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"CAULIFLOWER POWER" STORYBOOKS AND CRUCIFEROUS VEGETABLE CONSUMPTION IN PRE-SCHOOL CHILDREN: EXAMINING THE EFFECTS OF REPEATED EXPOSURE ON ACCEPTANCE AND CONSUMPTION OF CAULIFLOWER, BROCCOLI, AND BRUSSELS SPROUTS

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ABSTRACT

Background: The obesity epidemic continues to be an urgent public health concern in the United States, with high rates in children as young as pre-school and early elementary school particularly alarming. With tendency for early weight status to permeate through the lifespan, early prevention is necessary (Llewellyn, 2015). Increasing cruciferous vegetable consumption and liking in 3- to 5-year-olds is proposed as a positive means for developing healthy eating habits early for a lifetime of positive lifestyle behaviors.

Objectives: The purpose of this study was to consider ***biological***, ***environmental*** (home and school), and ***social*** influences on children's liking and consumption of cruciferous vegetables, and whether those behaviors and ideas can be positively changed through repeated exposure to education and food tastings, as well exposure at home (recipes and fun fact sheets).

Methods: The "Cruciferous Crew" intervention study included 24 children ages 3 to 5 years and their parents, recruited from a university childcare center in Central Pennsylvania. Children's ability to identify liking for and willingness to try cauliflower, broccoli, and Brussels sprouts was measured before and after the intervention. Children were exposed to a series of 4 storybooks that introduced them to cauliflower (main focus), and other vegetables including broccoli and Brussels sprouts. Children also had the opportunity to taste a cauliflower-based snack after the lesson (e.g., cauliflower rice). It was hypothesized that repeated exposure to the stories and cauliflower in various forms, would increase children's liking for and willingness to try the target vegetables. Sensitivity to bitter taste ("taster" status) and parents-reports of child picky eating and the frequency of consuming the target vegetables were also measured.

Results: Results showed that the intervention was successful in significantly increasing children's ability to identify and liking for cauliflower. Children's ability to identify Brussels

sprouts also significantly increased after the intervention. However, in a subsequent offering, children's willingness to try the target vegetables decreased after the intervention, which was opposite of what I hypothesized. Children with a bitter taste sensitivity showed the greatest pre-post increases in liking of all target vegetables, although the differences did not reach significance. Qualitative data showed expressions of great enthusiasm around the phrase "Cauliflower Power" and excitement with the visits and tastings in general. The positive, neutral, and negative verbal and behavioral observations noted may give even more insight in a study this small on the relevance of the quantitative results.

Conclusions. Repeated exposure to storybooks about cruciferous vegetables can increase children knowledge about and liking for those vegetables. This approach may be particularly powerful for children with a bitter taste sensitivity. Although limitations such as shortened classroom time, limited research assistance, and small sample size did exist for this study, these complications are surmountable and future research on this topic is both feasible for the research team and likely to be a very rewarding, fun, and well-accepted experience for the participants.

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Chapter 1

INTRODUCTION

Childhood Obesity Epidemic: A Multifaceted Problem

The youth obesity epidemic continues to be an urgent public health concern in the United States and has reached pandemic levels in other areas of the globe. Overweight and obesity are defined by the World Health Organization as "abnormal or excessive fat accumulation that may impair health" and can be identified using the body mass index (BMI). For children, due to the variation in a child's body composition with age and sex, identification of BMI considers age- and sex-specific percentiles. Overweight in children is classified as a BMI that is above the 85th percentile and below the 95th percentile for children of the same sex and age. However, it is important to recognize that BMI is a simple index of weight-for-height and is limited in its prediction of overall health status and risk.

Most recent data from the Centers for Disease Control and Prevention shows the prevalence of obesity to have remained stable between 2011-2013 at about 17% for children and adolescents (Centers for Disease Control and Prevention, 2014). An alarming 1/3 of children in the United States is either overweight or obese, with minority children at an even higher risk (Centers for Disease Control and Prevention, 2014). Among preschool children ages 2-5 years, 24.4% were overweight or obese in the year 2010; that equates to approximately 1 in 4 children in an average preschool classroom being classified as overweight or obese. Among these preschool-aged children, where obesity was rarely seen in earlier years (1960s-early 1980s), children of African-American or Hispanic race and/or ethnicity have even higher rates. For example, 24.8% of African-American and 29.9% of Hispanic preschool

aged children also fit into the classification of overweight or obese (Centers for Disease Control and Prevention, 2010). The alarming reality of these statistics is that obesity is present in record high rates among young children, both pre-school and elementary school aged. This poses a risk for their current young lives as well as the years to come.

Obesity-Related Health Risks Across the Lifespan

There are many obesity-related health risks applicable to the pediatric population. Chronic, preventable diseases such as Type II diabetes, once only present in adult populations, are infiltrating at alarmingly high rates into children as young as elementary school (Caprio, 2011). With this increased risk of insulin resistance alone, children are at greater risk for other serious health issues such as heart disease, eye complications, nerve damage, etc. Children may also be faced with the limitations associated with asthma, sleep apnea, musculoskeletal discomfort, and bone disorders that may occur as a result of their weight (Hassan, 2015). Psychologically, children may have negative body image due to bullying, effecting overall self-esteem. Behavior in school and social settings may be affected due to higher rates of depression, anxiety, and low self-esteem (Hassan, 2015). Overall, there are a multitude of adverse biological and psychosocial consequences that are related to obesity in young children.

The high rates in children as young as pre-school and early elementary school are of particular concern because of the tendency for obese or overweight children to grow to also be obese in adulthood, leading to a number of additional severe health concerns associated with this trend. Once obesity is developed, the results are hard to reverse (Llewellyn, 2015). With children developing obesity earlier and earlier in life, the trajectory of reversal later in life is rare (Llewellyn, 2015). To investigate whether childhood body mass has any effect on body mass later in life, Tuomilehto (2003) used a periodical cross-sectional study design to track the BMI of 138 children for 15 years, at 6 months, 7 years, and 15

years old. The hypothesis was supported by the longitudinal data that the risk of obesity in adolescence (at the 15-year marker) could be determined in early childhood (Tuomilehto, 2003). This trend continues throughout the lifespan. The consequences of this ongoing obesity from childhood throughout adulthood can be life threatening (Hassan, 2015). The cardiovascular, metabolic, and other health consequences of childhood obesity penetrate into adulthood, becoming more severe if overweight continues.

Influence of Genetics & Environment

Although research studies have shown an overall trend of overweight status persisting from childhood to adulthood, being overweight as a child does not always mean a definite lifespan of obesity. This trend is far from a direct linear path. The risk for obesity both as a child and throughout life is not solely within one's genetic makeup; one is not guaranteed to be obese given a particular genetic code. And it also is not entirely based on one's lifestyle choices and behaviors. In fact, considerable findings support both genetic *and* environmental factors contribute to the development of childhood obesity. According to Llewellyn (2015), a theory proposed by many genetic researchers is that since the expression of BMI determining genes often depends on the environment, individuals who are exposed to a more "***obesogenic environment***" also have a stronger genetic effect on weight gain. Whether or not an individual is exposed to an obesogenic environment, such as one involving a high-fat diet and sedentary lifestyle, may determine whether certain genes that may increase the chance of obesity are expressed (Llewellyn, 2015). It is the constantly interacting biological and environmental systems in which we exist that work to determine an individual's overall body composition.

Biological, Social, Behavioral, and Environmental Factors Related to Obesity

As findings from these research studies have shown, childhood obesity is caused by a *complex interrelationship* between multiple factors on multiple levels – genetic, environmental, psychological, behavioral, etc. The complexity of the development of obesity truly poses a major public health concern – obesity is an epidemic of the times today. Certain populations are particularly at risk, including high rates in many minority groups and individuals of lower income. However, when assessing the research, one group that is often ignored in many obesity intervention programs, despite being faced with many barriers to health and wellness, are rural populations in Pennsylvania.

Rural Pennsylvania & Obesity Rates

Although childhood obesity is a widespread health epidemic, caused by many contributing factors, rural populations, populations far from urban cities pose a unique area of concern. Johnson & Mohamadi (2015) conducted a systematic review, through meta-analysis, studying the potential difference between urban and rural populations in regards to childhood obesity rates. Disparities do exist between these two populations. In all 10 studies investigated, rural obesity rates in children were higher than urban areas. The meta-analysis showed that rural children have 26% greater odds of being obese than urban children (Johnson & Mohamadi, 2015).

There are many potential explanations for the higher prevalence and greater odds of obesity in rural children (Johnson & Mohamadi, 2015). Using data from the Zip Code Business Patterns, examining food deserts and SES in the U.S., Blanchard and Matthews found that across the United States, counties classified as “food deserts” have a higher percentage of rural residence than counties that are not categorized as such (2007). They continued to find trends of rural food deserts correlated with

low education access and increased poverty rates (Blanchard & Matthews, 2007). Specific to the effect this has on obesity rates, regional studies across the United States have found strong evidence that obesity rates, correlated with these food deserts, tend to be higher in rural areas (Lewis et al. 2006).

Poverty also seems to be a huge component to high childhood obesity rates in rural populations. Specific to Pennsylvania, state and national data analyzed by the Center for Schools and Communities (2011) found that rural populations also have the highest poverty rates. The data shows that in Pennsylvania, the counties that are classified as "rural" (with 50% of population outside urban centers and areas) have the highest obesity rates and the highest poverty rates. In Pennsylvania alone, 19% of kids from 5 years – 18 years are considered obese, higher than the national average (the Center for Schools and Communities, 2011). Pennsylvania's obesity rate is in the top ¼ of the U.S., reaching an average of 30.3% as of 2016 (The State of Obesity, 2017). More specifically, the Center for Rural Pennsylvania broke down the obesity rates in Pennsylvania by county, showing that counties in the more rural regions have the highest rates. For example, in Clearfield County and Mifflin County, the counties surrounding Centre County (where the present study took place), have an adult (20+) obesity rate of 32.9% and 31.8% -- almost 1 out of 3 adults in the surrounding counties of Central Pennsylvania (The Center for Rural Pennsylvania, 2014). These high adult obesity rates are relevant to the rising rate of young childhood obesity because households with parents who are obese often foster the genetic and environmental increased risk for children to become overweight (Whitaker et al., 1997).

Given Pennsylvania's expansive rural population, addressing obesity must also consider community characteristics of these rural communities. Examining these findings compared to national-level statistics, Fast Response Survey System (FRSS) data on elementary school nutrition programing shows that rural schools are more likely to have unhealthy nutrition practices offered. Additionally, with a more access-oriented focus, rural residents across the country are less likely to receive governmental

services or preventive services, have limited access to health care workers and doctors, and have higher rates of low-quality medical care when acquired.

Preschoolers in these communities are just entering into some of the social, structural, economic-driven environments specific to contributions towards higher rates of obesity in these areas. Preschool children of Pennsylvania would be a crucial target audience for an obesity prevention intervention.

Chapter 2

Literature Review

The sections to follow delineate dynamic, multi-faceted perspectives on health to address obesity as being influenced by an interaction of genetics, environment, and societal factors. This study will highlight childhood vegetable consumption as a target for obesity prevention, and will address a number of environmental, societal, and biological components that may contribute.

The Importance of Vegetable Consumption

The Center for Disease Control (CDC) recommends for children about 1 – 3 cups of vegetables daily, however the range shifts slightly according to a child's age, gender, and level of physical activity. More specifically, the United States Department of Agriculture (USDA) Center for Nutrition Policy and Promotion set 2015-2020 Dietary Guidelines for Americans that recommends at least 1- 1 ½ cups of vegetables for children 3-4 years old. Quantified, 1-1 ½ cups is about ten baby carrots, 1 baked sweet potato, 1 large red pepper, etc. When looking at the MyPlate guidelines used by the USDA, half of a child's plate should be comprised of vegetables – whether previously frozen, canned, or fresh.

The reality of the situation surrounding the daily recommendations is that young children are simply not eating enough vegetables. According to the last Vital Signs report by the Centers for Disease Control and Prevention, children 2-18 years are eating more fruit, however, vegetable intake has not increased and remains alarmingly low (CDC, 2014). Findings show that 93% of children did not meet the daily recommendations in 2007-2010 for eating 1-3 cups of vegetables. In addition, data from

epidemiological studies show that dark green vegetables and cruciferous vegetable intakes were particularly low (Johnston, Taylor, Hampl, 2000). This is particularly concerning, as many of these dark green vegetables contain important nutrients that are crucial to healthy growth and development (Webb, 2018).

The American diet largely consists of high energy-dense foods and low nutrient-dense foods (Drewnowski, 2005). More healthful foods, henceforth referred to as **nutrient-dense**, are more commonly defined as "healthy" by the absence of advertised undesirable components such as sugar, fat, and sodium. Yet, the benefits of nutrient-rich foods, such as vegetables, are rarely specified in advertisements or general knowledge (Drewnowski, 2005). With the FDA and other institutions and guides only taking the position of health claims if specific low-rates of fat, saturated fat, etc. are fulfilled, the presence of beneficial nutrients have thus far been often overlooked. However, the FDA classifies healthy foods as containing over 10% of daily values per serving for at least one of the following nutrients: vitamins A and C, fiber, calcium, protein, iron (USDA, 1999). Vegetables have the potential to provide those daily nutrients important for individuals' proper growth and development – even if they don't have a big sticker on them that says "Healthy" or "Low-fat" like many other foods lining the aisles.

In a broad sense, vegetables are widely recommended as a nutrient-dense dietary component due to their basic high concentrations of vitamins, minerals, phytochemicals, fiber, and volumetric benefits (energy density). It is long been established through various, large bodies of research and literature that vegetable intake is important in the prevention of chronic diseases, such as obesity (USDA, 2014). Many people do realize that vegetables are in fact healthy, and yet young children are not provided or encouraged to eat these key ingredients for a healthy body, mind, and overall self.

The following sections highlight the specific health benefits of vegetable consumption – vitamins and minerals, fiber, phytochemicals, and low energy-density. By examining the positive nutritional components specific to vegetable consumption, conclusions can be derived on how these benefits then contribute to obesity prevention and better overall health in children. What is so healthy about vegetables that they themselves may be a huge factor in obesity prevention?

Health Benefits of Cruciferous Vegetables

The term "**cruciferous vegetables**" is a general classification for vegetables in the family Brassicacaea (also known as Cruciferae) or in other words the "cabbage family". This classification has many different subsets of species, but is often identified as vegetables that have a similar large green leaf characteristic. The category of cruciferous vegetables includes more common vegetables such as cauliflower, broccoli, Brussels sprouts, turnip, rutabaga, cabbage, and kale as well as less known vegetables to certain regions of the world such as Komatsuna, Tatsoi, wasabi, field pepperweed, etc.

This category of vegetables are known for being high in Vitamin C and soluble fiber, as well as containing multiple phytochemicals to fight cancer and cardiovascular related health ailments. Health experts are recognizing these nutritional components fighting illness and disease, as well as the secondary metabolites – sulfur containing glucosinolates and S-methylcysteine sulfoxide, flavonoids, antoxidant enzymes, and other compounds (Manchali, Kotamballi, Bhimanagouda, 2012).

Cruciferous vegetables are unique for their abundant vitamins (C, E, and K), folate, minerals, carotenoids (betacarotene, lutein, and zeaxanthin). Cruciferous vegetables are uniquely high in the group of sulfur containing compounds glucosinolates, which when broken down to isothicyanates and other compounds, are seen to significantly break down potential cancerous tumor cells, lowering the overall

risk of lung, prostate, pancreas, kidney, bladder, breast, colon, stomach, and endometrium cancers (although some may have significantly higher decreased incidence than others).

Also, studies show the correlation between high consumption of cruciferous vegetables and low risk of cardiovascular-related diseases. In one particular study, the participants that ate any cruciferous vegetables at least six times a week had an approximate ¼ less risk of having a heart attack compared to the other study participants who did not have as high consumption rates of cruciferous vegetables. Overviewing another study that had found a reduction in low-density lipoprotein (LDLs), associated with cardiovascular disease, in participants who ate about 2 ½ stalks of broccoli, a popular cruciferous vegetable, a week (Webb, 2018).

The 2015-2020 Dietary Guidelines for Americans recommends that children consume 1 cup of of dark green vegetables, including all cruciferous vegetables. By filling this requirement with cruciferous vegetables, particularly kale, spinach, broccoli, Brussels sprouts, etc., individuals will be boosting their overall wellbeing and disease prevention in more ways than imaginable, especially in regards to weight balance and prevention of obesity. According to Webb (2018), individuals either love cruciferous vegetables or hate them. Over ¼ of the entire population are sensitive to the bitterness of cruciferous vegetables, resulting in lips often curled in disgust. Children may see Brussels sprouts on their plate and scream ‘eeeew” or just push it to the side. Brassicaceous vegetables, such as cauliflower, broccoli, and Brussel sprouts, have such amazing chemoprotective effects, antioxidents, and nutrients described above, but why might it be that consumption of these very healthy vegetables is so low? With this in mind, the purpose of the study is to examine whether these likes can be altered by increasing children’s knowledge of and familiarity with these vegetables.

Food Preferences in Young Children

Eating patterns are shaped in the earliest moments of a child's life. To effectively influence a young child's nutritional intake, an understanding of the determinants of vegetable liking, and influential factors on children's food preferences in general, is key. Early and frequent exposures and experiences with vegetables especially are critical for children to accept the bitter taste in many vegetable flavor profiles. However, parents and caregivers are often challenged by the more biological roots of children's initial dislike of vegetables, such as genetic predispositions to bitter tastes in many vegetable families as well as the sensitivity to certain sensory aspects (Johnson, 2016). With repeated exposures as the "most powerful method to improve acceptance", children will often develop a liking for vegetables after persistent exposures to originally rejected vegetables (Johnson, 2016).

When determining vegetable liking in young children, the reality is that preschool-aged children will eat what they like to eat. Their wants or desires are shaped by many factors. Young children are not necessarily concerned with "health" but instead more interested in energy-dense items, such as sweet and salty foods in particular (Johnson, 2016). Research showed that more preschool children (82-89%) consumed low-nutrient, energy-dense beverages, desserts, and snack foods than a like serving of vegetables (Johnson, 2016). This makes sense with the common trend to push aside the not as tasty foods as well as the unknown foods. Young children, especially around 3 years old, are pleasure-seeking beings, seeking the satisfaction that comes with eating foods that they prefer over ones they are being forced to eat, blissfully ignorant to the sugar content or caloric intake that plagues many adult dietary decisions (Birch, 1998). But the positive is that those preferences and dislikes can be altered, especially with the introduction of a variety of foods early in life.

A child's potential desire to eat a cupcake over a carrot is *not* universal in its nature, but instead determined by an extremely complex interaction of biological and environmental factors. Preferences

may be biologically-driven (or an innate inclination), that interacts with specific environmental cues and modeling situations to produce differential likes or dislikes. More specifically, a child's preference for certain foods can be categorized by two main overarching determinants of childhood vegetable liking – biological determinants and environmental/social determinants. Although there is a slight influence of innate, sensory-driven preference towards certain tastes and textures found in particular foods, the daily applications of these biological determinants are limited. The literature emphasizes the second determinant, social and environmental factors, as a major influence on child's food preference. While keeping in mind the biological and genetic determinants briefly mentioned blow, this paper hopes to focuses on the social and environmental as having an extremely important role in influencing a child's liking and consumption towards vegetables.

Food Neophobia

Many parents and caregivers express particular concern that their children are "picky eaters", eating only very limited food items and a lack of willingness to try a new variety of foods (Brown, Vander Schaaf, Cohen, Irby, Skelton, 2016). ***Food neophobia*** is defined as a "fear of new foods," or an extreme hesitation towards eating new or novel foods and is considered a specific component of picky eating. Many children are hesitant to try new foods, however, only 20-30% of young children are actually neophobic, expressing a strong resistance to trying anything out of the "norm" for them (Wardle et al., 2008). The 2010 Dietary Guidelines for Americans issued by the USDA encourages all adults and children to emphasize variety in their daily diets. However, introducing this well-balanced diet full of new, unknown foods into a preschool child's routine may not be the simplest transition, especially those who are **"picky".**

For children who tend to be neophobic, vegetables, fruits, and proteins are more likely to be disliked (Wardle, 2008). In a simple survey of 550 parents of preschool children, parents of children rated as "***neophobic***" indicated that their children were less likely to consume fruit, vegetables, and protein foods (Cooke, 2004). This may lead to some children's aversion towards specific vegetables in particular. As a result, children's diets may lack in variety, limited to only a few select foods preferred, very few of which being a large range of fruits and vegetables (Dovey, 2008). In a review conducted by Dovey et al. (2008), although pickiness and food neophobia may play a role in some children, other factors such as social influences, modeling, parental/family practices, personality features, etc. actually have just as much effect on the duration and magnitude of any aversion to a particular food, especially fruits and vegetables.

