DEVELOPMENT OF A THEORY-BASED INTERVENTION TO INCREASE CHILDREN'S UNDERSTANDING OF HEALTH

Mary Beth McCullough

A Thesis Submitted to the
University of North Carolina Wilmington in Partial Fulfillment
of the Requirements for the Degree of
Master of Arts

Department of Psychology

University of North Carolina Wilmington

2008

Approved by

Advisory Committee

Dr. William Overman

Dr. Sally MacKain

Dr. Nora Noel

Dr. Simone Nguyen
Chair

Accepted by

Robert D. Roer
Digitally signed by Robert D. Roer
DN: cn=Robert D. Roer, o=UNCW, ou=Dean of the Graduate School & Research, email=roer@uncw.edu, c=US
Date: 2008.09.16 09:14:48 -04'00'

Dean, Graduate School

TABLE OF CONTENTS

ABSTRACT

The present study examined the effectiveness of a theory-based intervention in increasing 3-to 4-year-olds’ understanding (e.g., classification) and preference for healthy foods and exercise. This study used a pre-test/intervention/post-test design and children were randomly assigned to one of three conditions: theory (i.e., 20 children received the theory-based intervention); non theory (i.e., 20 children received the non theory-based intervention); and control (i.e., 20 children received no intervention). The results showed that children in the theory group performed significantly better on measures for understanding than children in the non theory and control groups. The theory group also performed significantly more accurately on the preference task, specifically on high-fat food and non exercise questions, than children in the non theory and control groups. These results suggest that theory-based interventions are effective in increasing children’s understanding and preferences for healthy behaviors, and could be used to educate children about health at a young age.

ACKNOWLEDGEMENTS

I would like to thank Dr. Simone Nguyen for her guidance, mentorship and encouragement throughout the development and completion of this thesis. Her positive support, patience and the time and effort that she has devoted to helping me have been invaluable during this process. I would also like to thank my other committee members, Dr. Sally MacKain, Dr. Nora Noel and Dr. William Overman for their patience, expertise and helpful contributions to this project.

Boundless thanks are due to the members of the Cognitive Development Lab, Tess Young, Ashley Noble and Julie Robinson. They have been incredibly helpful with data collection and a wonderful support system. Also, special thanks to Ashley Noble for her enthusiastic commitment to collecting data and the wonderful preschools, teachers, directors and parents for their willingness to participate in this project.

I am also grateful for the endless hours of support and insight that Barbie McCullough and Patrick Higdon have given to me. They have provided me with indelible support and wisdom throughout the life of this project. Thank you for all that you do.

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The National Health and Nutrition Examination Survey (NHANES) for 2003-2004 showed that approximately 13.9% percent of children ages 2 to 5 are overweight. This number nearly tripled since the NHANES report from 1971-1974 (Center for Disease Control, 2006). In response to the increasing number of overweight children, the U.S. Surgeon General issued a “Call to Action” to educate the public about the health problems associated with being overweight and to give suggestions to improve children’s health. The Surgeon General’s Call to Action (DHHS, 2001) states that the health problems of being overweight and obese in childhood include Type 2 diabetes, risk factors for heart disease, high blood pressure and high cholesterol. Overweight children are 70% more likely to become overweight or obese adults, in which the health problems become worse (DHHS, 2001). Some suggestions for improvement as stated in the “Call to Action” include increased physical activity (e.g., encouraging fun activities such as playing soccer, biking, and skating) and healthy eating (e.g., decreasing fat and sugar in diet and eating fruits and vegetables every day) (DHHS, 2001).

The goal of the present study was to develop an intervention to increase young children’s understanding and preference for healthy food and exercise. As the statistics show, the number of children ages 2 to 5 that are overweight and obese is increasing. The development of this intervention was in response to these staggering numbers, and targeted young children in this age group. In the following sections, three topics will be discussed that constitute the foundation of this intervention: the theory-theory perspective on children’s cognitive development; children’s misconceptions about biological processes; and the theory-theory approach to developing a theory-based intervention. The argument that will be made is that the theory-theory approach to an intervention is an effective means of educating children, especially in the area of health. In the following sections, limitations of current educational programs that target children's understanding of nutrition and exercise will also be explored. For example, they contain disparate facts that are not causally-related, provide more games than nutritional content and/or are focused on older children. These programs may be difficult for young children to comprehend and may result in misconceptions about nutrition and exercise that exist throughout development. Previous studies focusing on children's biological knowledge (Au & Romo, 1994; Krascum & Andrews, 1998; Solomon & Johnson, 2000; Zamora, Romo, & Au, 2006) show that theory-based interventions presented with causally-related facts and age-appropriate material are effective in increasing knowledge about biological processes; however, these interventions have yet to target children's understanding and preferences for nutrition and exercise. This gap in the research was the motivation behind the development of the current intervention.

Theory-Theory Perspective

According to the theory-theory approach, young children have naive theories, or distinct frameworks that represent innate areas of knowledge (Inagaki & Hatano, 2002). What is meant by "innate areas of knowledge" is that children come into the world with intuitions or hunches about certain concepts, but they do not have a complete or full understanding of these areas. According to this approach, children are born with frameworks for conceptual understanding, and these frameworks serve as the building blocks for concept acquisition. For example, as children develop, they encounter new concepts that contribute to their learning. These new concepts may provide evidence to support and strengthen their current theory, or counterevidence to refute and weaken their theory. A child can receive both evidence and counterevidence through personal experience, or input from parents, teachers or peers. Their frameworks can be modified and restructured over time in the presence of evidence and counterevidence (Gelman & Kalish, 2005). Therefore, according to this approach, children are eager and open to learning about the world around them, and their naive theories assist them in organizing this information.

"Naive theories" as defined by Inagaki and Hatano (2002) are "coherent bodies of knowledge that involve causal explanatory device" (p.2). The presence of naive theories allow children to predict, analyze and explain a series of events in a coherent and causal manner because the concepts embedded in the theories are organized in this way. The theory-theory perspective suggests that children's naive theories enable them to understand and search for coherent, causally-related frameworks for phenomena at an early age. The argument here is that educators should use this perspective to prepare curricula that satisfies children's need for explanations, which will provide children with the evidence to either restructure or strengthen their naive theories. This coherent, causally-related information will assist in their theory change from misconception to accurate understanding.

The theory-theory perspective suggests that infants are prewired to think deeply and acquire knowledge quickly within certain domains, specifically three that were critical for the human species to evolve and survive (Wellman and Gelman, 1992). The core domains that have evidential support are naïve physics, naïve psychology, and naïve biology. Naïve physics is represented by an understanding of the movement of solid objects; naïve psychology is represented with goal-directed behaviors; and naïve biology is represented with life-sustaining activities of the body of humans and other living entities (Inagaki & Hatano, 2002). Novel and innovative testing methods have revealed that infants as young as 2-months-old have a basic understanding of the physical world (Hespos & Baillargeon, 2001) and at 6-months-old have a basic understanding of the goal-directed behaviors of humans (Hamlin, Wynn, & Bloom, 2007). Studies have also revealed that young children have a basic understanding of biology at around 2 to 3 years of age (Inagaki & Hatano, 2002); however future research and novel testing methods may reveal children possess this biological knowledge at even younger ages.

The naïve theory most relevant to the present study is children's naïve theory of biology. Biological understandings concern the distinction between living and nonliving things, the relation of humans to other species, and natural processes involving health (Wellman & Gelman, 1997). Metaphorically, a naive theory of biology can be thought of as coming into the world with special glasses which allow children to think and look at the world biologically. These glasses help them to take notice, examine and think deeply about animals, plants, humans and nonliving things and divide these concepts into categories. Children's experiences and input about biological processes build on their naive theory of biology, and can either revise or strengthen their current theories.

Indirect evidence for a naive theory of biology includes children's natural curiosity about human bodily processes, such as eating, growing and getting sick. Many children are also interested in learning about animals and plants. For example, children enjoy the responsibility of taking care of a pet and they love going to visit the animals at the zoo. Many children are also intrigued with the growth process of plants, and enjoy watering and caring for them. This natural curiosity about biological phenomena points to the existence of a naive theory of biology (Inagaki & Hatano, 2002).

Direct evidence for children's naive theory of biology include the following studies that show young children's recognition of a "distinct biological domain," their differentiation of plants and animals from inanimate objects, and their understanding of growth and reproduction (Hickling & Gelman, 1995; Inagaki & Hatano, 1993; Inagaki & Hatano, 1996; Rosengren, Gelman, Kalish, & McCormick,1991; Schult & Wellman, 1997; Springer, 1995). In studies showing that children have a distinct biological domain, preschool children were given questions about human behavior, and were asked to choose between a psychological and biological response. They reported the appropriate biological prediction for the majority of the questions, showing that they possess a distinct domain (Inagaki & Hatano, 1993; Schult & Wellman, 1997). Studies have also found that young preschoolers understand the differences between animate and inanimate objects, and comprehend the growth processes of animals (e.g., an animal will grow to develop its species' characteristics) and plants (e.g., a seed will grow into a plant, which produces more seeds, and the process repeats) and do not apply the same concept of growth to inanimate objects (e.g., a television does not have the capacity to grow larger) (Hickling & Gelman, 1995; Inagaki & Hatano,1996; Rosengren et al., 1991). Young children have also demonstrated a basic understanding of reproduction by recognizing that a baby grows inside a woman and that the mother passes some important properties to the child (Springer, 1995).

The results from all of the previous studies regarding children's biological understandings provide direct evidence for the existence of a naive theory of biology. This evidence is directly related to the development of an intervention because it demonstrates that young children have the ability to understand biological processes and could be educated about health at an early age.

Children's Misconceptions about Biological Processes

Although children have a naive theory of biology, their knowledge is not entirely perfect. Young children are still susceptible to misconceptions about biological processes. Biological misconceptions are defined as "conceptions that are either inaccurate or in contrast with the accepted scientific viewpoint" (Nguyen & Rosengren, 2004). During development, children are inundated with information about the world from parents, teachers, peers and the media. Children develop knowledge from these external sources that includes accurate and/or inaccurate representations of concepts. For example, information provided by parents or teachers can interact with a child's direct observations of biological phenomena (e.g., telling a child that flowers have feelings). This can result in a child constructing an inaccurate concept that differs from science (e.g., thinking that plants have feelings). When new evidence conflicts with a naive theory or direct observation, children consistently misreport and misinterpret biological processes (Gopnik & Wellman, 1994).

There are various studies documenting children's misconceptions about biological phenomena. Children have misconceptions concerning plants, animals, aging, illness and death. Children are cited in studies as believing that “taller people are older than shorter people, plants will die if they are not kept on a windowsill” (Pine, Messer, & St. John, 2001, p. 87) and that a tulip is capable of “feeling happy or pretty” (Inagaki & Hatano, 1987, p.1016). The biological misconceptions that are most relevant to the present study are the misunderstandings that young children have about nutrition and exercise. According to Vosniadou and Brewer (1992), it is important to examine children’s comprehension and misconceptions in order to better understand the limits of children’s knowledge. With this in mind, both the previous studies concerning children’s naive theory of biology as well as the following studies showing children’s misconceptions guided the construction of the intervention. The goal was to increase young children’s understanding and preference for healthy food and exercise.

Evidence showing children’s misconceptions concerning health and nutrition have been documented in studies from Wellman and Johnson (1982), Nguyen (2007) and Nguyen (2008). Wellman and Johnson (1982) conducted a study with kindergarteners, third graders and sixth graders to examine children’s health beliefs; specifically knowledge of illness, injury, bodily organs and nutritional functioning. The study focused on two tasks to assess children’s knowledge about the areas of output (e.g., height, weight) and input (e.g., nutrition, physical activity) within the nutritional system. In the first task, children were asked what they believed caused the variation in the output of two characters; for example, what accounted for the differences in height, weight, health and strength of these two characters. The second task focused on children’s ideas about what the consequences would be if identical twins altered their inputs, for example if one twin started to eat junky food and one started to eat healthy food. The results suggest that younger children have difficulty connecting the processes of input and output within the body. For example, children believed that food and water produced the same output, height and weight were equally related to amount of input, and that physical activity, not nutrition, was related to the body's output of energy and strength. Most of the misconceptions that children had during kindergarten were resolved by the sixth grade, which is evidence for concept acquisition and revision of naive theories with development (Wellman & Johnson, 1982).

More specific misconceptions that young children have regarding healthy and unhealthy foods are shown in studies from Nguyen (2007) and Nguyen (2008). Nguyen (2007) examined the evaluative categories that children ages 3, 4, and 7 use when classifying a food as either healthy or junky. The results showed that by age 3, children have a basic understanding of healthy and junky foods and by age 4, children begin to provide explanations for their classifications. However, the foods that many of the children had difficulty categorizing correctly were less than healthy meats (e.g., corn dogs, hamburgers) and vegetable products or derivatives (e.g., French fries, potato chips). Another study from Nguyen (2008) also examined 4-and 7-year-olds' evaluative categories of foods and provides support for the previous findings. This study found that children have difficulty classifying foods such as meats (e.g., chicken, sausage), lunch foods (e.g., soup, hotdog) and dinner foods (e.g., hamburger, salad) as healthy or junky. Overall, these studies show that younger children have difficulty categorizing some healthy and junky foods, especially meats, vegetable derivatives and lunch/dinner foods. With development, children acquire the ability to use evaluative categories to represent and organize the nutritional messages that they receive from parents, teachers, peers and the media. The results from Nguyen (2007) and Nguyen (2008) suggest that an appropriate time to begin teaching children about food, health, and nutrition is during the early preschool years.

Another area of focus in the present study is children's understanding of exercise. Exercise is defined in the research literature as "a subset of physical activity that is planned, structured and repetitive and has a final or an intermediate objective: the improvement or maintenance of physical fitness" (Caspersen, Powell, & Christenson, 1985, p.126). As a subset of physical activity, the term "exercise" has an analogous definition to physical activity, such that they are both defined as "any bodily movement produced by skeletal muscle that results in energy expenditure" (Trost, Morgan, Saunders, Felton, Ward, & Pate, 2000, p.294). Therefore, the current intervention focused on teaching children about exercise, an analogous yet more child-friendly word than physical activity.

The research suggests that children have numerous misconceptions regarding the concepts of physical activity and exercise. Many children associate being active with playing on a team, such as a soccer, basketball or swimming team, but neglect other forms of exercise such as riding a bike, walking and playing active games with peers (Trost et al., 2000). Because many children may not fully comprehend the concept of physical activity, inactive behaviors such as playing video games or playing on the computer could be mistaken for physical activity. These sedentary activities are easily mistaken as physical activity because the child's level of involvement is very high, there is rapid hand movement and some of the characters in these games are very active. A study to determine the constraints of fourth graders' understanding of physical activity is the previously mentioned study by Trost et al. (2000). The results of this study showed that fourth grade children have many misconceptions concerning the areas of exercise or physical activity; indicating that children may not fully understand the concept. Many of the errors occurred when mistaking sedentary activities such as reading a book, working on the computer, singing a song, playing video games, and doing homework as physical activity. Since children in the fourth grade struggle with comprehending this concept, this study suggests that younger children will have as much, if not more difficulty interpreting its meaning (Trost et al., 2000).

The body of research regarding children's knowledge of biological processes such as health behavior, healthy/junky foods and exercise shows that children have many misconceptions within these areas. The misconceptions that children develop at an early age can be detrimental to their health because they can result in unhealthy nutritional choices throughout the lifespan. One way to help children develop an accurate understanding of nutrition and exercise is to modify or change the course of their knowledge through an intervention at an early age.

Building a Theory-Based Intervention

Presently, various interventions exist that attempt to increase children's knowledge of health and involvement in healthy behaviors. In 2007, an Associated Press

(AP) review examined 57 government-funded nutrition education programs for children and found that only four of these programs produced promising results. The AP review measured effectiveness by looking at increases in healthy behaviors such as increases in vegetables and fruit consumption and increases in physical activity. For example, one study in the AP review was an eight year, $7 million dollar USDA nutrition program for children and parents in the Los Angeles School District. The results from the review showed that the USDA program did not produce significant increases in child or parent consumption of fruits and vegetables. Additionally, there were no significant differences in preferences for healthy food between children in the program and children not participating in the program. The findings from the AP review suggest that the billions of dollars spent on developing nutrition programs has yet to produce a successful model for changing children's health behaviors (Mendoza, 2007). Unlike the studies in the AP review, the present study is not measuring children's consumption of healthy foods and involvement in exercise before and after the intervention; however, it is measuring the efficacy of an intervention in increasing children's understanding of health and how this knowledge may influence children's food and activity preferences. The argument here is that a theory-based intervention will help children to make healthier, more informed choices because they will have a better understanding of health.

Other interventions not included in the AP review are also limited for several reasons. Interventions such as *Media Smart Youth* (NICHD, 2005), *We Can!* (NIH, 2005), and *The Power of Choice* (USDA, 2003) focus on older children and contain mainly games and activities. Another intervention by Sesame Street (2006) is a great source for younger children, yet it assumes that children will not be able to understand coherent and causal explanations for the processes of health in the body. Therefore, it targets young children with games and songs. Levin, Maurice, McKenzie, and DeLouise (2002) and Trost et al. (2000) are two examples of interventions that provide select information about physical activity and exercise, but do not contain nutritional guidance. Each of these interventions is described in detail below.

Media Smart Youth: Eat, Think, and Be Active is an intervention that focuses on older children and contains more activities and games than nutritional information. It was developed by the National Institute of Child Health and Human Development (NICHD) in 2005. The goals of this program are to help 11-to 13-year olds think critically about how the media can affect their nutrition and physical activity choices, to help them make good nutrition and physical activity decisions in daily life, and to encourage them to establish healthy habits that will last into adulthood. Since this intervention is geared towards 11-to 13-year-olds, it would be too complex for 3, 4, or 5-year-olds to understand. For example, learning about all of the substances that make up a whole grain would be too difficult for younger children to understand. *Media Smart Youth* also contains a media aspect that involves the creation of an advertisement focused on nutrition and physical activity. This may be interesting and fun for older children, but it would be difficult for younger children to learn how to create an advertisement. The format of the intervention involves teaching a concept and performing several activities relevant to that concept. The activities and games in this program far outweigh the nutritional content, which would make it difficult for young children to learn basic nutritional facts.

Another intervention that is geared toward older children and contains more games than content is *We Can! Ways to Enhance Children's Activity and Nutrition.* This is a national public education program developed mainly by the National Institute of Health (NIH) and geared toward preventing overweight and obesity in children. *We Can!* is designed for children ages 8 to 11, as well as for their parents and/or caregivers (NIH, 2005). This intervention provides healthy eating recipes and easy ways to incorporate exercise into a routine, but offers less nutritional content. Similar to *Media Smart Youth*, much of the information would be too complex for younger children to comprehend. For example, the curriculum has sections about counting calories, the concept of energy in/energy out, and decreasing portion size. This kind of nutritional information would be too complex for young children to understand, and would result in confusion at an early age.

A third intervention that targets older children is *The Power of Choice: Helping Youth Make Healthy Eating and Fitness Decisions*. This was developed by the United States Department of Agriculture (USDA) and the Food and Drug Administration (FDA). It is a guide created for leaders of after school programs to help young adolescents, ages 11-13, understand how their decisions about eating and physical activity can affect their health. The curriculum is filled with creative snack recipes and activities, but contains less content and few explanations about nutrition or physical activity. For example, active living is described in the curriculum by stating, "Active living is good for your body. It also helps you make the most of your appearance" (USDA, 2003). This does not explain the health benefits of exercising, just the aesthetic benefits. As a whole, *The Power of Choice* would be difficult to use as a model for an intervention focusing on younger children.

Sesame Street's website is a great source for younger children, yet it assumes that children will not be able to understand coherent and causal explanations for the processes of health in the body. Therefore, it targets young children with games and songs. This is a media supported intervention targeted at many areas of children's learning. The one aspect that is relevant to my thesis is *Sesame Street's* objective to teach children about nutrition (Fisch, Truglio, & Cole, 1999). On the website, they offer children information about healthy behaviors and food choices in the form of games and songs. In the game entitled "Color me Hungry", Cookie Monster and Grover explain to children that this game involves putting fruits and vegetables into the colored bins that correspond to the specific fruit's colors. In the introduction, Cookie Monster asks, "How me choose what to eat?" Grover replies with, "It is simple. All you have to do is eat your colors. See if you can eat five different colors everyday!" While trying to help a child learn about fruits and vegetables, *Sesame Street* is giving the message that healthy foods are colorful, but they are not providing enough explanation for why it is good for your body. The *Sesame Street* website also provides children with songs about health and nutrition, such as "A Cookie is a Sometimes Food" and "Mango Tango." For example, a verse in the song "Mango Tango" is as follows, "I love to eat a mango. She loves to dance the tango. But I can't dance the tango while he eats a mango". Overall, the songs and games are fun for children, but do not provide them with enough coherent, causally-related information to inform them and help them to make healthy decisions (Sesame Street, 2006).

The following interventions target younger children with select information about physical activity, but do not contain any information about nutrition. An intervention focusing on children in kindergarten through second grade was conducted by Levin et al. (2002). The intervention involved watching an interactive fifteen minute video that engaged children in singing and dancing, as well as visual images and descriptions of physical activity. The goal of the video was “to increase children’s knowledge, self efficacy, and attitudes about physical activity and heart health” (Levin et al, 2002). The results of this study showed that children’s knowledge of the rudimentary functions of the cardiovascular system and the benefits of physical activity significantly increased one day after viewing a fifteen minute educational videotape (Levin et al., 2002). Although this study did increase children’s knowledge about physical activity one day after the intervention, it did not test any long-term benefits. Another problem with this study is that it did not include a segment about nutrition, which is a large component to children’s understanding of health.

Another intervention that focused exclusively on children’s understanding of physical activity is from Trost et al. (2000). The aims of the study were to evaluate the efficacy of two interventions (a video group and a verbal group) that focused on increasing fourth graders’ understanding of the concept of physical activity. The findings showed that without an intervention, fourth graders have a limited understanding of physical activity. The video intervention was more effective than the verbal instruction in increasing knowledge, but children in both the video and verbal groups still had some misconceptions after the intervention (e.g., walking to school was not a form of physical activity, doing chores was not a form of physical activity.) These results suggest that the intervention was not completely effective in increasing fourth graders' understanding of the concept of physical activity.

The evaluation of the previous interventions demonstrates the need for a theory-based intervention targeted at young children's understanding and preference for healthy food and exercise. The following section examines two features that constitute a theory-based teaching intervention: coherence and causality. Previous research has suggested that these components are vital in developing an effective intervention. However, this research has yet to examine theory-based interventions within the realm of children's health (e.g., nutrition and exercise). The deficit of research in this field was the motivation behind the development of this intervention.

A theory-based approach to an intervention is defined as when the information presented in the curricula is both coherent and causally-related. *Coherence* can be thought of as the overall structure of the intervention, when the information is presented in a logically ordered manner in which the facts are related and the information is presented clearly. *Causality* can be thought of as the internal logic of the intervention, when separate facts are connected together through the explanation of causes and effects. The terms coherence and causality are related concepts, and are the essential components of a theory-based curriculum.

