration of the potential influence of cultural, psychosocial, economic and situation factors on nutritional behaviors. For example, in applying social cognitive theory, role-modeling health eating behaviors, education on nutrition, exposure to fruit and vegetables, self-efficacy, and the ability to ask questions about and specifically for certain foods was found to have the highest impacts on fruit and vegetable consumption levels (Hinton, 1998). Within the ecological systems theory, the parent or caregiver controls much of the infant's immediate microsystem, including the nutritional environment through food experiences and choices. For example, parents decide which foods are provided, how the food is prepared, when the food is offered and how the food is offered (Evans et al., 2011), but the child is still responsible for consuming the food, creating a division of responsibility between the parent and the child (Ellyn Satter Institute, 2019). Within baby-led weaning, the parent is the “feeder”, determining the what, where and how much is being offered, but the child is the person being “fed” and in control of the what and how much is being eaten (Ellyn Satter Institute, 2019). During parent-led weaning, infants' responsibility and control are lessened, as the parent is crossing from the realm of “feeder” to “fed” by controlling what and how much is eaten. Parents do not always know when an infant is “full” even when infants demonstrate signs of satiety (e.g., turning away, fussing as food is offered, locking lips, throwing things). Control or agentive behaviors, a component of social cognitive theory, are strengthened or more easily practiced during baby-led weaning leading to a decreased likelihood of overfeeding.

Self-efficacy, one aspect of social cognitive theory, influences every aspect of an individual's life including food intake and preferences (Bandura, 1997). Parent-led weaning may provide less opportunity for autonomy because the parent has greater control over the feeding

than the infant. This lack of opportunity for autonomy when learning about food could lead to increased likelihood to exert control once one is in control. Once infants have the ability to exert control, it could be displayed as food rejection, not necessarily due to the flavor or taste of the food, but from increased ability to reject it. Even if in control of being “fed”, infants are still developing and learning what, when and how much to eat based on parental influences and choices around food and nutrition during mealtime (Ahlstrom, 2009).

One of the most influential times to learn about food is during the introduction of solid foods that occurs in infancy as it is the first time one interacts with foods beyond breastmilk or formula. Depending on which feeding method, baby-led or parent-led, is used, application of social cognitive theory provides a lens for learning about food usage (behavior), a child’s developing preferences (personal) and also the child’s dependence on parental food choices (environment). For example, if utilizing baby-led weaning, infants are given the opportunity to learn more about the food through the multisensory experience it provides (Chadwick et al., 2013). During a baby-led feeding session, infants display behaviors that include picking up the food, looking at it, squishing it, testing it, licking, and sniffing it while being allotted control over the food, the timing of the food and the method they choose to investigate it. Therefore, while the parent is influencing dietary choices by deciding what food is offered and how it is offered, the child is also able to influence their dietary choices by gaining full sensory experience and agentive control of the foods and pace of feeding.

Within the ecological model, taste preferences can also be influenced by the mesosystem, which consists of interactions between microsystems, such as family members within the household interacting with extended family outside of the household, via traditions related to food choice and personal preferences among family members (Arnold et al., 2012; Neal & Neal,

2013). Similar to microsystems forming mesosystems within the ecological model, social cognitive theory suggests that multiple dimensions (e.g., cultural, psychosocial, economic, and situational) influence each other bidirectionally, creating a multidirectional causation of behaviors, environment and personal influence. This dynamic pattern of interacting influences can be seen when applying social cognitive theory to the development of eating preferences. Infant eating preferences are being driven by choices made in all environments that infants are a part of, including daycare. Daycare settings also form a key element of the microsystems for many children and influences the child by the food-related choices of the daycare provider as well as the role-modeling behavior of the teachers and other children (Bronfenbrenner, 1977; Scott, 2016). When a parent requests that their child eat a particular food while in a daycare setting, the two microsystems form a mesosystem, together influencing the child's diet. However, choices related to food in daycare settings are also influenced by the exosystem. For example, government regulations at all levels of government influence daycare policy and practices regarding food (Schwartz et al., 2019; Yeatman, 2003). Due to such policies and regulations, daycares are required to offer and provide certain food options to children.

At the macrosystem level in Bronfenbrenner's model, culture is a large determinant of food offered and made in the home (Boak et al., 2016; Syracuse, 1998). Culture has a large influence on the food available to an individual and can lead to variations in food availability between individuals (Young, 2004). Every culture varies widely in the cuisines they offer, providing infants an opportunity to learn about foods specific to the cultures into which they are born. However, Bronfenbrenner's theory includes a biological component that Bandura's perspective is lacking. Infants are biologically equipped to interact with foods from a young age and thus they learn to accept the foods that are available to them through the specific culture in

which they live (Savage, et al., 2007). Additionally, some people are unable or unwilling to eat certain foods due to their cultural or religious values or prohibitions on particular foods, such as pork or other living animals. Whether it is due to limited options in a geographic area or cultural preferences for offering certain foods, some individuals offer certain foods more than others and so children are influenced by cultural and contextual influences at the macrosystem level.

Another consideration is that the season and year an infant is born in may also influence the foods available at the time of first introduction to some extent. For example, a natural disaster where a certain food type is commonly produced may limit the available supply of that food in a given year, thus influencing an infant's exposure to that food at the macrosystem level.

The chronosystem influences all aspects of infant diet due to the changes in food availability over time as well as ever-changing policies and regulations (Falb et al., 2020; Johnson & Markowitz, 2018). There are seasonal changes in fresh fruit and vegetable availability due to climate in some areas, such as peaches, corn on the cob, artichokes, squash, and avocado (Chapman et al., 2014). Additionally, as new research is discovered and political or societal shifts occur, there are changes in policies and regulations that govern food through imports, exports and prices that influence availability. These changes that occur at the chronosystem level impact an individual's ability to access certain foods or afford certain foods. If someone is dependent on government supported programming and budget allotments change from previous years, this could impact the food choices of an individual and their family. Additionally, increases in prices of food items or increased demand with limited supply will influence who is able to purchase food items and the variety they are able to afford.

Infant food preferences are influenced by what is offered to them, but preferences are also determined by an individual's biological inheritance. For example, numerous studies have

found there is a heritable component to food preferences indicating that some of the dietary choices one makes may be due to a genetic predisposition (Birch, 1999; Olatz et al., 2020; Rozin & Millman, 1987). In a dynamic process, each element of the ecological system influences what food an infant is offered from the chronosystem down to the microsystem involving parent choices. Each of Bronfenbrenner's systems, micro-, meso-, macro-, exo-, and chrono- ultimately have an impact on the choices each parent makes related to food, and therefore also impact an infant's ability to learn about varied foods through experience and observation. Applying Bronfenbrenner's theory, which includes both biological and environmental influences, to this topic further suggests that the development of eating preferences is influenced by both genetics and environmental factors, meaning that both nature and nurture influence nutritional development in young children (Faith, 2005; Smith et al., 2017).

Parental Influences of Infant Nutrition

Infants learn what, when and how much to eat based on the influences surrounding them and by observing food choices and eating behaviors of their parents and those around them (Savage et al., 2007). Food acceptance is a critical indicator for an infant's developing food and taste preferences. It is the first subjective experience with flavors that are not transferred through another fluid (e.g., amniotic fluid or breastmilk) and is a key influence of what an individual eats and how they eat it. This experience influences how our developmental trajectory will unfold and the impact it will have on our overall health and wellness. Food acceptance, or lack therefore, is the beginning of the manifestation of feeding difficulties such as picky eating. What foods a child accepts upon introduction of solid foods becomes very important to the child's overall health and development, as certain nutrients are important for the development of a child's immune system, other bodily systems, and the developing brain (myelination, etc.; Pardo &

Dewey, 2015). Ultimately, food acceptance is the beginning foundational piece in development and is a determinant of if nutrition adequacy is met and optimal development is encouraged or not.

A child's pattern of food acceptance is shaped by various experiences with food and develops into a set of taste preferences and nutrition behaviors that further influence their overall development and health in following years. Through the interplay of the systems influencing parent choices related to food, it is not unusual for parents to offer the same foods to young children repeatedly when solid foods are being introduced. When parents offer the same foods to infants on a repetitive basis, this makes it easy for infants to grow accustomed to certain items and ultimately reject others due to unfamiliarity, eventually leading to low dietary variety.

When offering new foods, it can take as many as 15 introductions of a new flavor for it to be accepted by a child due to the natural progression of development (Ellyn Satter Institute, 2019). Infants are equipped to interact and learn about the world around them through sensory experiences. Due to multisensory experience, neural connections are occurring in the infant's developing brain and forming the learning pathways that will help a child understand and respond to the world around them (Tierney & Nelson, III, 2009). These connections are formed primarily based on repeated experiences that happen over and over again. By having repeated experiences with particular foods, the child will develop brain pathways (or neural connections) that underlie food acceptance in general and taste and flavor preferences for particular foods. Understanding this process of development in a child's brain and the importance of repeated sensory experiences, helps to explain why children often refuse foods or display sensory reactions to new foods when they are first introduced; it is not necessarily refusal due to the

flavor but is due to the developmental need for repeated exposure and is a normal part of development.

If a parent decides to quit trying to introduce a food because they perceive their infant does not like it, this could impact the infant's developing preferences through limiting exposure and potentially creating a dislike for a food that would have otherwise been accepted. If an infant displays rejective behaviors toward a particular food, parents may misperceive that as picky eating behavior when it is actually a feature of the infant's development. Developmental science, or the science of the developing individual, helps us to understand and unravel why such food refusal exists and also the development of taste preferences. For example, spitting out food may be perceived as rejection but may actually be a parent's misinterpretation of the extrusion or tongue reflex (i.e., the involuntary movement for the tongue to thrust out of the mouth; Hendricks & Badruddin, 1992) or may be a satiety responsiveness signal from the infant. Parents need to be aware that this pattern of refusal can be a part of mealtime behaviors among infants, and children may outright refuse to try new foods for a time before accepting them but this is not necessarily the display of picky eating (Ellyn Satter Institute, 2019). However, continued refusal of new and familiar foods and having low dietary variety is a sign of picky eating. When dealing with picky eating, it is important in these instances to avoid bribing or pressuring the infant (Ellyn Satter Institute, 2019).

Picky Eating

When infants are identified as exhibiting picky eating, it is often due to limited food acceptance behaviors. Picky eating is often defined as having strong likes or strong dislikes for certain foods and ultimately having low dietary variety (Carruth et al., 2004; Taylor et al., 2015). A majority of individuals display picky eating behaviors at some point during childhood

(Wolstenholme et al., 2020) and it can be a time of challenging behavior and parental frustration (Boquin et al., 2014). Cathey and Gaylord (2004) identified three main influences that contribute to the occurrence of picky eating, including developmental readiness, a child's personal taste preferences, and family patterns. It is important to recognize that picky eating, characterized by limited acceptance of certain foods, extends beyond limited dietary variety, and includes meal-time behaviors (Ellyn Satter Institute, 2019). For example, throwing food, tantrums at the table, standing on chairs or running around are meal-time behaviors present with picky eating and are thought to be easy ways to display control. By the time they are four, a child's food preferences have been found to be the most significant predictor of later food preferences (Lynch, 2011). These potentially restrictive early food preferences are setting the stage for lifelong dietary limitations and have the power to negatively impact growth (Chong Cole et al., 2017).

In addition, picky eating in childhood is linked with continued limited dietary intake, weight status, and disordered eating behavior in young adulthood (Pesch et al., 2019). More specifically, studies have found an association between being a picky eater in childhood and limited fruit, vegetable, protein and whole grain intake later in adulthood (Megan et al., 2019; Volger et al., 2013). Megan et al. (2019) also found that adults who were reported as being picky eaters in childhood had higher intakes of snack foods and sugar-sweetened vegetables and also frequented fast-food restaurants more than their non-picky eater counterparts. Individuals who continuously consume diets similar to the one previously mentioned are at increased risk for chronic health conditions like diabetes, cardiovascular disease, unhealthy weight control practices and higher weight status (Hu et al., 2001; Yang et al., 2014). Therefore, the impact of picky eating extends beyond childhood and can potentially influence an individual's developmental and nutritional trajectory across the lifespan.

Picky eating is not just a childhood problem. The likelihood of being a picky eater at age 2 is 50% whereas 34% of young adults identified themselves as being picky eaters (Carruth et al., 2004; Westrom et al., manuscript in preparation). While there is a decrease in rates of picky eating from infancy, picky eating is still prevalent. Additionally, it is important to note that identification as a picky eater at age 2 is through parental report and not the self-identification that occurs in older individuals, which may influence response rates.

Picky eating is most likely to emerge during infancy between 12 and 36 months but has been identified by parents as early as 4 months of age (Carruth et al., 2004; Lumeng et al., 2018). The development of eating habits can start early with prenatal decisions regarding foods due to the transference of flavors through amniotic fluid (Cooke et al., 2003). Mennella et al. (2001) found that the children of mothers who drank carrot juice during their pregnancy were more likely to accept carrot-flavored cereal than those who were not exposed to carrot flavor within the amniotic fluid. Additionally, a mother's dietary choices have the power to influence which foods are accepted in later infancy and into early childhood through transference of flavors through breastmilk (Cooke & Fides, 2011; Horodynski et al., 2010). The dietary choices a mother makes during pregnancy, as well as pregnancy-specific preferences, may be influenced by the microsystem, due to foods that family members select, the mesosystem, due to local food availability, and the exosystem, due to policies regarding dietary recommendations (Bronfenbrenner, 1977; Scott, 2016). Beyond prenatal food choices that influence infants, a majority of the time it is mothers who make decisions about household diet and food choices ultimately based on their own preferences or recommendations from others.

Complementary Feeding

By 6 months of age, infant nutritional needs have increased so that complementary feeding is needed in addition to breastmilk or formula (Ciechero, 2016). In order to keep up with growth demands, parents need to introduce solid foods in addition to breastmilk or formula (i.e., complementary feeding). How parents choose to introduce complementary foods, even within the short timeframe of utilizing complementary foods (i.e., 6 to 10- months), is a decision that influences the immediate environment of the infant and may significantly impact later food preferences (Locke, 2015; Swanepoel et al., 2020). The feeding method parents choose to utilize when first introducing complementary solid foods (i.e., foods in addition to breastmilk or formula), whether baby-led (i.e., infants feeding themselves) or parent-led (i.e., parents offer pureed foods on a spoon), is an important decision as it is the first step in the foundational learning blocks of nutritional behaviors (Locke, 2015). As explained previously, infants are learning new things and developing skills daily that will impact their lifelong nutritional behaviors. For example, when solid foods are being introduced, parents are deciding how to share certain foods (environmental factors), infants have some developed preferences occurring from prenatal exposures (personal factors), and these factors combine with other elements to influence an infant's food acceptance (behavior). Thus, the parental decision to emphasize a parent-led or baby-led weaning approach can influence further development of food preferences and ultimately food acceptance.

Baby-led Weaning

Rapley (2018) is a lead researcher in the area of baby-led weaning and first coined the term in 2008 (Ciechero, 2016). Baby-led weaning refers to a transition to including solids in a child's diet and not weaning off of breastmilk or formula (Anderson et al., 2020). As opposed to

traditional weaning, which is a parent-led spoon-feeding approach (Arden & Abbott, 2014), baby-led weaning encompasses more than just a feeding method; it is a transition that Rapley (2018b) described as “recognizing and respecting the infant’s instincts, abilities, and desire for autonomy” (p. 263). Infants feeding themselves altered table foods (i.e., cut in smaller pieces) is not new and occurred before the development of commercialized pureed foods (Quinn, 2004).

This “new” approach to weaning is becoming more common, once again, across the world (Arden & Abbott, 2014; D’Auria et al., 2018; Springen, 2018). However, the influence of baby-led weaning on food preferences and health outcomes is relatively unknown. Given that baby-led weaning has only been growing in popularity within the last decade (Rowan et al., 2019), there is a significant gap in our knowledge of how baby-led weaning influences aspects of this critical developmental period including the pattern of food acceptance and other important elements of a child’s nutritional behavior. This background sets the stage for examining the confluence of feeding approaches selected by parents and infant food acceptance and further expanding our knowledge on this currently under-researched topic on infant development and nutrition.