Findings from studies have shown that food neophobia can be combatted with multiple exposures to the rejected or disliked food. Johnson (2016) concluded that when looking at the results of the studies on overcoming neophobia, sufficient 5-6 exposures (Calton et al, 2013) may be adequate for new foods but 8-12 exposures may be optimal (Johnson & Bellows, 2007, Wardle, 2003). Overcoming neophobia and pickiness in childhood is crucial in order to attain a healthy balanced diet for some children. According to Dovey et al (2008), interventions combining the complex inter-relationship between innate contributors to neophobia as well as social or environmental can help children consume vegetables and fruits once avoided.

Biological Component to Food Preferences and Liking

As mentioned above, for children with neophobia, the biologically driven fear of trying anything new plays a role in determining whether or not the child will try and then like a particular food. Sometimes, no matter how many times reinforced, an individual may just never like broccoli. Biology may be the dominant determinant in this instance. However, the literature emphasizes that the case where it is strictly biological is *rare*. Even when a child is extremely, extremely picky, over time, sometimes as late as adulthood, and with enough exposures and influencing factors, they may develop a liking for foods that they turned their nose up to as a young child.

Biology does play a role, as it does with just about everything, however, the study of solely genetic influence on food preferences poses a difficult endeavor considering the strong role that environmental and social factors play, and the difficulty of separating out genetic variability from these personal experiences. Social and environmental factors are often extremely influential, and will be focused on in later sections; however, the biological factors must also be highlighted to provide background and a basis for some innate preferences.

According to Elks (2012), sibling similarities in food preferences were strong, however, it was difficult to distinguish between environment and genetics in these cases. More clear to genetic influences can be seen in monozygotic (MZ) twin studies, however, samples have not been large enough to make accurate generalizable estimates. One larger study conducted by Wardle et al. (2001) examined the food preferences in 214 same-sex identical twin pairs aged 4-5 years old and how it may be related to biological factors. By collecting preferences for a list of 94 commonly consumed foods (classified as “Dessert/Sweet”, “Meat and Fish”, “Fruit”, and “Vegetables”), Wardle et al. (2001) concluded that mere

classification as sweet, salty, or fatty is not complex enough to predict food preferences. Rather, a more complex combination of sensory synthesis (texture, olfaction, taste, temperature, fluidity, etc.) determined the preferences of the twins – a *biological and learned basis*. Sensory perceptions are strongly influenced by cultural patterns, peer influence, parental control, exposure, etc. (Wardle et al., 2001). Even when trying to seek out mere biological components, Wardle et al. (2001) found that it was both the biological as well as environmental factors that influenced the twins.

Innate Preference: "Tasters" and "Non-tasters"

A foundational study by Beauchamp et al. in 1994 of infant sucking preferences indicated that only an infant's preference for sweet and rejection of bitter tastes are innate to an individual and unlearned. So solely the preference for sweet, maybe the preference for salty, and the definite rejection of sour/bitter are unlearned for a statistically significant majority of newborns (Beauchamp, 1994). Furthering Beauchamp's initial research, Keller et al. (2002) proposed that tasters of 6-n-propylthiouracil (PROP) are more sensitive to bitter taste, playing a genetic role in acceptance of certain more bitter cruciferous vegetables in children. In general, the ability to taste bitter thiourea compounds, such as 6-n-propylthiouracil (PROP) and phenylthiocarbamide (PTC) is inherited according to recent findings. Those who are classified as **"tasters"** are sensitive to PROP or PTC compounds and therefore are known to be more *sensitive to bitter tastes in certain food types*. Those who are "**non-tasters**" in testing are *not as sensitive* to these compounds in bitter tasting foods and therefore are known to better accept and consume these compounds without a problem (Keller et al., 2001). So despite many human genetic similarities in basic responses to tastes that make up our common human diet, there is certainly great variability in preference for certain tastes, bitter tastes in particular (Keller et al, 2001).

Keller et al. found that despite Beauchamp's findings in 1994 that bitter tastes are innately rejected by all, which is genetically similar among most infants, people have very different preferences for specific, individual foods past the infancy stage (2001). Keller et al. (2002) used the heritability of the ability to taste bitter thiourea compounds, such as 6-n-propylthiouracil (PROP) and phenylthiocarbamide (PTC) as the basis of an investigation of inherited genes and food preference. These compounds are found in many vegetables in which 70% of Americans reported the tastes being moderately to intensely "bitter" (Bartoshuk & Beauchamp 1994). PROP "tasters" are sensitive to PROP at low concentrations, which makes these individuals sensitive to oral sensations that result from bitter or extremely sweet tastes as well as the feeling of fats on the pallet (Keller, 2002). Drewnowski in 2000 found that PROP taster adults are *more sensitive to cruciferous vegetables* such as broccoli, Brussels sprouts, cabbage, and other similar green leafy vegetables.

Keller et al. investigated how taster status influenced pre-school aged children specifically with regards to acceptance of foods (2002). Sixty-seven 4-5-year-old preschool children from a university childcare center were the participants in the study. PROP taster status was determined by a method developed by Lawless in 1980, where the children tasted 10 mL of .56 mM PROP solution in 10 mL water where they were asked to answer yes or no to the question "Do you taste anything?". Those who were non-tasters classified the solution to taste like water, while tasters described the taste of the solution to be bad, sour, or yucky. The objective of this section of the study was to classify children as "tasters" or "non-tasters" of PROP. After PROP taste status was established, children were given 10 g of raw and cooked broccoli, orange juice, orange-grapefruit juice, semisweet and milk chocolate, American cheese, hot dogs. Each child was tested separately where they were given the chance to taste each food one by one, followed by the prompt to rate food preference on a 5-point facial hedonic scale that was confirmed to be understood by the child, showing liking of tested food. To measure food frequency, a questionnaire

was filled out by parents on food frequency and consumption. This was to fulfill the second objective: is there a relationship between PROP tasting/non-tasting status and the children's intake of bitter (often cruciferous) vegetables and other bitter tasting foods?

Significant results were found between tasters and non-tasters for raw broccoli, where tasters had lower acceptance of the raw cruciferous vegetable than non-tasters according to the testing. This finding that raw broccoli was less accepted by PROP tasters may be that raw broccoli uncooked "contains the bitter tasting flavonoids and isothiocyanates that are released during cooking" (Betz & Fox, 1994). However, this opens up the possibility that taster children may be more likely to accept cooked broccoli in comparison to raw broccoli, creating an opportunity for implications into a child's diet. However, it must be considered that the likability of food is a combination of taste, olfactory, and textural contributing factors (Szczesniak, 1990). Although the sample did not represent lower-income homes or minority groups or cultural differences, the acquired results that suggest genetic factors may contribute to cruciferous vegetable food preferences in preschool children more than previously recognized.

Bartoshuk et al. (1993, 1994) classified those who are non-tasters to have 2 recessive alleles (tt), medium tasters to have 1 dominant and 1 recessive allele (Tt), and supertasters to possess two dominant alleles (TT). The early foundational studies on the genetics of PROP and PTC found that those who are tasters often did not like cruciferous and green vegetables such as brussels sprouts, spinach, kale, cabbage, collard greens, sauerkraut, rhubarb, etc. Drewnowskii et al. sought to directly link PTC or PROP sensitivity directly to a pattern of individual food likes and dislikes – this study examined the connection between these genes and the acceptance of specific bitter-tasting vegetables to conclude that taste responsiveness to PROP may be a barrier to a vegetable-rich diet. The results supported previous findings that the subjects who were PROP tasters (medium or supertasters) were less likely to report

consumption of cruciferous vegetables, bitter salad greens, and other foods recommended by the dietary strategies for cancer and chronic disease prevention. (Drewnowski, 1995).

However, despite the evidence of the sensitivity underlying the liking of many specific vegetables, the research is limited in daily life; the PROP taster status has very narrow influence on the preference for foods experienced more commonly throughout each and every day of a child's life (Wardle, Cooke, 2008). The evidence supporting a link between certain vegetable liking and a certain genetic taste receptor may not be broad enough to effect overall vegetable liking in children – these results may play a contributing factor, however, are not the main determining factor.

The Role of Learning and Familiarity in Shaping Children's Food Preferences

Young children undergo the process of learning the taste of foods and formulating flavor preferences from the start, beginning with familiarization and then going on to associative and observational learning. A child's food preference is shaped by the child's experience with that food, whether it be the social context in which it was presented, peer reaction towards a food, parental modeling behaviors, or physiological consequences of actually ingestion. Children's acceptance or rejection of foods is greatly associated with the quantity and quality of a child's experience with the particular food (Birch, 1998).

When a food is repeatedly presented to a child, the food becomes familiar, impacting the likelihood of acceptance of the food. Aversions are less likely to be formed when foods are not unfamiliar as they do not pose as much of a threat (Wardle, 2008). Learned aversions are created with mainly unfamiliar foods, which is more likely to happen in childhood, creating diets more limited than adults. Familiarity poses the idea that if constantly presented with a food it is accepted as safe to eat, undermining a child's inherent fear of novel foods as potentially dangerous. Wardle's research found

when children were not commonly offered certain foods, a disliking or aversion is more likely to form (2001).

Familiarity is not an intrinsic characteristic of food, but instead a direct function of a child's experience or exposure with that particular food (Birch, 1982). Like the general "***mere exposure***" hypothesis states about all stimuli, "mere repeated exposure of the individual to a stimulus object enhances his attitude towards it" (hypothesis by Zajonc 1968). Food is no different – experience develops familiarity, developing a crucial role in the formation of food preference. (Birch,1982). Birch et al. (1998) proposed that between **10-15 exposures** are recommended to increase liking. However, additional research has indicated that even fewer exposures can have a similar effect (Williams et al., 2008). Presenting opportunities to try a variety of healthy foods early in a child's life can be the initial move to promoting a healthy, nutrient-dense diet.

Repeated Exposure and Children's Vegetable Liking

In a study conducted by Anzman-Frasca et al. (2012), two experiments, between-subject and within subject, were implemented in childcare centers with forty-seven children aged 3-6 years old, comparing repeated taste exposures of vegetables not initially liked either presented just by themselves or with a liked dip. The second approach, repeated tastings of the vegetable with a liked dip, displays *associative learning* examined in the next section. The first approach, mere exposure, was successful in increasing vegetable liking between pre- and post-test in both experiments (Anzman-Frasca et al, 2012). This suggests that giving preschool children little tastings of vegetables that were initially not preferred can have significant effects on increasing child's liking as well as sustaining a child's liking and intake of those vegetables (Anzman-Frasca et al, 2012). Only **6 exposures** to the vegetable were sufficient to increase liking (Anzman-Frasca et al, 2012).

However, in many cases, repeated exposure alone is not enough to encourage children to consume more nutrient-dense foods such as vegetables. Exposure does provide the opportunity to familiarize children with the food in ways that naturally increase liking over time, however, children's reluctance to try the food often prevents this process from happening.

Associative Learning

Expanding upon the description of the study conducted by Anzman-Frasca et al. (2012) briefly described above, the second condition, pairing the disliked vegetables with a liked dip, expands upon just mere exposure. The underlying mechanism behind pairing a disliked vegetable with a liked food is ***associative learning*** – the process by which one stimuli is associated with another stimuli or behavior, therefore learning that stimulus. An initially-neutral stimulus, the conditioned stimulus, starts to prompt a certain response after repeatedly being paired with a meaningful stimulus, the unconditioned stimulus. For example, if consuming a new food is followed by a stomach ache, the negative effect of illness is then paired with the novel food, even if there was no association between the two factors. Similarly, associating positive cues with novel foods can also shape children's food preferences.

Havermans (2009) determines two different types of associative learning in relation to increasing food preference – flavor-nutrient learning and flavor-flavor learning. ***Flavor-nutrient learning*** is the learned preference after an association made between a certain food's flavor and the post-ingestive result (Havermans, 2009). ***Flavor-flavor learning*** can be seen when two flavors are associated with one another, leading to the liking of one of the flavors due to the preference for the other flavor (Havermans, 2009). Anzman-Frasca et al. (2012) utilized the flavor-flavor associative learning paradigm by giving the children a disliked vegetable with a liked dip. Although the children then did seem to like the once disliked vegetable (when paired with the dip), significant evidence was not found for that liking

to be carried to when the vegetable was without the dip, posing questions about whether the selected stimuli had enough of a positive association to have any effect. It is possible that children may develop a learned preference for vegetables when they are paired with a fun and positive story. This question will be addressed in this study.

Children's Storybooks – A Main Mode of Early Childhood Communication

Although technology has a strong presence in society today in influencing children's nutrition perceptions and behaviors, children's storybooks still hold a strong place in many classrooms and homes. About 80-87% of parents read to their young children at least 3 times a week, while close to all preschool classrooms read stories every day (Matvienko, 2016). Despite this rise in technology with iPads in the hands of many children, reading remains to be extremely popular. With preschool children's often inability to read yet desire to learn, storybooks continue to provide that opportunity to promote cognitive development with activation of mental imagery and narrative comprehension (Hutton, 2015).

According to Bellows and colleagues (2014), reading storybooks to preschool children aged 3-5 years old is a practical and potentially effective mode to enforcing nutritional eating habits. Books are an important presence in learning as well as developing the foundation for perception, beliefs, and attitudes towards situations displayed in the reading. Storybooks are an effective means of conveying a positive nutritional message because they can be read slowly, multiple times to reinforce a particular message (Byrne, 2000). Regarding fruits and vegetables, which may often receive a constant negative image, *repeated exposure* to these healthy foods in a positive light may enhance a child's visual preference, leading to accept the foods that now seem familiar. (Houston-Price, 2009).

Storybooks as a Means of Increasing Children's Vegetable Liking

Storybooks are an effective method for engaging preschool children's active imaginations and interest to ultimately communicate healthy eating (Bellows, 2013). Previous interventions show success in influencing childhood eating behavior when the use of storybooks is engaging, involves multiple exposures, and involves both the school and home environments (de Droog et al., 2013). However, further research is needed. Osborne (2012) found that following a book promoting both fruits and vegetables, only fruit intake was positively affected, posing the need to further investigate vegetables specifically when not paired next to fruits. There is limited research in general that highlights vegetables in a positive light in a story. Byrne and Nitzke (2002) analyzed 114 popular educational storybooks for preschoolers where a mere 7% of the 199 that mentioned food were in reference to vegetables. While storybooks are an effective means to influence children's behaviors and perceptions, many times positives values are attached to foods high in fat, sugar, salt such as cookies or cakes. There have been very few studies designed that take the approach to conveying a positive message associated with vegetables, as opposed to low nutrient dense foods. It is important and timely to understand the potential impact that this approach may have on a child's attitudes and behaviors towards those food groups.

Study Overview and Objectives

In an attempt to fill the gap in the literature on effective methods for increasing children's preferences for vegetables and improving dietary patterns, this study was designed to examine the impact of repeated exposure to fun, interactive storybooks and vegetable tasting on preschool children's willingness to try and like cauliflower, broccoli, and Brussels sprouts. The Cruciferous Crew Intervention was based on the *Cauliflower Power* book series written and illustrated by the Principal Investigator, Anna Canova. Combining many passions – art, vegetables, health, young children, and education – the creation of the Cauliflower Power book series was based on a desire to understand whether books with a positive take on vegetables followed by a tasting of target vegetables, would have the potential to increase children's liking of target vegetables. The

Cauliflower Power book series, a series of four books, highlights a likable and relatable character navigating his way on an action-packed adventure developing vegetable liking with the help of his cruciferous vegetable friends. Could portraying vegetables as helpful, kind characters rather than the yucky enemy change children's behavior and thinking in a fun, relatable way?

Theoretical Frameworks

Theory of Planned Behavior. The "Cruciferous Crew" intervention utilized a multifaceted, integrated approach to nutrition education and overall health promotion. One theoretical framework used is the Theory of Planned Behavior (TPB), working to identify attitudes and perceptions that promote, or create barriers, to healthy eating of vegetables. TPB relates to decision-making, modeling that intention for behavior is driven by three major constructs – attitude, subjective norms, and perceived behavioral control.

When it comes to vegetable consumption in preschool-aged children, these three constructs may influence the impressionable young decision makers. Attitude, the degree to which the individual has a positive or negative perception of the behavior, may already be skewed negative due to media, advertisements, and peers. To combat this, the "Cruciferous Crew" intervention storybooks portray eating vegetable as a positive, highlighting the main character who consumes cruciferous vegetables throughout the tale to help keep him strong, healthy, and energized throughout his exciting journey! Subjective norms places importance on complying or not with one's desire to fit into the "norm". With having all of the children engaging in the story and trying the vegetable snack in school as well as at home, the supportive social environment is potentially creating a new "norm". Self-efficacy, the child's perceived control, is important for young children's food decision-making capability and it often comes

with knowledge and understanding. The children have the choice to consume the vegetable snack provided, support giving the autonomy to the child to make the decision about what they eat, with the knowledge learned in the stories and lessons to guide them.

Social Cognitive Theory. The construct *perceived behavioral control* from the Theory of Planed Behavior model relates specifically to the key component in Bandura's Social Cognitive Theory – self-efficacy. Self-efficacy relates to the child's individual perception of their ability to perform the behavior of say eating vegetables. So, the child may feel due to contributing factors that they have an internal motivation or belief of their ability to have control over what they eat and what they do not eat. The Social Cognitive Theory (SCT) is widely used for food studies in young children as the theory emphasizes that human behavior or behavior change depends on the "reciprocal interaction of the personal, behavioral, and environmental factors" (Hall, 2015).

Social Ecological Model: Bronfenbrenner's Ecological Systems Theory. The "Cruciferous Crew" Intervention utilized Urie Bronfenbrenner's Ecological Systems Theory to portray the idea that children in particular are greatly influenced by everything in their multiple surrounding environments. The food that young pre-school aged children eat depends largely on the environments of influence. The Microsystem, the system that is considered to be closest to the child every day, is the childcare center and the child's home – the two areas of focus in the study. This is considered to be the most influential level of the Ecological Systems Theory, with bidirectional influences from parents, peers, teachers, caregivers, etc.

The study also considers the Mesosystem of the interaction between the different components of the Microsystem creating an interconnected network between the most influential, daily aspects of the child's life, having an indirect impact on the child's potential

behaviors and decisions. If the Mesosystem all comes together for a joint cause of increasing vegetable consumption and liking, the child is more likely to form positive behavior change. The Exosystem and Macrosystem may not be seen as having a direct effect on the individual child, however, they contribute to the greater context in which the individual exists and the portrayal or availability of vegetables in which to be consumed.

Combining Theories and Frameworks. In an effort to view obesity from a greater context, the study aims to view young childhood vegetable consumption as an interaction between individual willingness and perception of control, daily influencing environments of school and at home, and the larger context of the view of vegetables across society. The "Cruciferous Crew" study utilizes the multifaceted approach to vegetable consumption behavior change by combining multiple theories' approach to incorporating many aspects of the child life as influencing behavior and attitudes. The study also recognizes that although supported by behavior change and environmental theories, there are biological components to consider and the larger context that is not just mere individual behavioral decisions.

Study Objectives

The purpose of the study is to consider biological, environmental (home and school), and social influence on a child's liking and consumption of cruciferous vegetables and whether those behaviors and ideas can be positively changed through repeated (6+) exposures in the form of a "Cauliflower Power" children's book series and cauliflower snack sample as well as at-home recipe use. The primary objective or endpoint for the "Cruciferous Crew" research study is for the storybook reading and taste exposures to lead to the participants' increased positive perception and willingness to try the cruciferous vegetables provided. A secondary study

objective is to measure the extent to which increasing knowledge and tasting opportunities at home contribute to a child's liking or willingness to try the featured vegetables. In other words, through analysis of a survey distributed to the participating parent or guardian, how many additional exposures were administered in the home environment? How did this compare to the results in the classroom data? Additionally, biological components are collected with the aim of exploring if a child's bitter taste sensitivity impacts the child's initial tasting/perception as well as influence the eventual possible change in those pre-intervention consumption and subjective perception after multiple exposures.