Research supporting the role of coherence in learning has been shown by Murphy and Medin (1985), who state that "a coherent category is one whose members seem to hang together, a grouping of objects that makes sense to the perceiver" (p.291). Murphy and Medin (1985) believe that there are two components to conceptual coherence. The first component involves the internal structure of a conceptual domain. Concepts that are connected with causal relations will be more coherent than those that are not and will be easily integrated with the rest of the knowledge base. The second component involves the position of the concept in the complete knowledge base. Concepts that have no relation with the background knowledge of the child will be unstable and easily forgotten (Murphy & Medin, 1985). Teaching new concepts based on the background knowledge, or naive theories of children, will be easier for children to understand and retain. This research shows that theory-based interventions, or curricula with causal relations and coherence, will help children to integrate information into their existing knowledge base.

The importance of causal relations in children's thinking and learning has been documented in numerous studies (Wellman & Gelman, 1997; Harris, 1994; Murphy & Allopenna, 1994; Gopnik & Sobel, 2000). Wellman and Gelman (1997) suggest that by preschool age, causal understandings are central in children's reasoning about biology. This is evidenced by young children's natural inclination to look for and expect events to have causes. An example of this is magic. If children willingly accepted uncaused events, they would have no need to appeal to magic (Harris, 1994). Young children are a good audience for magic shows because these "magical events" seem to have no explainable causes, and since children expect all events to have causes, magic shows are baffling and amusing to them (Harris, 1994). The importance of causal relations in children's learning is also shown in a study from Murphy and Allopenna (1994). The results showed that features that are related and linked to a theory (e.g., “These animals have sharp teeth because they help them to eat meat...”) are learned much faster than features not learned within a theory (e.g., “These animals have sharp teeth, eat meat, and have spots…”). Gopnik and Sobel (2000) provide another example showing the importance of causality in acquiring new concepts. Results indicated that children as young as 2-years-old use causal information to guide naming and induction. For example, objects with the same causal effects were more likely to receive the same label than objects sharing perceptual appearance, but differing in causal power (Gopnik & Sobel, 2000). The previous studies suggest that children benefit from learning new concepts when they are presented within a theory, or a coherent and causally-related framework.

The steps that are critical to include in the development of an intervention are documented in a study by Solomon and Johnson (2000). This study shows that the classroom setting can facilitate children’s causal theoretical understanding of biological inheritance. Solomon and Johnson (2000) suggest that an intervention should focus on three factors: making children aware that they lack an understanding of a certain biological concept, presenting them with relevant facts and teaching them causally-related information. Solomon and Johnson (2000) modeled their intervention around those three factors. Participants were 5-and 6-year-olds, and were placed in either an intervention or a control group. The task focused on the understanding that similarity in physical traits and similarity in beliefs are caused through different mechanisms: offspring should resemble their birth parents on physical traits and their adoptive parents on learned traits. The intervention was comprised of three main points: showing the children that they lacked an understanding of the material (e.g., children took a pre-test and were informed of the questions that they answered incorrectly), teaching them facts, and providing them with a causal mechanism (e.g., genes) that enabled them to link the facts together. The results demonstrated that children in the intervention condition made more accurate judgments and gave more explicit causal explanations for birth and learning than the children in the control group. This study relates to the current intervention because it suggests that providing children with a causal mechanism enables them to restructure their knowledge and reason about a specific biological process. One of the goals of this thesis was to increase children's understanding about another biological process through providing causal and coherent explanations about nutrition and exercise.

Studies by Krascum and Andrews (1998), Au and Romo (1996) and Zamora, Romo, and Au (2006) provide additional examples of a theory-based intervention for children. Krascum and Andrews (1998) examined whether theory-guided learning could help 4-and 5-year-olds learn more features of a fictitious animal than those who did not receive theory-guided learning. Two categories for fictitious animals were constructed; "fighting" animals called "wugs" and "hiding" animals called "gillies." Children were placed in a training session that involved either teaching the child a theory to explain the function of the animals' features, or labeling the animals without an explanation for the function or purpose of the features. An example of a passage based in theory is the following, "See these animals? They are called wugs. There is a special way to tell that these animals are wugs. <u>Wugs are animals that like to fight</u>. A wug has sharp claws <u>that</u>

he can scratch with" (Krascum & Andrews, 1998, p.337). The underlined parts represent the coherent and causally-related sections in the passage. An example of a passage not based in theory is the following, "See these animals? They are called wugs. There is a special way to tell that these animals are wugs. They have claws" (Krascum & Andrews, 1998, p.338). The underlined sections are absent in the non theory-based passage, showing that it lacks causality and coherence. The results of this study showed that children were able to identify and learn more features of a novel animal when they were presented within a theory, suggesting that it is beneficial to educate children by presenting information within a theory.

Au and Romo (1996) provide another example of a theory-based intervention. This study demonstrates the efficacy of a theory-based curriculum in helping 4th, 5th and 6th graders develop an accurate conception of AIDS transmission. It was developed in response to the ineffective AIDS curricula in the schools, which was causing adolescents to form many misconceptions concerning AIDS. For this study, 4th, 5th and 6th graders were assigned to either the experimental or control condition. In the experimental condition, children were taught a causal mechanism for AIDS transmission and were assisted in forming a coherent conception of the disease. The causal mechanism can be summarized as the following, "The AIDS virus is a living thing, and so it can reproduce, stay alive and will die in various environments" (Au & Romo, 1996, p.215). Basically, the causal mechanism is connecting all the facts together by describing the AIDS virus as having germ characteristics. In the control condition, children were taught the standard AIDS education program used by the school system, which is absent of this causal mechanism. The results showed that learning about a causal mechanism in the experimental condition helped children to form a coherent conception of AIDS transmission. It also helped them to reason about novel situations and enhanced their caution regarding AIDS without causing unwarranted fear (Au & Romo, 1996).

To expand on the study by Au and Romo (1996), Zamora et al. (2006) showed that a curriculum based around a biological causal mechanism is more effective in increasing 7th graders' knowledge about Sexually Transmitted Diseases (STDs) than a control group with no causal mechanism. Subjects were placed in one of two groups: an experimental group or a control group. The experimental group received facts about STDs and a biological causal mechanism for STD transmission (e.g., STDs have germ characteristics) to connect the facts together. The control group received factual information about STD transmission through the standard curriculum given by the school, which did not contain a biological causal mechanism. For example, the experimental group was told the following statement, "Here is a picture of a white blood cell that has been taken over by the HIV virus. The large, white circular shapes are pockets in the cells, vacuoles. Within these pockets, you can see the AIDS virus, HIV, which are the dark circular shapes, black spots. The black spots are HIV that were reproduced in the host cell. In this second picture, you can see HIV viruses leaving the host cell to invade other white blood cells. Once the virus enters a new white blood cell, then it will take over and multiply into hundreds of viruses" (Zamora et al., 2006, p.114). The underlined sections represent the causal explanations. The control group was told the following statement without the causal mechanism for STD transmission, "Here is a picture of a white blood cell that has been taken over by an HIV virus. The large, white circular shapes are pockets in the cells, called vacuoles. Within these packets, you can see the AIDS virus, HIV, which are the dark circular shapes, black spots" (Zamora et al., 2006, p.113). The results of this study showed that when provided with a causal mechanism, adolescents gave more biologically based explanations in response to open-ended questions about STDs and were better able to identify novel risky sexual behaviors. The results suggest that providing adolescents with a causal mechanism helps them to understand biological processes and reason about unfamiliar situations (Zamora et al., 2006). This finding establishes the importance of teaching a curriculum with a causal mechanism, and should be further explored with younger children in other areas of biology.

The previous research suggests that providing children with a theory-based intervention is effective in increasing children's biological understandings and allows them to apply this knowledge to areas not explicitly covered in curricula. Interventions that are not theory-based may result in confusion, no change, or an increase in children's understandings in the short-term concerning *only* the facts or events discussed in the curriculum. If they are not provided with a causal and coherent framework in which to organize this material, it could ultimately result in confusion and misconceptions in the future. Consequently, without a strong grasp of the information, children may not be able to apply this knowledge to areas not covered in the intervention. This could be problematic since an intervention cannot cover all of the information that a child experiences throughout development. Therefore, presenting children with a theory-based intervention may provide them with a strong base for concept acquisition, and allow them to make inferences about novel situations.

In summary, there were four motivations for the current study: 1) The percentage of young children, ages 2-5, that are overweight in the U.S. is increasing (CDC, 2006); 2) Children's naive theories allow them to understand biological processes at an early age, yet they have many misconceptions within the domain of health; 3) Current interventions targeting children's health are limited because they focus on more games and activities than nutritional content, target older children, and do not contain theory-based explanations; 4) There is a deficit of theory-based interventions focusing on both young children's *understanding* and *preference* for nutrition and exercise. Studies have shown that children benefit from learning various concepts within theory-based curricula, but they have yet to cover the field of nutrition and exercise. Theory-based interventions have also yet to focus on changing children's preferences, resulting in a gap in the research. Since preferences can motivate a child's healthy or unhealthy behaviors, it was important to focus on changing children's preferences in this intervention. When children are provided with a theory-based intervention that contains coherent and causally-related explanations for healthy behaviors, the prediction is that their preference for these behaviors will increase because they will have a better understanding of the processes involved in the body.

To help clarify the following hypotheses, the design will be briefly summarized. Children were randomly assigned to one of three groups: control (e.g., received no intervention); non-theory group (e.g., received a non theory-based intervention); theory group (e.g., received a theory-based intervention). The control group was included to measure children's natural increases and/or decreases in understanding and preferences over time without an intervention. The non theory group and theory group were provided with the same basic information; however the non theory group did not receive coherent and causal explanations for health. Therefore, the non theory group was included to demonstrate that children's performance in the theory group was not just a result of receiving information, but from receiving a specific type of information: coherent and causal explanations.

Although the same basic information was included in both interventions, the theory-based intervention, by definition, consisted of more components (e.g., coherent and causal explanations). Therefore, the theory-based intervention was naturally longer than the non theory-based intervention, which is a limitation and a confound. Since the theory-based intervention was composed of two enmeshed and intimately linked parts (e.g., coherence and causality), it was important to test the whole package first to ensure that it was effective. Thus, this confound was unavoidable and necessary in the present study to see if the intervention was effective. In future research, the components will be tested individually to see which part is the active ingredient. This confound will not be present in future studies because the two interventions will be equated in length, essentially testing the theory-based intervention against a different version of itself (e.g., testing a coherent version of the theory-based intervention against an incoherent version or scrambled version of the intervention). Therefore, the present study was the first step of many in determining the efficacy of theory-based interventions within the domain of health.

To test the impact of the intervention, the present study used a pre-test/intervention/post-test design, and was implemented in two sessions. During the first session, the participants were given a pre-test involving general classification, specific classification and preference questions about vegetables, high-fat foods, exercises, and non exercises. Approximately 1-6 days later, the subjects were given an intervention and post-test involving the same questions asked in the pre-test. The type of intervention received corresponded to the condition that the participants were assigned. Both the pre-test and post-test asked general classification (e.g., 4 classification and open-ended questions concerning the categories of vegetables, high-fat foods, exercises and non exercises), specific classification (e.g., 24 classification questions about specific items within each category) and preference questions (e.g., 24 questions about specific foods and activities) about items covered in the intervention and novel items not included in the intervention. Based on previous research, three outcomes were hypothesized: 1) At pre-test, there will be no differences in performance between the groups (e.g., control, non theory, theory) on general classification, specific classification, or preference questions, including novel items; 2) At post-test, the theory group will be more accurate on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions than the non theory group and control group, including novel items; 3) The theory group will show the largest increase in accuracy from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions, including novel items. Since the non theory group received basic information about health, they will improve slightly, albeit insignificantly, in their performance from pre-test to post-test. Since the control group did not receive any health-related information, they will show no significant changes from pre-test to post-test.

METHOD

Participants

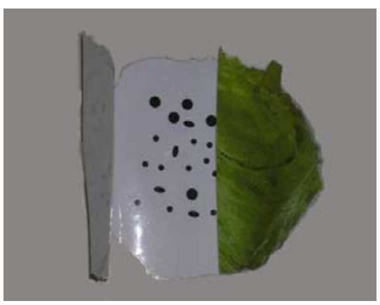
Participants were 60 three-to four-year-olds (*M* = 4.51, *range* = 3.8 - 4.9; 33 boys and 27 girls). This age group was used because as previous studies have shown (Nguyen, 2007; Nguyen, 2008), older 3-year-olds and 4-year-olds have a basic understanding of nutrition, but have many misconceptions regarding healthy and junky foods. Since this age group has a basic, but not complete understanding of nutrition, the intervention did not produce ceiling or floor effects. Previous studies have also revealed that 4-year-olds have the capacity to learn from a theory-based intervention (Krascum & Andrews, 1998), suggesting that this is a viable age group to focus on. A power analysis (using Cohen, 1988) suggested that for an expected medium effect size (.50) with a minimum power of .80 and an alpha level of .01, approximately 20 children per group were necessary. Therefore, 20 participants were randomly assigned to each of the three groups: the theory-based group (*M* = 4.53, *range* = 3.9 - 4.9; 11 boys and 9 girls); the non theory-based group (*M* = 4.46, *range* = 3.8 - 4.8; 12 boys and 8 girls); and the control group (*M* = 4.55, *range* = 4.0 - 4.9; 10 boys and 10 girls). There were no significant age differences between the groups as revealed by a one-way ANOVA, $p > .05$.

Sixty adults (*M* = 20.1, *range* = 18.5 - 24.6) participated to help select the stimuli and create the intervention. Ten children (*M* = 4.14, *range* = 3.4 - 4.9) also participated to help select the stimuli. These materials are described in the next section. The participants were predominately middle-class European-Americans recruited from preschools and a university located in the Southeastern United States.

Materials

In this section, an extensive description is given of the materials, including how they were developed and rated by adults and children. The items included in the intervention were from four different categories, and consisted of five vegetables, five high-fat foods, five exercises, and five non exercises. Color photographs of these items were collected from Internet Sources and were laminated and cut into 5 in. x 4 in. squares. Three additional items were used in the non theory-based intervention and theory-based intervention to teach children about vegetables, high-fat foods, exercises and non exercises. These items were labeled as “manipulables” because children could open and play with them during the intervention. The first item was a picture of lettuce that children could open to reveal vitamins inside. This was used to teach children about healthy foods, specifically vegetables. The second item was a picture of a cookie that children could open to reveal no vitamins inside. This was used to teach children about not healthy foods, specifically high-fat foods. The third item was a picture of a human body that children could open to reveal a heart, muscles and bones inside. This was used to teach children about both exercises and non exercises. Please see Table 1 below for photographs of these materials.

Table 1.
Photographs of the Manipulables

Healthy Foods: Vegetables	Not Healthy Foods: High-Fat	Exercise and Non Exercise
		
		

Note: The top row shows the closed manipulables. The bottom row shows the open manipulables. These items were used in both the non theory-based and the theory-based intervention.

Additionally, two boxes were constructed for the pre-test and post-test specific classification questions. The boxes were both black and had a slit in the top for children to place the laminated pictures of the foods and activities inside. One box was for healthy foods/exercise and had a small smiley face on the front of the box. The second box was for not healthy foods/not exercises and had a frowny face on the front of the box. Please see Table 2 below for a photograph of these two boxes.

Table 2.
Healthy Food/Exercise and Not Healthy Food/Not Exercise Boxes

<table>
<tr><td>A.
</td><td>B.
</td></tr>
<tr><td colspan="2">C.
</td></tr>
</table>

Note: A. Healthy Foods/Exercise box; B. Not Healthy Foods/Not Exercise box.
C. Children could place the specific food and activity pictures into the slits on the top of the boxes.

Ratings

The food and activity items used in the intervention were selected from a larger list of items based on adult ratings. It is standard practice to use adult ratings in developmental research in order to help guide stimuli selection. The first set of ratings focused on typicality to ensure that participants would be equally familiar with the items. A group of 16 adults rated the items for "typicality," which is defined as "how good of an example an item is of a category." They rated each item on a scale ranging from 1 (not at all typical) to 7 (very typical). Please see Appendix A1 to examine the typicality data sheet. All of the examples in each category are equated on typicality; vegetables (M = 6.44), high-fat foods (M = 6.45), physical activities (M = 6.34) and non physical activities (M = 6.64). The means of each category fall in the range from 6.34 to 6.64, which is defined as between "somewhat typical" and "very typical."

The second set of ratings focused on palatability/enjoyability to ensure that the participants would find the items to be equally palatable and enjoyable. A different group of 16 adults rated items from each category for palatability/enjoyability. "Palatability" is defined as "tastiness of the food" and "enjoyability" is defined as "receiving pleasure or satisfaction from." The scale ranges from 1 (not at all palatable/enjoyable) to 7 (very palatable/enjoyable). Please see Appendix A2 to examine the palatability/enjoyability data sheet. All of the items in each category are equated on both palatability and enjoyability; vegetables (M = 4.66), high-fat foods (M = 5.10), physical activities (M = 4.58) and non physical activities (M = 4.74). The means of each category fall in the range from 4.58 to 5.10, which is defined as "somewhat palatable/enjoyable."

After administering the adult typicality and palatability/enjoyability ratings, a group of 10 children rated the selected items for typicality and palatability/enjoyability to ensure that the items were equally typical and palatable/enjoyable to children. Changes were made in the presentation and wording of the task to reflect children's language and cognitive abilities. For example, the children were presented with a face likert scale, numbered 1-5 (e.g., a frowning face representing "1", a smiling face representing "5") Please See Appendix B1 to review the face likert scale. Additionally, the words "typicality" and "palatability/enjoyability" were changed to more child-friendly words: "example" for "typicality" and "yummy/fun" for "palatability/enjoyability."

A group of 10 children rated the items for typicality by pointing to the face and corresponding number on the face likert scale. Children rated each item on a scale ranging from 1 (not a good example) to 5 (very good example). Please see Appendix B2 to examine the child typicality data sheet. All of the examples in each category are equated on typicality; vegetables (M = 3.86), high-fat foods (M = 4.08), physical activities (M = 4.18) and non physical activities (M = 3.34). The means of each category fall in the range from 3.34 to 4.18, which is defined as between "kind of a good example" and a "very good example." This finding is analogous to the adult ratings, which showed the means of each category falling in the range between "somewhat typical" and "very typical."

The same group of 10 children rated items for palatability and enjoyability by pointing to the face and corresponding number on the face likert scale. Children rated each item on a scale ranging from 1 (not at all yummy/fun) to 5 (very yummy/fun).

Please see Appendix B3 to examine the child palatability/enjoyability data sheet. All of the items in each category are equated on both palatability and enjoyability; vegetables (*M* = 3.62), high-fat foods (*M* = 3.48), physical activities (*M* = 3.90) and non physical activities (*M* = 3.72). The means of each category fall in the range from 3.48 to 3.90, which is defined as “kind of yummy/fun.” This finding is analogous to the adult ratings, which showed the means of each category falling in the range of “somewhat palatable/enjoyable.” Thus, the child ratings confirm the adult ratings and provide confidence that both sets of participants find the items to be equally familiar and equally palatable/enjoyable.

<u>The Intervention</u>

A different group of 28 adults rated both the theory-based intervention and the non theory-based intervention for coherence and causality to ensure that these two interventions were different from one another. See Table 3 to examine the theory-based and non theory-based interventions. Also, please see Appendix A3 to examine the coherence data sheet and Appendix A4 to examine the causality data sheet. The participants were asked to rate the intervention on six sections: 1) The overall intervention (e.g., the entire curriculum), and five more sections showing the intervention broken up into separate passages: 2) The introduction; 3) Healthy foods; 4) Unhealthy foods; 5) Physical/Nonphysical activity; and, 6) The conclusion. The participants were asked to read both the theory-based and non theory-based passages for each section before rating each of them for coherence and causality. They were asked to rate the passages in this manner because the relative comparison between the two groups is of interest as opposed to the separate, absolute levels of coherence and causality ratings for each group. The term "coherent" is defined as, "the degree to which material is presented in a logically ordered manner in which the facts are related and the information is presented clearly." The term "causally-related" is defined as, "the degree to which separate facts are connected together through the explanation of causes and effects." The scale ranges from 1 (not at all coherent/causal) to 7 (very coherent/very causal). The ratings show that the two curricula are significantly different from one another, more specifically that the theory-based group's scores are significantly higher for the overall intervention in coherence (M = 6.61, SD = .88) than the non theory-based group's scores for coherence (M = 3.46, SD = 1.43), $t(27) = 9.46$, $p < .05$. Also, the theory-based group's scores are significantly higher for the overall intervention in causality (M = 6.75, SD = .52) than the non theory-based group's scores for causality (M = 3.32, SD = 1.39), $t(27)$ = 12.97, $p < .05$. Each of the five separate passages in the intervention were significantly higher in coherence and causality in the theory-based intervention than in the non theory-based intervention. Please see the note under Table 3 to examine these numbers.

Since the theory-based intervention consisted of more components than the non theory-based intervention, an independent samples t-test was run to compare the word amount from each section of the theory-based intervention to each section of the non theory-based intervention. The results revealed no significant differences in word amount between the interventions, $p > .05$.

Table 3.
Comparative Table of Interventions

Theory-based	**Non theory-based**
Learning Objective: Introduction	
We are going to learn today about how to have a healthy body. I'm going to point to my body (point to body). Now can you point to your body? Having a healthy body means your body has energy and strength to grow, learn, and play (NIH, 2005, p.1; NICHD, 2005, p.61).	We are going to learn today about different things. I'm going to point to my body (point to body). Now can you point to your body?
Learning objective: What is a healthy food?	
To have a healthy body, you need to feed it right (NICHD, 2005, p.61). Healthy foods give your body what it needs because they have many vitamins. Vitamins are inside of healthy foods. (Show lettuce) Look! This is lettuce. Lettuce is a vegetable and a healthy food because has vitamins inside. Let's look inside! (open flaps and point to vitamins) These are the vitamins, see? Can you point to the vitamins? Would you like to see the lettuce? Vitamins help you grow, give you long-lasting energy, and keep you from getting sick (NICHD, 2005, p.61; NICHD, 2005, p.K-3; NIH, 2005, p.1; AHA, 2006).	Healthy foods give your body what it needs (NICHD, 2005, p.61). (Show lettuce). Look! This is lettuce. Lettuce is a vegetable and a healthy food. Let's look inside! (open flaps) Can you point to the inside? Would you like to see the lettuce?
Learning Objective: Why are vegetables healthy for your body?	
There are many healthy foods you should eat a lot of. For example, vegetables are healthy foods because they have many vitamins inside of them. You should eat vegetables every day (NICHD, 2005, p.61-62).	There are many healthy foods you should eat a lot of. For example, vegetables are healthy foods. You should eat vegetables every day (NICHD, 2005, p.61-62).
Learning Objective: What are examples of vegetables?	
Examples of vegetables that have many vitamins inside are beans, celery, carrots, broccoli, and corn (NICHD, 2005, p.45-53). These foods help you grow, give you long-lasting energy, and keep you from getting sick (NICHD, 2005, p.61; NICHD, 2005, p.K-3; NIH, 2005, p.1; AHA, 2006).	Examples of vegetables are beans, celery, carrots, broccoli, and corn (NICHD, 2005, p.45-53).