Feeding Method and Picky Eating

A key difference between parent-led weaning and baby-led weaning (other than the actual method for exposing the child to selected foods), is the texture of the food (Rapley, 2018). Parent-led weaning utilizes smooth and watery purees of foods that require spoon feeding (Cichero, 2016). Infants, who do not yet have the motor skills necessary and have not yet learned through observation or experimentation to utilize utensils, are unable to effectively feed themselves when food is prepared in this way (McCarty et al., 2001). Baby-led weaning, on the other hand advocates for introducing small chunks of fruit, soft-cooked vegetable sticks, strips of

meat and other foods large enough for the baby to pick up, providing a more multisensory experience, that has the potential to shape food preferences (D'Auria et al., 2020). Exposure to a variety of textures, a pillar of baby-led weaning, is as essential as exposure to a variety of flavors when it comes to establishing healthy food preferences (Rapley, 2018). Diet diversity (i.e., the number of foods or food groups consumed) is a primary indicator of adequate complementary feeding practices and is associated with better nutritional status (D'Auria et al., 2020). However, the benefits of complementary feeding are present when solid foods are introduced at or around 6 months of age. Introduction of complementary foods prior to 6 months of age has been associated with various health and nutrition consequences (Moursi et al., 2016).

Lack of early patterns of food acceptance may be linked to later picky eating. Infants who accept more foods are less likely to be picky eaters (Cardona et al., 2015). Furthermore, the timing of the introduction to complementary foods has been shown to be significantly inversely associated with picky eating (Brown & Lee, 2013). For example, infants who were weaned at ages younger than 6 months are more likely to be picky eaters at 18-24 months (Brown & Lee, 2013). In addition to increasing risk for picky eating, the timing of introduction of solid foods is linked to a greater risk of excess weight and obesity in later childhood, with infants who are introduced solid foods before 4-months of age being at the greatest risk (Pearce et al., 2013). Furthermore, introducing solid foods at or around 6 months of age has been found to be protective against hypertension onset later in life (Brambilla et al., 2016). Overall, early introduction of solid foods is associated with negative nutritional behaviors as one ages including inability to recognize satiety signals, less desirable eating behaviors, increased feeding difficulties and a decreased likelihood of development of positive eating habits and patterns (Möller et al., 2013). For these reasons, there is a need for increased public awareness of how to

best introduce foods to infants and toddlers in a way that will increase healthy food acceptance and decrease the risk of picky eating and obesity. However, to achieve this goal, we must first have a better understanding of the factors that promote healthy eating beginning with the first introduction to solid foods as close to 6-months of age as possible.

Baby-led weaning requires infants to have already developed certain motor skills, such as sitting unsupported. For typically developing infants, these skills are acquired by six months of age, the recommended age for introducing solids (Cichero, 2016). McAndrew et al. (2012) found, however, that only 5% of parents waited until 6 months of age to introduce solid foods. A majority of parents introduced solid foods well before 6 months of age. Approximately 30% of infants were introduced to solid foods by four months of age—two months earlier than recommended. Introducing solid foods too early increases the risk of obesity (Gibson-Moore, 2015) and picky eating (Rapley, 2018). While there are, as of yet, no known direct links to baby-led weaning decreasing the risk of picky eating, it is established that there are certain developmental requirements for utilizing this method for introducing complementary foods (D’Auria et al., 2020). For example, for the safety of the infant when utilizing baby-led weaning, it is important that the infant be able to sit unsupported (Cichero, 2016). Regardless of whether a parent-led or baby-led, infants are learning to swallow and develop their chewing abilities, making the extinguishing of the gag- and protrusion-reflex a determinant of developmental readiness. Due to these requirements of developmental ability, usually present around 6 months of age, there is a need to introduce complementary foods closer to the recommended age. The American Academy of Pediatrics (AAP), the World Health Organization (WHO) and the Institute of Medicine recommends waiting until 6 months to introduce solid foods in addition to

breastfeeding for at least 6 months (but preferably up to a year; American Academy of Pediatrics, 2012; Institute of Medicine, 2011; World Health Organization, 2011).

Additionally, mothers who choose to baby-led wean are more likely to breastfeed longer (Fu et al., 2018). Overall, duration of breastfeeding is linked to a decreased likelihood of picky eating regardless of feeding method (Specht et al., 2018). The added benefit of continued breastfeeding has been shown to be negatively predictive of childhood obesity. A possible explanation for the decreased risk of childhood obesity is the ability of breastfed babies to self-regulate (Cichero, 2016; Jones et al., 2019). The development of a child's ability to self-regulate likely continues when a baby-led weaning approach is used due to the independence that this method offers (Brown & Lee, 2013). Baby-led weaning promotes infants' independence by providing infants the ability to direct and control what they eat, how much is eaten and how quickly (of the food provided on the tray) it is eaten, potentially leading to decreased risk of picky eating and increased healthier eating patterns (Brown, 2018). The research we propose here will contribute to the establishment of better-informed dietary guidelines for feeding infants and more accurate feeding recommendations for parents by understanding perceptions and behaviors of parents.

Sweetener Use and Baby-Led Weaning

When introducing complementary foods, parents often worry about food acceptance because early poor nutrition can lead to detrimental compromises in growth and subsequent development (Leonard et al., 2017). For example, picky eating in adulthood can lead to increased psycho-social impairment that can restrict one's ability to exist in any given environment as well as increased risk for depression, eating disorders and emotional and behavioral problems (Chong Cole et al., 2017; Ellis et al., 2018). Children who are picky eaters consume less protein, fruit

and vegetables and more fat and sweet compared to children who are not picky eaters – influencing weight status (Brown et al., 2017; Cooke et al., 2006; Rohde et al., 2017; Volger et al., 2013). Given the potential detrimental long-term influence picky eating can have into adulthood (e.g., continued limited dietary variety, frequent low nutritional quality food intake), most parents try to intervene as early as possible (Megan et al., 2019; Pesch et al., 2019; Volger et al., 2013). In order to combat picky eating or the potential for picky eating, parents often try numerous strategies to increase food acceptance (Lumeng et al., 2018). These strategies include things such as pressuring children to finish their plate or hiding the desired food, often a vegetable, in another food. Pressuring or tricking a child to eat a certain food does not decrease the risk of picky eating or increase a picky eater’s desire to try a food (Lumeng et al., 2018). Additionally, parents may be concerned about decreasing the risk of their child disliking a food and may take preemptive measures. For example, because most people have an inherent like for sweetness and the strong influence it has on food preferences (Murary, 2017), parents may use an additive such as a sauce (e.g., ketchup, ranch dressing) or a sweetener (e.g., sugar, fruit juice) to increase food acceptance (Savage et al., 2007). Based on a study by Sylvetsky et al. (2012) and anecdotal evidence, we suspect that many parents frequently use natural processed sweeteners (juice, refined sugar, etc.), natural unprocessed additives (e.g., honey), and/or artificial sweeteners (e.g., sugar substitutes) in or accompanying their infants’ or toddlers’ foods. The practice of preemptively adding sugar to make “healthy” foods more appealing to the palate is present in adulthood with food items such as commercial oatmeal which is heavily sweetened and may translate to parental use of additives and sweeteners in food preparations for children.

To make food more appealing, a majority of store-bought prepackaged food already contains added sweeteners and or sugar (Elliott, & Conlon, 2015). There are no universal or

world-wide recommendations for added sugar intake (i.e., sugar in addition to the sugars found naturally in an item). However, based on the Dietary Guidelines for Americans for adults, the average American adult consumes almost three times the recommended amount of added sugar, with 30% of more of their daily total calorie intake coming from added sugars (Erickson & Slavin, 2015). Furthermore, given the addictive nature of sugar and sweetness, which can be more intense than addictive drugs, it is not a surprise that repeated exposure to foods high in sugar can lead to difficulty controlling consumption (Ahmed et al., 2013; Westwater et al., 2016). Additionally, Wise and colleagues (2016) found that consumption of sugars influences the taste intensity of perceived sweetness, creating a level of tolerance that will need to be surpassed in order to achieve the same level of satisfaction. Due to this, it may be likely that people add more sugar to other types of food to acquire the same level of sweetness they typically find. Otherwise, they may reject the food entirely.

Townsend (2012) found that infants who are parent-led weaned have a higher preference for sweet foods compared to infants who are baby-led weaned. One possible reason for a sweet food preference may be due to growing accustomed to the sugar content in prepackaged infant foods. Furthermore, the sweet preference may cause infants who are parent-led weaned, and more likely to be exposed to prepacked infant foods, to be more likely to reject table foods when an additional sweetener or additive (e.g., ketchup) is not utilized. For example, with parent-led weaning, a majority of parents utilize store-bought infant and toddler food which is already high in sugar content (Cogswell et al., 2015). “High in sugar content” is defined as at least 35% of the total calories coming from total sugars per portion (Cogswell et al., 2015). Total sugars are calculated from natural processed sweeteners, natural unprocessed additives and artificial sweeteners. The sugar content of these foods would be increased by the addition of a sweetener

or additive. Additionally, parents who have a preference for sweet-tasting foods may be more likely to introduce such foods to their infant children rather than giving them foods they personally dislike.

There was previously a lack of dietary recommendations for children birth to 24 months of age; however, new guidelines were just released this year (USDHSS & USDA, 2020). It is too early to have much information on compliance with such guidelines, but it is now suggested children under 24-months-old should have no added sugar consumption. In contrast, there were and are recommendations for children over the age of two (USDHSS & USDA, 2020). The recommendation is for added sugar consumption over the age of two to consume less than 25 grams a day, half of the recommended amount for adults (USDHSS & USDA, 2020). Based on these recommendations, most young children, approximately 90%, do not meet current dietary recommendations (Anzman-Frasca et al., 2012). Similar to adults, young children consume added sugars above the daily recommended intake. Providing mainly sweet foods during the first introduction of solid foods has the potential to create a predisposition in taste preferences for foods with sweeter flavors (Lockyer, 2016).

For baby-led weaning, whole foods prepared at home are often utilized (Rapley, 2018). When comparing diets of infants who ate commercial infant and toddler foods to infants who ate homemade foods, those who had commercial foods had a significantly higher intake of added sugars in infancy (Foterek et al., 2015). Increased sugar intake for those who had commercial complementary foods was also found at both preschool and primary school ages (Foterek et al., 2015). We suspect when preparing whole foods at home and utilizing the baby-led weaning approach, parents may be less likely to utilize a sweetener or additive in comparison to parents utilizing a parent-led weaning approach. One reason for this is because in parent-led weaning,

even if they make food at home, something must be added to create the puree consistency (fruit juice, apple sauce, etc.) (Lockyer, 2016). However, the relationship between baby-led weaning and use of sweeteners or additives is under researched, and thus an opportunity exists to explore this topic further and contribute to the body of available knowledge on this and related topics.

Current Studies

The overarching goal of the following studies was to compare the baby-led weaning approach with the parent-led weaning approach and investigate potential differences in nutritional attitudes and behaviors among both infants and parents. Using a comparative approach, the first study investigated the relationship between weaning approaches, food acceptance and picky eating in infants. The first study addresses the question of whether infants who are baby-led weaned are less likely to be picky eaters. We sought to address this by investigating the link between baby-led weaning and food acceptance. The second study focused on if there were differences between the baby-led and parent-led groups specific to parental attitudes and behaviors. Previous research has demonstrated that parents who adopted the baby-led feeding method, compared to parents who did not, frequently differed in their attitudes and behaviors related to food (i.e., less concerned about weight gain; Cichero, 2016). Due to baby-led weaning requiring foods to be prepared whole or in large chunks, there is less opportunity to mix in sweeteners or additives; therefore, we hypothesize that parents of baby-led infants are less likely to use additional sweeteners than parent-led infants. Therefore, we wanted to investigate if these differences extended to the use of sweeteners and additives as well as parental attitudes in regard to willingness to give an infant sweeteners. By investigating reported use as well as parental attitudes separately, we will potentially be able to identify any possible cognitive dissonance that may be occurring.

CHAPTER TWO. GENERAL METHODS

Data for this project was collected in 2019 and was funded by the Sugar Association. The information was obtained using a descriptive, cross-sectional design with a quantitative approach (questionnaire) among respondents in the midwestern United States. Sample size and a summary of participant demographics are reported in chapter 3. Study approval was given through the Institutional Review Board (IRB) at North Dakota State University.

Participants

Parents of infants 6- to 48-months-old were eligible to complete the survey. Additionally, the only other requirement for participation was that the parent was at least 18 years old. There were no other eligibility guidelines. No participants were excluded from the study.

Procedure

A single questionnaire was constructed covering the topics of baby feeding approaches, child food acceptance and parental attitudes and behaviors. To gather data for the project, the questionnaire was made available electronically utilizing the online survey software, Qualtrics. Parents of children under the age of 4, but at least 6 months of age were recruited to participate in the study through single-access anonymous links to the questionnaire. Previously established recruitment methods within the Infant Cognitive Development Lab (ICDL) at North Dakota State University were utilized. These methods included: utilizing North Dakota State University email lists targeting undergraduate and graduate students, faculty and staff members, and a list specific to parents; distributing flyers and access codes through bulk mailouts to addresses provided from the North Dakota Department of Health records for North Dakota births (excluding non-married individuals due to Department of Health policies) by birth month; setting up a recruitment booth at events that target parents around the Fargo-Moorhead area in North Dakota and Minnesota;

and digital advertisements using popular social media sites that utilize algorithmic data to display advertisements within roughly a 150 mile geographical radius of the Fargo-Moorhead area targeting people who are most likely to fit the desired populations determined by their likes, interests and activities. A convenience sampling strategy was employed in recruiting participants into the study.

Eligible participants who accessed the link were directed to the consent form for the project. Upon giving consent, parents were then able to begin the questionnaire. The survey took approximately 20 to 40 minutes for participants to complete. Upon survey completion, parents were displayed a screen with a passphrase on it. Parents were then able to find the nearest research assistant to provide them the code at the location of the recruitment event or provide the code to a research assistant at the ICDL to pick up an age-appropriate book as compensation for participation.

Measure

The questionnaire set up for this study incorporated questions and measures that have been utilized in various studies and publications. The overall goal of the study was to investigate factors that are present in infancy that contribute to healthy eating habits, including infant feeding methods, child food acceptance, and parental attitudes and behaviors related to using sweeteners and additives. The questionnaire included various question types including Likert-type scales, multiple choice items, multiple answer, yes/no, and short response. The full questionnaire is attached as Appendix A, and specific items or measures for this study are detailed below.

Demographic Information

The demographic information was collected utilizing 10 related survey questions including parent gender, age, education level, income level and race/ethnicity. Other questions were specific to the child they were answering the survey about. These included the child's gender, age, race/ethnicity, number of siblings and where the child falls in birth order. Specific questions are listed in Table 1 and Table 2.

Feeding Method

In order to determine the feeding method parents employed, baby-led weaning or parent-led weaning, a measure called “Introducing Solids to Your Child” that was developed by Cameron, Taylor and Heath (2013) was used. Overall, this 22-item measure includes questions related to starting complementary foods, use of baby-led weaning, and attitudes towards infant feeding and their experience. However, for the purposes of the current project, only one item was analyzed specific to child feeding approach. The question selected was: “How much did you utilize the baby-led weaning approach?” This single item was used to determine comparison groups (baby-led weaned and parent-led weaned) for both of the current studies. Participants were asked to answer the question after being provided a definition of baby-led weaning. The question was rated on a 4-point Likert-scale ranging from 1 (*very little*) to 4 (*all of the time*). Parents were considered as having utilized baby-led weaning if they had utilized the approach “most” or “all of the time.” Though the variable described here is measured as a continuous variable, it was re-coded as a dichotomous (no/yes) variable and analyzed as an independent variable in the two studies that are described for this project.