Study Rationale

In this study, the repeated exposures to these cruciferous vegetables – cauliflower, broccoli, and Brussels sprouts – takes place at both school and home. The rationale behind the conducted work would be that *repeated exposures* in the school *and* in the home will increase a child's likelihood to try vegetables, which will ultimately increase vegetable consumption throughout the lifespan, decreasing the likelihood of development of obesity. By increasing vegetable exposure and modes of learning to like vegetables at an ***early age***, development of liking will be more likely to improve. Vegetables incorporated into the diet at an early age is important for the child's immediate health in preventing childhood obesity, but also formulating a healthy lifestyle for the years to come**.**

Hypotheses

With the study encompassing many different components influencing vegetable-based behavior change I propose a few main hypotheses regarding the study in the context of the classroom and the home environment. I propose four main hypotheses:

1. I hypothesize that the *Cauliflower Power* storybook-based "Cruciferous Crew" intervention will lead to an overall increase in target vegetable **liking** from pre-assessment to post-assessment, specifically cauliflower.
2. I hypothesize that support from the **home environment** through the use of the cruciferous vegetable recipes and overall serving of vegetables in the home will be related to children's liking of cauliflower post-intervention.
3. I hypothesize that **tasters** will be less likely to try, and will have a lower liking for the target vegetables, but through repeated exposures, will increase liking and willingness to try the foods.

In summary, the overall hypothesis for the proposed study is that multiple exposures (at school and at home) will increase the participating preschool-aged children's likelihood to have a positive perception towards and willingness to taste the featured cruciferous vegetables, combating "taster" status.

Chapter 3

METHODS

Participants

Participants included 24 children between the ages of 3 and 5 years old (58% female) enrolled in 2 preschool classrooms at a university childcare center and their parents. The parents or guardians of the participating children were also considered to be participants in the study, as they completed surveys and took part in the at-home component of the research. Teachers were asked to distribute a study recruitment letter addressed to parents and guardians summarizing the study (Appendix B). Exclusion criteria for participation in the study included allergies to cruciferous vegetables, diseases/illnesses that prevent food intake, and an inability to converse in English. Those without consent still received the story and snack, as that was part of the preschool classrooms' routine; data were not collected on children without consent. In addition, any child who was not present for the pre-assessment testing or post-assessment testing – two crucial data collection dates – was excluded from the study's final results and analysis.

The study was conducted over a period of 3 weeks and included 6 different classroom visits to each classroom. The pre and post-testing classroom visits took approximately 40 minutes to complete, with the individual one-on-one interviews with each child estimated around 3 minutes each. The implementation of the educational component – storybook reading and cruciferous vegetable taste testing – took around 20 minutes on 4 different occasions. The parental survey was estimated to take around 7-10 minutes total. Parents who participated in the study received a $10 Amazon gift card following the completion of the survey. Additionally,

each classroom that participated was given a set of the storybooks and a classroom gift (e.g., art supplies).

Procedures

Parental Consent. In addition to the letter sent home, the packet of Written Consent for Research was also distributed to each child and the child's parent/guardian. Written consent was obtained from each child's parent or guardian on behalf of the participation of their child as well as participation of themselves. Two separate consent forms were to be signed and returned prior to participation in the study – consent for the child and consent for the parent or guardian. Signed consent forms, with the mandatory signature page, were returned to one of three places – their child's mailbox, their child's teacher, or the front desk at the childcare center – and collected before the start of the pre-assessment.

Child Assent. Throughout the entire implementation of the research process in the preschool classroom, constant confirmation of desire of participation was obtained from each child. At any point during the process a participating child does not feel comfortable or wish to participate in the storybook reading or taste testing, an alternative activity was provided. Repetitive assent of children participants was obtained from all of the participating children. During the taste-testing portion described in a later section, children were given the choice of trying the snack or not trying the snack. Although the participants are young, the children were able to express yes/no reactions to study components (simple facial expressions, verbal yes or no, nodding or shaking of head, etc.).

Measures

The study took place over the course of 6 different classroom visits, which were spread out across the course of 3 weeks, as well as at-home participation also across the course of the 3 weeks. There are two main components to the study alluded to in previous sections: (1) in-class storybook and tasting exposure, and (2) at home recipes and activities. The study design was a within-subjects, or repeated measures, where each subject's perception of and willingness to taste the cruciferous vegetables are measured at the beginning of the study as a baseline pre-assessment, as well as multiple points throughout the study, and lastly at the end of the study. At the end of all of the classroom visits, including the storybook reading and taste exposure (and data collection), each participating child was given a post-assessment, the same as the pre-assessment, to provide an opportunity for comparison within the subject.

Intake Measures – Pre & Post Assessments

Measures were collected prior to the implementation of the "Cruciferous Crew" study, and immediately after the intervention ended. Pre-assessments were conducted during morning free-play in both of the participating classrooms. Each child was individually interviewed in a private area of the classroom, but within view of the other children and teachers. The pre-assessment consisted of 3 different parts – knowledge of cruciferous vegetables, PTC testing of biological influences on liking of the vegetables, and finally a sample tasting of the vegetables and a resulting display of liking.

Taster Status. Various studies show that a genetic predisposition to tasting or not tasting PTC (determined by the gene TAS2R38) influences one's tendency to like bitter, cruciferous

vegetables. The child had the option to place the PTC paper strip on their tongue. The piece of paper was held out and presented to the child to take and put on their tongue if desired. Recording of their answer to "What did it taste like?" was marked as well as an interpretation of their facial expression.

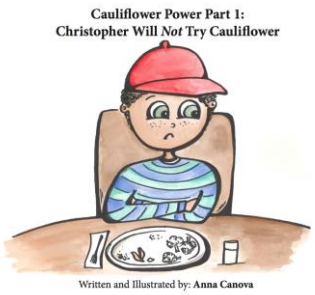
Vegetable Identification/Knowledge. The child's current knowledge of cauliflower, broccoli and Brussels sprouts was assessed using a two-step process. First, the child's recall knowledge was assessed by holding up a picture and asking "What is this?" If they were able to recall, they received 2 points. If they were unable, following round 1 the three cards were laid out in a row and the child was asked "Point to the picture of the cauliflower".

Vegetable Liking. The last component to the pre-assessment was a tasting to assess the child's willingness to try the presented vegetables as well as the resulting liking of the vegetables. The researcher placed in front of the child sample cup sized pieces of steamed cauliflower, broccoli, and Brussels sprouts in cut into bite-sized pieces. The child was presented with the option to taste any of the vegetables in any order, or not taste if they wish. Also placed in front of the child was three buckets with faces on front – Yuck face, Yum face, and So/So face. After confirming the child understood what each of the faces represented, if the child tasted

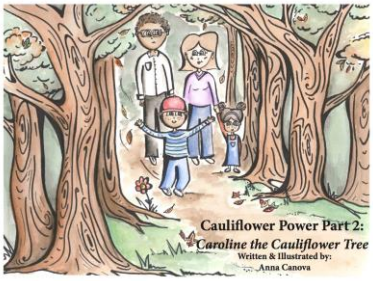
a vegetable, they were instructed to place the sample cup into the bucket with the face that represented how they felt about the taste of that vegetable.

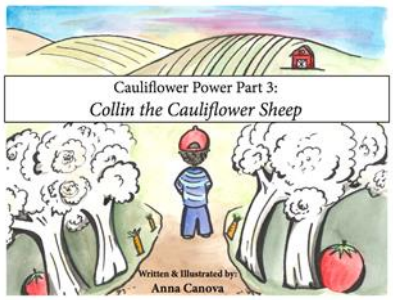
The process occurred for every child participating in the study, with each classroom having the same procedure occurring at the same time of day (~11 am). The following four classroom visits were devoted to the implementation of the storybook reading and snack sampling. Upon completion of the book series, the procedure described above for the pre-assessment, besides the PTC genetic testing, was repeated in order to collect post-assessment data on exactly the same terms.

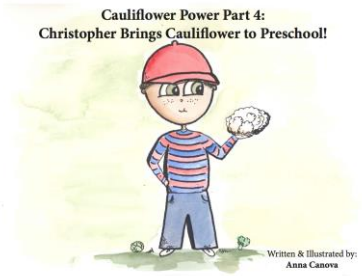
Cauliflower Power Book Series – Interactive Reading & Knowledge



Following the pre-assessment visit, the next four classroom visits were focused around the storybook series, consisting of four interconnected stories, written and illustrated by the Principal Investigator, Anna Canova. The storybook series – *Cauliflower Power* – highlight the main character, Christopher, a preschool-aged child who embarks on an adventure ultimately promoting the healthy power of cruciferous vegetables cauliflower, broccoli, and Brussels sprouts. Over the course of the chapters, Christopher goes from refusing to eat cauliflower to recognizing the health benefits, yummy crunchy taste, and ability of cauliflower to give him "Cauliflower Power"!







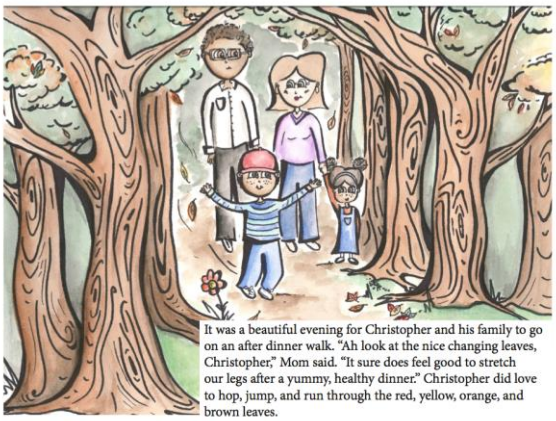
First, prior to the reading of the story, mini 5-minute intro lessons on vegetables and healthy eating were administered as the children were waking up from their nap and trickling over to the story time rug. A 15-minute window was available between nap time and snack time, making it necessary to condense the materials and lesson plans. The focus was to engage the children in learning about the vegetable that they are being asked to taste, while also recapping and reinforcing some of the lessons presented in the storybooks. During and after the stories, the researcher asked children a few questions on the story and what they learned about cauliflower, broccoli, and Brussels sprouts from the character within each tale.

Lesson/Book Themes Overview:

Table 1. Sample Summary of Books and Researcher-Prompted Interactive Questions				
	Cauliflower Power Part 1: Christopher Will *Not* Try Cauliflower	**Cauliflower Power Part 2: Caroline the Cauliflower Tree**	**Cauliflower Power Part 3: Collin the Cauliflower Sheep**	**Cauliflower Power Part 4: Christopher Brings Cauliflower to Preschool**
Summary	Christopher helped Grandma make dinner with vegetables they harvested from the backyard garden, but Christopher refused to eat the cauliflower. Maybe next time he will try it and like it!	Christopher and his family go for an evening walk, however, Christopher did not eat his vegetables at dinner so he suddenly did not have the energy to keep up! The forest came alive into giant foods, faced with having to decide between Sugar Lane and the Cauliflower Power trail. Luckily he had the help of Caroline the Cauliflower Tree, Bruce the Broccoli Tree, and Briana the Brussels Sprout.	Christopher ended up feeling a little sick and falling asleep in the rolling farmland. Collin the Cauliflower Sheep and his friends gave Christopher their shaved "wool" of cauliflower as a healthy snack to help him feel better and overcome the obstacles to come.	Christopher's preschool is having a harvest party, so Christopher, Dad, and his little sister make Cauliflower Popcorn together to share with all of Christopher's friends! Everyone loves it.
Example Prompting Questions	• "Does anybody know what this vegetable is called?" • "Does anybody see the cauliflower in this picture? There are 1, 2, 3 cauliflower plants." • "Raise your hand if you think Christopher should give the cauliflower a try next time."	• "Why do you think Christopher's body did not have enough energy? Do you remember from last time what Christopher did not eat at dinner?" • "One path has sugary candy and the other has lots of vegetables – which path do you think is the ***healthy*** path?" • "Can everyone say CAULIFLOWER POWER? Let's say it three times."	• "Can you tell what vegetable the sheep friends are?" • "What would be a healthy snack choice for Christopher – the pie or cauliflower?" • "Can everyone say Cauliflower Power 3 times to help Christopher run super fast away from the Eggplant Elephant?"	• Point to different vegetables in the garden asking: "Does anybody know what this is called? How about this?" • "Christopher sprinkled the cheese. Can you sprinkle with your hands? Go like this and rub your fingers together. Great!"

Rationale behind Storybook Characters – Diversity in Education

The main character in the stories is Christopher, a pre-school aged child just like the children participating in the study, allowed for the opportunity for the children to relate. Also, with the incorporation of Christopher's sister Claire as well, children who identify as boys and girls are both being represented and can feel as though they can potentially see themselves in one of the characters. Christopher's family is a multi-generational, with Grandma as part of the family unit, and biracial, with the mother being white and father being black. This provides imagery of a family that is more common in the real world, but not as well represented in the typical all white, nuclear family typical of many children's storybooks.



It was a beautiful evening for Christopher and his family to go on an after dinner walk. "Ah look at the nice changing leaves, Christopher," Mom said. "It sure does feel good to stretch our legs after a yummy, healthy dinner." Christopher did love to hop, jump, and run through the red, yellow, orange, and brown leaves.

The rest of the family arrived home just in time to sit together for dinner! Christopher helped bring the food out to the table. He carried the baked broccoli, cauliflower, squash, and brussel sprouts. They also had chicken and brown rice. Yum!

Snacks Served & Methods Prepared

The ingredients for the in-class snacks provided were from Trader Joe's grocery store and prepared in the Healthy Bodies Project kitchen prior to the classroom visit. The frozen snacks included Organic Riced Cauliflower, Organic Rainbow Cauliflower florets, Cauliflower and Broccoli Vegetable Patties. The cauliflower rice and veggie patties were both sautéed with olive oil, lightly seasoned with salt and pepper, and cut into bite-sized pieces. The Rainbow cauliflower was microwaved, seasoned, and cut into small florets. For the last snack, an Organic Cauliflower Head was prepared according to the Cauliflower Popcorn recipe provided in Appendix A. All snacks were placed in glass Tupperware and transported in a heat-containing bag that kept the snack warm during the components of the Intervention prior to the tasting. Food handling followed ServSafe guidelines and all researchers preparing food were ServSafe certified.

Measuring Participant's Tasting

Following each reading of the story was a tasting exposure of a sample of a special snack that incorporated mainly cauliflower as well as other cruciferous vegetables. Due to the limited time and lack of access to the Child Centre kitchen, the children were not able to engage in the cooking process and help with the preparation. The vegetable snacks were prepared in advance prior to coming into the classroom and held in heat-holding containers. Although not able to help

in the process in the classroom, the recipes were sent home with the children for them to try to make at home with a parent or guardian also participating.

Following the reading of the story, the children sat at a table and were served the childcare center's daily snack. Off to the side of the classroom was the table with a similar set-up to the pre and post-assessments, where the "Yum", "Yuck", "So/So", buckets were placed in the middle of the table. Each participating child was called over to the table one by one to do the tasting. A small sample of the snack was placed in a sample cup. The bottom of the sample of the cups had a red sticker that had written on it the child's study ID number. The researcher was careful to give the participating child the appropriate sample cup with the ID number that was correlated with them. This method was used for the next section – preference measures – in order to track whether or not the child liked the snack.

Upon presenting the participating child with the opportunity to taste the vegetable snack, the researcher instructed that the child could try as much or as little as they wished; they did not even have to try it at all! In order to assess whether the child consumed the vegetable or not, the researcher handing the child was asked to put it in the appropriate bucket. If they tasted it at all and put it in the appropriate bucket (described in the next section) then they were marked as tasting it. If they did not want to try and put it in the red "X" bucket, they were marked as not tasting it. The chart used to track Consumption Data is provided in Appendix C. All of the children were given the opportunity to try the cruciferous vegetable presented that day, however, data was only collected on the participating children with consent. All of the children were also given the regular snack provided by the childcare center, as the sample of the snack provided was only a small bite-sized sample as approved by the IRB.

Liking Measures

For those who made the decision to try the snack, the liking of that vegetable in the particular snack form was collected to get a sense of the overall perception of the vegetable. In order to gather data on who liked it and who did not, the children were instructed to place their sample cup in the bucket that corresponded with how they felt about the snack once they tasted.

A key component of measuring liking was the sticker on the bottom of the sample cup with the child's ID number. Each child placed their cup into the bucket that they felt appropriate and then the next child did the same. After all of the participating children had the opportunity to try the sample and put it in the bucket that showed their liking, the buckets were taken away while the rest of the classroom had a chance to taste the snack. Immediately following the in-class tasting, the researcher went through each bucket and marked off which ID numbers were placed in each bucket. The chart used to record liking is provided in Appendix C.

School-time Lunch Measures

During the month of March, when the study was in the classrooms, the childcare center added to the lunch menu the vegetables focused on that week. For example, during the three

weeks of the project, the chefs in the kitchen made steamed cauliflower and broccoli on rotation. The motivation behind also serving the cruciferous vegetables at lunchtime is that additional exposures and seeing the vegetables in a different context may allow for a higher likelihood to try and then like these vegetables over time.

Parent Questionnaire & Demographic Measures

The survey distributed to the parents following the completion of the study consisted of 3 separate sections – Demographics, Child Pickiness Scale, and At-Home Participation Measures. The survey was created in Qualtrics and distributed by the teachers through the classroom email listserv. The survey was estimated to take around 5-10 minutes and was to be completed by 1 week following the distribution. 18 out of 24 parent participants completed the survey.

At-Home Component Measures

An additional endpoint measured the number of times the at-home environment was involved with the implementation of the study going on in school. Included in the at-home part of the study are a few things – recipes and recipe books and fun fact sheets. The participating parents consented to incorporating the study's objectives into their home. The home involvement was measured in the survey distributed. The measures showed how many and what type of additional at-home exposures were given, seeing if additional exposures at home contributed to or correlated with change in a child's performance on consumption and liking measures in school. Examples of recipes used during the at-home portion can be seen in Appendix A.

Statistical Analysis

Data were entered and cleaned in Microsoft Excel, and then transformed and analyzed in SAS version 9.2. Descriptive statistics were generated to provide sample characteristics. Pearson's zero-order correlations were used to examine associations among continuous variables. Paired t-tests were conducted to examine pre-post changes in children's ability to identify and liking for target vegetables. T-tests were conducted to examine differences by taster status. The significance level used for all data analysis was $\leq .05$.

Chapter 4

RESULTS

Demographics

Table 2 describes descriptive information on the sample. The 24 participants who completed the entirety of the "Cruciferous Crew" storybook series and cruciferous vegetable snack were between the ages of 3 and 5 (mean age = 3.71). A total of 14 of the children participating were females, and 10 were males. Approximately 74% of the children were identified as white, 13% Asian, 4.3% Black or African American, 4.3% Native Hawaiian or other Pacific Islander, 4.3% Hispanic or Latino.

Of the parents who completed survey, 38.9% reported their highest education level to be their Doctoral (PhD), 38.9% Bachelors, 16.7% Masters, and 5.6% Associates and their partner/spouse's education level following similar trends, with even higher (41.2%) having obtained their PhD. 17 out of the 18 (94.4%) participating parents who filled out the survey reported being currently married with one participant single and never married. The annual total household income for the participating parents/guardians in the study showed that the majority fell into the over $100,000 category (77.8%), with one participant in the $20,000 - $34,999 range and one in the $35,000 - $49,000 range.