Table 3. cont.

Learning Objective: What is a not healthy food?

Remember, to have a healthy body you need to feed it right (NICHD, 2005, p.61). Foods that are not healthy do not give your body what it needs because they do not have many vitamins. Foods that are not healthy do not have vitamins inside (NICHD, 2005, p.136). (Show the cookie). Look! This is a cookie. Cookies are a high-fat food and are not healthy because they do not have vitamins inside. Let’s look inside! (Open the flaps and point to empty inside) Would you like to see the cookie? High-fat foods do not have vitamins that help you grow, do not give you long-lasting energy, and do not keep you from getting sick (NICHD, 2005, p.61; NICHD, 2005, p.K-3; NIH, 2005, p.1; AHA, 2006).	Foods that are not healthy do not give your body what it needs (NICHD, 2005, p.136). (Show the cookie). Look! This is a cookie. Cookies are a high-fat food and are not healthy. Let’s look inside! (Open the flaps) Can you point to the inside? Would you like to see the cookie?

Learning Objective: Why is a lot of fat not healthy for your body?

There are many foods that are not healthy that you should not eat a lot of. For example, foods that are high in fat are not healthy foods because they do not have many vitamins inside of them. You should not eat foods with a lot of fat every day (NICHD, 2005, p.136-139).	There are many foods that are not healthy that you should not eat a lot of. For example, foods that are high in fat are not healthy foods. You should not eat foods with a lot of fat every day (NICHD, 2005, p.136-139).

Learning Objective: What are examples of foods that are high in fat?

Examples of foods that are high in fat and do not have many vitamins inside are potato chips, bacon, cake, doughnuts, and fudge (NICHD, 2005, p.137). These foods do not help you grow, do not give you long-lasting energy, and do not keep you from getting sick (NICHD, 2005, p.61; NICHD, 2005, p.K-3; NIH, 2005, p.1; AHA, 2006).	Examples of foods that are high in fat are potato chips, bacon, cake, doughnuts, and fudge (NICHD, 2005, p.137).

Learning Objective: What is exercise?

To have a healthy body, you also need to treat it right by exercising. Exercise is anything that gets your body & muscles moving, your heart working, and keeps your body healthy and fit (NICHD, 2005, p.153-167). (Show human body.) Look! This is a human body. Let’s look inside! (Open flaps). This is a heart, bones, and muscles. Can you point to the heart? Can you point to the bones? Can you point to the muscles? Would you like to see the body?	Exercise is anything that gets your body & muscles moving, your heart working, and keeps your body healthy and fit (NICHD, 2005, p.153-167). (Show human body.) Look! This is a human body. Let’s look inside! (Open flaps). Can you point to the inside? Would you like to see the body?

Table 3. cont.

Learning Objective: Why is exercise healthy for your body?

Exercise is healthy for you because it makes your bones and muscles strong, makes your heart beat faster, gives you energy, and keeps you from getting sick. You should exercise every day (NICHD, 2005 p.154).	Exercise is healthy for you. You should exercise every day (NICHD, 2005 p.154).

Learning Objective: What are some examples of exercise?

Examples of exercise that make your bones & muscles strong, make your heart beat faster, give you energy, and keep you from getting sick are playing soccer, canoeing, playing on the jungle gym, playing tag, and riding a bike (NICHD, 2005 p.154). But, some things we do are not exercise. Let me show you…Watching TV, reading a comic book, typing on the computer, writing a letter, and watching a movie are not exercise because they do not make your bones and muscles strong, do not make your heart beat faster, do not give you energy, and do not keep you from getting sick (NICHD, 2005 p. 153-167).	Examples of exercise are playing soccer, canoeing, playing on the jungle gym, playing tag, and riding a bike (NICHD, 2005 p.154). But, some things we do are not exercise. Let me show you…Watching TV, reading a comic book, typing on the computer, writing a letter, and watching a movie are not exercise (NICHD, 2005 p.153-167).

Learning Objective: Conclusion

Today we learned about how to have a healthy body. We learned about healthy foods like vegetables that have many vitamins inside that help you grow, give you long-lasting energy, and keep you from getting sick (NICHD, 2005 p.61; NICHD, 2005 p.K-3; NIH, 2005 p.1; AHA, 2006). We learned about foods that are not healthy like foods that are high in fat that do not have many vitamins inside (NICHD, 2005 p.136-139). We also learned about exercise that makes your bones and muscles strong, keeps your heart healthy, gives you energy, and keeps you from getting sick(NICHD, 2005 p.154). You should eat vegetables and exercise every day.	Today we learned about different things. We learned about healthy foods like vegetables, not healthy foods that are high in fat, and exercise. You should eat vegetables and exercise every day.

Note. This table compares the theory-based intervention (left column) to the non theory-based intervention (right column). The underlined sections in the theory-based intervention represent the parts that make it coherent and causally-related. These underlined sections are absent in the non theory-based version. The *coherence ratings* for the theory-based and non theory-based interventions are the following: Introduction section: Theory (M = 6.79, SD = .63) and Non theory (M = 2.60, SD = 1.70); Vegetables: Theory (M = 6.54, SD = .69) and Non theory (M = 3.29, SD = 1.36); High-fat foods: Theory (M = 5.96, SD = 1.14) and Non theory (M = 3.57, SD = 1.53); Activities: Theory (M = 6.54, SD = .64) and Non theory (M = 4.36, SD

Table 3. cont

= 1.79); Conclusion: Theory (*M* = 6.68, *SD* = .61) and Non theory (*M* = 3.32, *SD* = 1.74), *t*'s(27) > 5.81, *p*'s < .05. The *causality ratings* for the theory-based and non theory-based interventions are the following: Introduction section: Theory (*M* = 6.14, *SD* = 1.21) and Non theory (*M* = 1.32, *SD* = .86); Vegetables: Theory (*M* = 6.64, *SD* = .78) and Non theory (*M* = 3.14, *SD* = 1.18); High-fat foods: Theory (*M* = 6.11, *SD* = 1.23) and Non theory (*M* = 3.18, *SD* =1.52); Activities: Theory (*M* = 6.79, *SD* = .50) and Non theory (*M* = 4.00, *SD* = 1.39); Conclusion: Theory (*M* = 5.86, *SD* = 1.46) and Non theory (*M* = 2.43, *SD* = 1.40), *t*'s(27) > 7.68, *p*'s < .05.

The Curriculum

The information contained in the curriculum is a combination of facts derived from many sources, such as the National Institute of Child Health and Human Development (NICHD, 2005), the American Heart Association (AHA, 2006), and the National Institute of Health (NIH, 2005). The intervention lasted approximately 10-15 minutes for each child: 10 minutes for the non theory-based intervention and 15 minutes for the theory-based intervention. Since the amount of time that the researcher spent with each child varied, a one-way ANOVA was run to examine if time spent was significantly different between the groups (control, non theory and theory). The results revealed no significant differences in time spent with the researcher between the groups, $p > .05$.

The curriculum focused on teaching children about four concepts: vegetables, high-fat foods, exercises, and non exercises. The reason for the inclusion of these four areas is related to a finding from Stice, Shaw and Marti (2006). These researchers performed a meta-analysis of 25 years of research on 64 different programs to establish which programs were the most effective in preventing weight gain in children and adolescents. The results showed that interventions focusing on few concepts are more effective than those focusing on a vast amount of concepts (Stice, Shaw & Marti, 2006). Therefore, targeting three or four important concepts is more effective in teaching children than providing children with an abundance of information. In addition, interventions that are brief and given by a dedicated interventionist are more effective than longer interventions delivered by a school teacher (Stice, Shaw, & Marti, 2006). See Appendix C to examine how the interventions were presented to the subjects.

Procedure

Before beginning the study, parental consent forms and parent questionnaires were passed out to the parents. See Appendices D and E. Parents were asked to return the completed consent forms and questionnaires to their child's daycare/school. A total of five preschools participated in the study, with an equal number of children in each group tested at each preschool.

The study used a pre-test/intervention/post-test design, and was implemented in two sessions. To keep things organized and to prevent overlapping interventions, researchers tested children in "waves." For example, in wave 1 researchers focused on testing three children in one group (e.g., theory, non-theory, or control) from start to finish, and this was repeated with the same number of children in each of the groups for wave 2, wave 3, etc. Towards the end of data collection, the researchers tested three children in separate groups (e.g., theory, non-theory, or control) from start to finish because there were an unequal number of children in the groups. For example, a researcher tested 3 children from start to finish: one child in the theory group, one child in the non theory group, and one child in the control group. This continued until there was a sufficient amount of children in each group (e.g., 20 children in each group). This was a double-blind study, with one female researcher administering the pre-test and post-test without knowledge of what intervention the child received, and with the children unaware of what condition they were in. A different female researcher administered the interventions (e.g., theory-based, non theory-based, control) to the children. During the first session, one researcher took the children's weight and height to calculate their Body

Mass Index (BMI). Children's BMI was only calculated in the first session because it was unlikely that their BMI would change significantly in one week. The second researcher administered the pre-test to children randomly assigned to the control group, the non theory-based group, or the theory-based group.

During the second session, the researchers returned to the school 1-6 days (M = 4.4 days) later to administer the intervention and post-test to the same children in each group: Theory group (M = 4.8 days later), non theory group (M = 4.7 days later) and control group (M = 3.6 days later). For example, if the first session occurred on Monday, the second session occurred between the days of Wednesday and the following Monday. Having 1-6 days in between session 1 and session 2 allowed for variability in children's attendance at preschool. If a child was not present 1-6 days later to receive the intervention and post-test, the researcher excluded the child's pre-test data. There were no significant differences between the groups for days in between pre and post-test as revealed by a one-way ANOVA, $p > .05$.

The intervention and post-test were administered on the same day to control for extraneous variables that could affect understanding and preference scores between the intervention and the post-test (e.g., watching a video about health, having a parent talk to the child about healthy behaviors, etc.). One researcher administered the intervention in a room while the second researcher waited in a separate room unaware of the intervention that the child received. After the child received the intervention, the second researcher was notified to enter the room to administer the post-test to the child. Since the control group did not receive an intervention, the first researcher sat down in the room with each child in this group to gather the child's name, DOB, teacher's name, and other general information. After this, the second researcher was notified to enter the room to administer the post-test.

The non theory-based intervention group received the non theory-based intervention and the post-test. The theory-based intervention group received the theory-based intervention and the post-test. The theory-based group and the non-theory based group were provided the same basic information in their interventions, but the theory-based group was provided with causal and coherent explanations. Please see Table 3 to examine both the theory-based and non theory-based interventions, and please see Appendix C to examine how each of the interventions was presented. See Table 4 below to examine the timeline for the implementation of these measures.

Table 4.
Timeline for Implementation of the Measures

Days/Sessions	Implementation
Before testing	Parent consent form & parent questionnaire sent home to parents
Day 1 (Session 1)	Pre-test
Days 2-7 (Session 2)	Intervention (all groups except control) & post-test

Parent Questionnaire (See Appendix E)

The parent questionnaire asked for information pertaining to children's food and activity behaviors, such as specific food allergies, preferences, food/activity availability, frequency of activities and food intake. These are all important factors to examine because they could account for a child's performance on the classification and preference tasks. For example, children's food allergies could account for a child's performance on the tasks, especially on the preference section. The foods included in this study were carefully selected to avoid common food allergies, such as lactose intolerance and peanut allergies. The questionnaire also examined parent demographic information such as education level, occupation and ethnicity. The purpose of the questionnaire was to provide additional information or a context for understanding the child data. Thus, children were not excluded from the study if their parents did not return the questionnaire.

Pre-test (See Appendix G1)

The pre-test consisted of 4 general classification questions, 24 specific classification questions and 24 preference questions. These questions are described in detail on pages 46-48. The questions in the pre-test concerned the items that were covered in the intervention, which included five vegetables, five high-fat foods, five exercises, and five non exercises. The pre-test also included four novel items (e.g., items not explicitly taught in the intervention); one for each category (vegetables, high-fat, exercise, non exercise). The novel items were equated with the items included in the intervention on both adult and child palatability/enjoyability and typicality ratings. The mean ratings for the novel items are provided below. Refer to pages 31-33 to compare the means of the novel items to the means of the items in the intervention.

For the adult palatability/enjoyability ratings, the mean novel ratings are the following: novel vegetable (*M* = 4.56); novel high-fat food (*M* = 4.68); novel physical activity (*M* = 3.93); and novel non physical activity (*M* = 3.62). The means for each category fall in the range of 3.62 to 4.68, which is defined as "somewhat palatable/enjoyable". For the child palatability/enjoyability ratings, the mean novel ratings are the following: novel vegetable (*M* = 3.30); novel high-fat food (*M* = 3.70); novel physical activity (*M* = 4.40); and novel non physical activity (*M* = 4.30). The means for each category fall in the range of 3.30 to 4.40, which is defined as between "kind of yummy/fun" and "very yummy/fun". For the adult typicality ratings, the mean novel ratings are the following: novel vegetable (*M* = 5.81); novel high-fat food (*M* = 5.56); novel physical activity (*M* = 7.0); and novel non physical activity (*M* = 6.32). The means for each category fall in the range of 5.56 to 7.0, which is defined as between "somewhat typical" and "very typical". For the child typicality ratings, the mean novel ratings are the following; novel vegetable (*M* = 3.40), novel high-fat food (*M* = 4.10), novel physical activity (*M* = 3.90), and novel non physical activity (*M* = 3.10). The means for each category fall in the range of 3.10 to 4.13 which is defined as between "kind of a good example" and "a very good example." Thus, it can be concluded that both sets of participants found the novel items to be equally as familiar and equally as palatable/enjoyable as the items included in the intervention.

Providing questions for one novel item per category was sufficient to examine 3-

to 4-year-olds' understanding of the concepts without overwhelming them with a long test. The reason for the addition of the novel items was to examine if children could use their acquired knowledge to make inductive inferences about new foods and activities. If they reasoned about these new items, it would show that generalization had occurred. The pre-test lasted approximately 10-15 minutes for each child.

<u>Post-test (See Appendix G2)</u>

The post-test is equivalent to the pre-test and consists of 4 general classification questions, 24 specific classification questions and 24 preference questions. The post-test lasted approximately 10-15 minutes for each child. The questions included in the pre-test and post-test are described in detail below.

General Classification Questions

The first section consisted of four general questions reflecting the four main categories of vegetables, high-fat foods, exercises, and non exercises. The children were first asked to classify these categories as "healthy/not healthy." The present study used the word "not healthy" instead of "junky" (e.g., see Nguyen, 2007) to avoid short-lived slang words and also to make the two categories simple opposites of each other. For example, the researcher asked the child, "Are vegetables healthy or not healthy for you?" This question required the child to classify the category as either healthy or not healthy. Second, the child was also asked to provide an explanation for his/her classification. For example, the researcher then asked the child "why" he/she provided that particular response. The researcher wrote the child's answers down verbatim on the data sheet.

Specific Classification Questions

The specific classification section consisted of 24 questions regarding specific foods and activities, and was administered in the following way: The researcher showed the child a photograph of a food/activity, for example a picture of a carrot, and asked, “This is a carrot. Is a carrot healthy or not healthy?” The child was asked to classify the food as either healthy or not healthy by placing the picture in one of two boxes. One box represented healthy foods/exercises and was marked with a smiley face on the front. The second box represented non healthy foods/non exercises and was marked with a frowny face on the front. See Table 2 for a picture of these boxes. The researcher circled the child’s answer on the data sheet.

Preference Questions

The preference section consisted of 24 questions about specific foods and activities, and was administered in the following way: The researcher showed the child a photograph of a food/activity (the same ones used in the specific classification task) and asked, “To have a healthy body, would you eat X food” or “To have a healthy body, would you do X activity?” The child was asked to answer “yes” or “no”. The researcher circled the child’s answers on the data sheet. The use of the word “would” in these questions allowed children to use their acquired knowledge of health to make informed *preference* choices. However, if the question asked “To have a healthy body, *should* you eat/do X,” this would be a selection question because children would be selecting items, not choosing what they would actually eat or do to have a healthy body. Thus, one word represents the main difference between preference and selection questions. To control for a potential response bias, 3 non-preference questions were included in the task. If the child answered these questions incorrectly, then it suggested that the child was answering with a response bias and the child's data was excluded. For example, one response bias question involved showing the child a picture of a dog and asking, "Is this a cat?" If a child was answering quickly and not listening, it was reflected in an incorrect answer to this question. Each child included in the study answered all of these questions correctly.

To ensure that children's performance was not due to the order in which information was presented in the pre-tests and post-tests, or to a preference for a certain side (e.g., right/left) with the boxes, children were given one of four orders of the tests. Children were randomly assigned to each order, and orders were distributed equally throughout each of the groups (e.g., 5 children assigned to each order in all three groups). There were no significant order effects as revealed by a one-way ANOVA, $p > .05$. For a description of these orders, please examine Appendix F3.

RESULTS

The main focus of the present study was to examine the effectiveness of a theory-based intervention in increasing children's understanding and preference for healthy foods and exercise. There were three hypothesized patterns of results: 1) At pre-test, there will be no differences in performance between the groups (e.g., control, non theory, theory) on general classification, specific classification, or preference questions, including novel items; 2) At post-test, the theory group will be more accurate on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions than the non theory group and control group, including novel items; 3) The theory group will show the largest increase in accuracy from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions, including novel items. Since the non theory group received basic information about health, they will improve slightly, albeit insignificantly, in their performance from pre-test to post-test. Since the control group did not receive any health-related information, they will not have any significant changes from pre-test to post-test.

The results will be presented in the following order: 1) results from the parent questionnaire; 2) between-group results addressing Hypotheses #1 and #2, in which the pre-test (e.g., Hypothesis #1) and post-test data (e.g., Hypothesis #2) will be presented separately; 3) within-group results addressing Hypothesis #3.

Parent Questionnaire

To provide a context for understanding children's nutritional choices and behaviors, information from the parent questionnaire will be reported first. The questionnaire asked parents for demographic information, information about their child's food allergies, frequency of activities/food intake, preferences, and food/activity availability. Please see Appendix E to examine the parent questionnaire.

Demographic Information

The questionnaire asked for demographic information such as the parent's date of birth (DOB), status (e.g., mother, father or guardian), occupation, household's highest level of education, and ethnicity. There were no apparent differences in age, status, education or ethnicity between the parents of children in each group (e.g., control, non theory, theory); therefore, the demographic information will be reported for the overall sample of parents. See Table 5 below to further examine parent demographic information by condition.

The majority of parents, 54 out of 60, returned the parent questionnaire. The parents had a mean age of 37.5 (*range* = 25.0-51.0) with 49 mothers and 5 fathers filling out the questionnaire. The parents were predominately Caucasian (96.3%), with one parent reporting an ethnicity of Asian American (1.9%) and one parent reporting an ethnicity of Black/African American (1.9%).

When examining parent education level and occupation, there were no apparent differences between the groups; thus, the entire sample's most frequently cited education level and occupation are reported below. For the household's highest level of education, the most frequently cited degree was a bachelor's degree (50.9%), followed by a master's degree (15.1%). The most frequently listed occupations were homemakers (25.9%) and teachers (16.7%). These two occupations were distributed fairly equally throughout each group. See Table 5 below to examine parent demographic information by condition.

Table 5.
Percentage (Frequency) of Parent Demographic Information by Condition

Parent demographic information	Control (*M* = 37.5 years)	Non theory (*M* = 37.2 years)	Theory (*M* = 37.8 years)	Total (*M* = 37.5)
Returned parent questionnaires	95 (19)	90 (18)	85 (17)	90 (54)
Parent status				
Mother	84.2 (16)	100 (18)	88.2 (15)	90.7 (49)
Father	15.8 (3)	0 (0)	11.8 (2)	9.3 (5)
Parent ethnicity				
Black/African American	0 (0)	5.6 (1)	0 (0)	1.9 (1)
Asian American	0 (0)	0 (0)	5.9 (1)	1.9 (1)
Caucasian	100 (19)	94.4 (17)	94.1 (16)	96.3 (52)
Parent education level				
High school degree/GED	10.5 (2)	17.6 (3)	5.9 (1)	11.3 (6)
Associate's degree	10.5 (2)	0 (0)	5.9 (1)	5.7 (3)
Bachelor's degree	42.1 (8)	52.9 (9)	58.8 (10)	50.9 (27)
Master's degree	10.5 (2)	11.8 (2)	23.5 (4)	15.1 (8)
Ph.D., M.D., J.D., etc.	10.5 (2)	5.9 (1)	5.9 (1)	7.5 (4)
Technical training	15.8 (3)	5.9 (1)	0 (0)	7.5 (4)
Other (e.g., some college)	0 (0)	5.9 (1)	0 (0)	1.9 (1)
Parent occupation				
Teacher	21.1 (4)	16.7 (3)	11.8 (2)	16.7 (9)
Homemaker	15.8 (3)	33.3 (6)	29.4 (5)	25.9 (14)
RN	0 (0)	0 (0)	11.8 (2)	3.7 (2)
Manager	10.5 (2)	5.6 (1)	0 (0)	5.6 (3)
Sales	10.5 (2)	0 (0)	5.9 (1)	5.6 (3)
Realtor/Broker	0 (0)	5.6 (1)	5.9 (1)	3.7 (2)
Health educator	0 (0)	0 (0)	5.9 (1)	1.9 (1)
Analyst	0 (0)	5.6 (1)	5.9 (1)	3.7 (2)
Graphic designer	0 (0)	0 (0)	5.9 (1)	1.9 (1)
Physical therapist	0 (0)	0 (0)	5.9 (1)	1.9 (1)
President of company	0 (0)	0 (0)	5.9 (1)	1.9 (1)
Technician	0 (0)	0 (0)	5.9 (1)	1.9 (1)
Artist	0 (0)	5.6 (1)	0 (0)	1.9 (1)
Customer service	0 (0)	5.6 (1)	0 (0)	1.9 (1)
Dog groomer	0 (0)	5.6 (1)	0 (0)	1.9 (1)
Librarian	0 (0)	5.6 (1)	0 (0)	1.9 (1)
Dental hygienist	5.3 (1)	0 (0)	0 (0)	1.9 (1)
Engineer	5.3 (1)	0 (0)	0 (0)	1.9 (1)
Mortgages	5.3 (1)	0 (0)	0 (0)	1.9 (1)
Music director	5.3 (1)	0 (0)	0 (0)	1.9 (1)
Yoga instructor	5.3 (1)	0 (0)	0 (0)	1.9 (1)
N/A	15.8 (3)	11.1 (2)	0 (0)	9.3 (5)

Child Allergies

The majority of parents reported that their child did not have food allergies (87%). Of the remaining 13% that reported food allergies, the most frequently cited allergy was lactose intolerance (71.4%). The other allergies listed included peanuts, amoxil and smoked salmon. Please see Table 6 below to examine the frequency of child allergies by condition.

Table 6.

Percentage (Frequency) of Child Allergies by Condition

Child Allergies	Control	Non theory	Theory	Total
No allergies	**84.2 (16)**	**88.9 (16)**	**88.2 (15)**	**87 (47)**
Allergies	**15. 8 (3)**	**11.1 (2)**	**11.8 (2)**	**13 (7)**
Lactose Intolerance	10.5 (2)	11.1 (2)*	5.8 (1)	9.3 (5)
Peanuts		5.5 (1)		1.9 (1)
Amoxil	5.2 (1)			1.9 (1)
Smoked salmon			5.8 (1)	1.9 (1)

Note. *one child in the non theory group had two allergies, lactose intolerance and peanut allergies.