Picky Eating

While there are multiple approaches and more extensive measures to assess picky eating, based on results from Iwinski et al. (2021) regarding the use of a single question to measure picky eating, a single question from the Mealtime Assessment Survey (MAS) (Boquin et al., 2014) was used to measure picky eating during mealtime. Parents were asked to identify if their child is a picky eater or not using *yes/no* response options. This item was assessed as a dichotomous variable and analyzed as a dependent variable in the study.

Food Acceptance

In order to investigate food acceptance, questions were developed based on behavioral coding procedures for food acceptance behaviors from the Feeding Infants: Behaviour and Facial Expression Coding System (FIBFECS; Hetherington et al., 2016). Approximately 45 questions were developed to measure the degree to which parents perceive their infants accept first foods. Parents were first asked a *yes/no* question to indicate which first foods they offered, selecting all that apply, including: rice cereal, green beans, carrots, sweet potatoes, bananas, avocado, apples and butternut squash. For this question, each food type option was treated as its own dichotomous variable and analyzed as a dependent variable. For the current analysis, rice cereal was excluded due to it commonly being used only in parent-led weaning.

Second, for each the first food choices that parents might have offered, a series of five questions were developed and asked that utilized Likert-scale response options to assess the child's food acceptance of that particular food item. While each of the five questions related to food acceptance, the scale range for each question was not the same and so each food acceptance measure was analyzed separately. The five questions asked about a child's food acceptance for each of seven specific food items and were rated by parents as follows: (a) parental rating of

their child's food item acceptance from 1 (*extremely pleased*) to 5 (*extremely displeased*), (b) their child's face of enjoyment in eating a food item from 1 (*always*) to 5 (*never*), (c) how often they turned away eating a food item from 1 (*always*) to 5 (*never*), (d) how often they spit out the food from 1 (*always*) to 5 (*never*), and (e) how many times in a single sitting they had to offer the food item before the child would accept it from 1 (*once*) to 7 (*refused every time*). All questions were analyzed for the current studies. Each of the scale variables described here were treated as continuous variables and analyzed as dependent variables. Parental rating, face of enjoyment, and number of offerings in a single sitting were reverse coded so that higher scores across all behaviors indicated higher acceptance rates.

Parental Perceptions and Behaviors Related to Sweeteners

Parents were asked a mix of Likert-type and multiple-choice questions that were developed to assess parental attitudes and behaviors regarding the use of food additives and sweeteners. To assess parental attitudes related to willingness to give sugar to a child, a single question from Bakke et al. (2018) was utilized. The question utilized was: "I would be willing to give a young child vegetable preparations with sugar added to mask a bitter taste." Parents were given the response options of *yes*, *no*, or another "fill in the blank" option. This item was treated and coded as a dichotomous variable and analyzed as a dependent variable in the analysis. Given the broadness of the term "young child," we asked a second modified version of this question that listed specific age ranges for a young child from 6 months to 48 months in 6-month increments up to 36 months, and then combining 37-48 months into one option. So, to add a developmental component to the study and further determine parental attitudes related to adding sugar for young children of different age groups, the modified question stated: "I would be willing to give vegetable preparations with added sugar to a: (6- to 12-month old, etc.)." We

presented multiple age groups to see if parents' responses differed when an identified age was presented. Additionally, we wanted to know how "young" a parent was willing to give to a child sugar as an additive. For this second question, each age-linked response option was treated as its own dichotomous variable and analyzed as a dependent variable.

To determine parental behaviors and their actual use of sweeteners and additives, 15 questions were utilized in the complete survey. However, for the current study, only questions related to current use of sweeteners and additives were utilized. Additionally, specific sweeteners and additives were excluded if few to no parents offered or utilized them (e.g., tarter sauce). To assess the usage of sweeteners in offering food to a young child, parents were given a multiple-option question that asked which sweeteners, if any, they have added when offering food to their child. Seven sweetener options including sugar, honey, applesauce, fruit juice, syrup, mashed sweet fruit, and mashed sweet vegetables were listed, as well as a "fill in the blank" other option or that they have added *none of the above*. Parents were also asked in a similar second question to indicate which additives their child uses, including ketchup, ranch, or any of six other options, but only ketchup and ranch dressing were included since there were no or few responses to all other options. For this question, each sweetener or additive option was treated as its own dichotomous variable and analyzed as a dependent variable. Specific questions utilized are displayed in Table 1.

Current Studies

Responses to the following questions (Table 1) were collected and analyzed for the current studies. Demographic and grouping variables are displayed first with questions specific to the goals of study one and study two being grouped after. The goal of study one focused on group differences specific to picky eating and food acceptance. The goal of study two focused on

group differences related to parental attitudes and behaviors specific to sweetener use. The analytical procedures used for each study are summarized in chapter three and chapter four. Specifically, statistical procedures used to explore and analyze the data for these specific studies included descriptive statistics, Chi-square analysis, and multivariate analysis of variance (MANOVA).

Table 1*Current Studies Survey Questions*

Question	Question type	Measure
What is your gender	Multiple Choice	What is your gender
How old are you	Fill in the blank	How old are you
What is your highest level of education	Multiple choice	What is your highest level of education
What is your yearly household income	Likert Scale	What is your yearly household income
Race/Ethnicity	Multiple Choice	Race/Ethnicity
Child's Sex	Male Female Prefer Not to Say	Sex
Child's Age	Fill in the blank	Age
Child's Race/Ethnicity	Multiple Choice	Race/Ethnicity
Number of Children	Multiple Choice	Number of Children
Where Child Falls in Birth Order	Multiple Choice	Birth Order
How much did you follow a Baby-led Weaning approach	Multiple Choice	Feeding Method
Paper One		
Is your child a picky eater	Multiple Answer	Picky Eating
When first introducing solid foods, how would you rate your child's acceptance of <i>insert first food</i>	Likert Scale	Food Acceptance
When first introducing <i>insert first food</i> how often would your child make a face of enjoyment	Likert Scale	Food Acceptance
When first introducing <i>insert first food</i> how often would your child turn away	Likert Scale	Food Acceptance
When first introducing <i>insert first food</i> how often would your child spit the food out	Likert Scale	Food Acceptance
When first introducing <i>insert first food</i> how many times did you have to offer the food before your child would accept it	Likert Scale	Food Acceptance
Paper Two		
When offering food to my child I have added	Multiple Answer	Parental Behavior
When eating table foods, my child uses	Multiple Answer	Parental Behavior
I would be willing to give vegetable preparations with added sugar to a:	Multiple Answer	Parental Attitude
I would be willing to give a young child vegetable preparation with sugar added to mask bitter taste	Yes/No	Parental Attitude

CHAPTER THREE. PAPER ONE

Introduction

Research on nutrition, feeding choices and the outcomes of those choices in the birth to 24-month-old range is limited. Given the influence that decisions made during infancy have on lifelong development, especially nutrition decisions, it is imperative to investigate these choices (Boak et al., 2016). The choices parents make can influence the likelihood of picky eating (i.e., having limited or low dietary variety, strong likes and dislikes for food, and having restrictive and rejective mealtime behaviors) and the rate of food acceptance, such as the method utilized to introduce solid foods. Food acceptance at introduction of solid foods between 6- and 8-months is linked to later rates of picky eating (Cardona et al., 2015; Taylor & Emmett, 2019). When introducing solids, the two most well-known choices are: parent-led weaning, which refers to a parent spoon-feeding purees, or baby-led weaning, which allows the infant to feed themselves soft-cooked and mashed foods (Locke, 2015; Rapley, 2018a). Infants who are baby-led weaned may be less likely to be picky eaters due to the factors associated with baby-led weaning that are also associated with a decreased likelihood of picky eating. These factors include exposure to a variety of food and textures, the timing of introduction to solid foods, the duration of breastfeeding, and acknowledgement of infants' desire for autonomy.

One of the key factors of baby-led weaning involves offering a variety of foods in a variety of textures (D'Auria et al., 2020). Offering a variety of food textures has been shown to increase food acceptance and decrease the rates of picky eating (D'Auria et al., 2020; Demonteil et al., 2018; Rapley, 2018). Exposure to multiple food textures during initial food introduction can lead to an increased acceptance of most textures at 12 months of age (Demonteil et al., 2018; Rapley, 2018).

Increased rates of picky eating have been linked to the timing of introduction of complementary food (Brown & Lee, 2013) and duration of breastfeeding (Specht et al., 2018). Infants who were weaned at an early age (i.e., earlier than 6 months) were more likely to be picky eaters at 18 to 24 months (Brown & Lee, 2013). Due to the developmental demands of baby-led weaning that require an infant to have trunk control and rudimentary hand-eye coordination (e.g., be able to bring food to mouth), parents who choose this approach are more likely to wait until 6 months to introduce solid foods. Therefore, parents who baby-led wean are potentially decreasing the risk of picky eating and increasing the rates of food acceptance due to waiting until closer to 6 months of age to introduce solids.

Mothers who baby-led wean are more likely to breastfeed longer than mothers who parent-led wean. This may be, in part, due to the need to wait until the baby is developmentally ready to engage in baby-led weaning. The duration of breastfeeding rates have been found to be significantly different when comparing infants who were baby-led weaned to infants who were parent-led weaned (Fu et al., 2018). Mothers who chose to baby-led wean breastfed for longer durations and closer to the American Academy of Pediatrics (AAP) recommendation to breastfeed until at least 6 months of age (AAP, 2012; Fu et al., 2018). The duration of breastfeeding has been shown to be inversely correlated with rates of picky eating; infants who are breastfed for shorter durations are more likely to be picky eaters (Specht et al., 2018). When breastfed, infants have control over the flow rate of breastmilk, providing the beginning of autonomy development through joint responsibility.

By using baby-led weaning as a feeding method, this early experience of control is extended into the next phase of feeding when infants continue the transition to table foods and mealtimes with family, which further fosters the development of autonomy. This is because

baby-led weaning provides a mealtime experience that is not solely focused on food consumption. Through baby-led weaning, infants are provided autonomy through the opportunity to investigate and explore the food (squish, sniff, taste, lick, etc.) at their own pace and in the order they choose. Thus, a key factor of baby-led weaning involves the respect for an infant's desire for autonomy and control; infants are given the opportunity to practice control over their food choices from the beginning of introduction to foods.

There is a division of responsibility, as defined by the Ellyn Satter Institute (2019), when it comes to control of food choices. The parent is responsible for deciding what food is offered, how and when. However, the child is responsible to decide what to eat (from what is offered), how much to eat and in what order. This division of responsibility acknowledges a child's desire for autonomy during mealtime and can reduce parental frustrations and picky eating. When this opportunity for autonomy is not present, behaviors related to picky eating may be escalated when a power-struggle for control over meal-time choices may occur. When this struggle occurs, parental frustrations can increase and child problem behaviors can also increase, which, in turn, can continue to increase parental frustration – creating a cycle that leads to continued displays of picky eating. Parents who baby-led wean are less concerned about weight gain and are calmer and more relaxed during mealtime than parents who parent-led wean (Cichero, 2016). Such parenting attitudes and behaviors can lead to less pressure during mealtime, potentially preventing a power-struggle cycle and leading to increased food acceptance.

In summary, infants who are baby-led weaned are introduced to solid foods at a developmentally appropriate age, are exposed to a variety of food textures, and are provided a mealtime experience that fosters autonomy (Brown & Lee, 2013; Cichero, 2016; Ellyn Satter Institute, 2019; Fu et al., 2018; Rapley, 2018). These factors are also associated with lower rates

of picky eating (D'Auria et al., 2020; Demonteil et al., 2018; Rapley, 2018; Specht et al., 2018). Given the overlap of the factors associated with baby-led weaning and those associated with picky eating, it is reasonable to conclude that there may be differences between infants who are baby-led weaned and parent-led weaned when it comes to picky eating. Additionally, if infants who are baby-led weaned differ in picky eating rates, they may initially be more likely to accept complementary foods than their parent-led counterparts. We aimed to assess these possibilities by investigating the link between feeding method and picky eating and feeding method and food acceptance.

Methods

Sample

Parents of children aged 6- to 48-months-old were recruited to participate in an online survey (demographics are presented in the results section). We utilized various recruitment methods including: email announcements, posting flyers in local establishments, mailouts using the state's Department of Health records, and geographical advertisements using social media sites that target people likely to be in the desired population. Eligible participants who clicked on the link were presented with a consent form and, upon giving consent, were able to continue to the questionnaire. Participants were able to collect compensation in the form of an age-appropriate book upon completion of the survey.

Measurements

In order to investigate the relationship between baby-led weaning and picky eating, parents were given a link to access a single questionnaire constructed through Qualtrics survey software. The questionnaire, attached as an appendix, briefly described below and used in previous studies (Westrom et al., submitted), is comprised of items selected from various

previously established surveys and questions developed by the research team to address specific research questions. Questions included Likert-type scales, multiple choice, multiple selection, yes/no, and short response. Basic demographic questions are included. “Skip logic” was used so that parents were not presented with questions that did not apply to them; therefore, the survey took approximately 20 to 40 minutes to complete.

The survey was approved by the university’s Institutional Review Board. Prior to beginning the survey, each participant was presented with a consent form that included information on their rights as a participant and asked if they would like to continue or not. If “no” was selected, the survey automatically ended.

Measure

Demographic Information

Parents were asked to identify their gender, age, education level, income level, and race/ethnicity. Additionally, they were asked to identify their child’s gender, age, race/ethnicity, number of siblings, and birth order. Specific questions are listed in the appendix.

Feeding Method

To assess feeding method, questions from the survey, “Introducing Solids to your Child,” created by Cameron, Taylor, and Heath (2013) were used to measure starting complementary foods, use of baby-led feeding, attitudes towards, and experiences of, feeding an infant. The measure has not yet been validated. Questions from this survey were used to determine comparison groups of baby-led weaned and parent-led weaned. For the current analysis, the question “How much did you utilize the baby-led weaning approach?” was utilized. Participants were asked to answer the question after being provided a definition of baby-led weaning. The questions were rated on a 4-point Likert-scale ranging from 1 (*very little*) to 4 (*all of the time*).

Parents were considered as having utilized baby-led weaning if they had utilized the approach most or all of the time.

Food Acceptance

To assess food acceptance, approximately 45 questions were developed by the research team based on behavioral indicators of food acceptance typically analyzed using the Feeding Infants: Behaviour and Facial Expression Coding System (FIBFECS), a validated coding method for assessing non-verbal indicators of food acceptance in infants (Hetherington et al., 2016). These questions were used to measure the degree at which parents perceive their infants accept a variety of individual (not mixed) solid foods, with a heavy emphasis on vegetables. Parents were asked to rate their child's acceptance of green beans, carrots, sweet potatoes, bananas, avocado, butternut squash and apples on a 5-point Likert-scale from 1 (*extremely pleased*) to 5 (*extremely displeased*). Rice cereal was excluded as fortified infant cereals are utilized only in parent-led weaning (Alpers, Blackwell, & Clegg, 2019). Additionally, parents were asked to rate their child's face of enjoyment on a 5-point Likert-scale ranging from 1 *always* to 5 *never*, how often they turned away on a 5-point Likert-scale ranging from 1 *always* to 5 *never*, how often they spit out the food on a 5-point Likert-scale ranging from 1 *always* to 5 *never*, and how many times in a single sitting they had to offer the food before the child would accept it on a 7-point scale ranging from 1 *once* to 7 *refused every time*.

Picky Eating

A single question from the Mealtime Assessment Survey (MAS) (Boquin et al., 2014) was used to measure picky eating during mealtime. Parents were asked to identify if their child is a picky eater or not on a yes/no scale.

Results

Sample Characteristics

Demographics are reported in Table 2. The final sample size consisted of 412 parents of children 6 to 48 months old, including 14 males and 396 females (2 participants did not report their child's sex) who completed the survey ranging in age from 19 to 42. Of the participants, 93.53% identified as Caucasian. A majority of the participants had at least a college degree.