Table 2: Demographics		
Variable	**Mean (SD) or Prevalence (%)**	**N**
Child Gender		
Female	58%	24
Male	41%	
Child Race/Ethnicity		
White	74%	
Asian	13%	
Black/African American	4.3%	
Native Hawaiian or Pacific Islander	4.3%	24
Hispanic or Latino	4.3%	
Parent 1 Highest Education Level		
Doctoral (PhD)		
Bachelor's	38%	
Masters	38.9%	17
Associates	16.7%	
	5.6%	
Parent 2 Highest Education Level		
Doctoral (PhD)		
Bachelors	42.9%	
Masters	23.8%	17
JD	19%	
	4.5%	
Household Income		
Over $100,000	77%	
$75,000-$100,000	9.1%	17
$35,000 – $49,000	9.1%	
$20,000 - $34,000	4.5%	
Relationship Status		
Married	95.5%	17
Single (never married)	4.5%	

Child Picky Eating

Overall, children's average score on the Child Pickiness Scale indicated that most parents rated their child as low on picky eating (mean=2.02, SD=1.4) on a scale with responses that ranged from 1 to 5. Children with higher picky eating scores had parents who reported that they consumed broccoli less in the past week ($r=.69$, $p<.01$) and consumed Brussels sprouts less in the past week ($r=-0.42$, $p=.10$). Also, the children with higher picky eating scores had a lower liking for broccoli at pretest, however this was not significant ($r=-0.42$, $p=.09$).

Storybook & Vegetable Literacy

Children's ability to identify cauliflower, broccoli, and Brussels sprouts was measured before and after the book readings. The results showed that there were significant increases in children's ability to identify cauliflower (mean=0.41; $t=2.61$; $p\leq.05$). In addition, there were pre-post increases in children's ability to identify Brussels sprouts (0.54, $t=2.81$, $p\leq.01$). There were no significant differences in children's ability to identify broccoli. By the end of the study, every participating child (n=23) was able to name cauliflower.

Children with greater cauliflower knowledge at pre-test had a higher liking for cauliflower ($r=.48$, $p\leq.05$), a greater broccoli knowledge at pre-test ($r=.41$, $p\leq.05$), and a greater Brussels sprout knowledge at pre-test ($r=.81$, $p\leq.05$). Children with greater broccoli knowledge at the pre-test also had greater broccoli liking at pre-test ($r=.43$, $p\leq.05$).

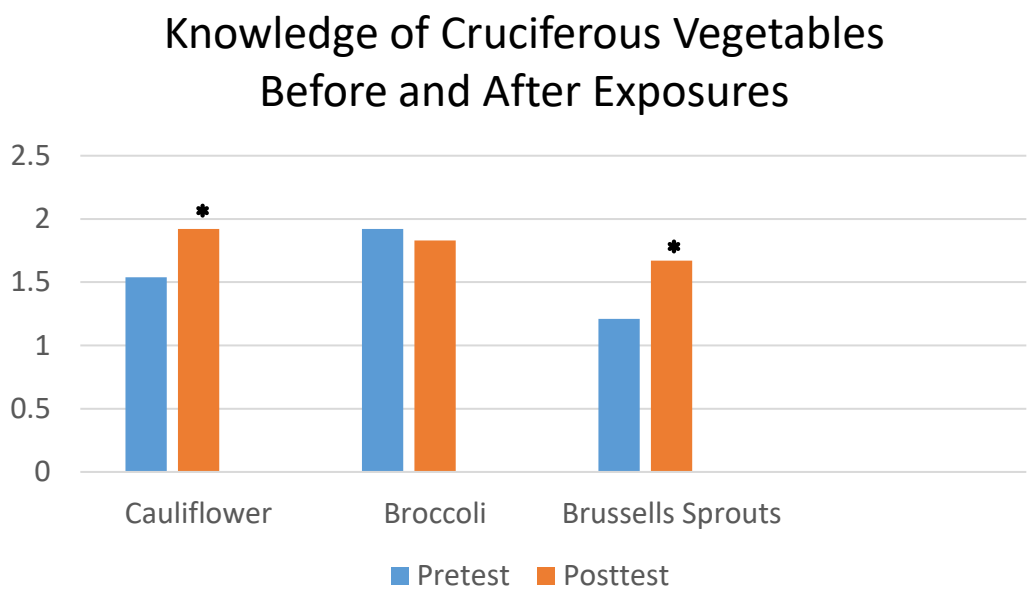


Figure 1: Average ability to identify cauliflower, broccoli, and Brussels sprouts from a set of picture flashcards during pre-assessment and post-assessment for all participants (n=24). Overall, significant increase for cauliflower, no significant change for broccoli, and an increase for Brussels sprouts. *p<.05

Storybook & Effect on Willingness to Taste

Children's willingness to taste cauliflower, broccoli, and Brussels sprouts was measured before and after the implementation of the intervention (Figures 2 and 3). Willingness to taste each of the target vegetables slightly decreased after the intervention. However, when examining the willingness to taste the exposure sampling of the prepared special cauliflower snack, over 81% of the participating children (n=24) tried the snack every exposure. The highest willingness to taste was the Cauliflower & Broccoli Veggie Patty (95.4% tasting) and lowest being Cauliflower Rice (81.8% tasting). The willingness to taste went from 81.8% (cauliflower rice) to 87.5% (rainbow cauliflower) to 95.5% (cauliflower and broccoli patty) to a final slight drop of 90.9% (cauliflower popcorn).

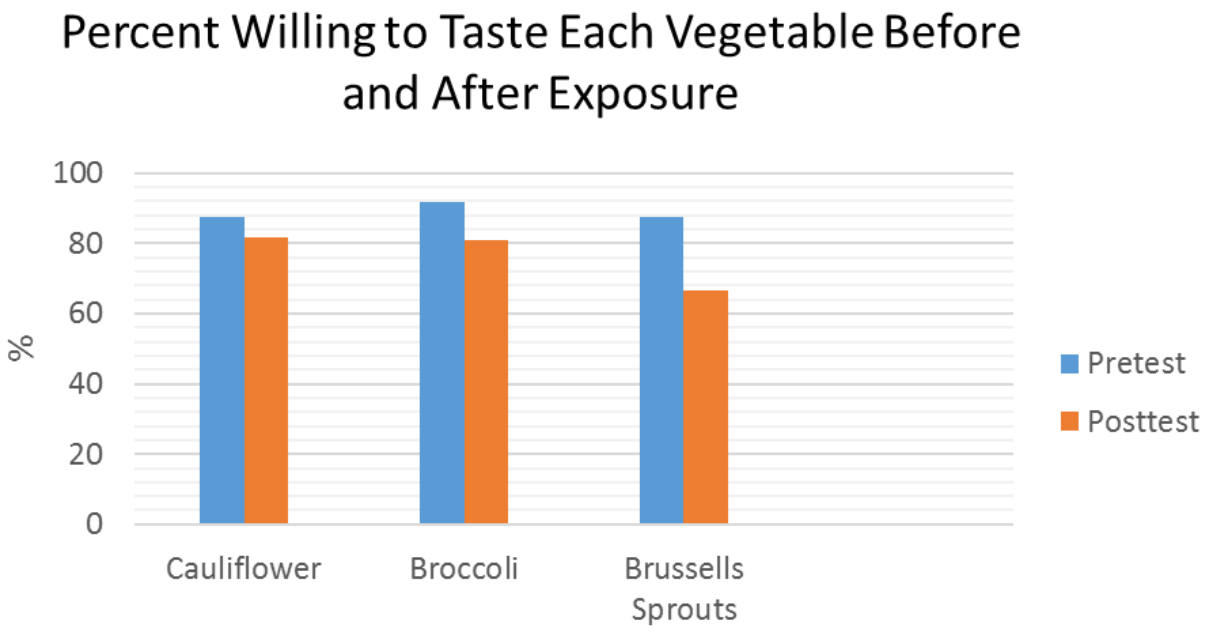


Figure 2: Percent of children willing to taste cauliflower, broccoli, and Brussels sprouts for the sample (n=24) during both pre- and post-testing. Overall, slight decrease in willingness to taste each vegetable.

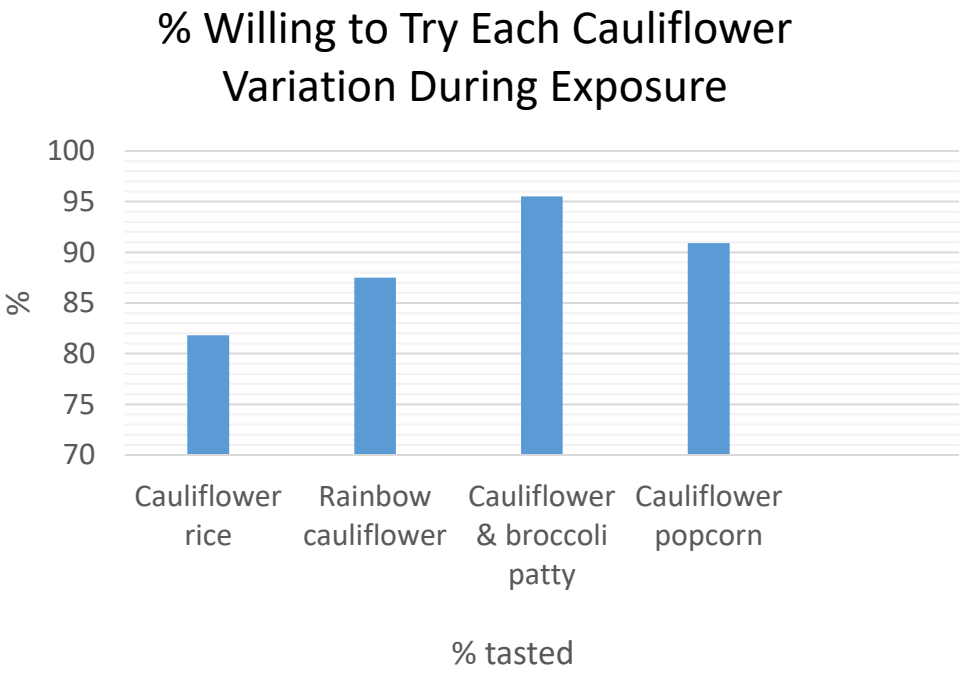


Figure 3: Average % of total participants (n=24) willing to taste the cauliflower rice, rainbow cauliflower, cauliflower & broccoli patty, and cauliflower popcorn snack variations during each in class exposure. Willingness to taste increased with each exposure until the last tasting.

Storybook & Effect on Liking

Participating children's vegetable liking before and after the implementation of the intervention were measured. The results showed that there were significant increases in cauliflower liking (0.86; t=2.90; p<.01). There were no significant increases in broccoli liking (≤0.15, t=-0.45, p=.66) and a slight increase in Brussels sprouts liking but this was not significant (0.15, t=0.55, p=.59). Children with a greater liking for cauliflower at pre-test also had a greater liking for broccoli (r=.73, p≤.05) and Brussels sprouts (r=.44, p≤.05) at pre-test.

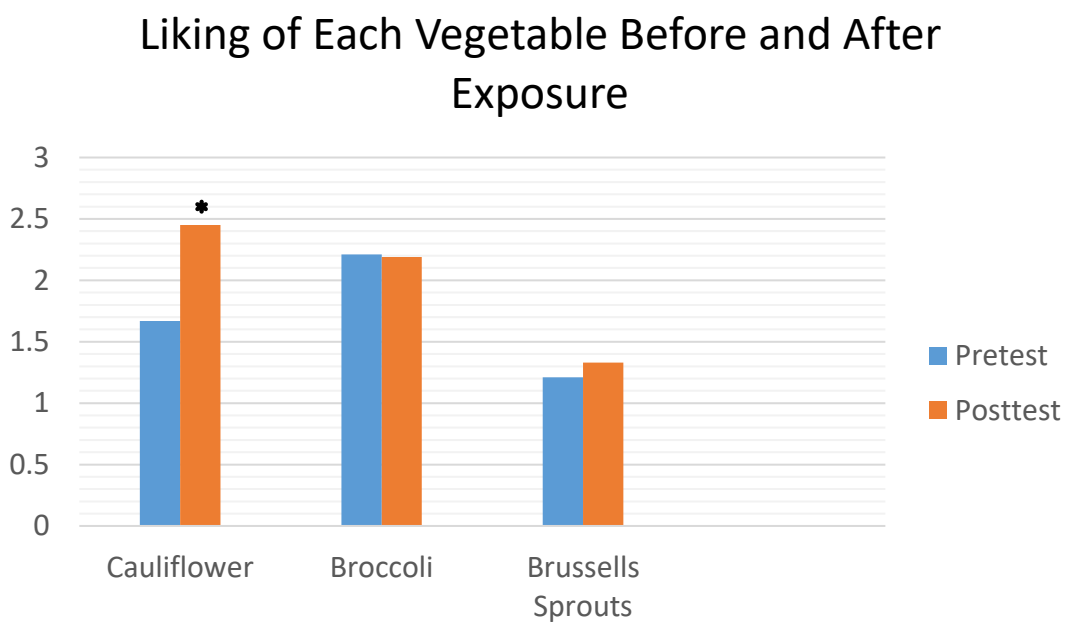


Figure 4: Average liking (3= Yum, 2 = So/So, 1 = Yuck) of each vegetable from pre- to post-testing for each participant (n=24). Liking of cauliflower significantly increased (.86; t=2.90; p<.01), broccoli remained constant, and liking of Brussels sprouts slightly increased but this change was not significant (0.15; t=.55, p=.59). *p <.05.

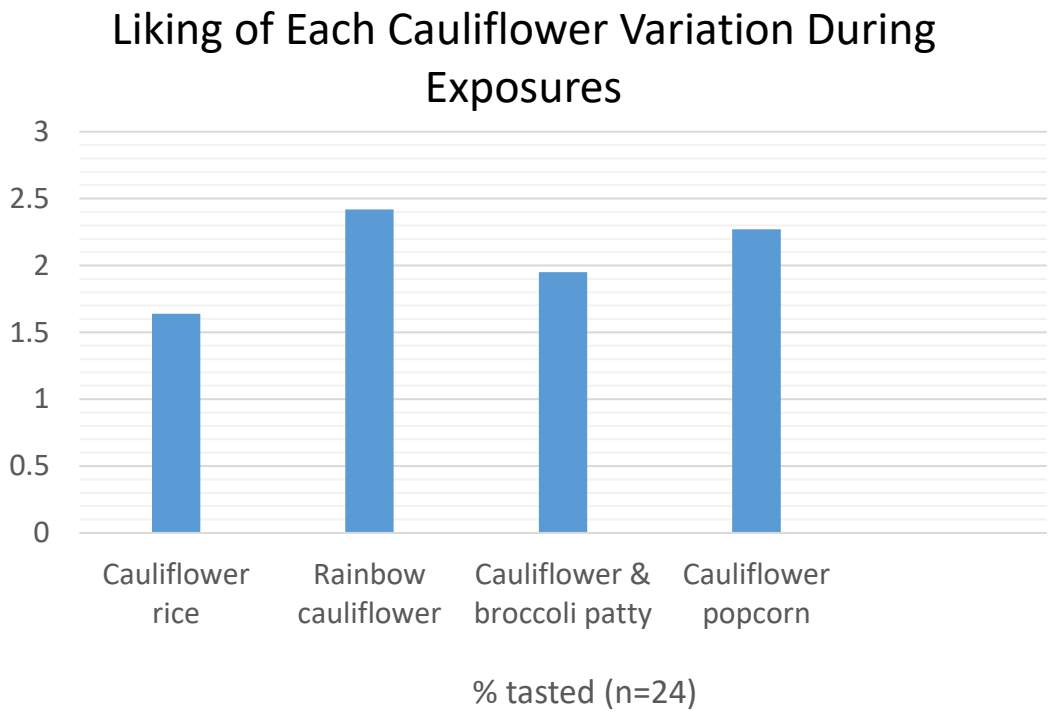


Figure 5: Average liking (3=Yum, 2=So/So, 1=Yuck) of cauliflower rice, rainbow cauliflower, cauliflower & broccoli patty, and cauliflower popcorn during in-class exposures for all participants (n=24) is shown.

Influence of Biology

As a result of the PTC test administered during the pre-assessment, out of all participants (n=24), 8 were categorized as "Tasters", possibly genetically more sensitive to some compounds in cruciferous vegetables, 15 were categorized as "Non-tasters", and 1 refused to take part in the test. Comparing the Tasters (33.3%) and Non-tasters (66.7%) at pre-test revealed that "Tasters" reported liking lower than "Non-tasters in all three cruciferous vegetables. In other words, before any of the exposures, "Tasters" reported liking the vegetables less. Comparing the different taster status liking of the vegetables at post-test revealed different results from pre-testing. After the exposures, "Tasters" actually reported liking the cruciferous vegetables higher on the scale than "Non-tasters". "Taster" reporting of liking jumped from an average of 1.35 on the 3 point scale

(3 = Yum, 2 = So/So, 1 = Yuck) to about 2.55, however these differences failed to reach significance.

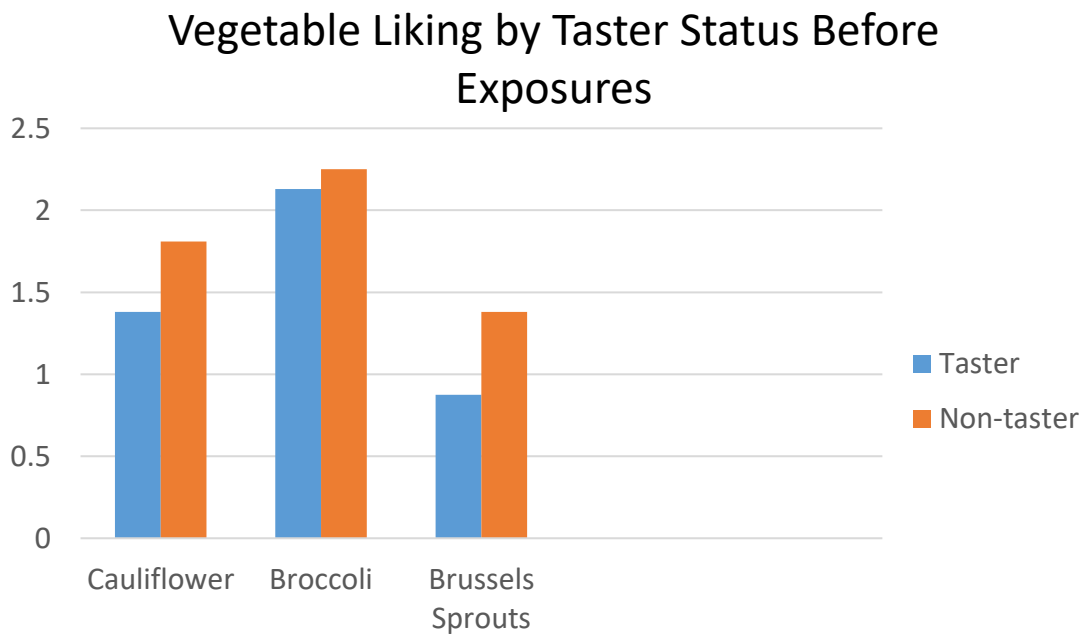


Figure 6: Average cauliflower, broccoli, and Brussels sprouts liking during pre-test by Taster or Non-taster status for all participants (n=24). Overall, liking of ALL vegetables was lower in tasters compared to non-tasters at pre-test tasting.

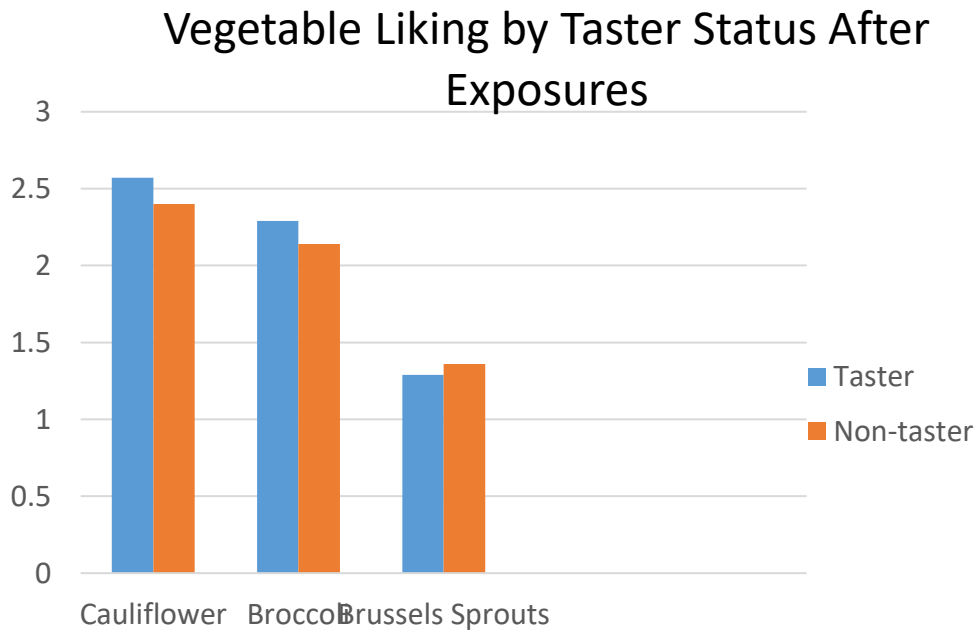


Figure 7: Average cauliflower, broccoli, and Brussels sprouts liking during post-test by Taster or Non-taster status for all participants (n=24). Overall, liking of cauliflower and broccoli was higher in tasters at post-test.