Servings of Food/Amount of Activity

The questionnaire asked parents to report how many servings of vegetables and high-fat foods that their child eats each day, and how much exercise and non exercise that their child gets each day. The percentages for the most frequently cited serving and activity amount are provided in this section. Fifty-two percent of parents reported that their child consumes two servings of vegetables a day, with examples including “asparagus” and “beans.” Sixty-three percent of parents reported that their child consumes only one serving of high-fat foods a day (e.g., “fries, doughnuts, nuggets”). Ninety-eight percent of parents reported that their child exercises for 20 minutes or more each day (e.g., “ride bike, scooter”) and 88.9% of parents reported that their child participates in non exercises for 20 minutes or more each day (e.g., “board games, reading, videos”). According to the USDA, 4-year-olds should be eating about 1 ½ servings of vegetables a day and exercising for more than 20 minutes each day (USDA, 2008). Given the parent reports, children in all three groups appear to be eating the recommended amount of vegetables and getting the recommended amount of exercise each day. See Table 7 to examine the percentage of parent reports.

Children’s Preferences for Foods/Activities

The questionnaire also included questions assessing children’s preferences for vegetables, high-fat foods, exercises and non exercises. The percentages for the most frequently cited requests are provided in this section. Sixty-six percent of parents reported that their child requests vegetables, with examples including “corn”, “carrots” and “green beans.” Eighty-three percent of parents reported that their child requests high-fat foods (e.g., “cookies,” “fries,” “milkshakes”). Ninety-eight percent of parents reported that their child requests to do exercises (e.g., “chase outside,” “ride bikes,” “hide and seek”) and 92.6% of parents reported that their child requests to do activities that are not exercise (e.g., “T.V.,” “videos,” “art”). There are no apparent differences in preferences between the groups, however a paired samples t-test comparing high-fat food requests with vegetable requests revealed that children request high-fat foods ($M = .83$, $SD = .38$) significantly more than they request vegetables ($M = .66$, $SD = .48$), $t(52) = 2.27$, $p < .05$. Additionally, children prefer to exercise slightly more, but not significantly more, than non exercises. See Table 7 to examine the percentage of parent reports.

Food/Activity Availability

The last set of questions focused on the availability of foods and activities in a household. Availability is important to examine because children’s food and activity choices can be determined by the availability of certain items or opportunities. For example, if vegetables are never provided to a child, the child is less likely to eat vegetables and more likely to eat what is easily accessible.

The percentages for the most frequently cited availability amount are provided in this section. Fifty-five percent of parents reported that they provide vegetables to their child two times a day, with examples including “at lunch and dinner.” Fifty-seven percent of parents reported that they provide high-fat foods to their child only one time a day (e.g., “sausage/bacon at breakfast”). Forty-three percent of parents provide opportunities for exercise four or more times a day (e.g., “all day long”) and 49.1% of parents provide opportunities for non exercise two times a day (e.g., “in the morning before leaving for school and at bedtime”). According to the parental reports, children are provided with more vegetables than high-fat foods, and with more opportunities for exercise than non-exercise. See Table 7 below for a frequency table of the parent questionnaire data by condition.

Table 7.

Percentage (Frequency) of Parent Reports by Condition

Parent reports	Control	Non theory	Theory	Total
Servings/Amount each day				
Vegetables				
0	10.5 (2)	0 (0)	0 (0)	3.7 (2)
1	26.3 (5)	33.3 (6)	17.6 (3)	25.9 (14)
2	42.1 (8)	55.6 (10)	58.8 (10)	51.9 (28)
3	21.1 (4)	5.6 (1)	17.6 (3)	14.8 (8)
4 (or more)	0 (0)	5.6 (1)	5.9 (1)	3.7 (2)
High-fat foods				
0	10.5 (2)	11.1 (2)	17.6 (3)	13.0 (7)
1	57.9 (11)	72.2 (13)	58.8 (10)	63.0 (34)
2	31.6 (6)	11.1 (2)	17.6 (3)	20.4 (11)
3	0 (0)	5.6 (1)	5.9 (1)	3.7 (2)
Exercise				
15 min.	5.3 (1)	0 (0)	0 (0)	1.9 (1)
20 min.(or more)	94.7 (18)	100 (18)	100 (17)	98.1 (53)
Non exercise				
15 min.	5.3 (1)	16.7 (3)	11.8 (2)	11.1 (6)
20 min.(or more)	94.7 (18)	83.3 (15)	88.2 (15)	88.9 (48)
Child Requests				
Vegetables				
no	47.4 (9)	27.8 (5)	23.5 (4)	33.3 (18)
yes	52.6 (10)	72.2 (13)	76.5 (13)	66.7 (36)
High-fat foods				
no	21.1 (4)	11.1 (2)	18.8 (3)	17.0 (9)
yes	78.9 (15)	88.9 (16)	81.3 (13)	83.0 (44)
Exercise				
no	5.3 (1)	0 (0)	0 (0)	1.9 (1)
yes	94.7 (18)	100 (18)	100 (17)	98.1 (53)
Non exercise				
no	10.5 (2)	5.6 (1)	5.9 (1)	7.4 (4)
yes	89.5 (17)	94.4 (17)	94.1 (16)	92.6 (50)
Provide each day				
Vegetables				
0	5.3 (1)	0 (0)	0 (0)	1.9 (1)
1	21.1 (4)	22.2 (4)	17.6 (3)	20.4 (11)
2	52.6 (10)	50 (9)	64.7 (11)	55.6 (30)
3	15.8 (3)	16.7 (3)	11.8 (2)	14.8 (8)
4 (or more)	5.3 (1)	11.1 (2)	5.9 (1)	7.4 (4)
High-fat foods				
0	5.3 (1)	27.8 (5)	18.8 (3)	17.0 (9)
1	63.2 (12)	55.6 (10)	50 (8)	56.6 (30)
2	31.6 (6)	16.7 (93)	25 (4)	24.5 (13)
3	0 (0)	0 (0)	6.3 (1)	1.9 (1)
Exercise				
1	5.3 (1)	5.6 (1)	18.8 (3)	9.4 (5)
2	21.1 (4)	33.3 (6)	37.5 (6)	30.2 (16)
3	5.3 (1)	27.8 (5)	18.8 (3)	17.0 (9)
4 (or more)	68.4 (13)	33.3 (6)	25 (4)	43.4 (23)
Non exercise				
1	15.8 (3)	22.2 (4)	12.5 (2)	17.0 (9)
2	47.4 (9)	44.4 (2)	56.3 (9)	49.1 (26)
3	5.3 (1)	16.7 (3)	6.3 (1)	9.4 (5)
4 (or more)	31.6 (6)	16.7 (3)	25.0 (4)	24.5 (13)

To summarize, based on the parent questionnaire data, the majority of parents included in the study are highly educated, Caucasian, and are mindful of their child's health. The majority of children included in the study are provided with an ample amount of healthy foods and opportunities for healthy activities each day, and are getting the daily recommended amount of vegetables and exercise.

<u>Between-Group Performance</u>

<u>Pre-test</u>

In the following section, between-group results from performance on the pre-test will be examined. These results address Hypothesis #1 which states that at pre-test, there will be no significant differences in performance between the groups (e.g., control, non theory, theory) on general classification, specific classification, or preference questions, including novel items.

Body Mass Index

During session one, children received the pre-test and had their Body Mass Index (BMI) calculated. Children's BMI was calculated by taking each child's height and weight and plugging them into a formula (i.e., weight (lb)/ $[\text{height (in)}]^2$ x 703) (CDC, 2008). Children's BMI percentile ranking was also calculated by looking at a chart to compare each child's BMI with children of the same age and gender. This percentile ranking was used to determine a child's weight status (e.g., underweight, healthy weight, overweight).

Overall, there were no significant differences in BMI and percentile rankings between children in each group (e.g., control, non theory, theory), p's > .05; therefore the weight status for all of the subjects will be provided. The majority of the children were at a healthy weight (81.7%), with three children classified as underweight (5%), and eight children classified as “at risk for being overweight/overweight” (13.3%). See Table 8 below to examine the percentage of children’s weight status as determined by percentile ranking.

Table 8.
Percentage (Frequency) of Children's Weight Status/Percentile Ranking by Condition

Weight status/Percentile range	Control	Non theory	Theory	Total
Underweight (less than 5th percentile)	10 (2)	5 (1)	0 (0)	5 (3)
Healthy weight (5th percentile to less than 85th percentile)	70 (14)	95 (19)	80 (16)	81.7 (49)
At risk of overweight (85th to less than 95th percentile)	15 (3)	0 (0)	10 (2)	8.3 (5)
Overweight (Equal to or greater than the 95th percentile)	5 (1)	0 (0)	10 (2)	5 (3)

General Classification Questions

The pre-test consisted of three sections: general classification; specific classification; and, preference. The general classification section consisted of a classification and explanation component. First, children were asked to classify the categories of vegetables, high-fat foods, exercises, and non exercises as "healthy/not healthy." These questions were scored with 1s and 0s according to accuracy: 1 representing a correct response and 0 representing an incorrect response. For example, if a child classified vegetables as "healthy," a 1 was given to score the response. However, if a child classified vegetables as "not healthy," then a 0 was given to score the response. A single summary variable was created by collapsing across all of the questions: vegetables, high-fat foods, exercise and non exercise. Since children were randomly assigned to groups, it was predicted that there would be no significant differences between the groups on the pre-test general classification questions. An ANOVA with children's responses as the dependent variable was run and confirmed this prediction, revealing no significant differences between the groups, $p > .05$. When comparing children's performance to chance, 50%, a one-sample t-test revealed that all three groups performed significantly higher than chance, t's(19) > 2.13, p's < .05. Please see Figure 1 for a representation of the general classification data.

After children classified these categories as "healthy/not healthy," they were asked to provide explanations for their responses. Thus, there were four explanation questions concerning the categories of vegetables, high-fat foods, exercises and non exercises. These explanations were scored with a qualitative coding system. This coding system was created by examining children's responses from the present study and developing coding categories based on the common themes. Please see Appendix G to examine the coding category system. Four main coding categories were used to score the open-ended responses. The first category was the *health-related correct* code, which included four subcategories: a) *health-related correct/outcome on body* (e.g., "vegetables have vitamins inside", "exercise makes you stronger"); b) u*se of correct health terms* (e.g., "vegetables are healthy because they are healthy"); c) *example-based correct* (e.g., "exercise is healthy because it makes you run really fast"); d) *parent-modeling correct* (e.g., "exercise is healthy for you because my dad says it is good").

The second category was the *health-related incorrect* code, which also included four subcategories: a) *health-related incorrect/outcome on body* (e.g., "vegetables do not have vitamins inside," "exercise does not make your body stronger"); b) i*ncorrect use of health terms* (e.g., "vegetables are not healthy"); c) *example-based incorrect* (e.g., "high-fat foods are healthy because cookies and cake are good for you"); d) *parent-modeling incorrect* (e.g., "high-fat foods are healthy because mommy says they are good").

The third category was the *uncertainty* code, which included two subcategories: a) *don't know* (e.g., "I don't know," shrugging); b) r*epeating* (e.g., "exercise is healthy because it is exercise").

The fourth category was the *miscellaneous* code, which included six subcategories: a) *preference* (e.g., "because I like to eat them"); b) *taste* (e.g., "because they taste good"); c) *appearance* (e.g., "because they look healthy"); d) *box-related* (e.g., "because I am going to put it in smiley box"); e) *irrelevant/off-task* (e.g., "because I like your hair”); f) *ambiguous* (e.g., “because it makes you little”). All of the children included in the study provided a codeable response. Two researchers independently coded all of the explanations, and all disagreements were discussed and resolved. The overall percentage of inter-rater reliability between the two researchers was 92.3% and Cohen’s kappa was .88.

It was predicted that at pre-test, there would be no apparent differences in responses between the groups. This prediction was confirmed to an extent. Although there was a substantial amount of variability between the groups for explanations, the most frequently coded explanation for all three groups was in the *health-related correct* category. See Table 9 below to examine the frequency of coded explanations by condition.

Table 9.
Pre-test Percentage (Frequency) of Coded Explanations by Condition

Codes	Control	Non theory	Theory	Total
Health-related correct	**42.5 (34)**	**37.5 (30)**	**42.5 (34)**	**40.8 (98)**
Health-related	37.5 (30)	32.5 (26)	30 (24)	33.3 (80)
Use of health terms	2.5 (2)	2.5 (2)	8.8 (7)	4.6 (11)
Example-based	2.5 (2)	1.3 (1)	2.5 (2)	2.1 (5)
Parent modeling	0 (0)	1.3 (1)	0 (0)	.4 (1)
*Health-related/parent	0 (0)	0 (0)	1.3 (1)	.4 (1)
Health-related incorrect	**22.5 (18)**	**12.5 (10)**	**21.2 (17)**	**18.8 (45)**
Health-related	18.8 (15)	11.3 (9)	15 (12)	15 (36)
Use of health terms	0 (0)	0 (0)	5 (4)	1.7 (4)
Example-based	2.5 (2)	1.3 (1)	0 (0)	1.3 (3)
Parent modeling	1.3 (1)	0 (0)	0 (0)	.4 (1)
*Health-related/example	0 (0)	0 (0)	1.3 (1)	.4 (1)
Uncertainty	**20 (16)**	**36.3 (29)**	**27.5 (22)**	**27.9 (67)**
Don’t Know	18.8 (15)	27.5 (22)	26.3 (21)	24.3 (58)
Repeating	1.3 (1)	8.8 (7)	1.3 (1)	3.8 (9)
Miscellaneous	**15 (12)**	**13.8 (11)**	**8.8 (7)**	**12.5 (30)**
Preference	3.8 (3)	1.3 (1)	1.3 (1)	2.1 (5)
Taste	1.3 (1)	1.3 (1)	5 (4)	2.5 (6)
Appearance	1.3 (1)	0 (0)	0 (0)	.4 (1)
Box-related	2.5 (2)	0 (0)	0 (0)	.8 (2)
Irrelevant/Off-task	2.5 (2)	7.5 (6)	1.3 (1)	3.8 (9)
Ambiguous	3.7 (3)	3.7 (3)	1.3 (1)	2.9 (7)

*Note.**combination of two coding categories. An explanation received more than one code when it could belong to two different categories. For example, the explanation, “Vegetables make your body stronger. My mom tells me that vegetables are really good for me” would be a combination of the *health-related correct* category and the *parent modeling correct* category.

Specific Classification Questions

The specific classification questions asked children to classify 12 foods as "healthy/not healthy" and 12 activities as "exercise/not exercise." The classification questions were scored with 1s and 0s according to accuracy: 1 representing a correct response and 0 representing an incorrect response. For example, if a child classified a carrot as a "healthy" food, a 1 was given to score the response. However, if a child classified a carrot as a "not healthy" food, then a 0 was given to score the response. A single summary variable was created by collapsing across all of the questions: vegetables, high-fat foods, exercise and non exercise. Since children were randomly assigned to each group, it was predicted that the three groups (control, non theory, theory) would perform at similar levels of accuracy on the specific classification questions. To examine group differences, an ANOVA with children's responses as the dependent variable was run. The results confirmed these expectations, such that there were no significant differences between the groups on the specific classification task, $p > .05$. Additionally, a one-sample t-test compared each group's performance on the specific classification section to chance, 50%. The results revealed that children in all three groups performed significantly higher than chance, t's(19) > 3.69, p's < .05. Please see Figure 2 for a representation of the specific classification data.

Since the specific classification questions consisted of food and activity questions, another way that the data was examined was by looking at the food and activity questions separately. A single summary variable was created for the food items by collapsing across the vegetable and high-fat food questions. A single summary variable was created for the activity items by collapsing across the exercise and non exercise questions. To determine if there were group differences for classification of foods and classification of activities, a one-way ANOVA with condition as the between subjects variable and response as the dependent variable was run. The results revealed no significant differences in food or activity classification, p's > .05. Additional analyses were run to examine specific food classification (e.g., vegetables and high-fat foods) and specific activity classification (e.g., exercises and non exercises) questions separately. An ANOVA with children's responses as the dependent variable was run and revealed no significant group differences in classification of vegetables, high-fat foods, exercises or non exercises, p's > .05. To compare each group's performance to chance, 50%, on vegetable, high-fat food, exercise and non exercise questions, one-sample t-tests revealed that all three groups performed significantly above chance levels on vegetable and exercise classification questions, t's(19) > 4.72, p's < .05; however, none of the groups performed significantly above chance levels on high-fat food and non exercise classification questions at pre-test, p's > .05.

The classification section also included questions about one novel item per category (e.g., items not explicitly covered in the intervention). To examine performance on the novel items for pre-test classification, a one-way ANOVA with condition as the between subjects variable and response as the dependent variable was run. The results revealed no significant differences between the groups for performance on classification novel items, p > .05. Also, one-sample t-tests revealed that the theory and non theory groups performed significantly better than chance (50%), t's(19) > 2.94, p's < .05;

however, the control group did not perform above chance on the pre-test classification of novel items, $p > .05$.

Preference Questions

The preference questions asked children if they would eat a certain food or do a certain activity to have a healthy body. The preference questions were scored with 1s and 0s according to accuracy. For example, if a child responded with a “yes” to the question, “To have a healthy body, would you eat celery,” a 1 was given to score the response. However, if a child responded with a “no” to the question, “To have a healthy body, would you eat celery,” a 0 was given to score the response. A single summary variable was created by collapsing across all of the questions: vegetables, high-fat foods, exercise and non exercise.

Since children were randomly assigned to each group, it was predicted that the three groups (control, non theory, theory) would perform at similar levels of accuracy on the pre-test preference questions. To examine group differences, an ANOVA with children’s responses as the dependent variable was run. The results confirmed these predictions, showing that there were no significant differences between the groups on the preference task, $p > .05$. To compare each group’s performance on the preference section to chance, 50%, one-sample t-tests were run and revealed that children in all three groups performed significantly higher than chance, t’s(19) > 2.83, p’s < .05.

Since the preference task consisted of food and activity questions, another way that the data was examined was by looking at the food and activity questions separately. A single summary variable was created for the food items by collapsing across the vegetable and high-fat food questions. A single summary variable was created for the activity items by collapsing across the exercise and non exercise questions.

To determine if there were group differences for performance on food questions and activity questions, a one-way ANOVA with condition as the between subjects variable and response as the dependent variable was run. The results revealed no significant differences in performance on the food or activity preference section, p's > .05. To examine specific food preference (e.g., vegetables and high-fat foods) and specific activity preference (e.g., exercises and non exercises) questions separately, an ANOVA with children's responses as the dependent variable was run and revealed no significant group differences for vegetable, high-fat food, exercise or non exercise questions, p's > .05. To compare each group's performance to chance, 50%, on vegetable, high-fat food, exercise and non exercise preference questions, a one-sample t-test was run and revealed that all three groups scored significantly above chance levels on vegetable and exercise preference questions, t's(19) > 3.24, p's < .05; however none of the groups scored significantly higher than chance levels on high-fat food and non exercise questions, p's > .05. Please see Figures 3 and 4 for a representation of the preference data.

The preference section also included questions about one novel item per category. To examine performance on the novel items for the pre-test preference task, a one-way ANOVA with children's responses as the dependent variable was run. Similar to the classification novel items, the results revealed no significant differences between the groups for performance on preference novel items, p > .05. Also, when comparing performance to chance, 50%, a one-sample t-test revealed that the theory group performed significantly higher than chance, $t(19) = 3.20$, $p < .05$; however, both the non theory and control groups did not score significantly higher than chance on the pre-test preference novel items, p's > .05.

To summarize, children in all three groups performed at similar levels of accuracy on the pre-test general classification (e.g., classification and explanation components), specific classification and preference questions, confirming Hypothesis #1. Additionally, children in all three groups performed at higher than chance levels on vegetable and exercise items for the classification and preference tasks; however, children in all three groups did not perform at higher than chance levels on high-fat food and non exercise items.

Post-test

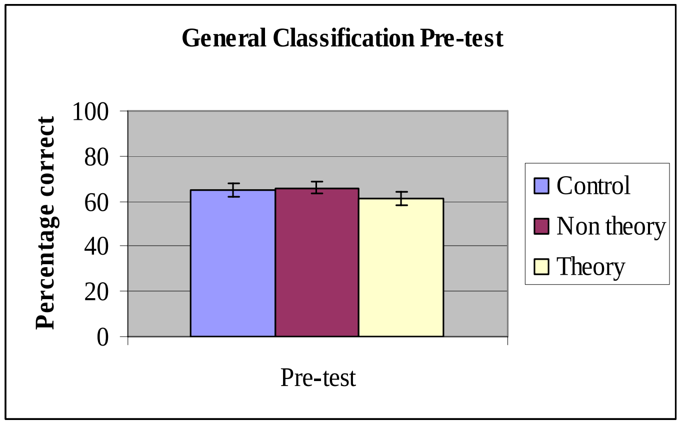
In the following section, between-group results for performance on the post-test will be examined. These results address Hypothesis #2, which states that at post-test, the theory group will be more accurate on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions than the non theory group and control group, including novel items. The same scoring system described in the previous section was used for the general classification, specific classification and preference questions in the post-test.

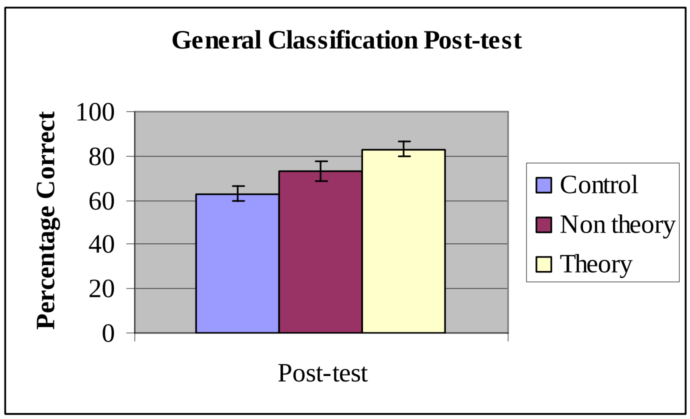
General Classification Questions

It was predicted that at post-test, there would be significant group differences in performance on the general classification questions. Given previous research, the theory group was expected to perform at higher levels of accuracy than both the non theory group and the control group. A one-way ANOVA with children's responses as the dependent variable revealed significant group differences, $F(2,59) = 3.72$, $MSE = .01$, $p < .05$. Tukey post hocs were conducted to examine specific group differences and found that the theory group ($M = 83\%$, $SD = 20\%$) scored significantly higher than the control group ($M = 63\%$, $SD = 21\%$), p's $< .05$. To compare each group's performance to chance, 50%, one-sample t-tests were run and revealed that all three groups were significantly above chance in their post-test classification of general items, t's$(19) > 2.70$, p's $< .05$. Please see Figure 1 below for a representation of the general classification data.

Fig. 1.