Table 2

Demographics

Demographic	N (%)	Measure of Central Tendency
Parent's Gender		
Male	14 (3.16)	NA
Female	396 (96.51)	
Prefer Not to Say	2 (0.33)	
Total	412	
Parent's Age		
19 to 24 years	59 (15.00)	<i>M</i> : 28.84 years <i>SD</i> : 4.85
25 to 29 years	140 (35.34)	
30 to 34 years	132 (31.50)	
35 to 39 years	68 (15.33)	
40 to 42 years	13 (2.83)	
Total	412	
Education		
Some HS	0 (0)	NA
HS	30 (7.16)	
Some College	97 (23.46)	
College Degree	181 (46.92)	
Post-Graduate Degree	104 (21.96)	
Total	412	
Income		
< \$20,000	30 (7.02)	Median: \$60,001 - \$70,000
\$20,001 to 30,000	12 (3.85)	
\$30,001 to 40,000	37 (8.19)	
\$40,001 to 50,000	47 (11.53)	
\$50,001 to 60,000	42 (10.87)	
\$60,001 to 70,000	39 (8.70)	
\$70,001 to 80,000	48 (11.37)	
\$80,001 to 90,000	38 (9.03)	
\$90,001 to 100,000	50 (13.71)	
Other	68 (15.73)	
Total	412	

Table 2*Demographics (continued)*

Demographic	N (%)	Measure of Central Tendency
Parent's Race/Ethnicity		
Caucasian	387 (93.51)	NA
AI/AN	4 (1.16)	
Hispanic	6 (2.00)	
Asian	4 (1.00)	
Pacific Islander	1 (0.16)	
Black	7 (1.50)	
Asian Indian	1 (0.17)	
Other	2 (0.50)	
Total	412	
Child's Sex		
Male	197 (46.75)	NA
Female	214 (52.58)	
Prefer Not to Say	1 (0.67)	
Total	412	
Child's Age		
6 to 12 months	121 (29.45)	<i>M</i> : 21.74 months <i>SD</i> : 11.51
13 to 24 months	135 (32.78)	
25 to 36 months	100 (24.29)	
37 to 48 months	56 (13.48)	
Total	412	
Child's Race/Ethnicity		
Caucasian	358 (86.52)	NA
AI/AN	7 (1.83)	
Hispanic	12 (2.82)	
Asian	6 (1.83)	
Pacific Islander	1 (0.17)	
Black	8 (1.50)	
Asian Indian	1 (0.17)	
Other	19 (5.16)	
Total	412	
Number of Children		
1	170 (40.90)	<i>M</i> : 1.56 <i>SD</i> : 1.68
2	137 (34.89)	
3	67 (15.52)	
4	27 (5.85)	
5	8 (1.67)	
> 5	3 (1.17)	
Total	412	
Birth Order		
First	221 (55.24)	NA
Second	113 (26.79)	
Third	53 (11.65)	
Fourth	18 (3.82)	
Fifth	5 (1.33)	
Sixth	2 (0.33)	
Total	412	

To assess if there are difference in picky eating between baby-led infants and parent-led infants, a chi-square analysis was used to analyze feeding method (independent variable) and picky eating (dependent variable). The results, as shown in Table 3, of the chi-square test of association (2 x 2) showed that there is a significant association between feeding method and picky eating $X^2 (1, N = 412) = 6.6, p = .01$. Baby-led weaned infants were less likely than parent-led weaned infants to be reported as picky eaters.

Table 3

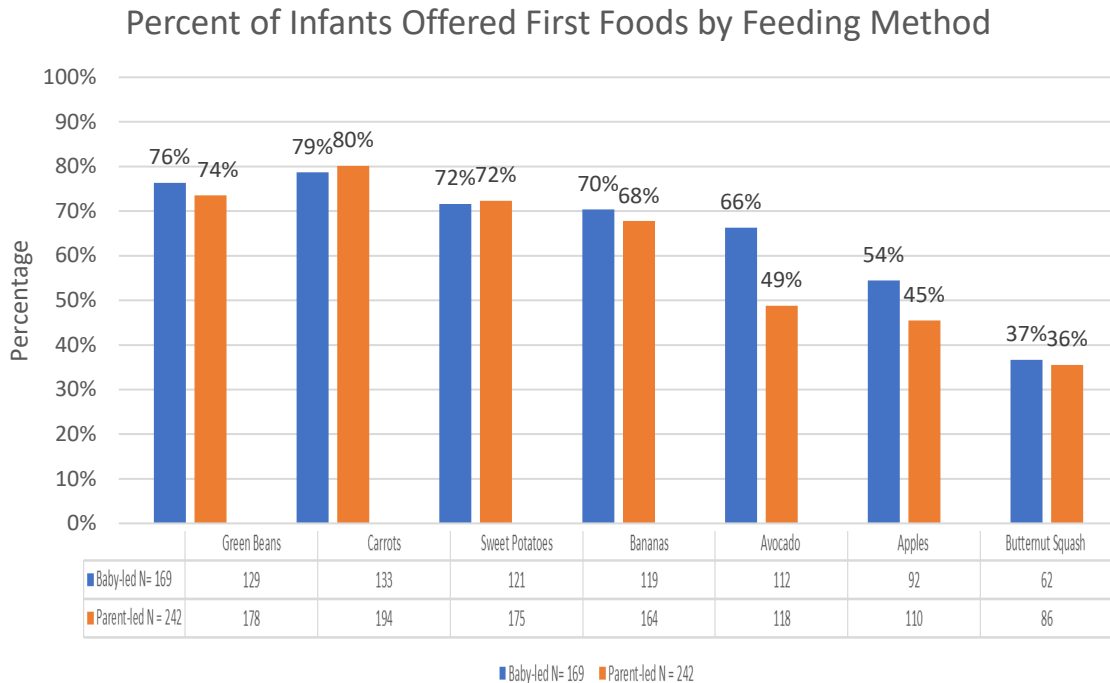
*Picky Eating * Feeding Method Crosstabulation*

			Feeding Method		Total
			Baby-led	Parent-led	
Picky Eating	Yes	Count	20	52	72
		Expected	29.7	42.3	72
	No	Count	150	190	340
		Expected	140.3	199.7	340
Total	Count	170	242	412	
	Expected	170	242	412	

Parents were prompted to answer which first foods they offered and were only asked questions related to the foods they offered. The number of parents that offered each food can be seen in Figure 1.

Figure 1

Percentage of Infants Who Were Offered Each First Food in Each Feeding Method Group



Note. Bars represent the percentage of infants in each feeding method group who were offered the first foods surveyed. The sample size for each first food is displayed in the data table.

Seven one-way multivariate analysis of variance (MANOVA)s were used to analyze differences in food acceptance (dependent variable) between infants who are baby-led weaned and infants who are parent-led weaned (independent variable). These analyses examined five food acceptance behaviors for each of seven infant foods. Results are displayed in Table 4. The five different behaviors assessed for each food include: parental ratings of food acceptance, how often the child made a face of enjoyment, how often the child turned away, how often the child spit out the food, and how many times in a single sitting the food had to be offered before the child would accept it. The seven different common first foods included: green beans, carrots, sweet potatoes, bananas, avocado, butternut squash and apples. Of the first foods offered, there

were only significant differences in acceptance behaviors for green beans. These were in parental ratings of acceptance ($F(1, 310) = 9.21, p < .01, \text{partial } \eta^2 = 0.02$) and how many times in a single sitting the food was offered ($F(1, 308) = 4.06, p < .05, \text{partial } \eta_p^2 = 0.01$) with baby led-weaned infants being rated by parents as more likely to accept green beans and having a lower level of offerings (e.g., tastes) before the food was accepted.

Table 4*Comparison of Acceptance Behaviors for First Foods*

Behavior	N	Baby-led Weaning		Parent-led Weaning		df	F	η_p^2
		Mean	SD	Mean	SD			
Green Beans	307							
Parental rating ^a		3.71	1.19	3.35	1.31	(1, 301)	5.81*	.02
Face of enjoyment ^a		3.06	1.21	2.88	1.33	(1, 301)	1.48	.00
Turned away		3.98	1.03	3.81	1.13	(1, 301)	1.36	.00
Spit out food		3.91	1.05	3.79	1.15	(1, 301)	0.88	.00
Offering in single sitting ^a		5.98	1.60	5.58	1.80	(1, 301)	4.06*	.01
Carrots	327							
Parental rating ^a		3.87	1.07	4.05	0.96	(1, 321)	2.36	.00
Face of enjoyment ^a		3.25	1.13	3.28	1.18	(1, 321)	0.73	.00
Turned away		4.11	0.89	4.05	0.93	(1, 321)	0.36	.00
Spit out food		4.07	0.86	4.13	0.95	(1, 321)	0.20	.00
Offering in single sitting ^a		6.23	1.29	6.22	1.34	(1, 321)	0.26	.00
Sweet Potatoes	296							
Parental rating ^a		4.22	0.99	4.35	0.86	(1, 290)	1.50	.00
Face of enjoyment ^a		3.23	1.15	3.31	1.19	(1, 290)	0.31	.00
Turned away		4.08	0.91	4.08	0.91	(1, 290)	0.00	.00
Spit out food		4.06	0.86	4.13	0.91	(1, 290)	3.49	.00
Offering in single sitting ^a		6.21	1.30	6.22	1.24	(1, 290)	0.26	.00
Bananas	283							
Parental rating ^a		4.31	1.11	4.34	1.00	(1, 277)	0.06	.06
Face of enjoyment ^a		3.56	1.16	3.60	1.13	(1, 277)	0.09	.09
Turned away		4.09	1.02	4.09	0.93	(1, 277)	0.00	.00
Spit out food		4.07	1.02	4.14	0.89	(1, 277)	0.48	.00
Offering in single sitting ^a		6.21	1.54	6.21	1.23	(1, 277)	0.01	.01
Avocado	230							
Parental rating ^a		3.77	1.17	3.75	1.27	(1, 224)	0.02	.00
Face of enjoyment ^a		3.76	1.32	3.83	1.21	(1, 224)	0.09	.00
Turned away		3.97	1.09	3.84	1.09	(1, 224)	0.00	.00
Spit out food		3.91	1.10	3.92	1.14	(1, 224)	0.48	.00
Offering in single sitting ^a		6.36	1.39	6.34	1.00	(1, 224)	0.00	.00
Apples	202							
Parental rating ^a		4.30	0.92	4.41	0.86	(1, 196)	0.70	.00
Face of enjoyment ^a		3.18	1.30	3.05	1.37	(1, 196)	0.47	.00
Turned away		4.34	0.75	4.43	0.80	(1, 196)	0.70	.00
Spit out food		4.25	0.82	4.43	0.70	(1, 196)	2.76	.00
Offering in single sitting ^a		5.36	1.40	6.44	1.28	(1, 196)	0.17	.01
Butternut Squash	148							
Parental rating ^a		4.21	0.90	4.06	0.90	(1, 145)	1.03	.00
Face of enjoyment ^a		3.94	1.14	3.93	1.12	(1, 145)	0.00	.00
Turned away		4.13	0.90	4.30	0.81	(1, 145)	1.40	.00
Spit out food		4.21	0.81	4.33	0.71	(1, 145)	0.85	.01
Offering in single sitting ^a		5.94	1.28	5.80	.80	(1, 145)	0.24	.00

Note: *p*-value of <.05 denoted *

Higher scores indicate a higher acceptance rate, ^a denotes items that were reverse coded

Discussion

The results show a difference between infants who are baby-led weaned and those who are parent-led weaned with regards to picky eating. Infants who were baby-led weaned were less likely to be identified as a picky eater by their parents. However, there were few differences in initial acceptance of first foods. Infants in both the baby-led weaned group and the parent-led weaned group had similar initial preferences; the baseline acceptance was the same for most of the first foods surveyed. However, because there was a difference in rates of picky eating between the groups, this suggests that the overall experience of baby-led weaning has a positive impact on the development of healthy eating habits. For example, at the beginning of introduction to solid foods, infants in both groups would have similar rates of acceptance at initial introduction before any learning (related to food) occurred. Reported rates of being a picky eater would not have occurred until after repeated exposure to the feeding method utilized. Therefore, the baby-led weaning infants' divergence from the parent-led weaning infants would have occurred after gaining experience with and learning about food through baby-led weaning, lending support to the hypothesis that the process of baby-led weaning may influence picky eating rates.

Although acceptance rates of first foods were largely similar, there was one first food surveyed that differed in initial acceptance between the two groups. We found that infants who were baby-led weaned were rated by their parents as being more accepting of green beans at initial introduction and required fewer offerings before accepting the food when compared to their parent-led counterparts. It should be noted that these differences were not found for all the acceptance behaviors, and effect sizes were small. Nevertheless, there are a few possible reasons that green beans may be more likely to show a difference relative to the other foods. While green

beans are the most bitter of the foods we surveyed and had lowest ratings of acceptance of all the first foods surveyed, the baby-led weaning group may have had an advantage that would have increased acceptance. Whole green beans, as would likely be utilized in baby-led weaning, may offer a more diverse and interesting texture than pureed green beans, which would likely be utilized in parent-led weaning. Whole green beans, even when cut into smaller portion sizes, would include the skin from the pod as well as the seed, thereby providing multiple textures. Additionally, whole green beans would taste different overall (Zhu et al., 2018). Baby-led weaned infants would likely receive whole green beans that were fresh, frozen or canned and contain fewer additives than the commercialized infant-food commonly utilized in parent-led weaning (Elliot & Conlon, 2015; McGuire, 2010). The fresher the green beans, and the more pure and unaltered form they are served in, the sweeter they will taste (Zhu et al., 2018). Lastly, when compared to the other foods surveyed, green beans may be below a sweetness threshold. More specifically, the other first foods surveyed are naturally sweeter than green beans but are commonly mixed with sweeter foods. The higher level of natural sweetness may explain the lack of differences in the other first foods in initial acceptance between the baby-led weaned and parent-led weaned infants. For example, individuals have an inherent like for sweetness that can strongly influence acceptance (Murary, 2017). There may have been a lack of difference due to the “sweeter” foods being readily, and more easily, accepted regardless of feeding method due to the sweetness level of the foods.

To utilize baby-led weaning as an intervention, there must be a causal relationship between baby-led weaning and picky eating. If baby-led weaning is preventative against the likelihood of picky eating, it would create a domino effect, thereby decreasing the risk of the long-term health concerns linked to picky eating (e.g., obesity, depression, emotional and

behavioral problems, decreased cognitive function; Cole et al., 2017). However, it is also possible that these differences are due to other differences between groups. For example, there are genetic factors that are linked to an increased risk of picky eating, such as a predisposition for taste preferences and bitter taste sensitivity (Sharma & Kaur, 2014). If one group had more infants with a stronger predisposition to dislike bitter, the differences in picky eating rates would be due to that difference and not feeding method. However, this is unlikely. Results indicated infants were initially similarly accepting of most foods. This suggests that the differences in picky eating are unlikely to be preexisting differences in food preferences and instead likely have something to do with experiences or other factors related to the development of picky eating.

One of these experiences associated with the feeding methods is the food-type utilized. Feeding method is frequently correlated with type of food offered (e.g., baby-led infants may be more likely to be offered homemade food) which may indicate that food type may be a predicting factor influencing picky eating due to differences in sugar, sodium, and fat amounts (D'Auria et al., 2020; Demonteil et al., 2018; Rapley, 2018). Further research is needed to determine if food-type is a major contributing factor of the differences in picky eating rates between the feeding method groups.