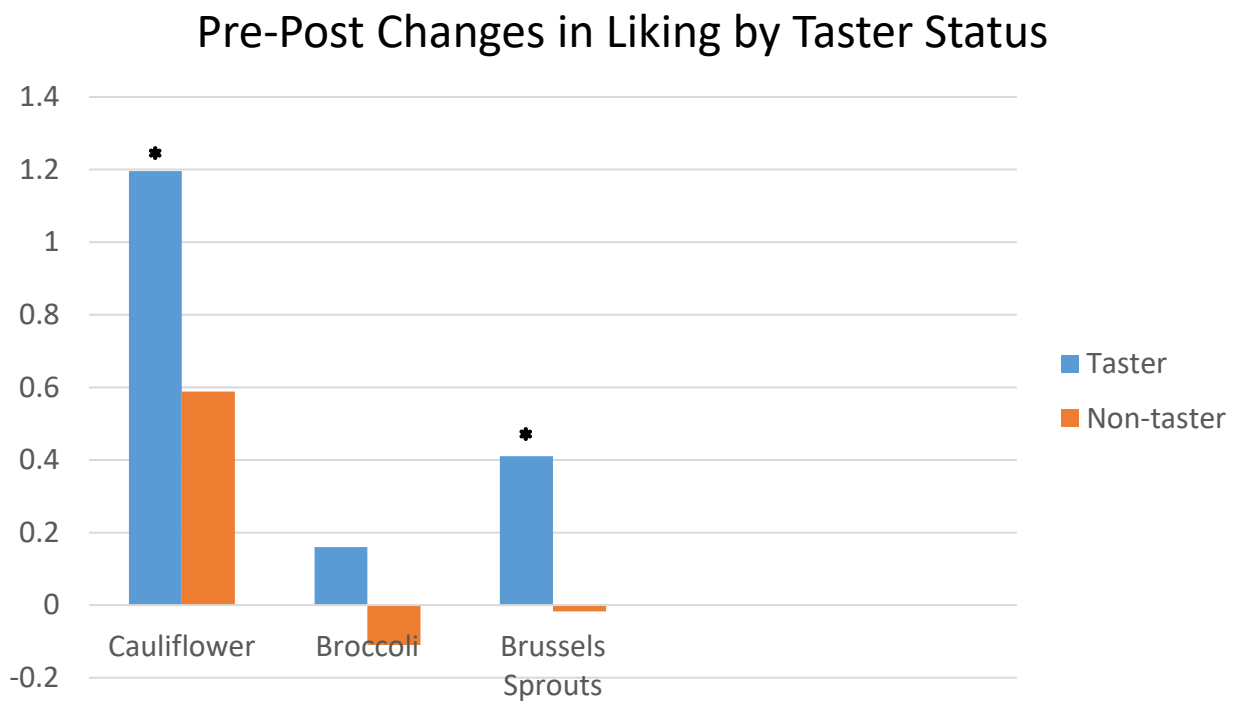


Figure 8: Changes in liking by taster status show a non-significant increase in cauliflower liking for tasters from pre- to post-testing.

Influence of Home Environment

A total of 7 out of 17 (41%) parents reported using the recipes that were sent home several times or a few times; the remaining 59% never used them. Parents reported serving their children cauliflower an average of approximately 2 times in the past week; broccoli was served an average of more than 3 in the past week. Brussels sprouts were reportedly served the least often, won an average of .5 days in the past week.

A total of 41% (n=7) of parents reported no change in their child's liking or perceptions of cauliflower over the course of the intervention. However, 29% (n=5) noticed a small increase, and 29% noticed a large increase. A majority of parents reported no changes in their child's liking or perception of broccoli (71%, n=12) or Brussels sprouts (76%, n=13), with the remainder indicating no change. A sample of general feedback from parents is presented in Table 3.

Table 3: At Home Parent Reported Feedback
My son has always liked many vegetables, but cauliflower has been a new addition. He especially likes talking about "Cauliflower Power!"
“Thanks for doing this study! What a great idea. My son really seems to like cauliflower now, where he was neutral about it before. He always liked broccoli, but he likes it more now. I shall need to try serving brussels sprouts soon too! Thank you again. Best wishes with your study.”
“I think this idea is great, for kids who don't eat many vegetables.”
My daughter has never been a picky eater and in fact, one of her favorites has always been broccoli. Within the last year or so she has really embraced cauliflower as well. Brussel sprouts have not really been of interest to her but that definitely could be because we do not eat these at home. (Both of our families never ate Brussel sprouts at meal times when we were growing up, and unfortunately the only time we tried to make them at our house, they didn't roast so well.) She really enjoyed the study and often came home and told us about what she experienced during the food study. She often times has used her "cauliflower power" to complete tasks that require energy or strength. (Running, climbing, jumping) Thank you for offering this experience to her. She loved bringing home the recipe book as well because she truly loves to cook and help in the kitchen. Although we did not use the recipe book yet, there are a number of recipes that she has chosen for us to try in the near future. Thank you!”
My daughter talked about the snacks and would tell me if she liked them. She is interested in cooking recipes from the cookbook!!
She also mentioned cauliflower power a few times! :) Thanks, this seems like interesting research!

Qualitative Assessments

Children’s behavioral observations and voicings were measured during the tasting component of the study. The researcher observed, tallied, and took note of any positive or negative reactions to the vegetable sample provided during the four different classroom tastings.

Observations of vocalizations and behaviors were recorded by hand, with a sampling of the results provided in Table 2. Simply comparing the positive and negative qualitative data across the different exposures, the number of marks in the positive behavior/vocalization boxes (21 marks) compared to the negative boxes (13 marks) show that the children were more likely to express positive exclamations when being assessed rather than negative.

Table 4: Common Behaviors and Vocalizations to In-Class Intervention Implementation

	Qualitative Data			
	Cauliflower Rice	**Rainbow Cauliflower**	**Cauliflower & Broccoli Patties**	**Cauliflower Popcorn**
Positive	**Book**: "I have a garden like that!" and "Christopher, come on try it! Just a little!" "Mmm I like rice like this"	"Wow it's so pretty! Yummo!" "I love the purple cauliflower" "Yum the orange looks cheesy"	Loved the story! Engaged the entire time "I have veggie burgers at home I love these!"	"Cauliflower popcorn just like the story! Yum!" "Yum I love cheese do you have more?
Neutral	"Hmm I don't really taste it"	"It kind of tastes just like cauliflower" "Did you use food dye for these?"	"Hmm … I don't really know about this"	Would eat a little nibble but not the whole piece (just the cheesy part)
Negative			"It's kind of stinky" "It looks a little burnt" "Why can't I have a whole patty?"	"Cauliflower again?" "This doesn't feel like popcorn"

Chapter 5
DISCUSSION

The “Cruciferous Crew” Intervention was successfully implemented in the preschool classrooms (n=24). All at-home materials were distributed, all books were read, and all intended snacks were made and distributed according to the three-week timeline. The overall hypothesis was that children who participating in the Cruciferous Crew Intervention, including the Cauliflower Power 4 Part book series, in-class provided cauliflower snack, and at-home recipes would be more likely to try and like the cruciferous vegetables provided. The results of this study did not significantly support this general hypothesis, however, the various components of the hypothesis as well as supporting hypotheses were also analyzed, resulting in several important findings that are most definitely worth discussing.

Intervention Effects

Exposures

The intervention provided the participating children with 2 tasting exposures to broccoli and Brussels sprouts, and 6 tasting exposures to cauliflower within the classroom. With the materials sent home and parents also participating, additional exposures were also provided at home. Birch et al. (1998) proposed that around **10-15 exposures** are recommended to obtain the repeated exposure effect of increasing chance of liking. However, additional research has indicated that

even less exposure events can still have a similar effect (Williams et al., 2008). In a study conducted by Anzman-Frasca et al. (2012), two experiments, between-subject and within subject, were implemented in childcare centers with forty-seven children aged 3-6 years old, comparing repeated taste exposures of vegetables not initially liked either presented just by themselves or with a liked dip. The study suggested that giving preschool children little tastings of vegetables that were initially not preferred can have significant effects on increasing child's liking as well as sustaining a child's liking and intake of those vegetables (Anzman-Frasca et al, 2012). Just **6 exposures** to the vegetable were sufficient to increase liking (Anzman-Frasca et al, 2012).

The greatest increases in liking for cauliflower and broccoli were seen in children who were identified as "Tasters" – biologically sensitive to bitter compounds – possibly influenced by the multiple environmental exposures.

Influence of Biology

Examining the initial liking of cauliflower, broccoli, and Brussels sprouts used in the pre-assessment prior to the Intervention reveals that Tasters (n=8) were less likely to report liking all three of the cruciferous vegetables than the Non-tasters (n=15). This supports the literature that proposes tasters of the bitter thiourea compounds of 6-n-propylthiouracil (PROP) and/or phenylthiocarbamide (PTC) may be more sensitive to bitter cruciferous vegetables, contributing a genetic role in the acceptance of these vegetables (Keller et al., 2001). When Keller et al. (2002) examined this in sixty-seven 4-5 year-old preschool children, there were significant differences in raw broccoli consumption between Tasters and Non-Tasters, showing a lower acceptance of the cruciferous vegetables used in testing in general. The Cruciferous Crew study followed a similar trend.

A child's food liking, however, is not purely genetic and with repeated exposures and a supportive environment, children may develop liking for vegetables originally rejected (Johnson, 2016). Substantial findings from the results of the Cruciferous Crew study show this crucial gene-environment interaction that contributes greatly to childhood development of food liking. After the Cruciferous Crew Intervention exposures were complete, the post-assessment cruciferous vegetable liking results revealed that "Tasters" actually reported liking the cruciferous vegetables more than "Non-tasters". Just to emphasize the findings, prior to the study "Tasters", with the genetic predisposition to reject bitter compounds in cruciferous vegetables, reported liking cauliflower **less** than "Non-tasters". After the study, "Tasters" reported liking the cruciferous vegetables **more** than "Non-tasters".

The Potential for Storybooks to Increase Children's Vegetable Liking

Bellows (2013) designed the *Food Friends* Program around the storybook prototype that tells the story of two preschool children, Zack and Zoe, who have the adventure of tasting new foods with appealing Food Friends characters. The storybooks were read to the children by their teachers. These books were also taken home by the parents of preschool-aged children where included with the story was a Parent Information Page, recipe ideas, and fun activities. By acknowledging the interactive relationship between the home and school as well as the impactful nature of a storybook in both of these environments, the study created key insight into the effectiveness of offering the opportunity for new information to be enforced across the preschooler's environments (Bellows, 2013).

Byrne (2002) investigated the influential power of references to unknown vegetables in a preschool-aged focused storybook on the child's perceptions and behavior towards the vegetable. Nine classes of 3-5 year old children were randomly assigned to read a book with a negative message or a

positive message around the target vegetable. The unfamiliar vegetable used in this study was *kohlrabi* – none of the children were familiar with this vegetable prior to the test. The positive story had the little boy character discover kohlrabi in his grandfather's garden where he ended up expressing messages that he loved it. In the negative message story, the character strongly disliked kohlrabi, stating, "At least I didn't have to eat kohlrabi!" In the posttests to follow, the children from all classrooms had the chance to taste kohlrabi and express their knowledge and perception of the vegetable. The children who were exposed to the positive message were significantly more likely to taste kohlrabi (Byrne, 2002).

Similarly, Simone M. de Droog (2013) compared a control group of pre-school children who was *not* exposed to the storybook and an experimental group who *were* read the story on their likelihood of tasting the promoted vegetable – carrots. De Droog (2013) then examined two modes of storybook elements – *interactive shared reading* and *character-product congruence* in the effectiveness of the vegetable promotion. De Droog emphasizes that influencing a child's healthy food preferences and consumption via a storybook or picture book is effective due to *Entertainment Education* (EE). The two characteristics, *educational message* and *entertaining narrative*, make storybooks an effective means of nutrition education and changed behavior in *preschool aged children specifically* (de Droog, 2013). The results showed that exposure to positive carrot-promoting storybooks did increase the preschool child's consumption of carrots. Secondly, interactive reading enhanced the influence, showing that shared reading between parents, teachers, and preschool children is has an impact. With an estimated 10-15 exposures necessary to increase a child's liking of a vegetable, if children wish to read the story promoting the vegetable over and over and these readings are followed by a snack with this vegetable, then long-term effects may occur (Birch & Marlin, 1982, de Droog, 2013Ys).

Visual exposure affects the young child's willingness to taste a certain fruit or vegetable. By reading two books about four foods, two familiar and two unfamiliar fruits and vegetables, followed by

a “taste test”, neophobia, defined as a reluctance to try new, unfamiliar foods, was reduced. Visual exposure manipulation through storybook reading decreased the children’s natural aversion towards unfamiliar foods and even reversed in the case of fruit. If constant taste exposure is not plausible, initial repeated visual exposure through storybooks may be used to introduce unfamiliar and initially undesired fruits and vegetables into a child’s diet. (Houston-Price, 2009).

Houston-Price’s earlier research finding set the basis that toddlers who are repeatedly exposed to novel fruit and vegetable pictures within a picture book or storybook learned to give these now familiar foods more attention (2010) and less reluctant to taste (2009). To seek out additional support for these findings and extend Houston-Price’s research, Osborne et al (2012) had a similar hypothesis that exposure to a variety of healthful foods would increase a preschool child’s consumption of the exposed foods. However, to expand upon this further, Osborne et al (2012) specifically examined whether exposure to books that depicted healthy foods and information about healthy eating would increase the child’s overall reception of these foods. Fifty mothers and sixty-four 4 to 8-year-old children volunteered to participate in a 10-day experiment using a 2 x 2 between subject design. There were four groups – Group F (food exposure only), Group B (book exposure only), Group F-B (food and book exposure), and Group C (control). Four fruits and vegetables were given to Group F and Group B-F to feed the children on Days 2 – 8. Groups B and F-B were given two books, Eat Healthy, Feel Great (Sears, 2002) and Eating the Alphabet (Ehlert, 1996). All child participants on Day 1 were given a “buffet” of apple, banana, orange, broccoli, baby carrots, and red pepper where they could eat as much as they wished; this same scenario was presented Day 10. Additional items, which the parent indicated as rarely eaten, were presented on day 10.

During the 8-day testing period, parents who received books read one to their child each day and those who were given food presented one of the fruit or vegetables when the child was hungry. The

statistical analysis of each child's consumption of the buffet and home exposure food was found by finding the difference between pre- and post-weight and then converting that into calories. Those who received books showed an increase in fruit consumption and were more willing to try the novel fruit on Day 10. Osborne et al concluded that either exposure to a variety of fruits and vegetables or nutrition information in storybooks increased the children's acceptance of common fruits (2012). The children who received the books were also more likely to try a novel fruit than those who did not receive any nutrition information exposure, but only marginally. The results supported the findings of Houston-Price et al. (2009, 2010). Although there was an increase in fruit acceptance, the likelihood to accept vegetables did not have any significant results; a possible explanation is the comparison of being presented next to more palatable, sweet fruits as opposed to previous research that examined just vegetables alone. Further investigation is needed to investigate if these results are confirmed to only occur with fruit, or whether exposure to familiar and unfamiliar vegetables through informative stories and taste exposure also leads to an increase in acceptance when faced with more appealing options. How can one increase a preschool child's acceptance of vegetables that have a negative connotation, when faced with more palatable food options? Is exposure an effective means? (Osborne, 2012).

A recent intervention conducted by Houston-Price (2014), builds upon past research findings on picture's positive effect on young children's willingness and acceptance to try previously unknown fruits (Houston, 2009). The Let's Look at Leeks! Intervention investigated two experiments – Experiment 1 examined visual preferences of exposed foods vs. non-exposed foods through books and Experiment 2 focused on a child's initial experience with unknown foods effects willingness to try. The sample of 154 toddlers was recruited through the parents in the University of Readings' Child Development Group database, making the sample

predominantly white (87%) and highly educated (76% at least one parent graduate level education). Bias may exist due to the low poverty rate in the study's sample.

Children were randomized to one of five initial groups: Liked Vegetable, Disliked Vegetable, Unfamiliar Vegetable, Liked Fruit, Unfamiliar Fruit. If the parent suggested that the child's liking or familiarity matched the expected feelings towards the particular group's food two times, each of those two foods were then used as the target food or control food. A picture book was created specifically for each fruit and vegetable where seven pages of big, colorful pictures and simple text describe the progression of the fruit or vegetable from where it is grown to how it is presented eating. Each parent read the book with the child about 5 minutes each day for 14 days. After the 14 days of exposure to the book were complete, a visual preference test was conducted through presenting of series of trials of pictures shown on a big projector screen. Two pictures were shown side by side; one picture was a target food exposed to the child in the book and the other was a control food (but still known to the child from the initial parental-given status). Additionally, half the children were assigned to see the exact pictures from the book and half were subject to "new" pictures. Two researchers blind to the conditions measured visual preference as the difference between the time that the child spent staring at the target picture and the control.

Houston-Price (2014) first confirmed the finding that picture books increased exposure based on the results that showed that visual preference for the foods seen increased. No matter what the initial status of the food, liked, disliked, unfamiliar, fruit, vegetable, the data showed that the exposure to the picture book enhanced visual attention to and preference for the exposed foods, relative to the controls. The effect was strongest for initially unfamiliar foods that were then exposed in the book and when the visual test used the same pictures as the book presented.

However, not as strong, positive exposure effects were also found for children that were presented with pictures they were not exposed to (of the target foods), which may propose that the book had targeted curiosity in the food as a whole, not just the picture (Houston-Price, 2014).

Experiment 2 again distributed vegetable picture books to each participating family to be read consecutively for 14 days, where they then returned to the lab for a taste test of target vegetables and control vegetables. Two vegetables were presented from the parental report as one liked and one disliked, and two vegetables were from the book exposure period, one target vegetable and one control. There was no main effect of exposure or initial status in association with the likelihood of a child tasting the vegetables offered. This supported previous research where there was only a positive effect of exposure on frequency of tasting for fruits, but not for vegetables (Houston-Price, 2009). The children were more likely to eat the target vegetables exposed to in the book than the control vegetables, regardless of the initial status of the vegetable. Unlike the negative effects of exposure to vegetables found by Houston-Price in 2009, measures showed only positive effects. Similar findings were supported that unfamiliar foods initially to the child had the most positive effects (Houston-Price, 2009, 2014). Future studies would benefit from including a control group that did not receive the book. Additionally, a more representative sample is needed in order to generalize the results to low-income children.

The Let's Look at Leeks! Intervention relied heavily on "*mere exposure*" effects where visual stimuli relies on "perceptual fluency", increasing positive attitudes due to the ease of the perceptual systems process stimuli that has been seen before. According to this proposal, Houston-Price's research in both 2009 and again confirmed in 2014 proposes that use of storybooks as a means of exposure, rather than repeatedly giving the child the food to taste try, may lessen the difficulty associated with getting young children to try and like new vegetables.

However, another possibility of the influence of use of picture books specifically is the ideas of "learned safety" first proposed by Kalat and Rozin in 1973. This is the idea that through trying a food multiple times, a child is internally accepting the food as safe to eat, or in the case of story books, multiple exposures without negative consequences means the stimulus is also safe to accept. Another basis for seen results may be mere schema development. By having a loved one read the picture book with positive phrases associated with vegetables, children who had no previous familiarity, no previous schemas, have the opportunity to then build new or modify schemas to be positive towards the food being presented.