Percentage of Accuracy on the General Classification Questions at Pre-test, Post-test





It was also predicted that at post-test, children in the theory-group would provide more *health-related correct* responses than the other two groups because they would have a more coherent and accurate understanding of health. The results confirmed this hypothesis, such that the theory group provided more *health-related correct* responses (60%) than the non theory group (47.5%) and the control group (43.8%). Another interesting finding is that the theory group provided fewer *health-related incorrect* and *miscellaneous* responses than the other two groups. This suggests that they have a better understanding of health because they are making fewer errors. Please see Table 10 below for the percentage of coded explanations by condition.

Table 10.

Post-test Percentage (Frequency) of Coded Explanations by Condition

Codes	Control	Non theory	Theory	Total
Health-related correct	**43.8 (35)**	**47.5 (38)**	**60 (48)**	**50.4 (121)**
Health-related	38.7 (31)	42.5 (34)	42.5 (34)	41.3 (99)
Use of health terms	0 (0)	1.3 (1)	13.8 (11)	5 (12)
Example-based	2.5 (2)	2.5 (2)	2.5 (2)	2.5 (6)
Parent modeling	0 (0)	0 (0)	0 (0)	0 (0)
*Health-related/example	1.3 (1)	0 (0)	1.3 (1)	.8 (2)
*Health-related/parent	1.3 (1)	0 (0)	0 (0)	.4 (1)
*Example/health terms	0 (0)	1.3 (1)	0 (0)	.4 (1)
Health-related incorrect	**31.3 (25)**	**17.5 (14)**	**12.5 (10)**	**20.4 (49)**
Health-related	26.3 (21)	13.8 (11)	10 (8)	16.7 (40)
Use of health terms	3.7 (3)	2.5 (2)	2.5 (2)	2.9 (7)
Example-based	1.3 (1)	1.3 (1)	0 (0)	.8 (2)
Parent modeling	0 (0)	0 (0)	0 (0)	0 (0)
Uncertainty	**16.3 (13)**	**26.3 (21)**	**22.5 (18)**	**21.7 (52)**
Don't Know	12.5 (10)	18.8 (15)	17.5 (14)	16.3 (39)
Repeating	3.7 (3)	7.5 (6)	5 (4)	5.4 (13)
Miscellaneous	**8.8 (7)**	**8.8 (7)**	**5 (4)**	**7.5 (18)**
Preference	5 (4)	0 (0)	1.3 (1)	2.1 (5)
Taste	0 (0)	0 (0)	0 (0)	0 (0)
Appearance	0 (0)	0 (0)	0 (0)	0 (0)
Box-related	1.3 (1)	0 (0)	0 (0)	.4 (1)
Irrelevant/Off-task	2.5 (2)	5 (4)	3.7 (3)	3.8 (9)
Ambiguous	0 (0)	3.7 (3)	0 (0)	1.3 (3)

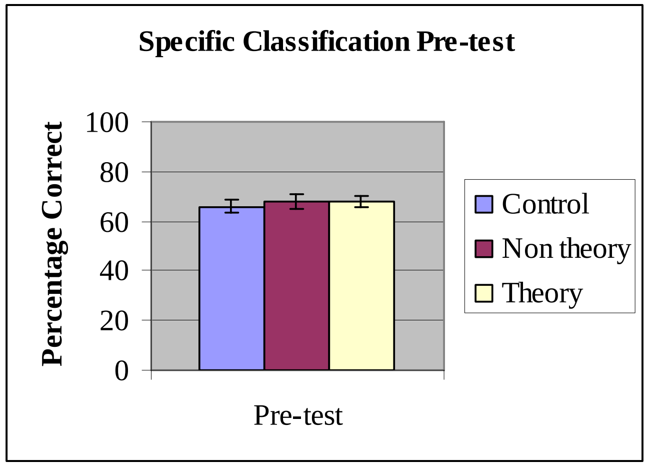
Note. *combination of two coding categories.

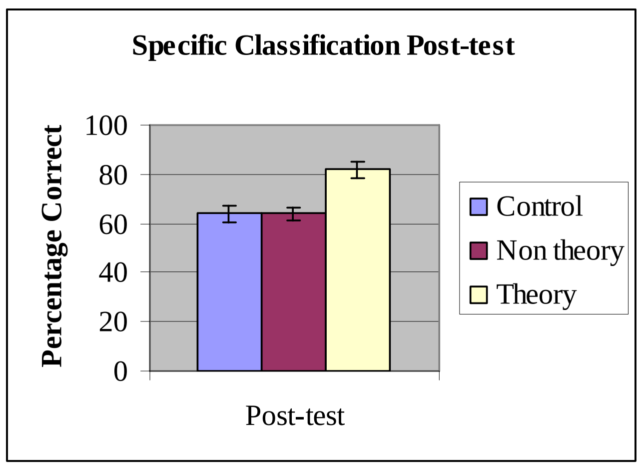
Specific Classification Questions

It was predicted that at post-test, there would be significant group differences in performance on the specific classification questions, such that the theory group would perform at higher levels of accuracy than both the non theory group and the control group. To examine differences between groups, an ANOVA with children's responses as the dependent variable was run. The results showed that indeed there were group differences, $F(2, 59) = 6.22$, $MSE = .22$, $p < .05$. Follow-up analyses showed that the theory group (M = 82%, SD = 16%) was significantly more accurate than the non theory group (M = 64%, SD = 19%) and the control group (M = 64%, SD = 21%) as revealed by Tukey post hocs, p's < .05. Additionally, one-sample t-tests compared group performance to chance, 50%, and found that all three groups performed significantly higher than chance on specific classification questions, t's(19) > 3.07, p's < .05. This is strong evidence supporting the argument that young children do benefit from learning information with a theory, and could be educated about health with a theory-based curriculum at an early age. See Figure 2 below for a representation of the specific classification data.

Fig. 2.

Percentage of Accuracy on the Specific Classification Questions at Pre-test, Post-test





Since the specific classification questions consisted of food and activity questions, another way that the data was examined was by looking at the food and activity questions separately. A single summary variable was created for the food items by collapsing across the vegetable and high-fat food questions. A single summary variable was created for the activity items by collapsing across the exercise and non exercise questions.

To determine if there were group differences for classification of foods, a one-way ANOVA with condition as the between subjects variable and response as the dependent variable was run. On food classification questions, there were in fact significant group differences, $F(2, 59) = 3.75$, $MSE = .25$, $p < .05$. Tukey post hocs revealed that the theory group (M = 82%, SD = 22%) performed significantly better than the non theory group (M = 63%, SD = 25%) on the food classification questions, p's < .05. Additional analyses were run to examine the two components of the food classification section, vegetables and high-fat foods, separately. A one-way ANOVA with children's responses as the dependent variable was run and found group differences in performance on the high-fat food classification questions, $F(2, 59) = 5.17$, $MSE = .53$, $p < .05$. Tukey post hocs revealed that the theory group (M = 80%, SD = 29%) was significantly more accurate than the non theory group (M = 47%, SD = 32%), p's < .05. There were no group differences in performance on the vegetable classification questions, $p > .05$. To compare each group's performance to chance, 50%, on the high-fat food and vegetable classification questions, one-sample t-tests were run and revealed that the theory group scored significantly higher than chance on the high-fat food items, $t(19) = 4.20$, $p < .05$; however, the control and non theory groups did not score higher than chance levels, p's >

.05. Also, all three groups scored significantly higher than chance on vegetable classification questions, *t*'s(19) > 3.34, *p*'s < .05. These findings suggest that learning information in an incoherent, non causally-related manner may lead to confusion, as evidenced by the non theory group's performance on the high-fat food classification questions.

To determine if there were group differences for classification of activities, a one-way ANOVA with response as the dependent variable was run and found a main effect of group, *F*(2, 59) = .20, *MSE* = 5.65, *p* < .05. Follow-up analyses were run to examine the specific group differences and found that the theory group (*M* = 83%, *SD* = 16%) classified activities significantly more accurately than the non theory group (*M* = 65%, *SD* = 20%) and the control group (*M* = 65%, SD = 18%) as revealed by Tukey post hocs, *p*'s < .05. Additional analyses were run to examine the two components of the activity classification section, exercises and non exercises, separately. A one-way ANOVA with children's responses as the dependent variable was run and found no significant group differences in performance on exercise or non exercise classification questions, *p*'s > .05. To compare group performance on exercise and non exercise classification questions to chance, 50%, a one-sample t-test was run and revealed that the theory group was the only group to score significantly higher than chance on the non exercise classification questions, *t*(19) = 4.38, *p* < .05; both the control and non theory groups did not score significantly higher than chance levels, *p*'s > .05. Children in all three groups performed significantly higher than chance on the exercise classification questions, *t*'s(19) > 3.87, *p*'s < .05.

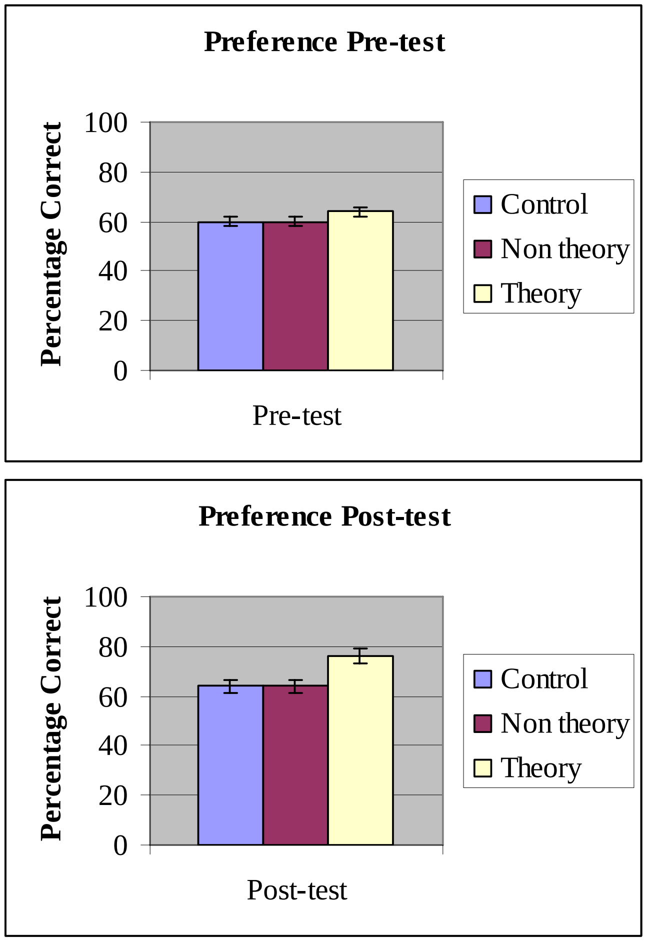
It was also predicted that children in the theory group would be better able to generalize about novel items than both the non-theory and control groups. The theory group did classify the novel items slightly more accurately than the non theory group and the control group; however these findings were not significant, as revealed by a one-way ANOVA with children's responses as the dependent variable, $p > .05$. When comparing group performance to chance, 50%, one-sample t-tests showed that the only group performing significantly above chance was the theory group, $t(19) = 3.85$, $p < .05$. Both the non theory and control groups did not classify novel items significantly above chance levels, p's > .05.

Preference Questions

The results from the classification section provide strong support for the argument that theory-based information helps children to form a coherent and accurate conception of health. Does this information also help to change children's health behaviors and preferences? The prediction was that, yes, children receiving theory-based information would have a higher preference for healthy foods and exercise than the other two groups because they would have a better understanding of health. However, the results did not fully support this prediction. An ANOVA with response as the dependent variable was run and found no significant group differences in performance on the preference task as a whole, $p > .05$. When comparing group performance on the preference task to chance (50%), a one-sample t-test revealed that all three groups performed significantly higher than chance, t's(19) > 3.08, p's < .05. Please see Figure 3 below for a representation of the total preference data.

Fig. 3.

Percentage of Accuracy on the Preference Questions at Pre-test, Post-test

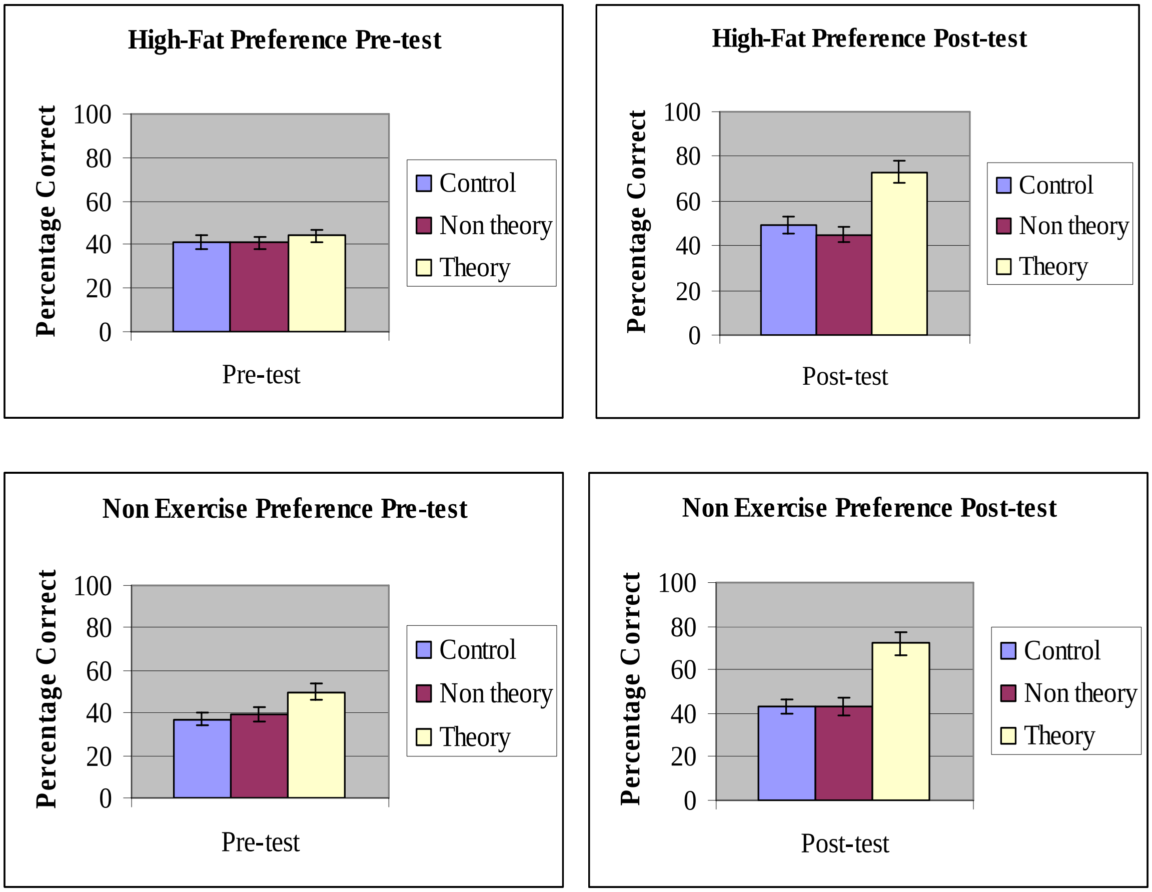


Since the preference task consisted of food and activity questions, another way that the data was examined was by looking at the food and activity questions separately. A single summary variable was created for the food items by collapsing across the vegetable and high-fat food questions. A single summary variable was created for the activity items by collapsing across the exercise and non exercise questions. To determine if there were group differences for performance on the food and activity preference questions, a one-way ANOVA with condition as the between subjects variable and response as the dependent variable was run. The results revealed no significant group differences in performance on these questions, *p*'s > .05. Additional analyses were run to examine the two components of the food section, vegetables and high-fat foods, separately. A one-way ANOVA with children's response as the dependent variable was run and found a main effect of group in performance on the high-fat food preference questions, $F(2, 59) = 3.83$, $MSE = .44$, $p < .05$. Tukey post hocs revealed that the theory group (M = 72%, SD = 29%) was significantly more accurate than the non theory group (M = 45%, SD = 35%) on high-fat food preference questions, *p*'s < .05. There were no significant group differences when examining vegetable preference questions, $p > .05$. To compare group performance on vegetable and high-fat food preference questions to chance, 50%, one-sample t-tests were run and revealed that the theory group scored significantly higher than chance on high-fat food preference questions, $t(19) = 3.38$, $p < .05$. Both the control and non theory groups did not score higher than chance levels on these questions, *p*'s > .05. Also, all three groups scored significantly higher than chance levels on the vegetable preference questions, *t*'s(19) > 3.71, *p*'s < .05

Analyses were also run to examine the two components of the activity section, exercises and non exercises, separately. A one-way ANOVA with children's response as the dependent variable revealed a main effect of group in performance on the non exercise preference questions, $F(2, 59) = 4.19$, $MSE = .54$, $p < .05$. Follow-up analyses to determine specific group differences were conducted and showed that the theory group (M = 72%, SD = 30%) performed significantly better on the non exercise preference questions than the non theory group (M = 43%, SD = 39%) and control group (M = 43%, SD = 37%) as revealed by Tukey post hocs, p's < .05. There were no significant findings when examining exercise preference questions, $p > .05$. To compare group performance on exercise and non exercise preference questions to chance, 50%, a one-sample t-test was run and revealed that the theory group scored significantly higher than chance on non exercise preference questions, $t(19) = 3.21$, $p < .05$; however, both the control and non theory groups did not score higher than chance levels on these questions, p's > .05. Also, all three groups scored significantly higher than chance levels on the exercise preference questions, t's(19) > 3.56, p's < .05. See Figure 4 below for a representation of the high-fat food and non exercise preference data.

Fig. 4.

Percentage of Accuracy on the High-Fat Food and Non Exercise Preference Questions at Pre-test, Post-test



It was also predicted that children in the theory group would be able to generalize about novel items and perform better on the preference novel items than the other two groups. However, there were no significant differences between the groups in their performance on the novel items as revealed by a one-way ANOVA with response as the dependent variable, p's > .05. When comparing group performance to chance, 50%, one-sample t-tests revealed that all three groups scored significantly higher than chance, t's(19) > 2.34, p's < .05.

To summarize, children in the theory group were significantly more accurate on the post-test general classification (e.g., *health-related correct* responses) and specific classification questions, partially confirming Hypothesis #2. The theory group was also more accurate, albeit not significantly, on the preference task than the non theory and control groups. When examining food and activity preference questions separately, the theory group was significantly more accurate than the other groups on the high-fat food and non exercise items, the only items in which children had room for improvement.

These findings suggest that theory-based information is influential in changing children's preferences, specifically within the areas of high-fat foods and non exercises. As stated earlier, children in all three groups performed at high levels of accuracy on vegetable and exercise preference questions at both pre-test and post-test. Therefore, 3- and 4-year-old children may already have a solid understanding of vegetables and exercises, which does not leave much room for improvement on the post-test. The most notable finding was children's performance on the high-fat food and non exercise preference questions, in which the theory group outperformed both the non theory and control group on the post-test. These results suggest that theory-based information may be most effective when used to teach children about areas of confusion such as high-fat foods and non exercises.

Within-Group Performance

In the following section, within-group results will be examined for all of the groups. This section addresses Hypothesis #3, which states that the theory group will show the largest increase in accuracy from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions, including novel items. Since the non theory group received basic information about health, they will improve slightly, albeit insignificantly, in their performance from pre-test to post-test. Since the control group did not receive any health-related information, they will show no significant changes from pre-test to post-test. The control group's results will be presented first, followed by the non theory group and then the theory group.

Group 1: Control Group

Since the control group did not receive an intervention or any health-related information, it was predicted that there would be no significant changes from pre-test to post-test on the general classification, specific classification, or preference questions.

General Classification Questions

To examine performance on the general classification questions, a paired samples t-test compared the control group's pre-test performance with post-test performance. The results confirmed the first set of predictions, showing that there were no significant differences between performance on the pre-test and post-test general classification questions, $p > .05$. Also, there was a small increase from pre-test (22.5%) to post-test (31.3%) on *health-related incorrect* responses, and a small decrease in *miscellaneous* responses from pre-test (15%) to post-test (8.8%). There were no other apparent differences between pre-test and post-test explanations. Please examine Tables 9 and 10 to review the percentage of coded responses for the control group.

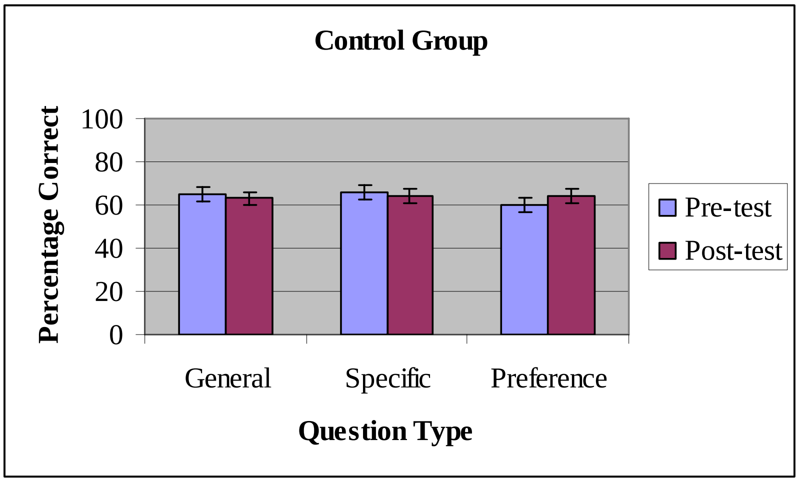
Specific Classification Questions

For the specific classification questions, a paired samples t-test compared the control group's pre-test performance with post-test performance. The results confirmed the second set of predictions, such that there were no significant differences between performances on the pre-test and post-test specific classification questions, including performance on the novel items, p's > .05.

Preference Questions

A paired samples t-test also compared the control group's pre-test performance with post-test performance on the preference questions. The results confirmed the third set of predictions, showing that there were no significant differences between performances on the pre-test and post-test preference questions, including novel items, p's > .05. Please see Figure 5 below for a representation of the control group's results.

Fig. 5.
Control Group's Percentage of Accuracy on the General, Specific and Preference Questions by Test



Group 2: Non Theory Group

Since the non theory group received information about health, it was predicted that there would be a small, insignificant increase in accuracy from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification, and preference questions.

General Classification Questions

To examine performance on the general classification questions, a paired samples t-test compared the non theory group's pre-test performance with post-test performance. The results showed that there were no significant differences between performances on the pre-test and post-test, $p > .05$; however, there was a slight increase in accuracy from pre to post-test, confirming the first set of predictions. Also on the general questions, there was an increase in both *health-related correct* responses from pre-test (37.5%) to post-test (47.5%) as predicted and *health-related incorrect* responses from pre-test (12.5%) to post-test (17.5%). Please examine Tables 9 and 10 to review the percentage of coded responses.