While aspects of baby-led weaning could be preventative against picky eating, studying baby-led weaning in isolation is challenging because there are other related factors to consider. Due to variations in parental preferences for baby food regardless of feeding method (i.e., home-made vs. store bought), there is a need to further investigate the likelihood of picky eating based on store-bought versus homemade food. Furthermore, there would need to be additional questions regarding additives and sweeteners in store-bought foods. While we did not evaluate the use of mixing additional additives to the foods utilized in baby-led weaning, it would be an

important research question to ask. A first step in addressing the use of sweeteners and additives present in store-bought food is to investigate items parents frequently utilize for the amount of sweeteners prior to the use of additional additives. Parent-led weaning often utilizes store-bought commercialized baby-food, most of which is high in sugar, sodium, and fat (Elliot & Conlon, 2015). If parents are utilizing commercialized infant foods, this may result in a predetermined preference for sweet food, resulting in rejection of less sweet or bitter foods thus limiting food preference. This preference for sweetness may lead to the rejection of first foods and lead parents to preemptively add additional sweeteners and additives to infant food. Furthermore, additional information is needed regarding differing attitudes between parents who parent-led wean and those who baby-led wean when it comes to sweetener use. These questions are addressed in chapter four.

If, however, it is found that food type is not a contributor to picky eating, other aspects of the baby-led weaning experience may be the key influencers on mealtime preferences. For example, being allowed to control the feeding process (a key aspect of baby-led weaning) may be linked to decreased likelihood of developing picky eating. Baby-led weaning increases the opportunity for autonomy earlier than parent-led weaning due to the multisensory experience it provides (Chadwick et al., 2013). During baby-led feeding sessions, infants have more control over the food and have more ample opportunities to explore it utilizing all five sense (Chadwick et al., 2013). This extends the control and autonomy of infants who were also breastfed prior to being introduced solids utilizing baby-led weaning (Cichero, 2016; Jones et al., 2019). It is possible that these experiences led to a decreased risk of picky eating. The division of responsibility within feeding between the parent and the child is an exhibition of control and respect for autonomy of both the parent and the child. This control, if previously having a lack of

autonomy, may result in an increased display of control relative to infants who have been able to display autonomy during all mealtimes since birth (e.g., breastfed and baby-led weaned).

CHAPTER FOUR. PAPER TWO

Introduction

Infant feeding practices beyond breastfeeding are an under-researched area of nutrition knowledge given the impact that food acceptance has on the first two years of life. The eating habits established in infancy that are already being shaped at the beginning of solid food introduction set the stage for lifelong dietary patterns (Duffy & Bartoshuk, 1996; Gale et al., 2009; Koleztko, 2011; Martins, 2006; Skinner et al., 2002). Parental choices during this critical period of development shape children's eating habits (Lynch, 2011). The decisions parents make are based on their own preferences and are influenced by their attitudes and beliefs (Riley et al., 2018). The first choice parents make when it comes to introducing solid foods is feeding method. The two most common methods of introducing solid foods are parent-led, where the parent spoon feeds the child, or baby-led, allowing the infant to feed themselves (Rapley, 2018). The feeding method parents choose to utilize could influence the rate of food acceptance and the likelihood of later picky eating.

Parents' decision to baby-led wean or parent-led wean can be influenced by their beliefs and the information they receive from others. Previous research shows that parents who choose to baby-led wean differ from parents who parent-led wean in a variety of ways. Differences in parent attitudes, beliefs and personalities have been found when comparing parents who choose to baby-led wean to their parent-led weaning counterparts (Brown, 2016; Brown & Lee, 2013). For example, parents who baby-led wean tend to be less concerned about weight gain, perceive their child as being less fussy at mealtime, and report being calmer and having less anxiety during mealtime as well as being more relaxed when it comes to infant nutrition and health

(Brown & lee, 2013; Cameron et al., 2012;D’Andrea et al., 2016). The focus of the current study is to investigate if these differences extend to use of sweeteners and other additives in infancy.

There is evidence to suggest that parents who choose to baby-led wean may be less willing to give sugar to increase vegetable consumption and less likely to utilize sweeteners and additives. First, baby-led weaned infants differ from parent-led weaned infants in their overall body-mass index (BMI). Brown and Lee (2013) found that infants who were baby-led weaned had a lower, but still within a healthy range, BMI than parent-led weaned infants. Parents who choose to baby-led wean may be less concerned about weight gain due to baby-led weaned infants having lower BMIs than their parent-led counterparts. The lower BMI could be due to a variety of factors and not due to lower food intake. The choices parents are making with regard to type of food being offered. If parents are utilizing non-commercialized foods, that are typically high in sugars, sodium and fat, this could explain the lower BMI’s and therefore reduced risk of obesity later. Having a high BMI in infancy can place a child on a trajectory for increased weight gain which can lead to later obesity, that is difficult to change (McGovern et al., 2008). Infancy is a critical window for reducing the risk of childhood obesity as obesity trajectories can become established by 2 years of age (Dooley et al., 2020; Robinson et al., 2015).

Mothers who baby-led wean perceive the feeding approach to be healthier than the alternative (D’Andrea et al., 2016). Additionally, health professionals also perceive this approach as promoting healthier eating behaviors (Cameron et al., 2012). Due to potentially making more health conscious decisions, parents who baby-led wean may use sweeteners and additives less due to health concerns. However, the extent of this potential connection is currently unknown.

Parents who baby-led wean have less concerns overall related to infant feeding time and behaviors. For example, mothers of baby-led weaned infants are typically less concerned about weight gain and provide less pressure for the child to eat (Cichero, 2016). Being less concerned about weight gain is linked to being less concerned a child is eating enough leading to a decreased need for interventions related to increasing consumption (Brown & Lee, 2013; Cichero, 2016). A common way to increase food acceptance and combat picky eating is to utilize sweeteners and additives as an intervention. Due to having less concerns that can lead to parental behaviors that increase picky eating and the need for interventions, parents who baby-led wean may be less likely to use sweeteners as a method to increase net consumption. Additionally, remaining calmer and having less anxiety around mealtime influences an infant's emotions as well. Parents who baby-led wean have lower emotions around meal, which can have a positive influence on food consumption (Cichero, 2016). Therefore, the decreased need to focus on food consumption could also lessen the desire to use sweeteners or additives to increase acceptance.

If there is a difference in attitudes and behaviors related to sweetener and additive use based on feeding method, the method utilized could be used as a preventative tool against unhealthy behaviors that impact dietary habits. The 2020-2025 Dietary Guidelines for Americans include recommendations for infants under the age of two. These guidelines recommend infants have no daily added sugar intake. Disseminating these new guidelines to parents could have an impact on the food choices they are making. These guidelines, in addition to the feeding method utilized could be an initial step in preventing childhood obesity and changing obesity trajectories for children under two.

We hypothesize that parents who utilize baby-led weaning will differ from other parents in their attitudes and behaviors regarding use of sweeteners. Previous research has demonstrated

that parents who adopted the baby-led feeding method, compared to parents who did not, frequently differed in their eating behaviors (Brown, 2016) and their attitudes and behaviors related to infant health (Cichero, 2016). Additionally, there is evidence to suggest that parents of infants who are baby-led weaned perceive their infants to be less fussy eaters (Brown & Lee, 2013). Therefore, we anticipate that baby-led infants are less likely to use additional sweeteners than parent-led infants because there may be a decreased need to utilize them to increase food acceptance.

Methods

Sample

Parents of children aged 6- to 48-months old were recruited to participate in the survey through email lists, promotional flyers and mailouts. Additionally, we utilized social media advertisements that target users based on demographic data. Participants were presented with a link and then a consent form. Eligible and willing participants were then able to continue to the questionnaire after providing consent. Sample demographics are presented in the results section.

Measurements

In order to investigate the relationship between parent's choice of feeding method and attitudes and behaviors related to sweetener and additive use, online survey software, Qualtrics, was used to distribute the survey to participants. Parents were given a link to access the survey to complete it wherever was convenient for them. The questionnaire has been used in several of our previous studies (Westrom et al., submitted). Various question types were used including Likert-type scales, multiple choice, multiple selection, yes/no, and short response. Questions about parent and child demographics were also included. In order to ensure parents were not presented

with questions that do not apply to them “Skip logic” was used. In total, the survey takes approximately 20 to 40 minutes to complete.

The survey was approved by the university’s Institutional Review Board. A consent form was included at the beginning of the survey that informed parents of their rights as participants. Consent was obtained from all participants prior to beginning the survey. If parents did not consent to participate, the survey ended.

Parents were able to pick up an age-appropriate baby book upon survey completion.

Measures

Demographic Information

Parents were asked questions about their gender, age, education level, income level, and race/ethnicity. In addition to parental demographics, parents were also asked about their child’s gender, age, race/ethnicity and to identify where the child they are filling the survey out for falls in birth order (including adoptive children.) Specific questions can be found in Table 2.

Feeding Method

To assess feeding method, questions from the survey, “Introducing Solids to your Child,” Cameron, Taylor, and Heath (2013) were used to measure starting complementary foods, use of baby-led feeding, attitudes towards, and experiences of, feeding an infant. The measure has not yet been validated. Questions from this portion were used to determine comparison groups of baby-led weaned and parent-led weaned. For the current analysis, the question “How much did you utilize the baby-led weaning approach?” was utilized. Participants were asked to answer the question after being provided a definition of baby-led weaning. The questions were rated on a 4-point Likert-scale ranging from 1 (*very little*) to 4 (*all of the time*). Parents were considered as having utilized baby-led weaning if they had utilized the approach most or all of the time.

Parental Perceptions and Behaviors Related to Sweeteners

To determine parental attitudes about use of sweetener, a single question from Bakke et al. (2018) was utilized, “I would be willing to give a young child vegetable preparations with sugar added to a young child to mask the bitter taste.” Additionally, a modified version was added to the measure providing age ranges from 6 months to 48 months in 6 month increments up to 36 months and then combining 37-48 months with the question: “I would be willing to give vegetable preparations with added sugar to a:” to further determine parental attitudes related to sugar for different age groups. We presented multiple age groups to see if parents’ responses differ when an identified age was presented. Additionally, we wanted to know how “young” a parent was willing to give a child sugar.

To further determine behaviors and actual use of sweeteners and additives, a mix of Likert-type and multiple-choice questions were developed to assess parental perception of the use of food additives and sweeteners including sugar, honey, applesauce, fruit juice, syrup, and other naturally sweet food, such as sweet potato. We crafted multiple choice questions to assess the type, amount, and frequency of additive use, as well as parents’ reported use of additives.

Results

Sample Characteristics

The final sample size consisted of 412 parents of children 6 to 48 months old, including 14 males and 396 females (2 participants did not report their sex) (reported in paper one) who completed the survey ranging in age from 19 to 42. Of the participants, 93.53% identified as Caucasian. A majority of the participants had at least a college degree.

To assess if there were differences in parental attitudes regarding if they would be willing to offer a child vegetable preparations with sugar between baby-led infants and parent-led

infants, multiple chi-square analyses were used to analyze feeding method (independent variable) and parental attitudes (dependent variable).

Differences between feeding method broken down by age group were analyzed; results are displayed in Table 5. Participants were first asked whether they would be willing to give sugar in a vegetable preparation to a young child, a phrase not specific to an age group. The results of this question are in the last row of Table 5 and included 170 parents who utilized baby-led weaning and 242 who utilized parent-led weaning. There were no significant differences between groups. , Next, participants were asked if they would give sugar in a vegetable preparation to children of a specific age group. The frequencies for willingness to give a young child, the 6- to 12-month old group, the 13- to 18- month-old group, the 19- to 24- month-old group, the 25- to 30- month-old group, the 31- to 36- month-old group, and the 37+ month old group did not differ significantly.

Table 5

Proportion of Parents Willing to Give a Child Vegetables with Added Sugar

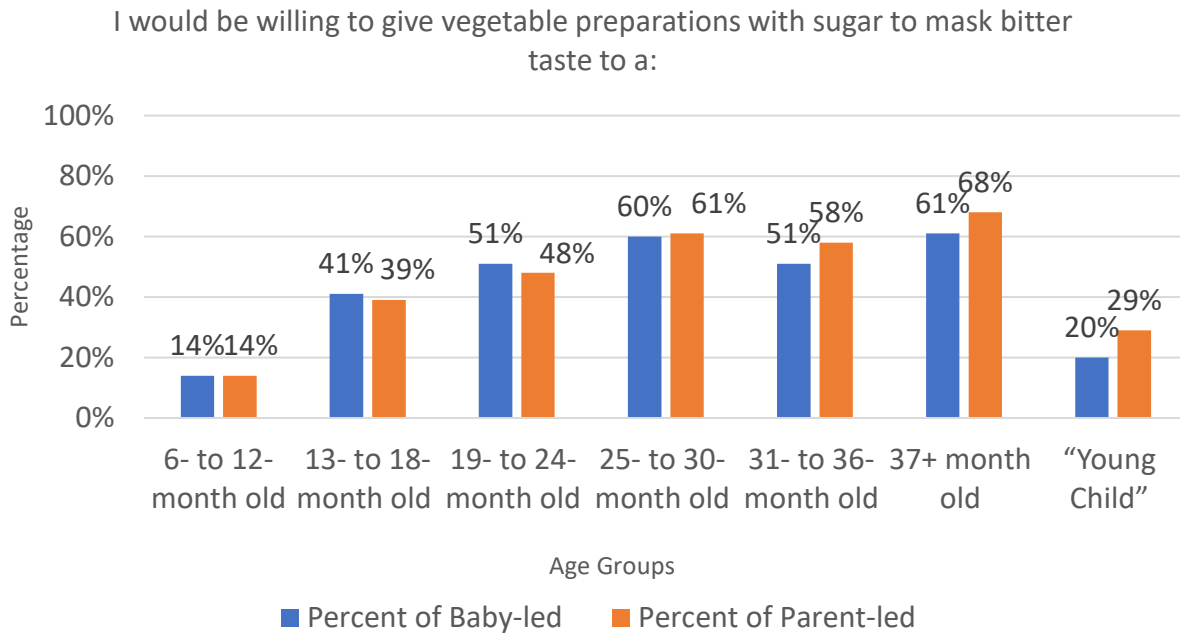
	Baby-led N (%)	Parent-led N (%)	df	Chi- Square	p	Cramer's V
6- to 12-month-old	12 (14%)	16 (14%)	1	0.01	0.91	0.01
13- to 18-month-old	35 (41%)	46 (39%)	1	0.10	0.75	0.02
19- to 24-month-old	44 (51%)	57 (48%)	1	0.24	0.63	0.03
25- to 30-month-old	51 (60%)	73 (61%)	1	0.07	0.79	0.02
31- to 36-month-old	44 (51%)	69 (58%)	1	0.90	0.34	0.07
37+ month-old	52 (61%)	80 (68%)	1	0.95	0.33	0.07
“Young Child”	32 (20%)	64 (29%)	1	4.36	0.11	0.10

Parents were asked if they would be willing to give vegetable preparations with sugar added to mask the bitter tastes to a young child and then also asked the same questions but given the choice of ages. Percentages of parents’ willingness to give sweetener based on age group are displayed in Figure 2. When asked about just a young child, the rates are 20% for baby-led

weaning and 29% for parent-led weaning. However, when asked by age group, this number almost doubles in some cases.

Figure 2

Percentage of Parents Willing to Give Sweetener by Age Group



Note. Bars represent the percentage of parents willing to give vegetable preparations with added sugar to mask the bitter taste of a vegetable and increase vegetable consumption by feeding method group.

To assess parental behaviors related to actual use of sweeteners and additives, nine chi-square tests were used to determine if there were differences between groups based on feeding method (independent variable) and behaviors based on sweetener or additive (dependent variable). Results are reported in Table 6. The sweeteners and additives utilized included: ketchup, ranch, sugar, honey, applesauce, fruit juice, syrup, mashed sweet fruits, and mashed sweet vegetables.