Parental influence cannot be disregarded in the Let's Look at Leeks! Intervention as well as previous studies that infiltrated into the home and family environment. In Houston-Price's research (2009, 2014), the parents were heavily involved in the intervention as the sole deliverers of exposure through reading the story as well as encouragement for the children to taste the foods. The effects are not limited to the influence parents have, but also the effect the intervention may have on the parents directly. For example, by reading the book to their child, the parent may be influenced to purchase the vegetables in the book for the home or even adopt the habits themselves. This is a prime example of the key interaction between school and home in the learning process of developing food preferences in young children.

Home Food Environment

The home, in the context of childhood obesity and dietary behaviors, can be seen as a space where the intersection of multiple domains – environmental, sociocultural, political/economic, micro-level, to macro-level environments – form a major setting for shaping young children's determinants for

development of obesity. The home brings together foundational aspects contributing to how a child grows, develops, feels, acts, and eats (Rosenkranz, 2008). Many eating behaviors in very young children preschool aged are rooted in the home. At this age, much of the children's *initial* influences on food choice and food preference occur in and around the home food environment (Couch, 2014).

The home is the first food environment in a young child's life. The physical aspects of the home food environment (availability of healthful food in the house/neighborhood, SES, etc.), sociocultural home food environment (culture, family rules/parent feeding techniques), and family modeling characteristics all are associated with a child's dietary quality and/or weight status (Couch, 2014).

Observational Learning

Eating and mealtimes are social contexts, creating an environment full of constant opportunity for children to observe and learn from the behaviors of those around them. Observational learning, also known as modeling, can have positive or negative effects on a child's food intake depending on the behavior of those in the surroundings. Adult parental models are effective at increasing the likelihood of a child to try a novel food. Peers are also extremely effective models, even more effective than adult models as children are even more likely to alter behavior to align with that of models similar to themselves (Birch & Anzman, 2010). These three paradigms, familiarization, associative learning, and observational learning greatly influence children's learning of food preference.

Preschool – Learning Life Skills such as Eating

During preschool years, behavior affected by what is learned from the social and physical environment may not be evidence in a laboratory setting and may not even immediately be reflected in their weight. However, as a child grows older and gains independence in making food choices, these previously learned and now foundational behaviors may be acted upon and therefore affect the child's weight as a result (Johannsen, 2006). Early life learning both in the home and at school create the basis for behavior both during young childhood, but also as the child gains more independent choice on food intake and preference, and throughout a lifetime. Behaviors are being learned from the time children are introduced to foods. This learning continues as more and more foods are introduced throughout the lifetime, but the foundational perceptions of foods may be formed very early in childhood.

Johnson articulated that there needs to be a shift away from the worsening dietary intake patterns and resulting life-long chronic diseases with the incorporation of research related to very young children's development of food liking and consumption (2016). This is where the root of the overwhelming epidemics of obesity and related chronic diseases stem from. If research works to study the influencing factors that determine preschool-aged children's intake of vegetables and healthful diets, then we will be able to not only have healthier young children but also healthier people as a whole. These years are a "sensitive period" or a crucial time for development for young children. Their brains are going at full speed for sensory, motor, and experimental learning on so many different levels. These developments and the experimental behaviors that come with those learning processes are influenced by so many different environmental factors. Preschool-years are key times of hopefully healthful development, so working within these malleable moments to better the health of the child can lead to a basis of growth for a healthy lifetime (Johnson, 2016).

Developing Healthy Habits in Preschool Years

Currently, in the United States 25-30%, that's over ¼ young pre-school aged children do not consume a single vegetable a day and the vegetables that are eaten by 3-4 year olds often are not the green leafy or the cruciferous vegetables that would provide them with necessary sources of micronutrients for healthy lifelong development (Johnson, 2016). During the preschool years, between the age of 3 and 5, children are being introduced to more and more foods, moving towards foods seen in "adult" diet. This expansion of exposure to new foods creates key early experiences with foods. WHO recently highlighted the years 3 – 5, preschool years, to be a critical period for obesity prevention, with the preschool environment being the optimal, most successful setting for obesity-prevention interventions. Early childhood interactions with food can provide important life trajectory of weight and overall health in the future.

Habit Formation

Efforts to create healthy habits for a lifetime of healthy eating must begin early in life. Skinner et al (2002) conducted a longitudinal study that identified in a Food Preference Questionnaire children's food liking at 2 years, 3 years, 4 years, and 8 years old. The study showed that the liked foods (especially vegetables) did not change very much during the 6 year study within each child participant. The study determined that the strongest predictors to the number of foods liked and the types of foods like at the 8 year old data point was in fact the foods that the participant liked at 2, 3, and 4 years old. And at these younger age points, the parent questionnaires marked a higher likelihood for their young preschool aged child to try a new food, much higher than the 8 year old mark. This study really highlights the

importance of exposing young preschool aged children to new foods, especially vegetables, as this is the key period of healthy habit formation for the years to come (Skinner, 2002).

Preschool years are crucial for development of nutritional knowledge due to the formulation of familiarity and routine. Habits that are formed during a child's early years are often carried on throughout life. Children are accumulating experiences with foods and along the way formulating "norms" for daily dietary intake. As more and more foods are incorporated into a child's experience, certain foods are seen as preferred or not preferred – liked or not liked. The child then, when given the choice, will stick to what is familiar and liked.

Early Prevention Rather Than Treatment

Starting eating behaviors healthy for the body earlier, will put children ahead for life-long health benefits. Starting on the right foot will jump-start prevention of serious health concerns normally associated with later in life (i.e. obesity, diabetes, etc.) (Cooke, 2003). Prevention is significantly easier than treatment of chronic conditions, such as obesity (Pandita, 2016). Obesity's onset is creeping up earlier and earlier in life, making it imperative to stop this onset earlier in a child's life, preventing it from even taking hold on a child's health. Pandita (2016) suggests that the management of obesity through prevention techniques in young children will have a more sustainable, long-term effect on the obesity epidemic of today.

Research Limitations

Due to the small sample size (n-24), the results cannot be generalized to most preschool children. The small sample size did not permit examination of the results by age, sex, or other demographic variables. In addition, the study sample was fairly homogenous. Given that the convenience sample recruited from a childcare at a large university in Central Pennsylvania, the sample was predominantly non-Hispanic, white, highly educated and middle to high income. These factors limit the ability to generalize findings to other populations.

Due to time, space, and budget constraints, broccoli and Brussels sprouts were not offered as a tasting each week. This may have resulted in less clear changes in children's liking for those particular vegetables, despite being featured in the story. The story focused on cauliflower as the main characters, with broccoli and Brussels sprouts also featured and well-received vegetables, which may have contributed to more predominant effects in cauliflower rather than the other vegetables. It is still promising to note that even just with just the storybook exposures and not the weekly tasting exposures of broccoli and Brussels sprouts, broccoli liking changed pre-post. In addition, children's exact quantity of intake of target vegetables was not measured, just willing to taste and liking. It is possible that more meaningful findings would have emerged if intake was measured.

Factors restricted the liking status to be recorded after leaving the preschool. As mentioned, the liking status was marked following the classroom visit as the cups with the ID number written on the bottom were kept in the buckets. One possible limitation of this method is in transport of the buckets, risking the possible mix up of which bucket (Yum, So/So, Yuck, or did not try) the child would be marked down as reporting as their liking status.

The shortening of the education component was a limiting factor for the Intervention as a whole, however, was not as detrimental due to the high level of knowledge of cruciferous vegetables in study's particular population. With the exposure fitting into a 15-to-20 minute block, the created curriculum was converted to brief "mini-lessons" in the form of conversation. Although the children all did perform well on the knowledge component of the post-assessment, additional education on the growing, cooking, health-benefits, etc. of the cruciferous vegetables may have been beneficial in overall investment and interest in the vegetables and the resulting possible effects on the consumption and liking.

Again due to time constraints, the post-test was squeezed into the last day of the exposure, possibly effecting the post-test results. Following the reading of the last storybook, the children were given the last cauliflower exposure snack for that day and immediately following that taste of cauliflower the same child was presented with the cauliflower, broccoli, and Brussels sprouts used for the post-testing. Many of the children expressed, "More cauliflower? I just ate cauliflower" or would run off to play thinking they were done, not wanting to come back and try the post-test vegetables. Also, some children refused to taste the cauliflower, broccoli, and Brussels sprouts for this post-test sample because they either said "I just liked that cauliflower so I already know that I like it I don't need to try it again" or "I already know I don't like those so I don't want to try them again".

Suggestions for Future Studies

Future research in this field would benefit from a control group, a sample of participants that were not given the "Cruciferous Crew" Intervention (book series, recipes and information sent home, etc.) but given the opportunities to taste the exposure cauliflower snack. Comparing the willingness to taste and the liking of the same exposure samples in both the treatment group and the control could would better show the specific effect of "Cruciferous Crew" Intervention.

Implementing all of the components of the "Cruciferous Crew" Intervention over a longer period of time may provide more information about long-term changes. Although Anzman-Frasca et al. (2012) suggested that just 6 exposures to the vegetable was sufficient to increase liking, Birch et al. (1998) proposes around 10-15 for definite change. Increasing the number of exposures over a longer period of time to around 10-15 may have a greater likelihood of influencing the children who continued to not like or refuse to try the cauliflower throughout the study (Birch et al., 1998).

As mentioned previously, low income or underserved preschool centers would likely benefit from the incorporation of the interactive books, informative lessons, and various tastings. Future studies may find more significant results when working with children who are less likely to otherwise have access to cruciferous vegetables in school or at home (Kamphuis et al., 2006). The study design and materials will work well within schools where exposures may not be otherwise present.

In relation to study design, future studies will likely greatly benefit from having a research team to help with the complications involved with implementing the intervention at the same time as data collection. Also, securing access to a school kitchen would make for easier transport and maintenance of

the snacks at an appropriate temperature. Also related to design, the liking buckets were effective in this population, however, the children rarely knew when to put their sample into the “So/So”, the just ok, bucket. Elimination of this bucket may be ok with certain populations or further explanation of what that bucket means may be beneficial for future studies. Lastly, BMI or weight status measurements could be gathered to derive conclusions in relation to the suggested association between BMI and eating behaviors (in particular vegetable consumption).

Chapter 6

CONCLUSIONS

Study Implications

Success of the "Cruciferous Crew" Intervention showed support for the theory that young children's vegetable consumption is largely influenced by two main environmental influences at this time in the child's life – preschool and home. Although 8 children were classified as "Tasters" and were not technically genetically supposed to like the taste of the compounds in cruciferous vegetables, many ended up liking the cauliflower by the end of the study, showing that biology is not the only factor. Vegetable liking and food preference in general is greatly influenced by biological as well as environmental factors and can be influenced by repeated exposure.

The preschool-age population (3-5 years old) population was key to this particular study. Around the age of 2-5 years old, children are starting to be able to make their own decisions on foods to eat, solidifying their food preferences as well as daily eating patterns (Skinner, 2002). With the intervention involving participants undergoing this developmental process of eating habits, possible increased liking of cruciferous vegetables may lead to liking extending throughout childhood and on to a lifelong pattern of eating more vegetables than previously (Johnson, 2016). With vegetables as a main factor in a nutrient-dense diet that supports healthy weight maintenance and overall wellbeing, the study creates an avenue towards obesity prevention.

Conclusions

The rising rates of youth obesity across the globe, and specifically in relation to this study rural areas of Pennsylvania, pose for particular concern and necessary attention in the eyes of public health experts and individuals alike. With youth obesity often leading to a lifestyle that extends the weight status and resulting life-long health complications throughout the lifespan, prevention is often the preferred method of decreasing the overtaking of the epidemic. Interventions that are specifically implemented as a means of prevention have the potential for significant changes in the overall health of our nation, our world, and our future generations. With preschool years as pivotal for learning, development, influence of elders/peers, and growth, prevention interventions during these crucial years may influence the resulting formation of vegetable consumption and resulting healthy habits in years to come.

The overall goal of the "Cruciferous Crew" study was to not only improve the immediate cruciferous vegetable consumption in the participating children but also to influence the development of a willingness to eat and possible liking of the cruciferous vegetables into the future.

Lessons Learned from the Field

Creating an Original Study – IRB Approval

Creating an original study required the constant communication with and approval of the Institutional Review Board (IRB), which, when trying to complete a project within the year,

posed halts along the way. With the unknown of when first approval or modifications will be approved and the inability to recruit or continue on without approval, the process took longer than anticipated. Modification approval became necessary as things constantly changed with the preschool, undergraduate research assistants, lesson plan lengths, etc.; when working with so many different groups of individuals, things are bound to constantly change, and with changes come further need for approval.

Working with Parents

With the release of the consent forms, one parent posed concern that his son had advanced knowledge on cauliflower and vegetables and may not be challenged enough by the Cruciferous Crew Intervention. He described his family, and many of the families in the classroom, grow cauliflower and broccoli and Brussels sprouts in gardens at home, snacking and grazing on these vegetables quite often. This posed the immediate hesitation the population was not like the previous preschools used as the basis for the needs assessment and that the whole design was not appropriate. Despite the initial concern of the parents, each child seemed to find value and fun in the study and loved to share what they knew about the vegetables growing in their garden – just like the character, Christopher, in the story!

Conducting a Research Study in a Preschool

The childcare center I worked with is strongly affiliated with the university, and provides exceptional learning and care for 170 children ages 6 weeks to 5 years. As with any school or

daycare setting, especially when working with very young children, outsider access is often strongly regulated and limited. FBI Fingerprint Clearance, Child Abuse Clearance, TB Test, and Physical examination documentation are required prior to entering the building. The Principal Investigator was cleared early on, however, the fellow undergraduate students that were supposed to be assisting were held up in this process. This is covered in a later section, but basically it entirely prohibited access in the preschool entirely.

Structure and a schedule gives the 3-5 year olds a sense of self-efficacy and control as they know what is supposed to happen and in which order each day. Although much time is allotted for free-play, a huge opportunity for development and growth, the schedule is very much so a schedule. A problem faced when trying to incorporate the study into the preschool was squeezing it into the firmly set schedule. The initial intention was to have a twenty minutes to do the lesson, reading of the story, and possible assistance of cooking the snack, however, the children's schedule did not cater to this big of a chunk of time in the day. A few minutes during the transition from naptime to snack-time were allotted for story-time and the snack sample was fit to coincide with the children's provided snack.

Absences led to multiple pieces of missing data during each exposure measure. Possibly due to the snowy winter weather, winter-related illnesses, or inability to get to pre-school due to weather-related barriers, attendance was impacted daily. Additionally, with the intervention taking place around 3:15 pm, children who got picked up early often left prior to the tasting component of the study. With the sample size very small to begin with, absences and early pick-up largely impacted the potential for significant results.

As previous mentioned in the Methods section, access to the preschool kitchen for cooking the snack was prohibited due to how busy the kitchen operation was during the time of

the classroom visits. After much confusion and miscommunication as to whether the kitchen could be used or not, access was prohibited and the food had to be safely transported to the location. Without the use of the kitchen, the children were unable to assist with the preparation of the snack. This could be coordinated in future studies to provide the added component of having the children feel involved in the preparation of the snack, a key aspect to control over the food they consume.

Working with a Team of Undergraduates

The study was initially designed to take place in three of the preschool classrooms at the childcare center, with a team of undergraduate research assistants in the Healthy Bodies Project under Dr. Lori Francis assisting. Each classroom was projected to have 2-3 researchers to assist with running the study – reading the story, organizing and distributing the snack, collecting data and writing observations, cleanup, etc. As previously mentioned, the students were required to have necessary clearances to participate, which were filed for prior to the study. Due to unknown backups, the FBI clearances were not approved for over three months, prohibiting their participation. All jobs that were initially projected to be shared among the team were to be completed by the Principle Investigator only.

Working with Food and Young Children

Handling food served to young children within the walls of an established childcare center posed problems with allergies and approved foods to be served. Recipes had to be

approved prior to being served and allergies were to be marked to make sure that everything provided to the children fit into the childcare center's requirements. Allergies are a main concern when serving young children who may not have had access to the particular food at this point in their lives. Precautions were exercised, ServSafe methods were implemented, and in case of emergency, protocol was discussed.

Lessons Learned Overview:

Throughout the process of creating an original research study, each step lent itself to multiple obstacles and ensuing lessons learned. With the incorporation of each moving part into the study, problem solving was required to learn how to best integrate and align the components that make up that institution, population, field of work, etc. This study faced challenges in the sheer fact that it tackled gaining approval from the IRB, working with very young children, engaging parents and parent participation, fitting into the workings of a structured preschool institution, and cooking/handling/providing food to young children in such a short period of time. Working through the barriers enhanced the richness of the study. The lessons learned in this type of research show that this work is not easily accessible or straightforward, making it more important to learn from the problems faced and how to work through them more effectively in the future. The complications present in this particular study are most definitely surmountable and future research on this topic is both feasible for the research team and likely to be a very rewarding, fun, and well-accepted experience for the participants.

The pure passion to do everything and anything to give these kids positive energy and enthusiasm around vegetables was the drive that made it all come together to work out. It really is a wonderful thought that maybe real little lives were changed in the implementation of this study. The days of the visits the children directly ate more vegetables, which is magnificent in itself, but maybe they will continue to try and create a pattern of liking all sprouted from the *Cauliflower Power* book series or the intervention as a whole. If a child now thinks of Caroline the Cauliflower Tree or Briana the Brussels Sprout when the vegetables are scooped onto their plate, and just maybe even shouts out with a ***smile*** and a chomp "Cauliflower Power!" everything else is nominal. That right there is why the study was created and that right there is the inspiration to continue to make smiles in the presence of vegetables.

Appendix A

Intervention Materials

Lesson 1: Introduction to Cauliflower Lesson

Date: _____ **Classroom Number:** _____ **Researchers:** _____ **Time:** _____

GETTING YOURSELF READY			
Materials: - Head of cauliflower (to eat) - Head of cauliflower in half/pieces (to show the kids and have them feel) - Printed out picture of Carl the Cauliflower - Printed out pictures of cauliflower growing (multiple stages) - Cutting board, knife, sample cups, preference trays/boxes, disinfectant wipes, aprons, gloves - Book Ch. 1! (printed out prompting questions if desired)	**Your Preparation**: - Have most of the cauliflower cut up (but a little bit left to show the kids the process of cutting it into smaller pieces) - Print pictures - Read the chapter and have questions to ask ready - Set up supplies and prep station before starting - Set up where data will be collected (preference and consumption)	**Overview:** 1. Hello & reminder of who we are and what the research is 2. Lesson Intro to cauliflower (what it is, where it grows, the parts of the cauliflower) 3. First Chapter of Christopher Book – Christopher Crunches on Cauliflower! (Further emphasize what cauliflower is, where it grows, how to cook it, and that Christopher might not like it the first time he tried it!) 4. Explain Taste-Testing Procedure 5. Taste-Test #1 6. Cleanup and Goodbye!	**Agenda (w/times)**: 1. Hello (3 minutes) 2. Lesson (5 minutes) 3. First Chapter (8 minutes) 4. Explain Taste-Testing Procedure/demo behavior (3 minutes) 5. Taste-Test and data collection (8 minutes) 6. Cleanup/goodbye (2 minutes) Total = 30 minutes (+)
GETTING YOUR STUDENTS READY			
Introduction: Hi everybody! My name is Ms. Anna and this is _____ and we are here from Penn State to read a little story and have a little snack today. Are you guys excited? Awesome!			
Location: On the story-time rug!			
BUILDING THE SKILL (SAY, SEE, DO)			
Step 1: **Carl**	**SAY** – "Hello everybody! Let me introduce myself! My name is Carl. I am a vegetable that is white and crunchy… does anybody know what I am?" …."Great a cauliflower!" **SEE** – Show picture of Carl the Cauliflower  **DO** – Have everybody say cauliflower together!		
Step 2: **Cruciferous family**	**SAY** – "Other vegetables in my family, the cruciferous family, are broccoli, cabbage, brussel sprouts, and so many more! Has anyone ever had broccoli? How about brussel sprouts? Great!" **SEE** – Picture of Cruciferous Crew **DO** – Have everybody to try to say cruciferous crew. Ask – "What letter do you think Cruciferous Crew starts with?"		