Specific Classification Questions

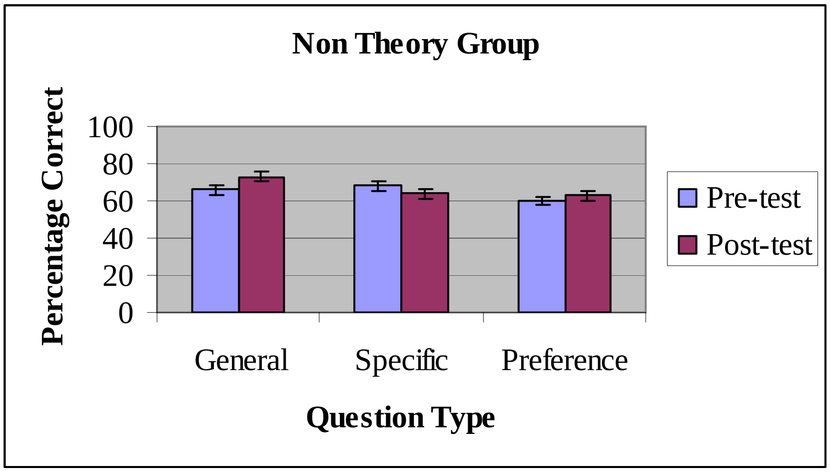
To examine specific classification questions, a paired samples t-test compared the non theory group's pre-test performance with post-test performance. The results did not reveal any significant differences, including performance on the novel items, p's > .05. Although not close to significance, it is important to note that the non theory group's performance on specific classification questions decreased from pre-test to post-test.

Preference Questions

For the preference questions, a paired samples t-test examining pre-test performance with post-test performance was run and revealed no significant differences, including performance on the novel items, *p*'s > .05. However, performance did increase slightly from pre-test to post-test on the preference questions as predicted.

The findings from the general classification, specific classification and preference sections suggest that the non theory group gained basic information about health, but they were unable to fully organize this information because it was not presented in a coherent, causally-related manner. This resulted in their basic understanding of health, as seen in their slight increase on the general classification and preference questions. However, it also resulted in their confusion, as evidenced by their decrease in accuracy on the specific classification questions. Please see Figure 6 below for a representation of the non theory group's data.

Fig. 6.
Non Theory Group's Percentage of Accuracy on the General, Specific and Preference Questions by Test



Group 3: Theory Group

Since the theory group received coherent, causally-related information about health, it was predicted that they would show the largest increase from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification and preference questions. The argument here was that they would be better able to organize and integrate the material into their existing knowledge base because the information was presented in a coherent and causally-related manner.

General Classification Questions

To examine performance on the general classification questions, a paired samples t-test compared the theory group's pre-test and post-test performance. The results confirmed the first set of predictions, such that the theory group showed a significant increase on the general classification questions from pre-test (M = 61%, SD = 24%) to post-test (M = 83%, SD = 20%), $t(19) = 3.85$, $p < .05$. Additionally, it was predicted that children in the theory group would show the greatest increase from pre-test to post-test in *health-related correct* responses for general classification questions. *Health-related correct* responses did increase from pre-test (42.5 %) to post-test (60%), confirming these predictions. Also the *health-related incorrect*, *uncertain* and *miscellaneous* responses decreased from pre-test to post-test. Please examine Tables 9 and 10 to review the percentage of coded responses.

Specific Classification Questions

To examine specific classification questions, a paired samples t-test compared pre-test performance with post-test performance. The results confirmed the second set of predictions, showing that the theory group increased significantly in accuracy on specific classification questions from pre-test (*M* = 68%, *SD* = 13%) to post-test (*M* = 82%, SD = 16%), $t(19) = 4.65$, $p < .05$. Therefore, children in the theory group are improving both in their general knowledge of health, and in their specific knowledge of foods and activities.

Since the theory group improved significantly in their performance on both general and specific classification tasks, additional analyses were conducted to examine the areas in which theory-based interventions were most beneficial. To look more in depth at specific classification questions, analyses were conducted on the food classification and activity classification questions separately. For food classification questions, a paired samples t-test compared pre-test performance with post-test performance and found a significant increase in accuracy from pre-test (*M* = 68%, *SD* = 18%) to post-test (*M* = 82%, *SD* = 22%), $t(19) = 3.56$, $p < .05$. Additional analyses were conducted to examine if the theory group improved on both components of the food section: vegetables and high-fat foods. Paired samples t-tests compared pre-test performance on vegetable and high-fat food classification questions with post-test performance. The results showed a significant increase in accuracy on high-fat food classification questions from pre-test (*M* = 49%, *SD* = 32%) to post-test (*M* = 78%, *SD* = 29%), $t(19) = 4.42$, $p < .05$. However, no significant findings emerged when examining vegetable classification questions, $p > .05$. Children were highly accurate when classifying vegetables at both pre-test and post-test.

For activity classification questions, a paired samples t-test compared pre-test performance with post-test performance. The results showed that the theory group increased significantly from pre-test (*M* = 68%, *SD* = 17%) to post-test (*M* = 83%, *SD* = 17%), $t(19) = 3.61$, $p < .05$ in their classification of activities. Additional analyses were conducted to examine if the theory group improved on both components of the activity section: exercises and non exercises. A paired samples t-test compared pre-test performance on the exercise questions and non exercise questions with post-test performance. The results revealed significant increases for exercises from pre-test (*M* = 76%, *SD* = 24%) to post-test (*M* = 88%, *SD* = 24%) and for non exercises from pre-test (*M* = 61%, *SD* = 33%) to post-test (*M* = 77%, SD = 27%), *t*'s(19) > 2.14, *p*'s < .05.

It was also predicted that children in the theory group would have a significant increase in performance on the classification of novel items from pre-test to post-test. A paired samples t-test comparing pre-test performance with post-test performance revealed no significant differences in the theory group's classification of novel items, $p > .05$. However, there was a small increase, albeit not significant, in accurate classification of novel foods. This suggests that the theory group was able to use their acquired knowledge to generalize to some, but not all of the novel items.

Preference Questions

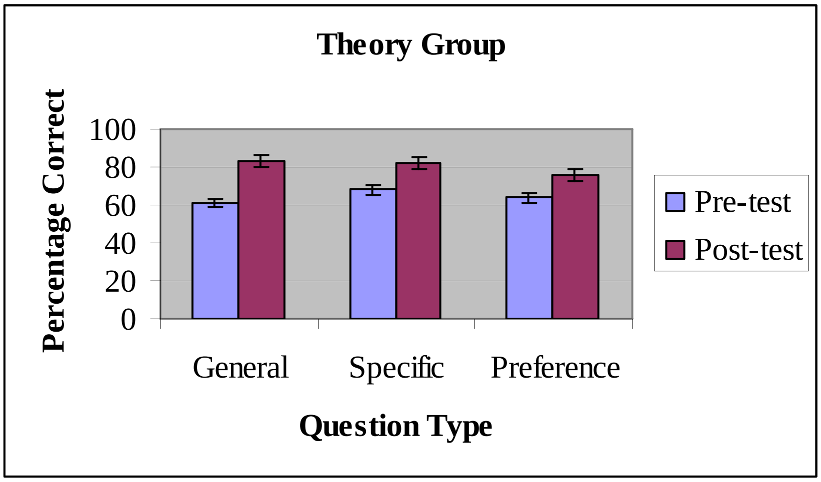
Lastly, it was predicted that the theory group would show the greatest increase in accuracy from pre-test to post-test on the preference questions. A paired samples t-test compared the theory group's pre-test and post-test performance on the preference task. The results support this hypothesis, showing a significant increase in performance from pre-test (*M* = 64%, *SD* = 15%) to post-test (*M* = 76%, *SD* = 17%), $t(19) = 3.62$, $p < .05$. To gain more insight into the theory group's performance, the food and activity preference questions were examined separately. A paired samples t-test compared pre-test performance on the food preference questions with post-test performance. The results showed that the theory group increased in their performance on food preference questions from pre-test (*M* = 63%, *SD* = 18%) to post-test (*M* = 80%, *SD* = 19%), *t*(19) = 3.78, *p* < .05. Additional analyses were conducted to examine if the theory group improved on both components of the food section: vegetables and high-fat foods. A paired samples t-test compared pre-test performance on vegetable and high-fat food preference questions with post-test performance. The results showed that the theory group increased significantly in their performance on high-fat food preference questions from pre-test (*M* = 44%, *SD* = 26%) to post-test (*M* = 72%, *SD* = 30%), *t*(19) = 3.85, *p* < .05.; however, no significant differences emerged for performance on vegetable preference questions, *p* > .05. Children performed at high levels of accuracy on the vegetable preference questions at both pre-test and post-test.

To examine the activity preference questions, a paired samples t-test comparing pre-test performance with post-test performance was run and revealed no significant differences, *p* > .05. However, significant findings did emerge when examining the two components of the activity section, exercises and non exercises, separately. A paired samples t-test compared pre-test performance on the exercise and non exercise preference questions with post-test performance. The results revealed a significant increase in performance on non exercise questions from pre-test (*M* = 51%, *SD* = 34%) to post-test (*M* = 72%, *SD* = 30%), *t*(19) = 2.70, *p* < .05. No significant findings emerged for exercise preference questions, *p* > .05. Children in the theory group performed well on the exercise preference questions on both the pre-test and post-test. Based on these findings, it appears that theory-based information can influence health behaviors, specifically within the areas of high-fat foods and non exercises.

It was also predicted that children in the theory group would have a significant increase in performance on the novel items from pre-test to post-test for preference questions. A paired samples t-test revealed no significant differences in performance on the preference novel items from pre-test to post-test, $p > .05$.

The theory group's performance provides strong evidence that theory-based information is effective in increasing children's accurate understanding of health and preferences for healthy behaviors. Overall, these results suggest that children greatly benefit from learning information with a theory, and could be educated about health with a theory-based curriculum at an early age. Please see Figure 7 below for a representation of the theory group's results.

Fig. 7.
Theory Group's Percentage of Accuracy on the General, Specific and Preference Questions by Test



To summarize, the within-group analyses confirmed Hypothesis # 3, such that the theory group showed the largest increase from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification and preference questions. The control group and non theory group did not show any significant changes from pre-test to post-test on any of these questions. These results suggest that theory-based information helps children to learn about the general categories of health, specific foods and activities, and also helps them to make healthier food and activity choices.

Additional analyses

Additional analyses were run to examine gender differences in performance on the pre-test and post-test. An independent samples t-test revealed no significant differences between gender and performance on all three types of questions (e.g., general classification, specific classification, preference) on the pre-test or post-test, p's > .05.

To examine if the number of days in between pre and post-test affected children's performance on the post-test, a one-way ANOVA was run and revealed no significant differences between days in between and performance on all three types of questions (e.g., general classification, specific classification, preference) on the post-test, p's > .05. Overall, 14 children were tested with 1 day in between, 5 children were tested with 2 days in between, 3 children were tested with 3 days in between, and 38 children were tested with 6 days in between. Please see Table 11 below for days in between pre and post-test by condition.

Table 11.
Days in Between Pre-test and Post-test by Condition

Days in between pre and post-test	Control	Non theory	Theory	Total
1 day	5	5	4	14
2 days	4	0	1	5
3 days	2	0	1	3
4 days	0	0	0	0
5 days	0	0	0	0
6 days	9	15	14	38

DISCUSSION

The present study focused on answering three main questions. The answers to these questions provide insight into the efficacy and importance of using theory-based interventions to educate children about health. Overall, the findings clearly demonstrate that theory-based information assists children in forming a coherent conception of health, and helps them to make healthier, more informed food and activity choices. This is an important discovery because the rate of childhood obesity in our country is increasing exponentially (CDC, 2006) and overweight children are at a greater risk for developing numerous health problems throughout their lifetime (DHHS, 2001). Therefore, finding an effective method for teaching young children about health is critical. The three questions that guided the present study and their subsequent answers are provided below.

Question 1: At pre-test, were there any differences in performance between the groups (e.g., control, non theory, theory) on general classification, specific classification, or preference questions, including novel items? The answer to this question is "no." Since children were randomly assigned to groups, children in all three groups (e.g., control, non theory, theory) performed at similar levels of accuracy on the general classification (e.g., classification and explanation components), specific classification and preference questions, including novel items. Interestingly, all three groups performed at high levels of accuracy on exercise and vegetable items on both the pre-test classification and preference tasks. Also, children in all three groups did not perform at above chance levels on the non exercise and high-fat food items on both the pre-test classification and preference tasks. These results suggest that this sample of children is already familiar with identifying vegetables and exercises as “healthy”; however, they do not have as much knowledge or experience with identifying high-fat foods and non exercises as “not healthy.”

Overall, the results from the pre-test data showed that there were no significant differences in performance between the groups (e.g., control, non theory, theory) on general classification, specific classification, or preference questions. This is an important finding because it establishes that children in all three groups started the study with a similar knowledge of health. Since children in all three groups were above chance on the pre-test general classification, specific classification and preference questions, it suggests that this was an ideal age group for the present study because children started with an existing knowledge of health, but not a complete understanding. This finding is also consistent with the theory-theory perspective on children’s cognitive development, showing that children have a basic, intuitive understanding of health (e.g., naïve theory of biology) at a young age and are eager and open to learning more about it.

Question 2: At post-test, was the theory group more accurate on the general classification (e.g., health-related correct responses), specific classification, and preference questions than the non theory group and control group, including novel items? The answer to this question is “yes (except for novel items).” Children in the theory group performed at higher levels of accuracy on the general classification (e.g., *health-related responses*), specific classification and preference tasks than children in both the non theory and control groups. Theory-based information seems to be effective in increasing children’s understanding of the *general categories* of health (e.g., vegetables, high-fat foods, exercises, non exercises) and helps them to provide more accurate, health-related explanations for the processes of health in the body (e.g., "vegetables are healthy because they make you stronger."). Additionally, theory-based information seems to be effective in increasing children's understanding of *specific* foods (e.g., carrot, doughnut) and activities (e.g., riding a bike, watching TV) within each of these categories, specifically high-fat foods and non exercises. Coherent and causally-related information also appears to help children to make healthier, more informed food and activity choices because they have a better understanding of the consequences of engaging in healthy and unhealthy behaviors (e.g., eating vegetables gives your body lots of strength, helps you grow…). The theory group's performance on the preference task, specifically on the high-fat food and non exercise preference questions, supports this finding. However, the theory group was not significantly more accurate on the post-test classification or preference novel items than both the non theory and control groups. Possible explanations for these results are described in detail below.

Novel Items

Given the results showing the efficacy of theory-based interventions, why did the theory group not perform significantly more accurately than both the non theory and control groups on the novel items (e.g., classification and preference novel items)? If you recall, novel items were items included in the pre-tests and post-tests that were not explicitly mentioned in the intervention. These questions examined children's ability to use their acquired knowledge to make inductive inferences about novel items. If they reasoned about these new items, it would show that generalization had occurred.

Although children in the theory group did not perform significantly more accurately than the other groups, they were the only group to score significantly above chance levels on their classification of novel items. Therefore, the theory group was able to organize the theory-based information in a systematic way and use it to make *some* inductive inferences about novel items. However, children in all three groups performed at similar levels of accuracy on the post-test preference novel items, with all three groups performing at higher than chance levels.

One explanation for the theory group's inability to consistently reason about novel items is that two of the four novel items, Cheetos (e.g., a novel high-fat food) and videogaming (e.g., a novel non exercise), were extremely difficult for children to reason about, and thus deflated the averages. Children in all three groups did not perform at higher than chance levels, 50%, p's > .05 (as revealed by one-sample t-tests) in their preference and classification of Cheetos and videogaming at both pre-test and post-test. Children's spontaneous explanations for their classification of these novel items provide insight into their thought process. For example, several children stated that Cheetos were healthy "because they have cheese on them" and that playing video games was an exercise because "you are moving your hands" or "it is exercise for your fingers." These findings suggest that children were attempting to reason about these novel items; however, they may have been too difficult or too complex for young children to understand.

Another explanation for the theory group's performance on the novel items stems from research on inductive reasoning. Inductive reasoning is the process of extending one's knowledge of categories to generalize and reason about novel category members (Murphy, 2002). Induction is important and efficient because it allows us to use our preexisting knowledge of categories to reason about new situations and things. The novel items were included in this study to examine if children could use their acquired knowledge of these categories (e.g., vegetables, high-fat foods, exercises, non exercises) to reason and make inductive inferences about novel members of the categories (e.g., red pepper, Cheetos, running, videogaming). It's important for children to have a rich knowledge base so that they can use this body of knowledge to draw from when making inferences. Therefore, the theory group's inability to consistently reason about these items may be because the intervention did not provide enough information about the main categories (e.g., vegetables, high-fat foods, exercise, non exercise). For example, the intervention provided the following information about vegetables: "Vegetables are healthy for you because they have many vitamins inside them…" It might have been helpful to provide more information about the category of vegetables such as "Vegetables are parts of plants that you can eat and they are healthy for you because…" Future research should focus on providing more information about the categories themselves in order to assist children in making inductive inferences about novel members of categories.

Coherence and Causality

Why did the theory group outperform both the non theory and control group on all of the tasks? The theory group was better able to organize and integrate the information into their existing knowledge base because they received a coherent and causally-related intervention (e.g., a theory-based intervention). Coherence and causality are the essential components of a theory-based intervention: *coherence* meaning the information is presented in a logically ordered manner in which the facts are related and the information is presented clearly and c*ausality* meaning that separate facts are connected together through the explanation of causes and effects. Coherence and causality have been shown in several studies to be central in children's thinking and learning (Wellman & Gelman, 1997; Harris, 1994; Murphy & Allopenna, 1994; Gopnik & Sobel, 2000; Murphy & Medin, 1985). Additionally, children's naïve theories allow them to understand and search for coherent, causally-related frameworks for phenomena at an early age (Inagaki & Hatano, 2002). Therefore, the theory group outperformed the other two groups because this coherent and causally-related information was easily organized and integrated into their naïve theories (Gelman & Kalish, 2005) and they were able to gain a better understanding of health.

How do we know that coherence and causality were responsible for the theory group's performance? The non theory group was included in this study to answer this question. The theory group and non theory group were given the same information, except for the non theory group did not receive coherent and causally-related explanations. Therefore, any difference in performance can be attributed to the coherent and causally-related information. The results showed that the theory group was consistently more accurate then the non theory group on all of the tasks, suggesting that coherent and causally-related explanations helped children to form a coherent conception of health. These findings support previous research showing the efficacy of theory-based interventions within other biological domains (Solomon & Johnson, 2000; Krascum & Andrews, 1998; Au & Romo, 1994; Zamora, Romo, & Au, 2006) and demonstrate that theory-based interventions can also be effective when teaching children about health.

Question 3: Does the theory group show the largest increase in accuracy from pre-test to post-test on the general classification (e.g., health-related correct responses), specific classification, and preference questions, including novel items? The answer to the third question is "yes (except for the novel items)." Children in the theory group were the only ones to show significant improvements on the general classification, specific classification and preference task from pre-test to post-test. In addition, the theory group had the largest increase in *health-related correct* explanations (e.g., 14 point increase), followed by the non theory group (e.g., 8 point increase), and then the control group (e.g., 1 point increase). However, the theory group did not show significant increases on the novel items, for both the classification and preference tasks. As stated earlier, this performance may have been caused by the difficulty of the novel items, or because children needed more information about the categories to reason about these new items.

Overall, children in the theory group had the largest increase in accuracy from pre-test to post-test on the general classification (e.g., *health-related correct* responses), specific classification and preference task. This bolsters the argument that coherent and causally-related explanations assist children in forming a coherent, more accurate understanding of health and also helps them to make healthier food and activity choices.

Theory-Theory Perspective

The results from the present study provide support for the theory-theory perspective on children’s cognitive development. This perspective argues that children have theory-like knowledge systems, or naive theories, that help them to organize and mentally represent the world around them. According to this perspective, children learn best when provided with information that matches how concepts are organized within their naïve theories, or in a coherent and causally-related manner (Inagaki & Hatano, 2002). The naïve theory most relevant to the present study is children’s naïve theory of biology, which is a prewired, distinct framework for understanding biological phenomena. This naïve theory allows children to think deeply and acquire knowledge quickly about biological processes. The findings from the present study provide support for the theory-theory approach for three reasons. First, children were excited and interested to learn about health at a young age (e.g., 3-4 years of age) suggesting that they have an inherent interest in biology, or a naïve theory of biology. Second, the results showed that children were able to quickly form an accurate understanding of health when provided with information that matched how their naïve theories are organized, or coherent and causally-related information. Third, when children were presented with information that did not match how their naïve theories are organized (e.g., incoherent, non causally-related information); it resulted in confusion (e.g., non theory group’s performance on specific classification questions) and only a slight insignificant increase in understanding (e.g., non theory groups’ performance on general classification and preference questions).

Conceptual Change

How did children in the theory group go from an inaccurate and inconsistent understanding of health to an accurate, coherent understanding? The theory-theory approach suggests that children's knowledge is flexible and theory-like. It can undergo modifications and reorganizations similar to how theories change in science (Gopnik, 2000). Children are constantly encountering new concepts and information that provide evidence to support and strengthen their naïve theories, or counterevidence to refute and weaken their theories. Their naïve theories, or frameworks, can be modified and restructured over time in the presence of evidence and counterevidence, otherwise known as conceptual change (Gelman & Kalish, 2005). Through conceptual change, the main principles underlying a domain are restructured and revised in order to fit the new information (Gopnik, 2000). Children's frameworks seek to find coherent, causal information in order to revise and replace the existing theory (Gopnik, 2000).

The results from the present study, specifically on the high-fat food and non exercise items, provide support for the theory group's conceptual change within the domain of health. Children in all groups started out with an inaccurate understanding of certain items (e.g., high-fat foods and non exercises). The theory group was the only group to show a significant increase in understanding and preference for these items, suggesting that their concepts were revised and changed. This theory change is also evident when examining children's explanations for these items. At pre-test, the theory group had 40% *health-related correct* responses and 20% *health-related incorrect* responses. After receiving the theory-based intervention, children had 60% *health-related correct* and 12.5% *health-related incorrect* responses. Therefore, children that received coherent and causal information were able to revise and restructure some of their existing theories concerning health.

Limitations

The sample of parents and children included in the study were mostly Caucasian, highly educated and health conscious, showing that this sample was not very diverse. There were pros and cons to using this homogenous sample of children in the present study. On one hand, since this sample of children has parents that are very health conscious and highly educated, they provide a great starting point for showing the effectiveness of a theory-based intervention. For example, parents in this sample would most likely encourage their child to learn about health and engage in healthier behaviors. On the other hand, they may have been the hardest group to show an effect because they are starting out at ceiling in their performance on some areas (e.g., vegetables, exercises), not leaving much room for growth. Therefore, in future studies it is important to examine diverse samples of children to provide further insight into the efficacy of theory-based interventions within the domain of health.

Also, since this study did not measure children's consumption of healthy foods and amount of exercise before and after the intervention, it is difficult to assess if children's health behaviors changed as a result of the intervention. The results showed that when children received theory-based information, their preferences for vegetables and exercises increased and their preferences for high-fat foods and non exercises decreased; however, it is not clear if this knowledge influenced their behaviors. Since some research has found that health education and knowledge does not influence behaviors (Wardle & Huon, 2000), it is possible that this intervention may have little impact on children's health behaviors. Future studies should measure children's consumption of healthy foods before and after they receive a theory-based intervention to gain more insight into how these interventions influence behaviors.