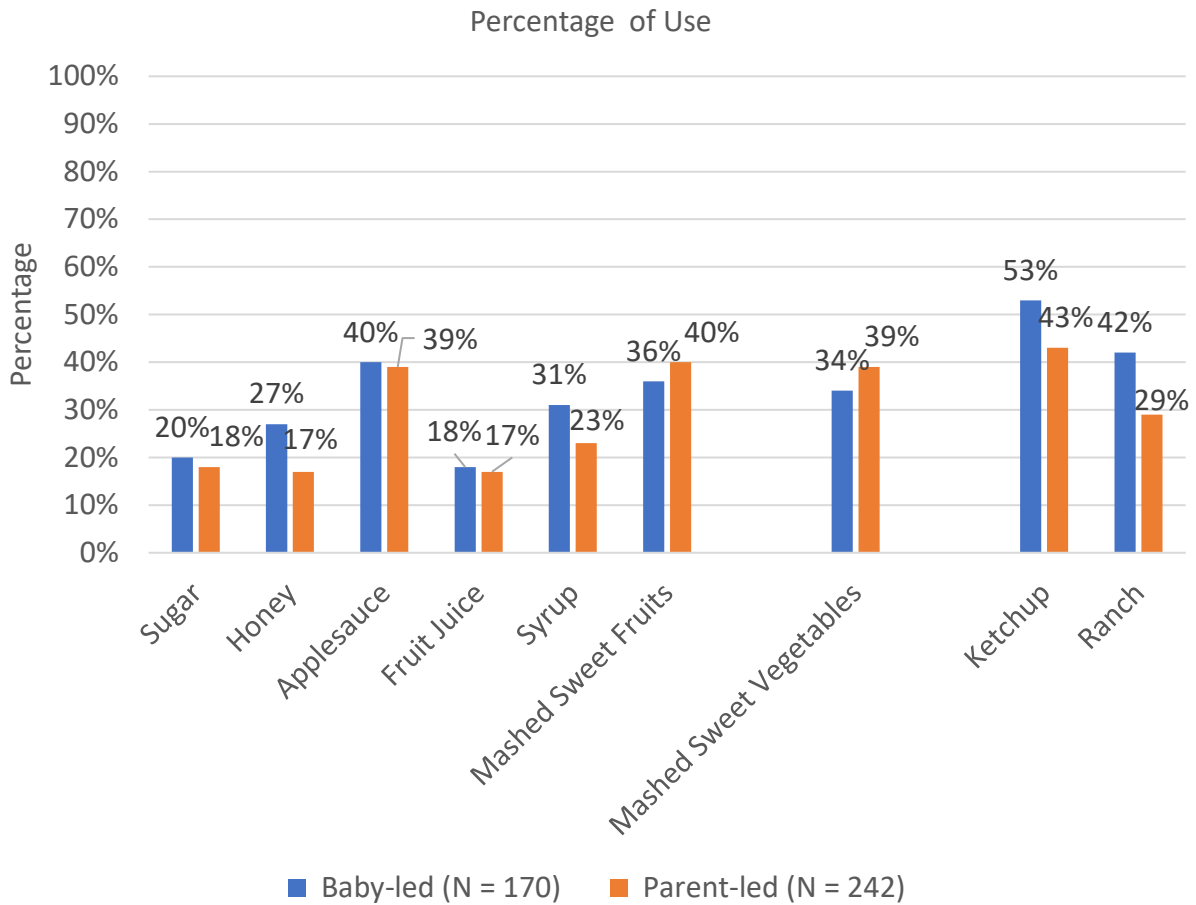
Table 6*Comparing Utilization of Sweeteners and Additives Based on Feeding Method*

Sweetener or Additive	Percent of Baby-led <i>N</i> (%)	Percent of Parent-led <i>N</i> (%)	df	Chi-Square	p	Cramer's V
Sugar	34 (20%)	44 (18%)	1	0.34	0.56	0.03
Honey	47 (27%)	40 (17%)	1	7.47	<.01*	0.14
Applesauce	69 (40%)	94 (39%)	1	0.13	0.74	0.02
Fruit Juice	30 (18%)	42 (17%)	1	0.04	0.85	0.01
Syrup	52 (31%)	55 (23%)	1	3.25	0.07	0.09
Mashed Sweet Fruits	61 (36%)	97 (40%)	1	0.79	0.37	0.04
Mashed Sweet Vegetables	57 (34%)	94 (39%)	1	1.28	0.26	0.05
Ketchup	90 (53%)	105 (43%)	1	2.92	0.09	0.09
Ranch	71 (42%)	71 (29%)	1	6.02	0.01*	0.12

For these analyses, a total of 170 parents utilized baby-led weaning and 242 parents utilized parent led weaning. The percentage of parents in the baby-led weaning group and parent-led weaning group that utilized sugar, applesauce, fruit juice, syrup, mashed sweet fruits, mashed sweet vegetables, and ketchup did not differ significantly. However, there were significant differences in use of honey ($X^2(1, N = 412) = .7.47, p < .01$) and ranch ($X^2(1, N = 407) = 6.02, p = .01$) between the baby-led weaning and parent-led weaning groups, such that parents who baby-led weaned were more likely to use both honey and ranch. Percentages are reported in Figure 3.

Figure 3

Use of Sweetener by Feeding Method



Note. The percentage of parents that offered their child each of the sweeteners and additives are displayed in the figure separated by feeding method group.

Discussion

Our results indicated that there were no significant differences between parents who chose to baby-led wean and those who parent-led weaned when it came to willingness to give sugar as a way to increase vegetable consumption. Additionally, our results showed that, for the most part, parents who baby-led weaned were not less likely to utilize sweeteners and additives. However, there were two exceptions; parents who baby-led weaned were more likely to use honey and ranch compared to their parent-led counterparts.

The rate of parents willing to give sugar as a way to increase vegetable consumption were relatively the same across all age groups regardless of feeding method. Parents in each group were willing to give sugar and gave sweeteners and additives at similar rates. Additionally, the additives that were used the most, applesauce, mashed sweet fruit, and mashed sweet vegetables, were likely to be used by both groups. These three additives are also the most likely to be independently eaten foods as opposed to being additives.

Both feeding styles also likely allow some common types of sweeteners once transition to table food occurs. During this transition the foods offered to baby-led weaned and parent-led weaned infants may be similar. Some of the sweeteners and additives offered could be considered common practice in American food preparation such as offering ketchup with fries, ranch with vegetables or syrup with pancakes.

Although there were no differences between parent-led and baby-led groups, there were age related differences in the rates of willingness to give sugar and there were no age groups surveyed that zero percent of parents were willing to give sugar. For example, the majority of parents, regardless of feeding method, were willing to give sugar to children who were 19 months and older. As the age surveyed increased, so did the percentage of parents willing to give infants sugar. These results indicate that while most parents would limit sugar intake, particularly for younger infants, a surprisingly large proportion (roughly 20% in both groups) were willing to utilize sugar.

Furthermore, parents in both feeding method groups reported actually giving sugar and gave other sweeteners at similar rates regardless of the amount of calories or added sugars in the additives surveyed. These results are not consistent with the perception from parents and practitioners that parents who baby-led wean making healthier choices. However, there are a few

possible reasons why parents may be willing to make these unhealthy choices. First, there was previously a lack of clear dietary recommendations for infants under two. The 2020-2025 Dietary Guidelines for Americans were the first set to include recommendations for infants under two as well as only the second set to include quantified values for added sugar consumption; before the new guidelines, parents were left to determine the best choices for their infants. These choices could be influenced by the nutritional recommendations from non-nutrition professionals including family members, other parents, and friends. Second, parents may view the risks of utilizing artificial sweeteners as greater than those of utilized natural, processed sugar. Artificial sweeteners that are marketed as low-calorie are often sweeter than sugar. For example, aspartame, a common sugar substitute, is 200 times sweeter than sugar (Carlson & Alvin 2016). Once an individual habituates to this intensified sweetness, more is needed to achieve the same perceived level of sweetness (Ahmed et al., 2013; Wise et al., 2016). Third, parents in both groups may be unaware of the amount of added sugar and sweeteners in the additives utilized. For example, honey contains 17 grams of sugar per 1 tablespoon, 1 gram higher than sugar, with an energy content of 64 kilocalories per tablespoon, while ranch only contains 1 gram of sugar per 1 tablespoon and has an energy content of 65 kilocalories (USDHHS & USDA; 2015). Both of these additives are more calorically dense than sugar, which has 48 kilocalories in 12 grams of sugar (United States Department of Agriculture [USDA], Agricultural Resource Center, n.d.)

Parents who baby-led weaned were very similar to parents who parent-led weaned in the rates of use for sweeteners and additives except for ranch and honey. Previous research suggests that parents who baby-led wean perceive it as a healthier way to introduce solid foods (Brown & Lee, 2013). While we did not assess reasons for use of each sweetener or additive or investigate parental reasoning for using one sweetener over another, it may be possible that we found

significant differences for honey and ranch due to the potential parental perception of these items being healthier (Roberto et al., 2012). Additionally, it is important to note that while parents may perceive that ranch and honey are healthier than sugar or other sweeteners, they are more calorically dense than sugar (USDA Agricultural Resource Center, n.d.). It is possible that ranch and honey could be perceived as healthier due to an association with healthy foods. For example, parents could perceive ranch as associated with vegetables and salads, whereas ketchup may be more likely to be associated with unhealthy fried foods, such as French fries. Honey is a natural processed sweetener and therefore, unlike some of the other additives surveyed, has no additional additives or sweeteners mixed in. Furthermore, honey has immune supportive properties and can be used to control diabetes, cancer, asthma and gastrointestinal diseases (Samarghandian et al., 2017). Based on these differences, there is a need to further understand parent's reasoning for utilizing sweeteners and additives. If the reasoning is that parents are trying to select healthier options, this would indicate a need for recommendations specific to the use of common additives that considers the amount of added sugars in each item.

There may be other aspects to weaning method related to infant health outcomes that are not accounted for here. For example, parents who baby-led wean may differ from those choosing to parent-led wean in personality characteristics and eating behaviors (Brown & Lee, 2013; Cameron et al., 2012; D'Andrea et al., 2016). Since there is evidence that parents who baby-led wean do indeed differ from parents who choose to parent-led wean when it comes to other areas of development influenced by nutritional behaviors (e.g., weight gain), it is important to further extend this line of research (Cichero, 2016). For example, parents may be using additives with the sole purpose of increasing acceptance of vegetables but not utilizing sugar to achieve this goal. Future research should address other potential additives, such as melted processed cheese,

while providing specific food item examples to better assess the additional additives and sweeteners that infants are exposed to.

CHAPTER FIVE. DISCUSSION

The overarching goal of the current studies was to investigate if there were differences between baby-led and parent-led weaning styles. Specifically, we wanted to determine if there were differences in rates of children's picky eating and food acceptance as well as parental behaviors and attitudes related to sweetener and additive use. Research question one investigated if there were differences in picky eating outcomes based on the feeding method utilized. Additionally, research question one focused specifically on whether there were differences in food acceptance behaviors based on the feeding method utilized. More specifically, the first study focused on comparing baby-led weaned infants to parent-led weaned infants with regard to parental rated picky eating (e.g., parent identifying if their infant was picky or non-picky) as well as food acceptance behaviors of seven popular first foods (green beans, carrots, sweet potatoes, bananas, avocado, butternut squash and apples). The outcome of this study showed that there were significant group differences in rates of food acceptance behaviors; baby-led weaned infants were more likely to accept first foods. Specifically, we found that baby-led weaned infants were significantly more likely to accept green beans compared to their parent-led counterparts, but there were no significant differences for the other first foods.

Potential differences in likelihood of picky eating could be due to food type, which would include sweeteners and additives. A common parental intervention against picky eating is utilizing sweeteners and additives as a way to increase food acceptance (Cathey & Gaylord, 2004; Chawner et al., 2019). Therefore, our research questions for the second study sought to determine if there were differences between parents in their attitudes related to potential sweetener use and if this translated to their behavior (e.g., if their stated unwillingness to utilize a sweetener was also seen in their usage of sweeteners and additives high in added sugar and

calories). The second study focused on parental behaviors and perceptions. Specifically, we compared parents who chose to baby-led wean to those who chose to parent-led wean in their attitudes regarding sugar use with young children. We found that there were no significant differences between the feeding method groups. Even though there were parents willing to give sugar to increase vegetable consumption, the distribution between feeding method groups was relatively the same. We were not able to determine at this time if attitudes towards unwillingness to give sugar extends to sweeteners and additives beyond sugar and if this would differ between groups. For the most part, we did not find group differences in use of sweeteners and additives, although there were two exceptions. Specifically, parents who chose to baby-led wean were more likely to use honey and ranch salad dressing compared to their parent-led counterparts. While numerous parents from both groups utilized a majority of the sweeteners and additives addressed here, there were not significant differences in use for the other condiments due to both groups using the sweeteners and additives at similar rates.

Implications of Feeding Method on Picky Eating and Food Acceptance

Our results confirm our hypotheses that there was an association between feeding method and parental perceptions of their child being a picky eater. Infants who were baby-led weaned were less likely to be picky eaters than parent-led weaned infants. Additionally, there were differences between baby-led weaned infants and parent-led weaned infants in acceptance behaviors related to first food introduction for green beans. Potential reasons baby-led weaning is associated with a decreased risk of picky eating and an increased rate of food acceptance include timing of introduction and parental attitudes and behaviors surrounding mealtimes. Not only is first food acceptance linked to picky eating, the timing of introduction of first foods is predictive of later picky eating; infants who are more likely to be picky eaters are significantly less likely to

accept first foods (Brown & Lee, 2013). Our results are consistent with previous research when taking into consideration that infants who are baby-led weaned are more likely to be introduced solid foods closer to 6-months of age than their parent-led counterparts (Cichero, 2016; D’Auria et al., 2020; Specht et al., 2018). Infants who are introduced to solid foods prior to the AAP recommendation of 6 months, a parental decision that influences the micro-system of the infant, are more likely to be picky eaters (Brown & Le, 2013). Additionally, parents who utilize baby-led weaning are more likely to breastfeed longer, potentially due to the increased developmental demands for safety reasons due to food presentation. Previous research has demonstrated that infants who are breastfed longer are less likely to be picky eaters (Specht et al., 2018). Therefore, the overall supporting factors of baby-led weaning, not just the method of food introduction itself, may be the influencing preventative factors against picky eating and increased rates of food acceptance.

There are additional benefits of utilizing baby-led weaning that could explain the impact on of this feeding method on the likelihood of picky eating. For example, baby-led weaning allows for greater participation in family meals, both for the infant and whoever would otherwise hold or spoon-feed the infant, leading to increased opportunities for observational learning and parental role-modeling (Cichero, 2016). Theoretical models show that one way infants learn about food is through observation (Bandura, 1997). Based on our findings, and previous research, this learning opportunity may be an influencing factor in our findings of reduced picky eating rates (Brown & Lee, 2013; Cichero, 2016; D’Auria et al., 2020; Demonteil et al., 2018; Ellyn Satter Institute, 2019; Fu et al., 2018; Rapley, 2018; Specht et al., 2018). Furthermore, baby-led weaning is associated with reduced, negative maternal nutritional behaviors which otherwise would influence the perception of the food being presented as well as influence the

nutritional behaviors of those learning about food (Brown & Lee, 2013). Parental behaviors impact overall nutrition by shaping the child's immediate environment (ecological systems theory) and passively or actively teaching them about eating behaviors (social cognitive theory). This impact can be seen within the division of responsibility regarding feeding choices, as defined by the Ellyn Satter Institute (2019), where parent is the "feeder" and the child is the "fed." Therefore, given the findings of previous research, our results extend the discussion that baby-led weaning may be one of the first feeding choices made for the infant that could be deemed a preventative decision related to picky eating.

Parents make decisions that influence the ecological system of their infant, often basing those decisions on what they believe are the best choices for optimal health and development. Previous research has found differences between parents who choose to baby-led wean and parents who choose to parent-led wean in those choices. Brown and Lee (2013) found that parents who adopt baby-led weaning differed in their attitudes and behaviors related to infant health. Specifically, it was determined that parents of baby-led weaned infants were less-concerned with overall weight gain of their infants. Additionally, mothers who utilized baby-led weaning were more relaxed in general when it came to feeding, demonstrating parental differences in both attitudes and behaviors. Suggesting that an additional supporting factor of the reduced picky eating and increased food acceptance may also be attributed to overall lifestyle factors.