Step 3: **Parts of Cauliflower**	**SAY** – • "But let me tell you a little bit about me and my cauliflower friends. • We all have "**heads**" that are round and can be all different shapes and sizes! Here is a real head of cauliflower (show raw head of cauliflower) This whole thing is a HEAD of cauliflower. Where's your heads? Good! haha • The parts on the end that look fluffy and white are called "Curds". Cauliflower kind of looks like fluffy white clouds don't they? But everyone is going to get a chance to feel it – Do you think it feels soft and fluffy or hard? • What do you think I look like? A tree? A cloud? Another vegetable you have had? **SEE** – While talking hold up carl the cauliflower (so the kids know he is talking); Have another researcher hold real head of cauliflower    **DO** – Walk around with the head of cauliflower to show everyone to start and then also walk around (or have another researcher or assistant) walk around with the head of cauliflower so each child individually can feel it.
Step 4: **Growth of Cauliflower**	**SAY** – Lucky for you, we are around all year round! We grow in all seasons, Does anybody know where cauliflower grows? Cauliflower starts out as little seeds planted in the soil, but then sprouts into a big plant we can eat! First, come the big green leaves, and then the bunches of white "curds". Once it is big, plump, and the size of a plate, it is ready to harvest! **SEE** –       **DO** –

Step 5: **Health of Cauliflower**	**SAY** – "Are you ready for the best thing about us? We are super HEALTHY! Cauliflower helps keep us healthy and strong Give us a try! We can be eaten raw or in dips, salads, snacks, or part of a main meal! We are broken up into smaller little tree-like pieces and thrown into yummy soups, side dishes, or casseroles!" Guess what! You guys get to taste cauliflower for a tasty, healthy snack! But first we are going to read the story ☺ **SEE** –    **DO** – (TASTE TEST)
PRACTICING THE SKILL	
Storybook: Ch 1	
Taste Testing Procedure/Instruction – - Have all of the little sample cups prepared and ready by the time the lesson is over Step by step procedure: 1. Tell the kids about the vegetable again. "What vegetable is this again?" "Great!, Cauliflower!" "Is this a healthy or unhealthy snack for us to have?" 2. Show them what the snack is and describe how it was made (if premade) or if it is being prepared in front of them, show them a step by step display on how it was made 3. Have each child sit down at the snack table 4. Describe the "Polite Taste Testing" Procedure: • Talk about how trying new foods can be fun!! And it's ok to not like foods, but if they haven't tasted it before – they may like it! • If you try a food and do not like it, that's ok! That was very brave and good of you to try it • If you do not like the sample, you can come over to _____ (wherever napkins/tissues are kept) and politely spit the sample into the tissue. 5. Bring around the sample cups filled with the snack. Have the other research assistant following around to quickly check off to see if the child tried the vegetable or not. Note in the comments section any additional observations. 6. Give the kids a couple of minutes to see if they end up deciding to try the vegetable served. The researchers and teachers should also try the sample. 7. One researcher should go around with the buckets that are labeled with the Smile Face, the Neutral Face, the "Yuck" Face, and Didn't Try X. Ask the child, "Did you like the vegetable? Which face do you think you made when you tried the vegetable? This face is YUM if you liked the vegetable, this is the OK face if it was just ok but you might not want more of it, this is the YUCK you don't really like it face and do not want to have more of it. 	

Brussel Sprouts Fun Facts!!

- Brussel Sprouts are part of the **cruciferous vegetables** family, which means they are closely related to cauliflower, broccoli, kale, collar greens, and cabbage. Cruciferous vegetables should be at the top of the grocery list as they are extremely low in calories and high in vitamins and nutrients!
- Brussel sprouts have a lot of antioxidants – they help us stay healthy!
- Brussel sprouts are higher in ***protein*** compared to other green vegetables, keeping you full longer.

  Roasting brussel sprouts for 20-30 minutes at 375 degrees F may be received better with young kids rather than just boiled brussel sprouts. Add some sea salt, pepper, olive oil, and any other spice you like and the flavor is delicious!

Broccoli Fun Facts!!

- Broccoli is part of the category **cruciferous vegetables**, which means it is in the cabbage family along with cauliflower, brussel sprouts, and cabbage!

- The average American eats about 4 pounds of broccoli a year!
- Broccoli can be eaten raw, boiled, baked, etc.
- Broccoli originated in Italy off of the Mediterranean and has been enjoyed by the ancient Romans since the 6th Century BC!

Health Benefits:

- Want something high in Vitamin C but don't feel like an orange? Broccoli is actually extremely high in Vitamin C – 1 cup of chopped broccoli has the same amount of Vitamin C as an orange!
- Broccoli is high in Vitamin A, which helps fight cancer, prevents eye degenerative diseases, and promotes healthy skin, bone and teeth!
- Broccoli is loaded with **fiber**, which is great for your digestive system!
- Studies reveal substances in cauliflower may prevent the development of certain cancers and heart disease

Roasted Cauliflower – Serves 4 +

Oven-roasted cauliflower sprinkled with cheese is a simple and delicious side dish that pairs well with any entrée.

Ingredients:

- Cauliflower (1 fresh head, 1 bag of frozen)
- 2 tablespoons olive oil
- ¼ teaspoon salt
- ¼ teaspoon pepper
- ½ cup shredded Parmesan cheese

Directions:

1. Remove outer leaves of cauliflower. Cut into little pieces. Wash and drain.
2. Spread cauliflower on a large rimmed baking sheet.
3. Sprinkle with olive oil, salt, and pepper. Toss.
4. Roast in the oven at 450 degrees 15-20 minutes until the cauliflower starts to soften and begins to brown.
5. Sprinkle with cheese; roast for 5-10 minutes.

Recipes found at: www.whatscooking.fns.usda.gov

Hiding Rabbit Snack – Serves 1

A cute and easy way to get kids excited about eating their veggies!

Ingredients:

- 2 celery stalks
- 2 small cauliflower florets
- 2 tablespoons peanut butter

Directions:

1. Wash vegetables.
2. Spread peanut butter in the crevice of one piece of celery.
3. Place second celery piece on top, forming a log.
4. Place cauliflower florets on ends of log, securing with remaining peanut butter.
5. Enjoy!

Recipes found at: www.whatscooking.fns.usda.gov

Quick Cauliflower Snack Ideas!

Quick Snack Ideas:

- Raw Cauliflower florets and hummus!
- Frozen cauliflower and peas topped with cheese, salt, and pepper!
- Raw cauliflower, carrots, and any vegetables with salad dressing!

Recipes found at: www.whatscooking.fns.usda.gov

Spanish Cauliflower Side Dish – Serves 4-6

Ingredients:

- 1 tablespoon oil
- 1 onion (medium)
- 1/4 teaspoon garlic powder or fresh garlic
- 1 head of cauliflower
- 2 tomatoes (large)
- Pinch of pepper
- 1 tablespoon parsley
- 1/4 cup Parmesan cheese (grated)

www.whatscooking.fns.usda.gov

Directions:

1. Chop the cauliflower, onion and tomato into small pieces.
2. Put cauliflower and 1 inch of water into a small/medium pan.
3. Cook over medium heat, and let it boil for 3 minutes.
4. In a large pan, heat the oil, and add the onion.
5. 7. Cook over medium heat for 3 to 5 minutes.
6. Add the garlic and cauliflower. Stir and let cook until lightly brown.
7. Add tomatoes and pepper + cook for 5 minutes.
8. Top with cheese and parsley. Serve and enjoy!

Bring it on Brussel Sprout Wrap!

Ingredients:

- **2 tablespoons** chili powder
- **1 tablespoon** ground cumin
- **1/2 tablespoon** paprika
- **1/2 teaspoon** garlic powder
- **1/2 teaspoon** dried oregano
- **1 teaspoon** black pepper
- **2 1/2 cups** Brussels sprouts finely chopped
- **1 can** pinto beans (rinsed)
- **2 small** avocados
- **10** whole wheat tortillas

1. In a bowl, combine all the spices.
2. In a large sauté pan over moderate heat, warm oil. Add the Brussels sprouts and the seasoning mixture and cook until the Brussels sprouts soften, about 5 minutes. Add the beans, lower the heat to low, and cook about 3 min.
3. Spread bean, brussel sprout mixture on each tortilla and top with slice of avocado.
4. Roll up and enjoy!

Recipes found at: www.whatscooking.fns.usda.gov

Chicken & Broccoli Bake

Ingredients:

- **1 cup** brown rice, uncooked
- **1 bag** broccoli, frozen
- **3 cups** chicken, cooked
- **2 tablespoons** butter
- **1/4 cup** flour
- **2 cups** chicken broth
- ¼ cup Parmesan cheese

Directions:

1. Cook rice in 2 cups of water
2. Melt butter or oil in large saucepan.
3. Add flour and stir (it may be lumpy).
4. Use broth from chicken
5. Add cheese and stir.
6. Add rice, broccoli, and chicken. Stir.
7. Place in casserole dish and bake at 350 for 30 minutes.

Recipes found at: www.whatscooking.fns.usda.gov

Broccoli Noodle Salad

Ingredients

- **6 cups** broccoli florets
- **2** green onions
- **1 tablespoon** cilantro
- **2 tablespoons** rice vinegar
- **1 tablespoon** honey
- **2 teaspoons** fresh ginger
- **2 teaspoons** Low Sodium Soy Sauce
- **1/4 cup** Chow Mein Noodles
- **1 teaspoon** sesame oil

Recipes found at: www.whatscooking.fns.usda.gov

Directions

1. Boil water and blanched the broccoli for just one minute.
2. Chill broccoli in the fridge for 20 minutes.
3. Mix the sauces together, and break the chow mein into bite size pieces.
4. Mix all the wet ingredients with the broccoli and top with noodles

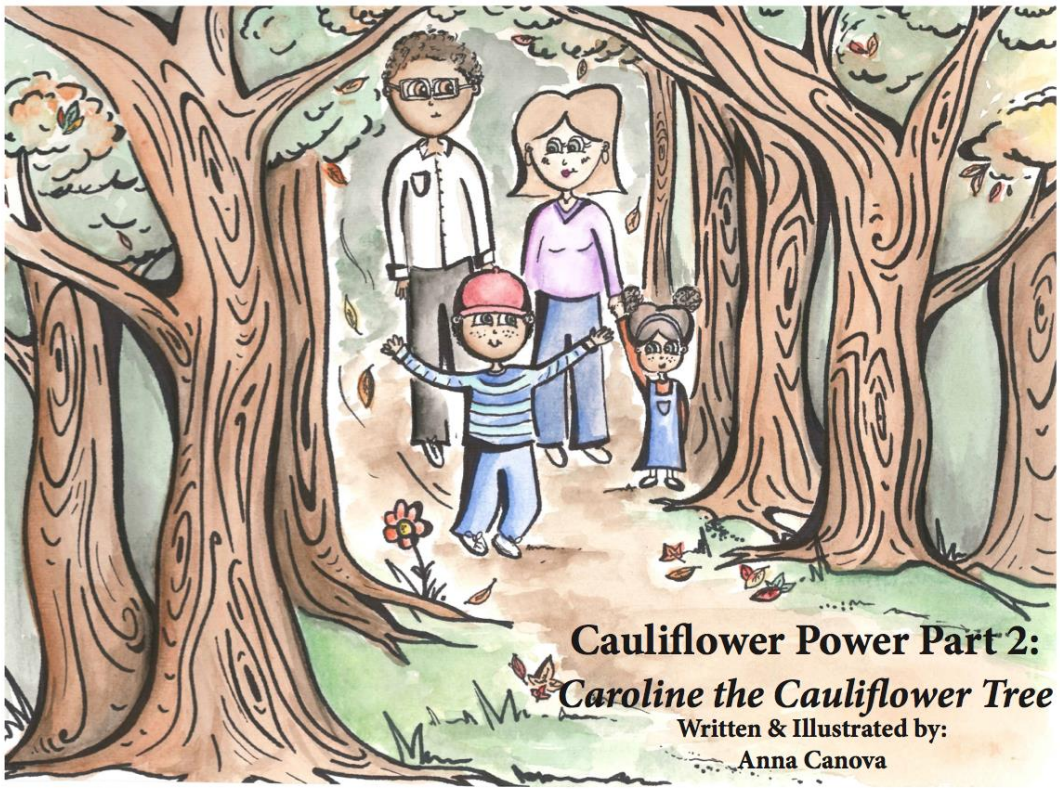
Brussel Sprouts & Mushroom Sauce

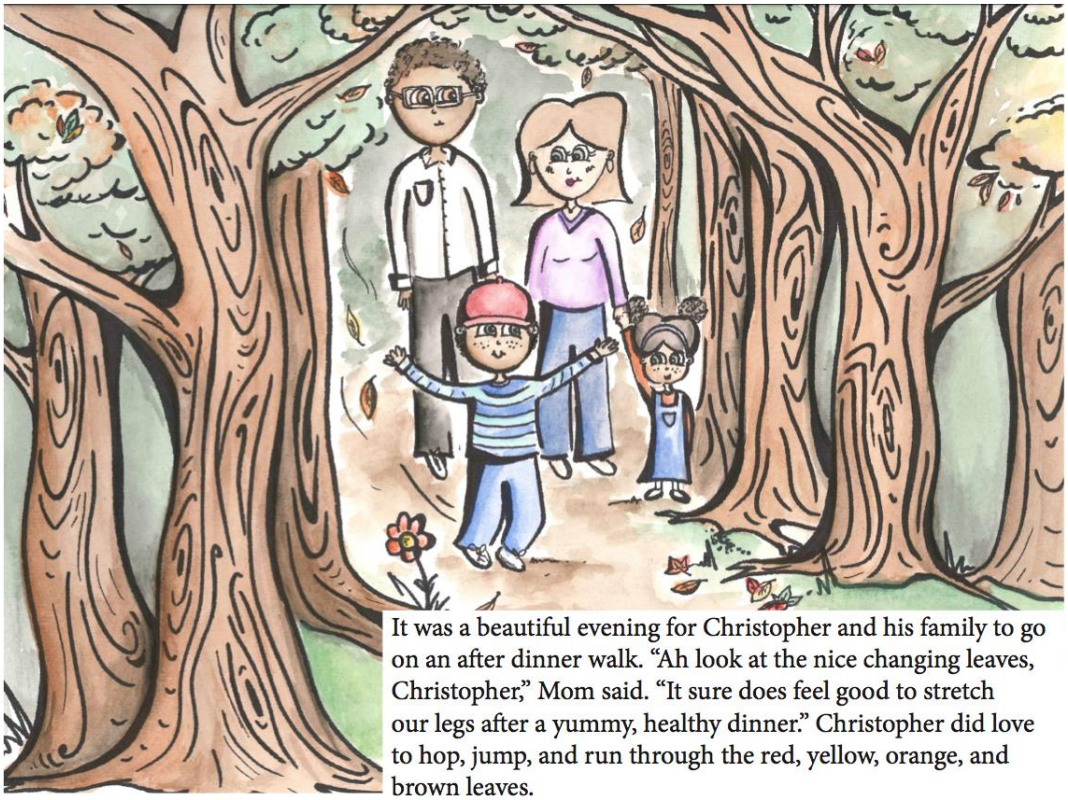
Ingredients:

- **2 cups** Brussels sprouts (or broccoli, cabbage, kale, collards)
- **1/2 cup** chicken broth
- **1 teaspoon** lemon juice
- **1 teaspoon** brown mustard (spicy)
- **1/2 teaspoon** thyme
- **1/2 cup** mushrooms sliced

1. Trim Brussels sprouts and cut in half. Steam until tender - about 6 to 10 minutes, or microwave on high for 3 - 4 minutes.
2. In a pot bring the broth to a boil.
3. Mix in the lemon juice, mustard, and thyme. Add the mushrooms.
4. Boil for about 5 to 8 minutes.
5. Add the Brussels sprouts (or other cooked vegetable).
6. Toss well to coat with the sauce.

Recipes found at: www.whatscooking.fns.usda.gov

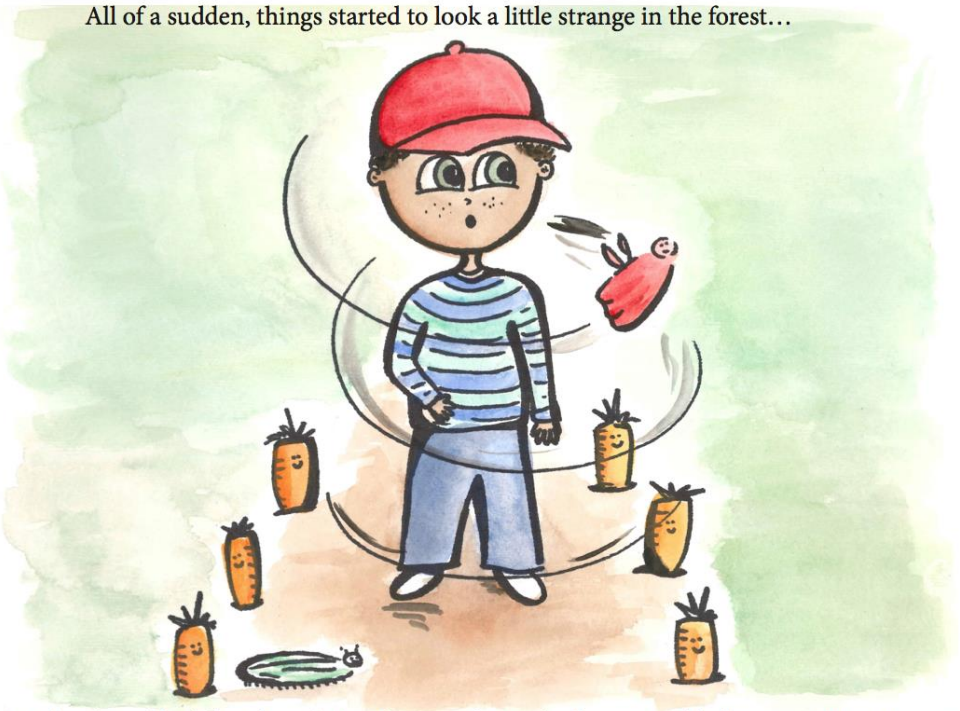




It was a beautiful evening for Christopher and his family to go on an after dinner walk. "Ah look at the nice changing leaves, Christopher," Mom said. "It sure does feel good to stretch our legs after a yummy, healthy dinner." Christopher did love to hop, jump, and run through the red, yellow, orange, and brown leaves.

Christopher was walking slower and slower and even slower... Soon his Mom, sister, and Dad were too far ahead! *Oh no*! he thought. *I have to catch up! But I feel so hungry and tired.*

All of a sudden, things started to look a little strange in the forest…



Woah! A bright red bird flew down below the trees, but its body was a red bell pepper! *Wow! I am super hungry and things seem to be turning into vegetables… I better catch up to my family quick!* Christopher thought.

A kind voice echoed through the forest. "I think I can help! I am Caroline the Cauliflower tree. Do you know what cauliflower is?

Christopher explained his Grandma grows cauliflower in the garden, but he was too nervous to taste it. The tree said, "Cauliflower is full of healthy vitamins and nutrients! If you eat cauliflower and vegetables like me, you will have energy and strength! "I do need a healthy body to catch up with my family!" Christopher said. "Yes, try a little taste." The tree said with a smile as he reached out a branch.