Another limitation was the difference in length between the theory-based and non theory-based intervention. Since the theory-based intervention was composed of two enmeshed and intimately linked parts (e.g., coherence and causality), it was naturally longer than the non theory-based intervention, which was absent of these two components. It was important to establish the effectiveness of the whole package, or the entire theory-based intervention first, so this difference in length between the two interventions was necessary. The next step is for future research to examine each of the components individually to see which part is more effective. In these studies, the two interventions will be equated in length because the theory-based intervention will be tested against a different version of itself (e.g., testing a coherent version of the theory-based intervention against an incoherent version or scrambled version of the intervention). Also in future research, researchers will be spending the same amount of time with children in each group (since the interventions will be the same length), addressing another confound and limitation to the present study.

Future Research

The results from both the classification and preference tasks are important and exciting because previous research has only explored theory-based interventions within other areas of biology (Solomon & Johnson, 2000; Krascum & Andrews, 1998; Au & Romo, 1994; Zamora, Romo, & Au, 2006). The present study replicated and extended the results from previous studies, showing that theory-based interventions are also effective within the domain of health. Additionally, this study generated other interesting questions for future research to address and answer. First, what are the long-term effects of theory-based interventions? Measuring long-term effects of theory-based and non theory-based interventions (e.g., testing children after 6 months or one year) would provide further insight into how well the information has been integrated into the child's knowledge base. Based on the results from the present study, I would predict that the theory group would have a better understanding of health and would continue to perform at higher levels of accuracy than the non theory and control group. Many studies have shown that it is easier to retain information when knowledge is acquired and organized in a theoretical framework (e.g., Krascum & Andrews, 1998). Therefore, the theory group would have an advantage because they have a theory for health, which will help with "maintaining" the information.

Second, would theory-based interventions be more effective if they provided children with more information about the general categories of foods and activities? Children may be better able to organize the material and make inductive inferences about novel items if they are provided with more information about each category.

Lastly, it would be interesting for future research to examine children's understanding of the healthfulness of less familiar categories such as high-sugar foods or drinks (e.g., soda, juice). Since children in all three groups were performing at ceiling on the categories of vegetables and exercise, there was not much room for improvement. Examining the effects of theory-based interventions in less familiar areas would provide a more fruitful account of the efficacy of coherent and causally-related information.

Children receiving a theory-based intervention improved in their classification of general and specific items, *health-related correct* explanations, and in their preferences for healthy foods and behaviors. Moreover, they performed more accurately on all of the above tasks than both the non theory and control groups. These findings suggest that theory-based information can help children to organize and integrate information about the world into their existing knowledge base. Consequently, this theory-based framework could be used to educate children about health, as well as other biological processes such as illness and reproduction. Educating children about health and other important biological processes in this manner may provide them with the knowledge necessary to make safe and healthy choices throughout their lifetime.

REFERENCES

American Heart Association (AHA): Learn and Live. (2006). *Our 2006 diet and lifestyle recommendations.* Retrieved November 2, 2006, from http://www.americanheart.org/presenter.jhtml?identifier=851.

Au, T.K., & Romo, L.F. (1996). Building a coherent conception of HIV transmission. *The Psychology of Learning and Motivation, 35*, 193-240.

Caspersen, C.J., Powell, K.E., & Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126-131.

Center for Disease Control and Prevention (CDC): National Center for Health Statistics. (2003-2004). *NHANES data on the prevalence of overweight among children and adolescents: United States.* Retrieved November 2, 2006, from http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overweight/overwght_child_03.htm.

Center for Disease Control and Prevention (CDC). (2007). *About BMI for children and teens.* Retrieved April 30, 2008, from http://www.cdc.gov/nccdphp/dnpa/bmi/childrens_BMI/about_childrens_BMI.htm

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2^{nd} ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Department of Health and Human Services (DHHS). (2001). *The Surgeon General's call to action to prevent and decrease overweight and obesity.* Retrieved October 23, 2006, from http://www.surgeongeneral.gov/topics/obesity/calltoaction/fact_adolescents.htm.

Fisch, S.M., Truglio, R.T., & Cole, C.F. (1999). The impact of Sesame Street on preschool children. *Media Psychology, 1*, 165-190.

Gelman, S.A., & Kalish, C.W. (2005). Conceptual Development. In D. Kuhn & R.S. Siegler (eds.), *Handbook of child psychology volume 2, cognition, perception, and language, 6^{th} edition* (pp. 687-733). Hobokan, NJ: Wiley.

Gopnik, A. (2000). Explanation as orgasm and the drive for causal knowledge: The function, evolution, and phenomenology of the theory formation system. In F. C. Keil & R. A. Wilson (Eds.), *Explanation and cognition* (pp. 299–324). Cambridge, MA: MIT Press.

Gopnik, A., & Sobel, D.M. (2000). Detecting blickets: How young children use information about novel causal powers in categorization and induction. *Child Development, 71*, 1205-1222.

Gopnik, A., & Wellman, H.M. (1994). The “theory theory”. In L. Hirschfeld & S.A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture.* (pp. 257- 293). New York: Cambridge University Press.

Hamlin, J. K., Wynn, K., & Bloom, P. (2007). Social evaluation by preverbal infants. *Nature, 450*, 557-559.

Harris, P.L. (1994). Magic [Special issue]. *British Journal of Developmental Psychology, 12*, 1-108.

Hespos, S. J. & Baillargeon, R. (2001). Reasoning about containment events in very young infants. *Cognition, 78*, 207-245.

Hickling, A.K., & Gelman, S.A. (1995). How does your garden grow? Early conceptualization of seeds and their place in plant growth cycle. *Child Development, 66,* 856-876.

Inagaki, K., & Hatano, G. (1987). Young children’s spontaneous personification as analogy. *Child Development, 58,* 1013-1020.

Inagaki, K., & Hatano, G. (1993). Young children’s understanding of the mind-body distinction. *Child Development, 64*, 1534-1549.

Inagaki, K., & Hatano, G. (1996). Young children’s recognition of commonalities between animals and plants. *Child Development, 67*, 2823-2840.

Inagaki, K., & Hatano, G. (2002). Naive biology as a core domain of thought. In *Essays in Developmental Psychology* (pp 1-17). New York: Psychology Press.

Krascum, R.M., & Andrews, S. (1998). The effects of theories on children’s acquisitions of family-resemblance categories. *Child Development, 69,* 333-346.

Levin, S., Maurice, M.W., McKenzie, T.L., & DeLouise, A.C. (2002). Assessment of a pilot video’s effect on physical activity and heart health for young children. *Family and Community Health, 25*(3), 10-17.

Mendoza, M. (2007). *Failing to fight fat.* Retrieved January 3, 2008, from http://www.usatoday.com/news/health/2007-07-04-fightingfat_N.htm.

Murphy, G. L. (2002). *The big book of concepts*. Cambridge, MA: MIT Press.

Murphy, G.L., & Allopenna, P.D. (1994). The locus of knowledge effects in concept learning. J*ournal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 904-919.

Murphy, G.L., & Medin, D.L. (1985). The role of theories in conceptual coherence. *Psychological Review, 92*(3), 289-316.

National Institute of Child Health and Human Development (NICHD). (2005). *Media Smart Youth: Eat, think, and be active!* Retrieved October 2, 2006, from http://www.nichd.nih.gov/msy/.

National Institute of Health (NIH). (2005). *Ways to Increase Children's Activity and Nutrition: We Can!*. Retrieved October 2, 2006, from http://www.nhlbi.nih.gov/health/public/heart/obesity/wecan/.

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

Nguyen, S. P. (2008). Children's evaluative categories and inductive inferences within the domain of food. *Infant and Child Development, 17*, 285-299.

Nguyen, S.P., & Rosengren, K.S. (2004). Parental reports of children's biological knowledge and misconceptions. *International Journal of Behavioral Development, 28*(5), 411-420.

Pine, K., Messer, D., & St. John, K. (2001). Children's misconceptions in primary science: A survey of teachers' views. *Research in Science and Technological Education, 19*, 79-96.

Rosengren, K.S., Gelman, S.A., Kalish, C.W., & McCormick, M. (1991). As time goes by: Children's early understanding of growth in animals. *Child Development, 62*(6), 1302-1321.

Schult, C.A., & Wellman, H.M. (1997). Explaining human movements and actions: Children's understandings of the limits of psychological explanation. *Cognition*, *62*(3), 291-324.

Sesame Street (2006). *Color me hungry*. Retrieved September 20, 2006, from http://pbskids.org/sesame/letter/colormehungry.html.

Sesame Street (2006). *Happy healthy songs*. Retrieved September 20, 2006, from http://pbskids.org/sesame/songs/index.html.

Solomon, G.E.A., & Johnson, S.C. (2000). Conceptual change in the classroom:

Teaching young children to understand biological inheritance. *British Journal of Developmental Psychology, 18,* 81-96.

Springer, K. (1995). Acquiring a naïve theory of kinship through inference. *Child Development*, *66*, 547-558.

Stice, E., Shaw, H., & Marti, N.C. (2006). A meta-analytic review of obesity prevention programs for children and adolescents: The skinny on interventions that work. *Psychological Bulletin, 132*(5), 667-691.

Trost, S.G., Morgan, A.M., Saunders, R., Felton, G., Ward, D.S., & Pate, R.P. (2000). Children's understanding of the concept of physical activity. *Pediatric Exercise Science, 12*, 293-299.

United States Department of Agriculture (USDA) and the Food and Drug Administration (FDA). (2003). *The Power of Choice*. Retrieved September 25, 2006, from http://www.fns.usda.gov/tn/RESOURCES/power_of_choice.html.

United States Department of Agriculture (USDA). (2005). *My Pyramid Plan*. Retrieved April 30, 2008, from http://www.mypyramid.gov/mypyramid/index.aspx.

Vosniadou, S., & Brewer, W.F. (1992). Mental models of the earth: A study of conceptual change in childhood. *Cognitive Psychology, 24*, 535-585.

Wardle, J., & Huon, G. (2000). An experimental investigation of the influence of health information on children's taste preferences. *Health Education Research, 15*(1), 39-44.

Wellman, H.M., & Gelman, S.A. (1992). Cognitive development: Foundational theories of core domains. *Annual Review of Psychology, 43*, 337-375.

Wellman, H.M., & Gelman, S.A. (1997). Knowledge acquisition. In D. Kuhn & R.S. Siegler (eds.), *Handbook of child psychology volume 2, cognition, perception, and language, 6th edition* (pp. 523–573). Hoboken, NJ: Wiley.

Wellman, H.M., & Johnson, C.N. (1982). Children's understanding of food and its functions: A preliminary study of the development of concepts of nutrition. *Journal of Applied Developmental Psychology, 3*(2), 135-148.

Zamora, A., Romo, L.F., & Au, T.K. (2006). Using biology to teach adolescents about STD transmission and self-protective behaviors. *Applied Developmental Psychology, 27*, 109-124.

APPENDIX A

Adult Data Sheets

A1: Typicality; A2: Palatability/Enjoyability; A3: Coherence; A4: Causality

A1: Typicality Ratings

Name______________________
Gender_____________________
Birthdate____________________
Today's Date_________________

Directions: In this study, you will be asked to rate, on a scale of 1 through 7, how typical a series of items are of certain categories—with 1 being "not at all typical" and 7 being "very typical." **The term "typical" refers to how good of an example an item is of a category.**

For instance, if you were asked whether a sedan is a typical example of a car, you would probably indicate 7 because it is very typical of the category of cars. Also, if you were asked whether a limousine is a typical example of a car, you would probably indicate 4 because it is somewhat typical of the category of cars. However, if you were asked whether a computer is a typical example of a car, you would probably indicate 1 because it is not at all typical of the category of cars. Do you have any questions?

Recall, the term "typical" refers to how good of an example an item is of a category. Consider the category of vegetables. Please circle your answers below.

Is a **carrot** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **broccoli** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **peas** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **mushroom** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **spinach** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **lettuce** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **cabbage** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **corn** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **green beans** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **cauliflower** a typical example of the category of **vegetables**?

1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **zucchini** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **asparagus** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **beet** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **peppers** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **squash** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **Brussels sprouts** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **celery** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is an **onion** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is an **artichoke** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **potato** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **sweet potato** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **squash** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **lima beans** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **black beans** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **cucumber** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **tomato** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **turnip** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is an **eggplant** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **radish** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **pumpkin** a typical example of the category of **vegetables**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Recall, the term "typical" refers to how good of an example an item is of a category. Consider the category of high-fat foods. Please circle your answers below.

Is a **cake** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **doughnut** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **fried chicken** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **ice cream** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **chocolate bar** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **oil** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **cookie** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **taco** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **potato chips** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **bacon** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **chicken nuggets** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **mayonnaise** a typical example of the category of **high-fat foods**?

1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **sausage** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **French fries** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical
Is a **hamburger** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **hotdog** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical
Is a **hushpuppy** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **pizza** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **grilled cheese sandwich** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **brownie** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **grits** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **Cheetos** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **corndog** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **hash browns** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **onion rings** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **butter** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is a **Funnel cake** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **cream cheese** a typical example of the category of **high-fat foods**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Are **nachos** a typical example of the category of **high-fat foods**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **fudge** a typical example of the category of **high-fat foods**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Recall, the term "typical" refers to how good of an example an item is of a category. Consider the category of physical activity. Please circle your answers below.

Is **playing soccer** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **swimming** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **playing video games** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **riding a bike** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **jumping rope** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **running** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **walking up stairs** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **dancing** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **eating candy** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **playing on the computer** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **gymnastics** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **sleeping** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **walking the dog** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **watching TV** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **reading a book** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **cleaning your room** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **playing music** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **writing a letter** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **talking on the phone** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **kayaking** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **doing homework** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **throwing a ball** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **raking leaves** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **canoeing** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **playing on the jungle gym** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **playing tag** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **skateboarding** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **surfing** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **ice skating** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **rollerblading** a typical example of the category of **physical activity**?
1 2 3 4 5 6 7
not at all typical somewhat typical very typical

Is **watching a movie** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **skiing** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **snowboarding** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

Is **walking to school** a typical example of the category of **physical activity**?

1	2	3	4	5	6	7
not at all typical			somewhat typical			very typical

A2: Palatability/Enjoyability Ratings

Name______________________
Gender_____________________
Birthdate____________________
Today's Date_________________

Directions: In this study, you will be asked to rate, on a scale of 1 through 7, how palatable a series of foods are—with 1 being "not at all palatable" and 7 being "very palatable." **The term "palatable" refers to the tastiness of the food.**

You will also be asked to rate, on a scale of 1 through 7, how enjoyable a series of activities are –with 1 being "not at all enjoyable" and 7 being "very enjoyable". **The term "enjoyable" refers to receiving pleasure or satisfaction from.**

Recall, the term "palatable" refers to the tastiness of the food. Consider the following foods. Please circle your answers below.

Is a **carrot** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **broccoli** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **cake** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **doughnut** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **peas** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **fried chicken** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **mushroom** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **spinach** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **lettuce** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **ice cream** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **chocolate bar** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **cabbage** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **corn** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **oil** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is a **cookie** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Are **green beans** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **cauliflower** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is a **taco** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Are **potato chips** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **bacon** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **zucchini** a palatable food?

1	2	3	4	5	6	7
not at all tasty			somewhat tasty			very tasty

Is **asparagus** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is a **beet** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is a **chicken nugget** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **mayonnaise** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Are **peppers** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **squash** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Are **Brussels sprouts** a palatable food?

1	2	3	4	5	6	7
not at all palatable			somewhat palatable			very palatable

Is **celery** a palatable food?

1	2	3	4	5	6	7

not at all palatable somewhat palatable very palatable

Is **sausage** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **French fries** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **hamburger** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **hotdog** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **hushpuppy** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is an **onion** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is an **artichoke** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **potato** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **pizza** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **grilled cheese sandwich** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **brownie** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **sweet potato** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **squash** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **lima beans** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **grits** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **Cheetos** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **corndog** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **Hash browns** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **black beans** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **cucumber** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **tomato** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **turnip** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **onion rings** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **butter** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **funnel cake** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is an **eggplant** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **radish** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **cream cheese** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Are **nachos** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is a **pumpkin** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Is **fudge** a palatable food?
1 2 3 4 5 6 7
not at all palatable somewhat palatable very palatable

Recall, the term "enjoyable" refers to receiving pleasure or satisfaction from. Consider the following activities. Please circle your answers below.

Is **playing video games** an enjoyable activity?
1 2 3 4 5 6 7

not at all enjoyable			somewhat enjoyable			very enjoyable

Is **riding a bike** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **dancing** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **playing soccer** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **swimming** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **jumping rope** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **playing on the computer** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **doing gymnastics** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **running** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **reading a book** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **walking the dog** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **watching TV** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **walking upstairs** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **cleaning your room** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **raking leaves** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **canoeing** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **talking on the phone** an enjoyable activity?

1	2	3	4	5	6	7
not at all enjoyable			somewhat enjoyable			very enjoyable

Is **kayaking** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **playing on the jungle gym** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **playing tag** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **horseback riding** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **doing homework** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **skateboarding** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **surfing** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **ice skating** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **rollerblading** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **watching a movie** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **skiing** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **snowboarding** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **walking to school** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **eating candy** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **sleeping** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

Is **writing a letter** an enjoyable activity?
1 2 3 4 5 6 7
not at all enjoyable somewhat enjoyable very enjoyable

A3: Coherence Ratings

Name ____________________
Gender ___________________
Birthdate __________________
Today's Date_______________

Directions: In this study, you will be asked to rate, on a scale of 1 through 7, how coherent a passage is with 1 being "not at all coherent" and 7 being "very coherent." The term "**coherent**" refers to the degree to which material is presented in a logically ordered manner in which the facts are related and the information is presented clearly.

1. Consider the following passage:

"There are some animals that live in the forest called wugs. There is a special way to tell that these animals are wugs. Wugs are animals that like to fight. They have claws, horns, armor, and a long spiky tail to fight with. Wugs can scratch with their sharp claws, hit with their horns, use the sharp armor on their backs to protect them from being bitten, and use their long tail with a spiky ball to swing at other animals."

For instance, if you were asked whether the previous passage is coherent, you would probably indicate **7** because it is very coherent. In other words, the material is ordered in a logical way, the facts are related, and the information is presented clearly.

Is this passage coherent?

1	2	3	4	5	6	**7**
not coherent			somewhat coherent			**very coherent**

2. Consider the following passage:

"They are called wugs that have claws, horns, armor, and a long spiky tail to fight with. Wugs are animals that like to fight. There are some animals that live in the forest. Wugs can scratch with their sharp claws, hit with their horns, use the sharp armor on their backs to protect them from being bitten, and use their long tail with a spiky ball to swing at other animals. There is a special way to tell that these animals are wugs."

Also, if you were asked whether the previous passage is coherent, you would circle **4** because it is somewhat coherent.

Is this passage coherent?

1	2	3	**4**	5	6	7
not coherent			**somewhat coherent**			very coherent

3. Consider the following passage:

"Animals live in the forest. Wugs can scratch with their long tail with a spiky ball, hit with their sharp armor, use the sharp claws on their backs to protect them from being bitten, and use their horns to swing at other animals. They have claws, horns, armor, and a long spiky tail. There is a special way to tell that these animals are wugs."

However, if you were asked whether the previous passage is coherent, you would probably circle **1** because it is not at all coherent.

Is this passage coherent?

1	2	3	4	5	6	7
not coherent			somewhat coherent			very coherent

Recall, the term "coherent" refers to the degree to which material is presented in a logically ordered manner in which the facts are related and the information is presented clearly. Read both of the following passages BEFORE rating each of them for coherence. The goal is to compare the two passages to each other before rating them.

Consider the following passages:

Passage 1:	Passage 2:
"We are going to learn today about how to have a healthy body. Having a healthy body means your body has energy and strength to grow, learn, and play. To have a healthy body, you need to feed it right. Healthy foods give your body what it needs because they have many nutrients. Nutrients are inside healthy foods. Nutrients help you grow, give you long-lasting energy, and keep you from getting sick. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods because they have many nutrients inside of them. You should eat vegetables every day. Examples of vegetables that have many nutrients inside are carrots, peas, mushrooms, broccoli, spinach, and beets. These foods help you grow, give you long-lasting energy, and keep you from getting sick. Remember, to have a healthy body you need to feed it right. Unhealthy foods do not give your body what it needs because they do not have many nutrients. Not many nutrients are inside of unhealthy foods. They do not have nutrients that help you grow, give you long-lasting energy, and keep you from getting sick. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods because they do not have many nutrients inside of them. You should not eat foods with a lot of fat every day. Examples of foods that are high in fat and do not have many nutrients inside are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. These foods do not help you grow, give you long-lasting energy, and keep you from getting sick. To have a healthy body, you also need to treat it right by being physically active. Physical activity is anything that gets your body & muscles moving, and your heart working. Physical activity is healthy for you because it makes your bones and muscles strong, makes your heart beat faster, gives you energy, and keeps you from getting sick. You should be physically active every day. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room because they make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities because they do not make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. Today we learned about how to have a healthy body. We learned about healthy foods like vegetables that have many nutrients inside that help you grow, give you long-lasting energy, and keep you from getting sick. We learned about unhealthy foods that are high in fat that do not have many nutrients inside. We also learned about physical activities that make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. You should eat vegetables and be physically active every day." Is this passage coherent overall? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent	"We are going to learn today about different things. Examples of vegetables are carrots, peas, mushrooms, broccoli, spinach, and beets. Healthy foods give your body what it needs. You should eat vegetables everyday. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods. Examples of foods that are high in fat are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. Unhealthy foods do not give your body what it needs. You should not eat foods with a lot of fat every day. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods. Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room. Physical activity is anything that gets your body & muscles moving, and your heart working. You should be physically active every day. Physical activity is healthy for you. You should eat vegetables and be physically active every day. Today we learned about different things. We learned about healthy foods like vegetables, unhealthy foods that are high in fat, and physical activities." Is this passage coherent overall? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent

You just rated whether passages were coherent overall. In the next section, you will be rereading the passages, one part at a time. You will be asked to rate whether each part is coherent. Read both passages

BEFORE rating each of them. Recall, the term "coherent" refers to the degree to which material is presented in a logically ordered manner in which the facts are related and the information is presented clearly. The goal is to compare the two passages to each other before rating them.