Implications of Feeding Method on Parental Perceptions and Behaviors

Due to parental differences between parents who baby-led wean and those who parent-led wean, we had originally anticipated parents would differ in their attitudes related to sweetener use. However, our results were not consistent with previous findings of group differences

between parents who baby-led wean and those who parent-led wean. We found no differences between parents when it came to attitudes regarding willingness to “give a young child sugar” as a way to increase food consumption or when it came to specific age groups. Our results extend current knowledge due to the limited research available related to parental attitudes specific to sweetener use. A majority of parents were not willing to give a young child sugar to increase consumption and there were no differences between the groups. These results indicate that regardless of lifestyle, personality, and other attitude differences between parents in each feeding method group, there seems to be agreement on limiting utilization of additional sugar in infancy. However, there were still numerous parents who were willing to use sugar; highlighting the need for continued parental education related to the negative effects of added sugar and sweetener consumption in infancy.

It is important to consider that there may yet be differences present but because sugar is deemed socially unacceptable to use—due to both accurate and inaccurate public messaging campaigns—parents may have adjusted their responses in our survey to meet what they consider societal standards of parenting (i.e., response bias). Additionally, while we did not find differences specific to sugar, there may be differences in willingness to give other additives that are less stigmatized but as equally high in added sugars and overall calories. For example, parents may not be aware that a majority of commercialized infant and toddler food products are high in added sugar, sodium, and fat or of the high level of sweeteners present in most condiments (Elliot & Conlon, 2015). Furthermore, given the question was specific to sugar, parents may be willing to give items that they believe are “healthier” with the goal of increasing vegetable consumption and food acceptance, but not sugar. There are numerous food items that are marketed as low-sugar, low-fat, low-carb, and low-calorie that are less healthy compared to

their non-low counterparts. Often utilizing the reduced or low-content items can have negative outcomes on overall nutritional behaviors as they can alter satiety responsiveness and contain artificial items that negatively influence gut health (Bleich et al., 2014; Carlson & Alvin, 2016; Möller et al., 2013). The types of sweeteners and additives parents chose to use may be specific to parental differences found in previous research specific to parents who baby-led wean.

Willingness to give a child sugar does not always translate to usage. Our findings indicate that when asked if they were willing to give a non-specific hypothetical child sugar, there were no differences between groups. However, a large percentage of parents reported utilizing sweeteners and additives that contain added sugars when feeding their own children. Our results that assessed, parental behaviors extend previous research demonstrating behavioral differences between parents who choose to baby-led wean and those who parent-led wean. We found that there were differences between baby-led infants and parent-led infants when it came to being offered some sweeteners and additives, specifically, honey and ranch.

Additionally, our results related to use of sugar and sweeteners are consistent with previous research findings. We found that at least 17% of parents, in both the baby-led and parent-led groups utilized each sweetener. Parents were able to select any sweetener and additive utilized so it is also possible that parents utilized multiple sweeteners and additives. This extends previous findings related to percentages of children consuming added sugar based on data from the National Health and Nutritional Examination Survey (NHANES).

According to NHANES data from infants 6- to 23-months-old, 85% consume added sugar on any given day and 99% of infants 19- to 23-months consumed over the recommended amount in the Dietary Guidelines for Americans (Centers for Disease Control and Prevention [CDC], 2014). Based on the 2020-2025 Dietary Guidelines, children under the age of 2 should

not consume food with added sugar and recommend that in general, adult Americans limit added sugar to less than 10% of total calories (approximately 50 grams) (USDHSS & USDA, 2020). The dietary guidelines for children 24-months of age and up recommend less than 25 grams, the equivalent of 6 teaspoons of added sugar daily (USDHSS & USDA, 2020). Our results show that parents, regardless of these recommendations, are still willing to give sugar and additives with added sugar to children that would put them over the recommended daily values.

Additionally, most infants consume at least a teaspoon over the recommended amount (Anzman-Frasca et al., 2012). The rate of parental food choices for infants that contain added sugars suggests the need for increased parental education and educational materials. While added sugars serve a function in the palatability and preservation of nutrient-dense food which allows for increased availability and diversity of food selection options, it is important to evaluate the level of additives in the items consumed and offered to infants (USDHSS & USDA, 2020). Continued high rates of consumption of added sugars can lead to growing accustomed to that level of sweetness which in turn leads to a decreased perception of sweetness and the need for increased levels to attain the same effect (Ahmed et al., 2013). Consuming high levels of sweeteners routinely at a young age can not only lead to later health problems such as obesity, dental problems, depression, and hypertension but sweeteners are also addictive which can also lead to difficulty controlling consumption (Ahmed et al., 2013; Westwater, Fletcher, & Ziauddeen, 2016).

Limitations

The current study has a few limitations. First, the generalizability of the results should be considered due to the limited diversity of the current sample. Second, while parental reports of picky eating occur frequently within research in infancy, it should be considered as a potential

limitation. Third, the nature of retrospective report within the current studies may result in parents' mis-reporting information due to the large age range or reporting information in ways deemed socially acceptable.

Future Directions

The results of our research have several implications for practitioners and parents however, many questions remain. The results of our study showed there are differences in being identified as a picky eater and in acceptance of one of the most common first foods between parent-led and baby-led feeding methods, future studies should investigate this outcome by studying the ingredient and textural food differences, maternal prenatal food consumption, and potential parental determinants. Furthermore, research should investigate the potential influence of demography (birth order, child gender, etc.) on feeding method choice as well as the potential of feeding method as a continuum (e.g., using a mixture of both methods) rather than grouping into two groups. Understanding what potential factors of baby-led weaning contributed to lower rates of picky eating would potentially lead to alterations of experiences offered during mealtime for parents who are not comfortable baby-led weaning or would prefer to utilize a combination of the feeding methods. In addition to further research investigating picky eating and food acceptance, there is also a need to continue research on sweetener and additive use in infancy and the overall consumption of added sugars. The 2020-2025 Dietary Guidelines were recently released and there is limited research on the impact these recommendations will have on parent behaviors and infant feeding practices.

First, future research is needed to determine elements predictive of picky eating such as ingredients utilized and textural differences. For example, a study investigating what ingredients, if any, utilized in parent led weaning or baby-led weaning led contributed to an increase picky

eating would help further investigate the results. Additionally, picky eating could be potentially linked to various food textures utilized in either baby-led or parent-led weaning. There may be various contributors to a decreased risk of picky eating. The texture of the food (e.g., pureed, mashed or mushy whole) may be a contributing factor for being identified as a picky eater or not. Baby-led weaning provides a variety of textures through food, compared to the often watery and pureed foods of parent-led weaning. There are numerous reasons for the textures of foods that play a role in picky eating. For example, if, in general, someone has a tactile sensitivity eating a food that is not commonly pureed (e.g., green beans) the texture of a whole food that has now changed forms can be off putting (Nederkoorn, Houben, & Havermans, 2019). Adults do not actively eat pureed foods such as “baby-food.” It can be theorized that for all intents and purposes, most adults verbally and physically (e.g., scrunched nose) would display rejective behaviors and disgust towards tasting common commercialized baby food. Additionally, prior to a development of tactile sensitivities, exposure to multiple textures early, as is common with baby-led weaning could provide a preventative defense. Demonteil et al., (2018) found that exposure to multiple food textures early lead to an increased acceptance of most textures at 12 months. Through exposure to multiple foods and textures that are parental choices related to the multiple systems influences of the ecological model, infants are also learning about the food through exposure and observation related to the application of social cognitive theory.

Second, picky eating may be attributed more to parental behaviors than to infant behaviors, either prenatally or upon food introduction. Parental mealtime behaviors may be a greater indicator of picky eating than available food options. For example, even if a child has lots of healthy food options available, if a parent rejects the food or states the child will not like it before it is even tried, this could be more influential of the development of picky eating than

originally thought or examined here. Additionally, further research would be needed to determine other factors that influence potential increased food acceptance for infants who are baby-led weaned. These factors could include investigating maternal prenatal food consumption, length of breastfeeding and food consumption during breastfeeding, and parental attitudes and behaviors related to food, table, and mealtime in comparison to mothers who choose to parent-led wean within the scope of picky eating.

Third, picky eating may be more complex than the binary (yes/no) categorization that currently exists. There are various definitions of picky eating and the term is often used interchangeably with other terms that explain other behaviors such as fussy eating, food neophobia, etc. There is a need for conformity in the definition of picky eating, create an identified list of behaviors and reasons for picky eating and potentially develop a tool for diagnosing those reasons and behaviors. This could assist in research on picky eating and in general but also aid in potentially determining why different feeding methods increase or decrease the risk of picky eating. Furthermore, picky eating may be influenced both biologically and environmentally, but the relative contribution of each requires further investigation. For example, an infant may come from a family of picky eaters and may be predetermined to reject bitter tastes commonly found in vegetables (Sharma & Kaur, 2014). Future research should also include whether parents identify as picky eaters and investigate the influence this has on their perception of if their child is a picky eater or not. This could lead to a likelihood of picky eating regardless of type of complementary food introduction utilized. Future research is needed to begin determining the level of involvement of different dimensions in picky eating outcomes.

Lastly, given the limited availability of recommendations specific to sweetener use in infancy, there is a need for further research addressing this issue. While we did not find

differences between willingness to give a child sugar it is important information for the development of parent education materials because a majority of parents, regardless of choice to baby-led or parent-led wean, were willing to give infants who were 19-months-old and older sugar. Further research addressing this information would be vital in making recommendations, policies and regulations related to use of additives or sweeteners in infancy and would extend research related to childhood outcomes such as picky eating, obesity, and mental health. For example, there is now a need for research on the new recommendations in the birth to 24-month-old range. There is a need to further investigate the information parents are receiving on the amount of sugar and numbers of calories in sweeteners and additives, policies related to infant feeding practice information and improved regulations for additives in store-bought infant food items.

Applications

Providing practitioners and parents information and resources related to baby-led weaning and the results of this study may help improve interventions and parental powered prevention. If utilizing baby-led weaning is one way to potentially prevent the development of picky eating this would result in a decreased use of parental interventions, some of which increase picky eating, as well as overall parental frustration. In applying social cognitive theory of learning through observation, if there are fewer individuals in the home displaying rejective behaviors of food (e.g., siblings) and less frustration related to nutritional behaviors of others (e.g., parents) this could have an overall positive impact on the development of the nutritional behaviors of other or younger individuals (Bandura, 1997).

Parents and practitioners alike have a desire to decrease or prevent picky eating. Picky eating can have life-long developmental consequences such as increased risk of later depression,

eating disorders and persistence emotional and behavioral problems (Cole et al., 2017). In addition to life-long consequences there can be more immediate ones in childhood such as vitamin and mineral deficiencies that can lead to the need for supplementation in order to support positive growth and development (Carruth & Skinner, 2001). Given the potential immediate and later problems linked to picky eating, the desire to prevent picky eating is monumental.

In addition to preventing picky eating, there is also a strong desire to prevent obesity. Infancy is a critical period of opportunity for reducing the risk of childhood obesity (Adamo & Brett, 2014; Robinson et al., 2015). Additionally, poor nutritional behaviors due to picky eating and introducing solid foods too early are predictive of obesity (Lynch, 2012). However, continued breastfeeding has been shown to be negatively predictive of childhood obesity (Specht et al., 2018). It is estimated that in 2013 nearly 37% of the world's adult population was considered obese, rising from 28.8% in 1980 (Westwater, Fletcher, Ziauddeen, 2016). This increasing trend is also seen in children and adolescents (Westwater et al., 2016). Given the positive influence on nutritional behaviors baby-led weaning provides, as well as the preventative aspect of longer breastfeeding duration, there may be a decreased risk of obesity in infants who are baby-led weaned compared to infants who are parent-led weaned.

The results of our study also show the need for further parental education and awareness of the current dietary recommendations related to added sugar consumption for children under the age of four that are specific to the requirements of under two and over two years of age. When children consume too much added sugar there is an increased the risk for obesity, tooth decay, heart diseases, high cholesterol, high blood pressure, type two diabetes, and other major health problems (Chowdhury et al., 2016; Kanigel, 2006; Keiley, & Bloyd, 2006; Lim, 2012; Mardis, 2001; Weichselbaum, & Buttriss, 2011).

Conclusion

The results of these studies further extend the limited research on baby-led weaning by initiating the discussion of baby-led weaning, picky eating, and sweetener use. We found that baby-led weaning is linked to lower rates of picky eating, and we began an exploration of the differences between the two feeding styles in the foods offered. To date, no other studies have investigated the influence of baby-led weaning on picky eating and sweetener use. The current studies begin this conversation, but there is still the need for further research.

Broadly, the outcome of the current studies could lead to new parental recommendations and potentially influence dietary choices across the lifespan. Given the potential lifelong consequences of picky eating (e.g., depression, diabetes, cardiovascular disease, increased weight gain), research regarding increasing food acceptance and decreasing picky eating is highly sought after by scientists, medical professionals but most importantly, parents. The findings of this study can be utilized to update parent recommendations and educational materials regarding approaches that decrease the likelihood of picky eating and increase initial food acceptance. These updated recommendations and materials may then potentially decrease the risk of childhood obesity, depression and other potential health concerns linked to picky eating (Cole et al., 2017). Given the strain that a picky eater can place on a household (van der Horst et al., 2016), it is important to provide parents with tools that can decrease picky eating and potentially influence other aspects within the family dynamic creating a ripple effect of positive lifelong development.

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APPENDIX. SURVEY

Q1.

Sugar: Investigating Parents' Perception and Use of Sweeteners and Additives with Children Under Two

Dear participant:

I would like to invite you to take part in a study investigating the contribution of sweetness to food acceptance in infants, toddlers, and young children. My name is Savanna Jellison. I am a graduate student in the Developmental Science at North Dakota State University, and I am conducting a research project investigating factors present in infancy and toddlerhood that contribute to picky eating or enhance healthy eating habits. It is our hope that the outcome of this study will contribute useful information for the development of better guidelines for healthy infant and toddler feeding practices.

Because you are a caregiver who is at least 18 with a child under the age of four, you are invited to take part in this research survey. Your participation is entirely your choice, and you may change your mind or stop participating at any time with no penalty to you. If you need assistance when filling out the survey, please contact the Infant Cognitive Development Lab at North Dakota State University at 701-231-8873.

It is not possible to identify all potential risks in research procedures, but we have taken reasonable safeguards to minimize any known risks.

Upon survey completion, you will be given a code word. You may use this code word to pick up a compensation baby item at the Infant Cognitive Development Lab or The Department of Human Development and Family Science at North Dakota State University as long as supplies last.

It should take about 20-40 minutes to complete the online survey. Questions ask about characteristics of you and your family, your preferences regarding health and parenting information, and parenting behaviors. If you need assistance completing the survey, please contact the Infant Cognitive Development Lab at North Dakota State University at 701-231- 8873.

This study is anonymous. That means that no one, not even members of the research team, will know that the information you give comes from you.

If you have any questions about this project or wish to receive a copy of the results, please contact me at savanna.jellison@ndsu.edu, or contact my advisor, Dr. Rebecca Woods by phone at 701-231-9791 or by email rebecca.woods@ndsu.edu.

You have rights as a research participant. If you have questions about your rights or complaints about this research, you may talk to the researcher or contact the NDSU Human Research Protection Program at 701.231.8995, toll-free at 1-855-800-6717, by email at ndsu.irb@ndsu.edu, or by mail at: NDSU HRPP Office, NDSU Dept. 4000, P.O. Box 6050, Fargo, ND 58108-6050.

Thank you for your taking part in this research.

Q2. Do you wish to participate?

Yes

No

Q3. What is your gender?

Male

Female

Prefer not to say

Q4. How old are you?