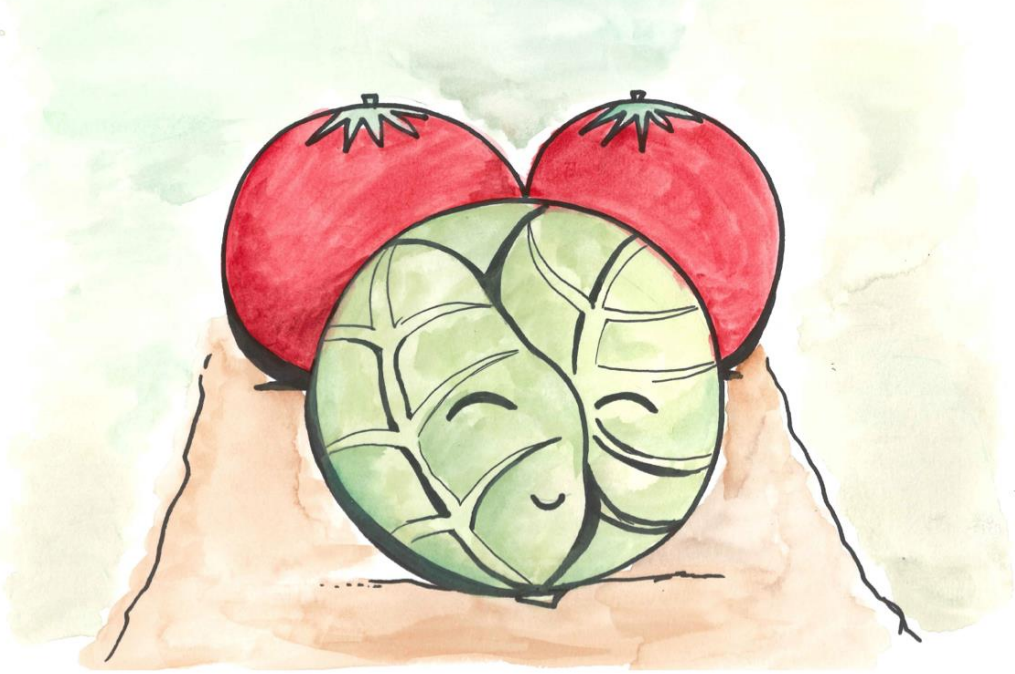
"Well, ok Caroline the cauliflower tree, I will give it a little try…." Christopher pulled off a piece of the cauliflower and took a crunchy bite. CRUNCHHHH!

"Yum! Cauliflower is not bad after all! And I feel healthier already!" Christopher said. Caroline leaned over and said, "That's the Cauliflower Power." Can everyone say Cauliflower Power?

With the help of Caroline the Cauliflower Tree, Christopher chose the Healthy Path.

Before long, tomatoes as big as an army were blocking his way.

Out from behind the cauliflower and broccoli trees rolled a brussel sprout as big as the tomatoes! "Hi there! Hehe. My name is Briana the Brussel Sprout and I think I can help!"



Christopher took a little taste of the brussel sprout that Briana gave him. He then used the energy to hop onto Briana and jump over the tomatoes! Wow! He did it!

Uh oh… there were more tomatoes in his path! This time they were smashed. "Jump and grab onto my branches!" A voice boomed through the vegetable forest. "My name is Bruce the Broccoli Tree and I can help! First, try a piece of my broccoli. It will give you the energy and health you need to get past this obstacle." Christopher willingly tried the broccoli and used his energy to jump super high, reach onto Bruce's branches and make it safely over the smashed tomatoes.

Christopher thanked his new friends. "Thank you Caroline the Cauliflower Tree, Briana the Brussel Sprout, and Bruce the Broccoli Tree, I feel great!" He set off on his way down the healthy path to find his family.

Appendix B

Forms & Surveys

Hello Hort Woods Parents and Guardians!

My name is Anna Canova, and I am a senior Schreyer Honors Scholar majoring in Biobehavioral Health at Penn State. Along with my advisor, I have developed a study that combines many of my passions: vegetables, young children, art, and storytelling! I am known for my deep rooted love for vegetables and I would love to share that with young children who tend to think veggies are "yucky!". I designed a research study around fun and informative books on eating vegetables that I both wrote and illustrated. I am excited to be sharing them with your children in their classrooms!

The study will be taking place in your child's Hort Woods classroom throughout February 2018. The study is intended to examine how repeated exposure to a target vegetable, through reading of ***storybooks*** featuring the novel vegetable followed by ***sample taste testing,*** influence preschool children's perception and consumption of that vegetable. The target vegetable that we will focus on in this study is **Cauliflower, Broccoli, and Brussels Sprouts**!

In School: As part of the study, children will be asked a few questions on their knowledge and perception of the cruciferous vegetables (cauliflower, broccoli, and brussel sprouts) followed by an opportunity to try a little piece of the vegetables. This will be done in the beginning and end of the study. A genetic test will be administered called a **PTC test**, which is a simple saliva test assessing whether the child has the gene or does not have the gene that contributes to a genetic predisposition to liking of cruciferous vegetables, the grouping of cabbage-family vegetables that cauliflower, broccoli, and brussel sprouts are a part of. This would require the child to lick a strip of "PTC paper" and see if it tastes like nothing or if it tastes slightly bitter or sour; their reaction will be recorded.

Then, the really fun part! I will come in to **read my stories** to the kids and engage them in a mini-lesson about vegetables. They will each be given a small sample cup of the vegetable served that day (cauliflower, broccoli, or brussel sprouts), taste it if they want, and place it on a chart, indicating whether they liked the snack or not.

I am super excited to finally be sharing the creation of my children's books and love for vegetables with your children! I hope they are just as excited for my special, fun visits :)
If you have any questions at all, don't hesitate to reach out. Thank you in advance for your cooperation and participation!

Sincerely,
Anna Canova
acc5407@psu.edu

Cruciferous Crew Parent Survey

Hello Hort Woods Parents!

I want to express my gratitude to you for allowing your child to participate in my honors research study, "The Cauliflower Power Study," as the children refer to it. By the end of the study, your child will have had an opportunity to try cauliflower rice, rainbow cauliflower, cauliflower-broccoli patties or cakes, and baked cauliflower cheesy "popcorn".

Your children have enjoyed the stories I developed about Christopher and all of his veggie adventures. This last step in the study, collecting information from parents, will help me understand more about the impact my study had beyond the classroom. I will also be able to examine any family factors that may explain how children responded differently to the foods that I prepared.

This survey should take between 5 and 10 minutes to complete. In exchange for your participation, we will send you a $10 Amazon gift e-code that you can use towards a purchase at Amazon.com.

Again, thank you for your participation. I'm looking forward to sharing the results of the study with you in April!

Anna Canova
Senior, Biobehavioral Health
Schreyer Honors College

Please answer the following questions about the child in the study, and your family.

YOUR first and last name (Example: Mary Henry). _____

YOUR CHILD'S first and last name. _____

Your child's classroom at Hort Woods.

- ❍ Sky House
- ❍ Roof Top Roots

What is your relationship with the participating preschool child enrolled at Hort Woods?

- ❍ Mother
- ❍ Stepmother
- ❍ Father
- ❍ Stepfather
- ❍ Grandmother
- ❍ Grandfather
- ❍ Aunt
- ❍ Uncle
- ❍ Other, describe: _____

What is **your** race or ethnicity? Mark all that apply.

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White
- ❑ Hispanic or Latino
- ❑ Other _____

What is **your preschool child's** race or ethnicity? Mark all that apply.

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ White
- ❑ Hispanic or Latino
- ❑ Other _____

What is your preschool child's sex or gender?

- ❍ Female
- ❍ Male
- ❍ Other _____

What is your **preschool child's** date of birth (mm/dd/yy)? _____

Does your **preschool child** have any food allergies or restrictions?

- ❍ No
- ❍ Yes, please explain: _____

Does your preschool child have any developmental delays that affect his/her ability to learn and participate in the routine day at preschool? No

- ❍ No
- ❍ Yes, please explain: _____

What is your highest level of formal education?

- ❍ High School
- ❍ Associates
- ❍ Technical
- ❍ Bachelors
- ❍ Masters
- ❍ PhD
- ❍ MD
- ❍ JD
- ❍ Other, describe. _____

What is your Marital Status?

- ❍ Married
- ❍ Single
- ❍ Divorced
- ❍ Remarried
- ❍ Separated
- ❍ Widowed
- ❍ Other _____

What is your partner's highest level of formal education? (If applicable)

- ❍ High School
- ❍ Associates
- ❍ Technical
- ❍ Bachelors
- ❍ Masters
- ❍ PhD
- ❍ MD
- ❍ JD
- ❍ Other, describe. _____

What is the total or combined family income, before taxes?

- ❍ Less than $20,000
- ❍ $20,000 - $34,999
- ❍ $35,000 - $49,999
- ❍ Over $50,000

The next few questions are about your child's eating behaviors. Please list the extent to which you agree or disagree with the statements.

My child's diet consists of only a few foods.

- ❍ Agree
- ❍ Slightly Agree
- ❍ Neither Agree nor Disagree (Neutral)
- ❍ Slightly Disagree
- ❍ Disagree

My child is unwilling to eat many of the foods that our family eats at mealtimes.

- ❍ Agree
- ❍ Slightly Agree
- ❍ Neither Agree nor Disagree (Neutral)
- ❍ Slightly Disagree
- ❍ Disagree

My child is fussy or picky about what he/she eats.

- ❍ Agree
- ❍ Slightly Agree
- ❍ Neither Agree nor Disagree (Neutral)
- ❍ Slightly Disagree
- ❍ Disagree

This next and final section includes questions about the vegetables, recipes and activities used in the study.

How often did you try the recipes we sent home?

- ❍ Never
- ❍ A few times
- ❍ Several times

Approximately how many times did your child eat CAULIFLOWER at home during the past 2 weeks?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5+

Approximately how many times did your child eat BROCCOLI at home in the past 2 weeks?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5+

Approximately how many times did your child eat BRUSSELS SPROUTS in the past 2 weeks?

- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5+

Have you noticed any changes in your child's liking or perceptions of CAULIFLOWER in the past 2 weeks?

- ❍ A large increase (please explain) _____
- ❍ A small increase
- ❍ No change
- ❍ A small decrease
- ❍ A large decrease (please explain) _____

Have you noticed any changes in your child's liking or perceptions of BROCCOLI in the past 2 weeks?

- ❍ A large increase (please explain) _____
- ❍ A small increase
- ❍ No change
- ❍ A small decrease
- ❍ A large decrease (please explain) _____

Have you noticed any changes in your child's liking or perceptions of BRUSSELS SPROUTS in the past 2 weeks?

- ❍ A large increase (please explain) _____
- ❍ A small increase
- ❍ No change
- ❍ A small decrease
- ❍ A large decrease (please explain) _____

Have you noticed any changes in your child's liking or perceptions of ANY VEGETABLE in the past 2 weeks?

- ❍ A large increase (please explain) _____
- ❍ A small increase
- ❍ No change
- ❍ A small decrease
- ❍ A large decrease (please explain) _____

Has your child ever mentioned the character, Christopher, from the storybooks read in class?

- ❍ No
- ❍ Unsure
- ❍ Yes, please explain _____

Thank you again for participating in my Cruciferous Crew Vegetable Study! As a token of my appreciation, you will be receiving a $10 Amazon e-code in a separate email message in the coming weeks. Please enter your name and email address, below. This information will only be used for the purposes of payment. Also, any comments, concerns or feedback on the study would be much appreciated!

Sincerly,
Anna Canova

Appendix C

Data Collection Materials

ClassroomID: _____ Date/Time: _____

ObserverID:_____

PRE-TEST

				Did the child like it?				PTC Test	
Child ID		Knowledge Assessment "1" or "2" Points		YES a lot! 	Kind of/neutral 	No, Yuck! 	Didn't Try 	Tasted Nothing/ "Good" 	Tasted Bitter 
	Cauliflower								
	Broccoli								
	Brussel Sprouts								
	Cauliflower								
	Broccoli								
	Brussel Sprouts								
	Cauliflower								
	Broccoli								
	Brussel Sprouts								
	Cauliflower								
	Broccoli								
	Brussel Sprouts								
	Cauliflower								
	Broccoli								
	Brussel Sprouts								

ClassroomID: _____
ObserverID:_____
Date/Time: _____

Tasting/Liking
Vegetable: _____

	Did the child taste it? (circle)	Did the child like it?				Notes Comments
Child ID		YES a lot! 	Neutral 	No, Yuck! 	Didn't Try 	
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					
	Yes/No					

Spring 2018
Cruciferous Vegetable Study

Pre & Post- Assessment Procedure Script
Hort Woods Preschool (North campus by Ford Building)

Checklist to Bring:

- Vegetable cards (cauliflower, broccoli, brussel sprouts)
- Buckets with faces (3 buckets – yum, yuck, eh)
- Pencil and/or pen
- This script ☺
- Chart to fill out data for each child (make sure there are enough slots for 20 children – may need 2-3 prints of the chart stapled together)
- Sample cups with broccoli, cauliflower, and brussel sprouts (20+ of each for each class)
- Tray
- Little cups for water (20+ for each class)
- Pitcher of water
- Picture of Christopher for intro
- PTC strips
- Paper towels/napkins for child to spit out if necessary
- Stickers
- Aprons
- Name Tags
- A smile!!!!

Arrive early for the start time of the pre-assessment (set up may take a few minutes longer than expected to get everything organized, especially the first time in). Sign in and walk over to the "art studio" to put down the trays of vegetable samples and materials.

Since this is the first time we are going into the preschool, start out by introducing the whole team that is there.

- **"Hi everybody! My name is Anna and this is _____ and we are going to be visiting your classroom every so often to read a story about vegetables and then bring a vegetable snack to try! It's going to be super fun ☺ This is Christopher (show cover of book or picture of Christopher) and he is going to be our new little friend in the books that we will be reading! But we will meet Christopher next time we come. Today, we will only be here for a little bit and are going to meet everyone, play a little game, lick a piece of paper, and have a taste of some foods we brought with us today. Is that ok?"**

- **"We are sitting right over there (point to where sitting) and so while everyone else keeps on doing _____ (reading book, etc.) we will call everybody over one at a time. Some friends may not get called over – and that's ok too!"**

Spring 2018
Cruciferous Vegetable Study

Go over to the table and get the papers set and the vegetable cards ready. Get your stack of vegetable cards together. Have pencil ready.

PTC TEST

(Genetic component)

- **"Ok, so can we have _____ (name) for a second to taste a piece of paper, play a quick game and taste some foods we brought with us today? Come on over _____. You'll be right back to keep _____. "**
    - **** If they don't want to come over then that's ok! No forcing – they may see someone else go over first and then want to ☺

- **"Hi again, my name is _____ are you _____(name)? It's very nice to meet you! I am super excited to be in your pretty awesome classroom."**

- **"Thanks for coming to say hi! This will be super quick. We are going to taste a little piece of paper, play a vegetable card game, and then try a taste of some little foods I brought today. Does that sound ok?"**

- **So first I have this little, little piece of special paper with me. When some kids lick it or put it on their tongue, it does not taste like anything at all. Some kids think that it tastes like something. Can you tell me what you taste?"**

Hand the child the PTC test (little strip of paper) and motion to them how to put it on their tongue. Encourage not to eat the paper. And again, if they do not want to do it they do not have to.

- **"How do you think it tastes?"**

Hold up the pictures of the 3 faces – tasted good, nothing, yuck face

- **"Point to how you think it tasted"**

(but you will probably be able to tell from their faces! Haha)

- **"Awesome! Thanks for your help with that. Here is some water (and possibly like a gram cracker or something). Take a quick sip before we have some other things to play and try."**

Spring 2018
Cruciferous Vegetable Study

VEGETABLE IDENTIFICATION

** Mark responses in the sheet

The next section is the "knowledge" section to see if the child can name the pictures of the vegetables, if they can verbally say it, so place the cards in a stack in any order. Be ready to hold them up one by one.

- **"I have a couple pictures here with me and I'm going to ask you to help me name some of the vegetables in the pictures. Are you ready to play?**

KEY: • ***2 Points:*** *If they were able to verbally name the vegetable* • ***0 Points:*** *If they named the wrong vegetable or were not able to name it*

Hold up the first vegetable on the list – broccoli – in front of the child. Ask:

"What is this?"

Give the child a few seconds to answer.
If they get it right OR wrong – neutral answer. **"Ok thank you"**

"What is this?"

"What is this?"

Continue through all of the vegetables listed on the data sheet.

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ACADEMIC VITA

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***Education*:**
The Pennsylvania State University — *University Park, Pennsylvania*
B.S. in Biobehavioral Health — Graduating: May 2018
Honors in Biobehavioral Health

***Thesis Title*:** "Cauliflower Power" Storybooks and Cruciferous Vegetable Consumption in Pre-School Children: Examining the Effect of Repeated Exposure on Acceptance and Consumption of Cauliflower, Broccoli, and Brussels sprouts in Children 3-4 years old
***Thesis Supervisor*:** Dr. Lori Francis

Work Experiences:

Breakthrough Collaborative of Greater Philadelphia Teaching Fellow
9th Grade Science & Engineering Practices & Art Teacher
June 2017 – August 2017
West Philadelphia, PA
Supervisors: Miriam Leisman, Miriam Harris, and Megan Conley

- Trained in the growth mindset, classroom management skills, curriculum building, and Philadelphia low-income youth population
- Taught under-served, high-potential 9th grade students for a full time summer program in engineering practices and mural painting arts
- Created original curriculum, grading system, classroom maintenance techniques, and overall class environment

Riverbend Environmental Center Assistant Educator
All Ages Assistant Educator
June 2016 – August 2016
Gladwyne, PA
Supervisor: Hadley Kunz

- Educated children of Philadelphia ages 3 – 13 yrs. about the natural world through hands-on lessons and guided exploration
- Created detailed, weekly lesson plans

Children's Book Illustrator
Artist
June 2016 – Present
State College, PA
Supervisor: Dr. Lori Francis & Michele McCamley

- Create original cartoon-style artwork to go with Dr. Lori Francis of Pennsylvania State's preschool books on healthy eating

Harlee Manor Rehabilitation Center Volunteer
Occupational Therapy Volunteer
May 2015 – September 2015
Springfield, PA
Supervisor**:** Maxine Shusman

- Assisted Occupational Therapists with patient rehabilitation schedules and evaluations
- Aided elderly patients with strength training exercises and daily routines (showering, dressing, etc.)
- Provision of psychological motivation/emotional support necessary for positive results and an overall pleasant environment

Delaware County Intermediate Unit Volunteer
Occupational Therapist Volunteer/Shadow
Summer 2014
Havertown, PA

- Worked in support of Occupational Therapists with motor skills development of special needs children
- Guided children with leg braces and muscular dystrophy through obstacle courses and games to strengthen gross motor skills
- Practiced object identification, word formation, and articulation with special needs children or children with speech impediments

Research Assistant, Healthy Bodies Project
Undergraduate Research Assistant
September 2015 – Present
Pennsylvania State University; Department of Biobehavioral Health
Supervisor: Dr. Lori Francis

- The Family and Child Health Project identifies biobehavioral mechanisms influencing the development of obesity in children of low income families in rural communities
- Develop and implement curriculum for preschool classrooms that promotes familiarity with fruits, vegetables, and healthy practices
- Organize fun and informative family events that bring awareness to inexpensive and healthy options for their families

Grants Received:

- Schreyer Honors College

Awards*:*

- President's Freshman Award (4.0)
- Dean's List 2014-2018
- Evan G. and Helen G. Pattishall Undergraduate Research Endowment in Biobehavioral Health in the College of Health and Human Development
- Helen Skade Hintz Biobehavioral Health Scholarship

Activities**:**

Healthy Penn State Ambassador

April 2016-May 2018

- Promoting holistic health and well-being practices across campus by encouraging participation in the University Health Services Healthy Penn State Initiative

Schreyer Honors Orientation (SHO time) Mentor *University Park, PA*
August 2015
Schreyer Honors College

- Mentor groups of freshman through the three day SHO time by providing emotional support and informative experience

Shaver's Creek Outdoor School Counselor *Petersburg, PA*
Fall 2016

- Taught groups of middle school students about Pennsylvania's ecology and environment through hands on experience in nature

Ceramics Studio Membership
Fall 2015-Spring 2018

Penn State Student Farm Club Member
Fall 2015-Spring 2017

- Organized community-wide locally grown series of collaborative meals

Community Service Involvement:

Dancer Relations THON Committee Member *University Park, PA*
October 2014- Present
Pennsylvania State University

- Responsible for ensuring the health of volunteers selected as dancers for 46 hour THON Weekend raising money for pediatric cancer

Fresh START Team Leader *University Park, PA*
August 2014 – Present
Pennsylvania State University

- Leading group of first-year students in Penn State's largest 'Day of Service', engaging in service on campus as well as community

Language Proficiency: Basic Spanish

Activities: Club Yoga, Student Farm Club, Community Art Classes, Schreyer Honors College Distinguished Mentoring program, IM Sports (soccer, volleyball, basketball), Cooking Collaborative

Interests: Painting, Cooking/Nutrition, Drawing, Pottery, Outdoors (hiking, backpacking, white water rafting), Running, Community Art