Fill in the blank

Q5. What is your highest level of education

Some High

School High

School

Some College

College

Graduate Post

Graduate

Q6. What is your yearly household income

Less than \$20,000

\$20,001 - \$30,000

\$30,001 - \$40,000

\$40,001 - \$50,000

\$50,001 - \$60,000

\$60,001 - \$70,000

\$70,001 - \$80,000

\$80,001 - \$90,000

\$90,001 - \$100,000

Other

Q7. Race/Ethnicity

White/Caucasian

American

Indian/Native Alaskan

Hispanic/Latino/Spanish

Other Origin Asian

Native

Hawaiian/Pacific

Islander Black/African

Asian

Other

Other

Other

Other

Other

Other

Other

Other

Other

Other

Q8. How old is your child (**in months**)?

Fill in the blank

Q9. What is your child's gender?

Male

Female

Prefer not to say

Q10. What is your child's race/ethnicity

White/Caucasian

American

Indian/Native Alaskan

Hispanic/Latino/Spanish

Other Origin Asian

Native

Hawaiian/Pacific

Islander Black/African

Asian Indian Other

Q11. How many children, including adopted, do you have?

1

2

3

4

5

Other *Fill in the blank*

Q12. Where does this child fall in birth order?

Fill in the blank

Block 2

Q13. When offering food to my child I have added (**select all that apply**)

Sugar

Honey

Apples

auce

Fruit

Juice

Syrup

Mashed Sweet

Fruits Mashed

Sweet Vegetables

Other *Fill in the
blank*

I have added none of these

Q14. What are your reasons for adding Sugar?

Fill in the blank

Q15. What are your reasons for adding Honey?

Fill in the blank

Q16. The FDA recommends that parents and caregivers not to give honey to infants or children younger than one year of age.

Q17. What are your reasons for adding Applesauce?

Fill in the blank

Q18. What are your reasons for adding Fruit Juice?

Fill in the blank

Q19. What are your reasons for adding Syrup?

Fill in the blank

Q20. What are your reasons for adding Mashed Sweet Fruits?

Fill in the blank

Q21. What are your reasons for adding Mashed Sweet Vegetables?

Fill in the blank

Q22. What are your reasons for adding Other?

Fill in the blank

Q23. I plan to decrease or have already decreased adding of the following additives as my child ages:

Sugar

Honey

Applesauce

Fruit Juice

Syrup

Mashed Sweet Fruits

Mashed Sweet Vegetables

Other *Fill in the blank*

I have added none of these

Q25. When eating table foods, my child uses

- Ketchup
- Ranch
- Steak Sauce
- Tarter Sauce
- Honey Mustard
- BBQ Sauce
- Relish
- None

Q26. Which do you offer, if any, as a way to increase the acceptance of another food?

- Ketchup
- Ranch
- Steak Sauce
- Tarter Sauce
- Honey Mustard
- BBQ Sauce
- Relish
- My child does not use any of these
- I do not offer any of these to increase the acceptance of another food

Q27. In the future, which of the following, if any, do you plan to add the following to increase your child's acceptance of another food?

- Ketchup
- Ranch
- Steak Sauce
- Tarter Sauce
- Honey Mustard
- BBQ Sauce
- Relish
- Sugar
- Honey

Applesauce
Fruit Juice
Syrup
Mashed Sweet Fruits
Mashed Sweet Vegetables
None

Q28. I would be willing to give vegetable preparations with added sugar to a: (**select all that apply**)

6- to 12-month old
13- to 18-month old
19- to 24-month old
25- to 30-month old
31- to 36-month old
37+ month old
None of the above

Q29. If no, why?

Fill in the blank

Q30. I would be willing to give a young child vegetable preparations with sugar added to mask bitter taste

Yes
No

Other *Fill in the blank*

Q32. For what reason WOULD you give vegetable preparations with sugar to a young child?

Fill in the blank

Q33. When introducing solid foods, did you spoon feed or did you allow your baby to feed themselves?

I fed using a spoon.
I let my baby feed themselves.
Both, but more spoon fed.
Both, but more baby fed.
Both, about equally.

Q34. When your baby began eating solid foods, what types of foods did you offer most frequently?

Store-bought pureed baby food

Home-made pureed baby food

Softened or smashed table food

Regular table food

Q35. Which best describes your baby's first experiences with solid foods?

My baby fed themselves small, chunked foods

I fed my baby purees with a spoon

I did a combination of the above

Q36. How old was your baby when you first introduced solid foods?

3 months

4 months

5 months

6 months

7 months

8 months

Other *Fill in the blank*

Q37. If your baby was breastfed (either directly from breast or a bottle), how old was your baby when they no longer received any breast milk?

My baby still drinks breast milk.

Months: *Fill in the blank*

My baby never received breast milk.

Block 3

Q38. When first introducing solid foods, which of the following did you offer? (Select all that apply)

- Rice Cereal
- Green Beans
- Carrots
- Sweet
- Potatoes
- Bananas
- Avocado
- Apples
- Butternut Squash

Q39. When first introducing solid foods, how would you rate your child's acceptance of Rice Cereal?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q40. When first introducing solid foods, how would you rate your child's acceptance of Green Beans?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q41. When first introducing solid foods, how would you rate your child's acceptance of Carrots?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q42. When first introducing solid foods, how would you rate your child's acceptance of Sweet Potatoes?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q43. When first introducing solid foods, how would you rate your child's acceptance of Bananas?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q44. When first introducing solid foods, how would you rate your child's acceptance of Avocado?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q45. When first introducing solid foods, how would you rate your child's acceptance of Apples?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q46. When first introducing solid foods, how would you rate your child's acceptance of Rice Butternut Squash?

- Extremely pleased
- Somewhat pleased
- Neither pleased nor displeased
- Somewhat displeased
- Extremely displeased

Q47. When first introducing Rice Cereal, how often would your child make a face of enjoyment?

- Always
- Most of the time
- About half the time
- Sometimes
- Never

Q48. When first introducing Green beans, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q49. When first introducing Carrots, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q50. When first introducing Sweet Potatoes, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q51. When first introducing Bananas, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q52. When first introducing Avocados, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q53. When first introducing Apples, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q54. When first introducing Butternut Squash, how often would your child make a face of enjoyment?

Always

Most of the time

About half the time

Sometimes

Never

Q55. When first introducing Rice Cereal, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q56. When first introducing Green Beans, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q57. When first introducing Carrots, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q58. When first introducing Sweet Potatoes, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q59. When first introducing Bananas, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q60. When first introducing Avocados, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q61. When first introducing Apples, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q62. When first introducing Butternut Squash, how often would your child turn away from the offering?

Always

Most of the time

About half the time

Sometimes

Never

Q63. When first introducing rice cereal, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q64. When first introducing green beans, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q65. When first introducing carrots, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q66. When first introducing sweet potatoes, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q67. When first introducing bananas, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q68. When first introducing Avocado, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q69. When first introducing Apples, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q70. When first introducing Butternut Squash, how often would your child spit the food out?

Always

Most of the time

About half the time

Sometimes

Never

Q71. When introducing Rice Cereal, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q72. When introducing Green Beans, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q73. When introducing Carrots, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q74. When introducing Sweet Potatoes, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q75. When introducing Bananas, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q76. When introducing Avocado, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q77. When introducing Apples, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q78. When introducing Butternut Squash, how many times did you have to offer the serving (in a single sitting) before your child would accept it?

Once

Twice

Three Times

Four Times

Five Times

More than Five Times

Refused Every time

Q79. Is your child a picky eater?

Yes

No

Block 4

Q80. How long did you exclusively breastfeed your baby (that is no food or drink except for breastmilk)?

I didn't exclusively breastfeed
my baby Up to one month
2 to 4 months

5 months

6 months

More than 6 months

- Q81. What was your main reasons for starting solids?
Encouragement or advice from your family
Encouragement or advice from a health professional
To help your baby sleep at night
Your baby was hungry and needed solids to satisfy their hunger
Your baby was reaching for food
Your baby was putting food in their mouth
Other *Fill in the blank*
- Q82. What was the first food you offered?
Baby
Cereal
Fruit
Vegetable
Other
- Q83. What form was the first food in?
Puree
Mashed
Whole
- Q84. How often was your baby having solid foods at 6 months?
Hadn't started solids yet
Less than once a day
Once a day
Twice a day
Three times a day
More than three times a day
- Q85. How would you describe the way your baby was fed at 6 to 7 months?
My baby was not eating solids at this age
Spoon fed by an adult
Mostly spoon fed by an adult, some baby feeding themselves
About half spoon feeding by an adult and half baby feeding themselves
Mostly baby feeding themselves, some adult spoon feeding
Baby feeding themselves

Q86. How would you describe the type of food your baby at at 6 to 7 months?

My baby was not eating solids at this age

All pureed or mashed food (including jars of baby food, or food you pureed yourself)

Mostly pureed or mashed food, some finger foods

About half purees or mashed and half finger foods

Mostly finger foods and some purees or mashed foods

All finger foods (for example sliced avocado)

Q87. What proportion of your baby's food at 6 to 7 months was bought?

My baby was not eating solids at this age

All of it

Most of it

Half of it

Hardly any of it

None of it

Block 5

Q88. When your baby is being looked after by someone else other than you (for example childcare, family member) how would you describe the method of feeding?

Spoon fed by an adult

Mostly spoon fed by an adult, some baby feeding themselves

About half spoon feeding by adult and half baby feeding themselves

Mostly baby feeding themselves, some adult spoon feeding

Baby feeding themselves

My baby is not looked after by someone else on a regular basis

Don't know

Q89. How many hours per week is your baby looked after by someone other than you?

Less than 1 hour per week

1 to 9 hours per week

10 to 19 hours per week

20 to 29 hours per week

30 to 39 hours per week

40 hours or more per week

Q90. How would you describe the way your baby is fed now?

Spoon fed by an adult

Mostly spoon fed by an adult, some baby feeding themselves

About half spoon feeding by an adult and half baby feeding themselves

Mostly baby feeding themselves, some adult spoon feeding

Baby feeding themselves

Q91. How would you describe the type of food your baby eats now?

All pureed or mashed food (including jars of baby food)

Mostly pureed or mashed food, some finger foods

About half purees or mashed and half finger foods

Mostly finger foods and some purees or mashed foods

All finger foods (for example, sliced avocado)

Block 6

Q92. For the next 6 questions: Meals with a family means that at least one adult is sharing the meal with the baby

Q93. At about what age did your baby start eating the same food as the rest of the family?

At the same time as they started solids

1 month after they started solids

2 months after they started solids

3 months after they started solids

4 months after they started solids

5 months after they started solids

My baby doesn't eat the same food as the rest of the family

Other *Fill in the blank*

Q94. How often does your baby eat foods from the meal the family is eating (even if you have modified their portion, for example by not adding salt)?

Occasionally

About half of the time

Most of the time

All of the time

Q95. How many of your baby's meals are eaten with the rest of the family?

None of their meals

Some of their meals

Most of their meals

All of their meals

Q96. When did they start to eat with the family?

At the same time as they started solids

About 1 month after they started solids

About 2 months after they started solids

About 3 months after they started solids

More than 3 months after they started solids

My baby doesn't eat with the family

Q97. When they eat with the family, how do they eat?

Baby feeding themselves

Mostly baby feeding themselves, some adult spoon feeding

About half spoon feeding by adult and half baby feeding themselves

Mostly spoon fed by adult, some baby feeding themselves

Spoon fed by adult

Q98. When they eat with the family, what consistency is their food? (Select all that apply)

Pureed

Mashed

Whole food - same as the family

Whole food - prepared differently (cooked longer)

Q99. How willing do you think your baby is to try new foods?

Not at all willing

Somewhat willing

Very willing

Q100. How does your baby let you know they are hungry?

Fill in the blank

Block 7

Q102.

Baby Led Weaning” (BLW) is a method of feeding solid foods. Traditional infant feeding involves first offering the baby pureed foods, then gradually adjusting offered food textures from puree to mash, to lumpy, and finally to family foods. Baby Led Weaning is different. Infants feed themselves right from the start, with no purees or spoon feeding. Instead, babies are offered pieces of soft food with sizes and shapes that they can easily handle (for example steamed broccoli or carrot cubes). The baby is allowed to explore the food at their own pace and they decide how much they will eat. Rather than preparing separate meals for babies, they are offered the same or similar foods as the rest of the family.

Q103. Had you heard of Baby-led Weaning before now?

Never heard of it

Heard of it but didn't know anything about it

Know a little about it

Know a moderate amount about it

Know a lot about it

Q104. Have you tried Baby-led Weaning (you may not have known that it was called Baby-Led Weaning)?

Yes

No

Q105. How much did you follow a Baby-led Weaning approach?

Very Little

Sometimes

Most of the time

All of the time

Q106. How did you first hear about baby-led weaning?

Doctor, nurse or other health professional

Friend or family member

Online or magazine or information session

Other *Fill in the blank*

Q107. Why did you decide to try Baby-led weaning (select all that apply)?

It sounded like a good idea

I think it is the natural way to feed a baby

I liked the idea of my baby being in control of their food intake

My Doctor recommended it

I experienced difficulties in the past with standard solid food introduction and was willing to try other options

Other

Q108. Where did you get most of your information about Baby-Led Weaning from?

Doctor, nurse or other health professional

Reading online blogs, threads, or articles

Friend or family member

Baby-Led Weaning book or DVDs

Other *Fill in the blank*

Q109. How old was your baby when you started Baby-Led Weaning?

Less than 3 months

3 months

4 months

5 months

6 months

7 months

8 months

9 months

10 months or older

Q110. How old was your baby when you first felt they were getting enough food?

Less than 3 months

3 months

4 months

5 months

6 months

7 months

8 months

9 months

10 months

11 months

12 months

We are still working on it

Always

Q111. What do you think are the advantages of Baby-Led Weaning? (Select all that apply)

I don't need to make purees or separate meals for baby

It saves time as my baby is able to feed themselves

We can share meal times and we don't need to entertain our baby while the rest of the family is eating

My baby is able to explore and learn about the food they are eating

My baby is able to control how much they eat and to stop eating when they have had enough

We don't need to take specific baby foods when we eat away from home

We don't need to prepare baby purees for childcare

Other

Q112. What do you think are the disadvantages of Baby-Led Weaning? (Select all that apply)

Its messier

I worry my baby won't eat enough

I worry that my baby will choke or gag

It's difficult to know if they have eaten enough

I worry that my baby may not be getting enough iron

It can be stressful trying to organize the family to be able to eat together

It can be difficult knowing what to feed my baby

Other *Fill in the blank*

Q113. Would you recommend Baby-Led Weaning to other parents?

Yes

No

Yes but I would recommend using pureed food and spoon feeding as well

Q114. Do you have any tips that might help other parents try Baby-Led Weaning?

Fill in the blank

Q115. Are you happy with the way you chose to introduce solids with this baby?

Very unhappy

Unhappy

Neither happy nor unhappy

Happy

Very Happy

Q116. In an Ideal world, would your chosen method of introducing solids be:

Much more baby led

Slightly more baby led

Stay the same

Slightly more parent led

Much more parent led

Q117. What do you think about the Baby-Led Weaning approach? (Select all that apply)

It sounds like a good idea

I like how the baby is included at mealtimes

It sounds very messy

It sounds very time-consuming

I think my baby would eat well

I don't think my baby would have been able to chew whole foods

Other *Fill in the blank*

Q118. Would you be willing to try Baby-Led Weaning if you had another child?

Yes

No

Q119. Why?

Fill in the blank

Q120. Do you have any concerns about Baby-Led Weaning?

Yes

No

Q121. What are your concerns?

Fill in the blank

Q122. *Are you happy with the way you chose to introduce solids with this baby, whether that is baby led or parent led?*

Very unhappy

Unhappy

Neither happy nor unhappy

Happy

Very happy

Q123. *How old was your baby when you felt that they were getting enough food?*

Less than 3 months

3 months

4 months

5 months

6 months

7 months

8 months

9 months

10 months

11 months

12 months

We are still working on it

Always

Q124. In an ideal world would you chosen method of introducing solids be:

Much more baby led

Slightly more baby led

Stay the same

Slightly more parent led

Much more parent led