<u>1. Consider the following passages:</u>

Passage 1:	Passage 2:
"We are going to learn today about how to have a healthy body. Having a healthy body means your body has energy and strength to grow, learn, and play." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent	"We are going to learn today about different things." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent

<u>2. Consider the following passages:</u>

Passage 1:	Passage 2:
"To have a healthy body, you need to feed it right. Healthy foods give your body what it needs because they have many nutrients. Nutrients are inside healthy foods. Nutrients help you grow, give you long-lasting energy, and keep you from getting sick. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods because they have many nutrients inside of them. You should eat vegetables every day. Examples of vegetables that have many nutrients inside are carrots, peas, mushrooms, broccoli, spinach, and beets. These foods help you grow, give you long-lasting energy, and keep you from getting sick." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent	"Examples of vegetables are carrots, peas, mushrooms, broccoli, spinach, and beets. Healthy foods give your body what it needs. You should eat vegetables everyday. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent

<u>3. Consider the following passages:</u>

Passage 1:	Passage 2:
"Remember, to have a healthy body you need to feed it right. Unhealthy foods do not give your body what it needs because they do not have many nutrients. Not many nutrients are inside of unhealthy foods. They do not have nutrients that help you grow, give you long-lasting energy, and keep you from getting sick. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods because they do not have many nutrients inside of them. You should not eat foods with a lot of fat every day. Examples of foods that are high in fat and do not have many nutrients inside are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. These foods do not help you grow, give you long-lasting energy, and keep you from getting sick." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent	"Examples of foods that are high in fat are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. Unhealthy foods do not give your body what it needs. You should not eat foods with a lot of fat every day. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent

<u>4. Consider the following passages:</u>

Passage 1:	Passage 2:
"To have a healthy body, you also need to treat it right by being physically active. Physical activity is anything that gets your body & muscles moving, and your heart working. Physical activity is healthy for you because it makes your bones and muscles strong, makes your heart beat faster, gives you energy, and keeps you from getting sick. You should be physically active every day. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room because they make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities because they do not make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent	"Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room. Physical activity is anything that gets your body & muscles moving, and your heart working. You should be physically active every day. Physical activity is healthy for you." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent

<u>5. Consider the following passages:</u>

Passage 1:	Passage 2:
"Today we learned about how to have a healthy body. We learned about healthy foods like vegetables that have many nutrients inside that help you grow, give you long-lasting energy, and keep you from getting sick. We learned about unhealthy foods that are high in fat that do not have many nutrients inside. We also learned about physical activities that make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. You should eat vegetables and be physically active every day." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent	"You should eat vegetables and be physically active every day. Today we learned about different things. We learned about healthy foods like vegetables, unhealthy foods that are high in fat, and physical activities." Is this passage coherent? 1 2 3 4 5 6 7 not coherent somewhat coherent very coherent

A4: Causality Ratings

Name______________________
Gender_____________________
Birthdate____________________
Today's Date_________________

Directions: In this study, you will be asked to rate, on a scale of 1 through 7, how causally-related a passage is with 1 being "not causally-related" and 7 being "very causally-related." The term "**causally-related**" refers to the degree to which separate facts are connected together through the explanation of causes and effects.

1. Consider the following passage:

"There are some animals that live in the forest called wugs. There is a special way to tell that these animals are wugs. Wugs are animals that like to fight. They have claws, horns, armor, and a long spiky tail to fight with. Wugs can scratch with their sharp claws, hit with their horns, use the sharp armor on their backs to protect them from being bitten, and use their long tail with a spiky ball to swing at other animals."

In this example, the causal parts of the passage are underlined. The sentence, "wugs are animals that like to fight" gives the reader an explanation for the wug's special features (e.g., wugs have claws and horns so it can fight). The sentence explaining the specific function of each feature, "Wugs can scratch with their sharp claws…" connects all of these separate features (e.g., horns, claws, armor) together through their functions. Therefore, if you were asked whether the following passage is causally-related, you would probably indicate **7** because it is very causal.

Is this passage causally-related?

1	2	3	4	5	6	**7**
not causal			somewhat causal			**very causal**

2. Consider the following passage:

"There are some animals called wugs. There is a special way to tell that these animals are wugs. Wugs are animals that like to fight. Wugs have claws, horns, armor, and a long spiky tail to fight with."

Also in this example, the causal parts of the passage are underlined. There are few causal parts in this passage. For example, there is no explanation for the wug's features like there was in the first passage (e.g., wugs can scratch with their sharp claws…). If you were asked whether the following passage is causally-related, you would circle **4** because it is somewhat causal.

Is this passage causally-related?

1	2	3	**4**	5	6	7
not at all causal			**somewhat causal**			very causal

3. Consider the following passage:

"There are some animals called wugs. There is a special way to tell that these animals are wugs. Wugs have claws, horns, armor, and a long spiky tail."

In this example, there are no causal parts of the passage. In other words, there are no explanations to connect the separate parts of the passage together. If you were asked whether the following passage is causally-related, you would probably circle **1** because it is not causal.

Is this passage causally-related?

1	2	3	4	5	6	7
not causal			somewhat causal			very causal

Recall, the term "causally-related" refers to the degree to which separate facts are connected together through the explanation of causes and effects. Read both of the following passages BEFORE rating each of them for causality. The goal is to compare the two passages to each other before rating them.

Consider the following passages:

Passage 1:	Passage 2:
"We are going to learn today about how to have a healthy body. Having a healthy body means your body has energy and strength to grow, learn, and play. To have a healthy body, you need to feed it right. Healthy foods give your body what it needs because they have many nutrients. Nutrients are inside healthy foods. Nutrients help you grow, give you long-lasting energy, and keep you from getting sick. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods because they have many nutrients inside of them. You should eat vegetables every day. Examples of vegetables that have many nutrients inside are carrots, peas, mushrooms, broccoli, spinach, and beets. These foods help you grow, give you long-lasting energy, and keep you from getting sick. Remember, to have a healthy body you need to feed it right. Unhealthy foods do not give your body what it needs because they do not have many nutrients. Not many nutrients are inside of unhealthy foods. They do not have nutrients that help you grow, give you long-lasting energy, and keep you from getting sick. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods because they do not have many nutrients inside of them. You should not eat foods with a lot of fat every day. Examples of foods that are high in fat and do not have many nutrients inside are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. These foods do not help you grow, give you long-lasting energy, and keep you from getting sick. To have a healthy body, you also need to treat it right by being physically active. Physical activity is anything that gets your body & muscles moving, and your heart working. Physical activity is healthy for you because it makes your bones and muscles strong, makes your heart beat faster, gives you energy, and keeps you from getting sick. You should be physically active every day. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room because they make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities because they do not make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. Today we learned about how to have a healthy body. We learned about healthy foods like vegetables that have many nutrients inside that help you grow, give you long-lasting energy, and keep you from getting sick. We learned about unhealthy foods that are high in fat that do not have many nutrients inside. We also learned about physical activities that make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. You should eat vegetables and be physically active every day." Is this passage causally-related overall? 1 2 3 4 5 6 7 not causal somewhat causal very causal	"We are going to learn today about different things. Examples of vegetables are carrots, peas, mushrooms, broccoli, spinach, and beets. Healthy foods give your body what it needs. You should eat vegetables everyday. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods. Examples of foods that are high in fat are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. Unhealthy foods do not give your body what it needs. You should not eat foods with a lot of fat every day. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods. Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room. Physical activity is anything that gets your body & muscles moving, and your heart working. You should be physically active every day. Physical activity is healthy for you. You should eat vegetables and be physically active every day. Today we learned about different things. We learned about healthy foods like vegetables, unhealthy foods that are high in fat, and physical activities." Is this passage causally-related overall? 1 2 3 4 5 6 7 not causal somewhat causal very causal

You just rated whether passages were causally-related overall. In the next section, you will be rereading

the passages, one part at a time. You will be asked to rate whether each part is causally-related. Read both passages BEFORE rating each of them. Recall, the term "causally-related" refers to the degree to which separate facts are connected together through the explanation of causes and effects. The goal is to compare the two passages to each other before rating them.

1. Consider the following passages:

Passage 1:	Passage 2:
"We are going to learn today about how to have a healthy body. Having a healthy body means your body has energy and strength to grow, learn, and play." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal	"We are going to learn today about different things." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal

2. Consider the following passages:

Passage 1:	Passage 2:
"To have a healthy body, you need to feed it right. Healthy foods give your body what it needs because they have many nutrients. Nutrients are inside healthy foods. Nutrients help you grow, give you long-lasting energy, and keep you from getting sick. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods because they have many nutrients inside of them. You should eat vegetables every day. Examples of vegetables that have many nutrients inside are carrots, peas, mushrooms, broccoli, spinach, and beets. These foods help you grow, give you long-lasting energy, and keep you from getting sick." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal	"Examples of vegetables are carrots, peas, mushrooms, broccoli, spinach, and beets. Healthy foods give your body what it needs. You should eat vegetables everyday. There are many important healthy foods you should eat a lot of. For example, vegetables are healthy foods." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal

3. Consider the following passages:

Passage 1:	Passage 2:
"Remember, to have a healthy body you need to feed it right. Unhealthy foods do not give your body what it needs because they do not have many nutrients. Not many nutrients are inside of unhealthy foods. They do not have nutrients that help you grow, give you long-lasting energy, and keep you from getting sick. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods because they do not have many nutrients inside of them. You should not eat foods with a lot of fat every day. Examples of foods that are high in fat and do not have many nutrients inside are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. These foods do not help you grow, give you long-lasting energy, and keep you from getting sick." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal	"Examples of foods that are high in fat are French fries, cookies, hotdogs, cake, fried chicken, and ice cream. Unhealthy foods do not give your body what it needs. You should not eat foods with a lot of fat every day. There are many important unhealthy foods you should not eat a lot of. For example, foods that are high in fat are unhealthy foods." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal

4. Consider the following passages:

Passage 1:	Passage 2:
"To have a healthy body, you also need to treat it right by being physically active. Physical activity is anything that gets your body & muscles moving, and your heart working. Physical activity is healthy for you because it makes your bones and muscles strong, makes your heart beat faster, gives you energy, and keeps you from getting sick. You should be physically active every day. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room because they make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities because they do not make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal	"Watching TV, playing video games, playing on the computer, reading a book, talking on the phone, and doing homework are not physical activities. Examples of physical activity are swimming, playing tag, raking leaves, riding a bike, skateboarding, and cleaning your room. Physical activity is anything that gets your body & muscles moving, and your heart working. You should be physically active every day. Physical activity is healthy for you." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal

5. Consider the following passages:

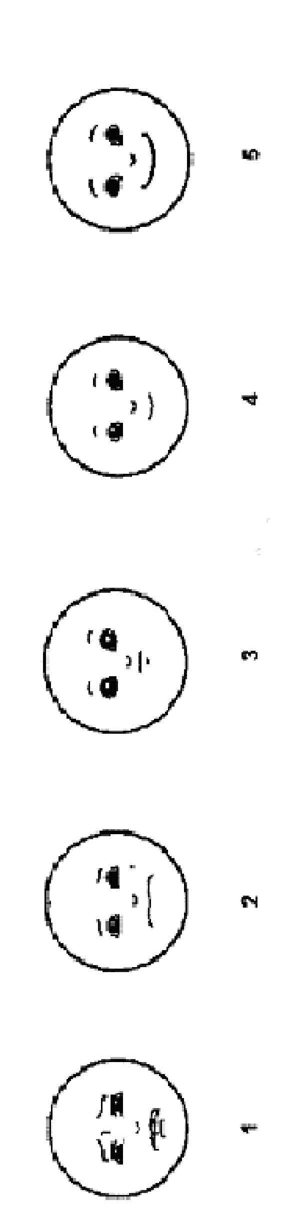
Passage 1:	Passage 2:
"Today we learned about how to have a healthy body. We learned about healthy foods like vegetables that have many nutrients inside that help you grow, give you long-lasting energy, and keep you from getting sick. We learned about unhealthy foods that are high in fat that do not have many nutrients inside. We also learned about physical activities that make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick. You should eat vegetables and be physically active every day." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal	"You should eat vegetables and be physically active every day. Today we learned about different things. We learned about healthy foods like vegetables, unhealthy foods that are high in fat, and physical activities." Is this passage causally-related? 1 2 3 4 5 6 7 not causal somewhat causal very causal

APPENDIX B

Child Data Sheets

B1: Face Likert Scale; B2: Typicality; B3: Palatability/Enjoyability

B1: Face Likert Scale



B2: Child Typicality Ratings

Name__________________________________
Gender_________________________________
Birthdate_______________________________
Today's date____________________________
Researcher______________________________
Order__________________________________

Directions: We are going to play a game today about foods and activities. I will be asking you questions about vegetables, high-fat foods, and physical activities. You can tell me your answers by pointing to a face on this sheet of paper. Each face means something different. Let me show you…if I ask you a question about food: The first face means that the food is not a good example of the category. The second face means that the food is between not good and kind of a good example. The third face means that the food is kind of a good example. The fourth face means that it is between kind of good and a very good example. The fifth face means that it is a very good example. There are no right or wrong answers. Do you have any questions? Let's try some warm-ups first.

1. Is a **dog** a good example of an animal?

1	2	3	4	5
Not a good example		Kind of good		Very good

2. Is an **apple** a good example of an animal?

1	2	3	4	5
Not a good example		Kind of good		Very good

"Let's talk about vegetables."

1. Is a **cucumber** a good example of a vegetable?

1	2	3	4	5
Not a good example		Kind of good		Very good

2. Is **celery** a good example of a vegetable?

1	2	3	4	5
Not a good example		Kind of good		Very good

3. Is a **carrot** a good example of a vegetable?

1	2	3	4	5
Not a good example		Kind of good		Very good

4. Is **broccoli** a good example of a vegetable?

1	2	3	4	5
Not a good example		Kind of good		Very good

5. Is **corn** a good example of a vegetable?

1	2	3	4	5	
Not a good example		Kind of good			Very good

6. Are **peas** a good example of a vegetable?

1	2	3	4	5	
Not a good example		Kind of good			Very good

7. Is a **red pepper** a good example of a vegetable?

1	2	3	4	5	
Not a good example		Kind of good			Very good

8. Are **green beans** a good example of a vegetable?

1	2	3	4	5	
Not a good example		Kind of good			Very good

"Now, let's talk about high-fat foods."

9. Are **potato chips** a good example of a high-fat food?

1	2	3	4	5	
Not a good example		Kind of good			Very good

10. Is **bacon** a good example of a high-fat food?

1	2	3	4	5	
Not a good example		Kind of good			Very good

11. Is a **cake** a good example of a high-fat food?

1	2	3	4	5	
Not a good example		Kind of good			Very good

12. Is a **doughnut** a good example of a high-fat food?

1	2	3	4	5	
Not a good example		Kind of good			Very good

13. Is **fudge** a good example of a high-fat food?

1	2	3	4	5	
Not a good example		Kind of good			Very good

14. Are **French fries** a good example of a high-fat food?

1	2	3	4	5	
Not a good example		Kind of good			Very good

15. Is **fried chicken** a good example of a high-fat food?

1	2	3	4	5

Not a good example Kind of good Very good

16. Are **Cheetos** a good example of a high-fat food?

1	2	3	4	5
Not a good example		Kind of good		Very good

"Now, let's talk about physical activities."

17. Is **playing soccer** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

18. Is **canoeing** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

19. Is **playing on the jungle gym** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

20. Is **playing tag** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

21. Is **riding a bike** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

22. Is **walking the dog** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

23. Is **running** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

24. Is **dancing** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

25. Is **watching T.V.** a good example of a physical activity?

1	2	3	4	5
Not a good example		Kind of good		Very good

26. Is **reading a book** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good Very good

27. Is **typing on the computer** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good Very good

28. Is **writing a letter** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good Very good

29. Is **watching a movie** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good Very good

30. Is **sleeping** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good Very good

31. Is **playing video games** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good Very good

32. Is **talking on the phone** a good example of a physical activity?

1 2 3 4 5
Not a good example Kind of good

B3: Child Palatability/Enjoyability Ratings

Name________________________________
Gender_______________________________
Birthdate_____________________________
Today's date__________________________
Researcher____________________________
Order________________________________

Directions: We are going to play a game today about foods and activities. I will be asking you questions about foods and activities and you can tell me your answers by pointing to a face on this sheet of paper. Each face means something different. Let me show you…if I ask you a question about food: The first face means that the food is not yummy. The second face means that the food is between not yummy and kind of yummy. The third face means that the food is kind of yummy. The fourth face means that it is between kind of yummy and very yummy. The fifth face means that the food is very yummy. There are no right or wrong answers. Do you have any questions? Let's try some warm-ups first.

1. Is an **apple** a yummy food?

1	2	3	4	5
Not yummy		Kind of yummy		Very yummy

2. Is **playing with your toys** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

"Let's talk about foods."

1. Is a **cucumber** a yummy food?

1	2	3	4	5
Not yummy		Kind of yummy		Very yummy

2. Are **potato chips** a yummy food?

1	2	3	4	5
Not yummy		Kind of yummy		Very yummy

3. Is a **carrot** a yummy food?

1	2	3	4	5
Not yummy		Kind of yummy		Very yummy

4. Is a **cake** a yummy food?

1	2	3	4	5
Not yummy		Kind of yummy		Very yummy

5. Is **corn** a yummy food?

1	2	3	4	5

Not yummy Kind of yummy Very yummy

6. Are **French fries** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

7. Is a **red pepper** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

8. Are **green beans** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

9. Are **Cheetos** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

10. Is **bacon** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

11. Is **broccoli** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

12. Is a **doughnut** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

13. Is **fudge** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

14. Are **peas** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

15. Is **fried chicken** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

16. Is **celery** a yummy food?

1 2 3 4 5
Not yummy Kind of yummy Very yummy

"Now, let's talk about activities."

17. Is **playing soccer** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

18. Is **writing a letter** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

19. Is **watching T.V.** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

20. Is **playing tag** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

21. Is **riding a bike** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

22. Is **sleeping** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

23. Is **running** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

24. Is **talking on the phone** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

25. Is **playing on the jungle gym** a fun activity?

1 2 3 4 5
Not fun Kind of fun Very fun

26. Is **reading a book** a fun activity?

1 2 3 4 5

Not fun		Kind of fun		Very fun

27. Is **typing on the computer** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

28. Is **canoeing** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

29. Is **watching a movie** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

30. Is **walking the dog** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

31. Is **playing video games** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

32. Is **dancing** a fun activity?

1	2	3	4	5
Not fun		Kind of fun		Very fun

APPENDIX C

The Presentation of the Interventions

<u>The theory-based version will be read as follows</u>:

“We are going to learn today about how to have a healthy body. I’m going to point to my body (point to body). Now can you point to your body? Having a healthy body means your body has energy and strength to grow, learn, and play.

To have a healthy body, you need to feed it right. Healthy foods give your body what it needs because they have many vitamins. Vitamins are inside of healthy foods. (Show lettuce) Look! This is lettuce. Lettuce is a vegetable and a healthy food because has vitamins inside. Let’s look inside! (open flaps and point to vitamins) These are the vitamins, see? Can you point to the vitamins? Would you like to see the lettuce? Vitamins help you grow, give you long-lasting energy, and keep you from getting sick. There are many healthy foods you should eat a lot of. For example, vegetables are healthy foods because they have many vitamins inside of them. You should eat vegetables every day. Examples of vegetables that have many vitamins inside are (“I’m going to show you these pictures and lay them down in front of you, ok? Show the pictures and place in a pile in front of the child) beans, celery, carrots, broccoli, and corn. (Point to pile of veggies)These foods help you grow, give you long-lasting energy, and keep you from getting sick.

Remember, to have a healthy body you need to feed it right. Foods that are not healthy do not give your body what it needs because they do not have many vitamins. Foods that are not healthy do not have vitamins inside. (Show the cookie that open with no vitamins inside) “Look! This is a cookie. Cookies are a high-fat food and are not healthy because they do not have vitamins inside. Let’s look inside! (Open the flaps and point to the inside) There are no vitamins inside, see? Would you like to see the cookie?” High-fat foods do not have vitamins that help you grow, do not give you long-lasting energy, and do not keep you from getting sick. There are many foods that are not healthy that you should not eat a lot of. For example, foods that are high in fat are not healthy foods because they do not have many vitamins inside of them. You should not eat foods with a lot of fat every day. Examples of foods that are high in fat and do not have many vitamins inside are (show the pictures and place in a pile in front of the child) potato chips, bacon, cake, doughnuts, and fudge. These foods do not help you grow, do not give you long-lasting energy, and do not keep you from getting sick.

GO OVER THE PILES OF HEALTHY AND NOT HEALTHY FOODS. These foods are healthy foods. They are vegetables. Let’s look at them again. They are cucumbers, celery, carrots, broccoli, and corn. But, these are not healthy foods. They are high in fat. Let’s look at them again. They are potato chips, bacon, cake, doughnuts, and fudge.

To have a healthy body, you also need to treat it right by exercising. Exercise is anything that gets your body & muscles moving, your heart working, and keeps your body healthy and fit. (Show the human body that opens to show bones, muscles, and heart) “Look! This is a human body. Let’s look inside! (Open the flaps and point to the inside) There is a heart, bones, and muscles. Can you point to the heart? Can you point to the bones? Can you point to the muscles? Would you like to see the body?” (Keep the body and point to everything) Exercise is healthy for you because it makes your bones and muscles strong (point to them on the body), makes your heart beat faster (point to the heart), gives you energy, and keeps you from getting sick. (Would you like to see the body?) You should exercise every day. Examples of exercises that make your bones and muscles strong, make your heart beat faster, give you energy, and keep you from getting sick are (show the pictures and place in a pile in front of the child) playing soccer, canoeing, playing on the jungle gym, playing tag, and riding a bike. But, some things we do are NOT exercise. Let me show you… (show the pictures and place in a pile in front of the child) watching TV, reading a comic book, typing on the computer, writing a letter, and watching a movie are not exercises because they do not make your bones and muscles strong, do not make your heart beat faster, do not give you energy, and do not keep you from getting sick.

GO OVER THE PILES OF EXERCISE AND NOT EXERCISE. This pile is for exercises. Let's look at them again. They are playing soccer, canoeing, playing on the jungle gym, playing tag, and riding a bike. But, this pile is not for exercises. Let's look at them again. They are watching TV, reading a book, typing on the computer, writing a letter, and watching a movie.

Today we learned about how to have a healthy body. We learned about healthy foods like vegetables that have many vitamins inside that help you grow, give you long-lasting energy, and keep you from getting sick. We learned about foods that are not healthy like foods that are high in fat that do not have many vitamins inside. We also learned about exercise that makes your bones and muscles strong, makes your heart beat faster, gives you energy, and keeps you from getting sick. You should eat vegetables and exercise every day.

The non theory-based version:

There are three sections within each learning objective: healthy food, unhealthy food, and exercise. The order of sections within each learning objectives has been changed to 3,1,2. Within each section, the ordering of the sentences has also been changed depending on the number of sentences, either to 2,1 (B, A) or to 3,1, 2.(C, A, B)

For example, the original passage reads as follows:

1a) Healthy foods give your body what it needs. 2a) There are many healthy foods you should eat a lot of. 2b) For example, vegetables are healthy foods. 2c) You should eat vegetables everyday. 3a) Examples of vegetables are cucumbers, celery, carrots, broccoli, and corn.

In the non theory-based version, it is changed to the following:

3a) Examples of vegetables are cucumbers, celery, carrots, broccoli, and corn.
1a) Healthy foods give your body what it needs. 2c) You should eat vegetables everyday. 2a) There are many healthy foods you should eat a lot of. 2b) For example, vegetables are healthy foods.

The whole non theory-based intervention will be read as follows:

We are going to learn today about different things. I'm going to point to my body. (Point to body) Now can you point to your body?

Examples of vegetables are (show the pictures and place in a pile in front of the child) beans, celery, carrots, broccoli, and corn. (Show the lettuce). "Look! This is lettuce. Lettuce is a vegetable and a healthy food. Let's look inside! Can you point to the inside? Would you like to see the lettuce?" Healthy foods give your body what it needs. You should eat vegetables everyday. There are many healthy foods you should eat a lot of. For example, vegetables are healthy foods.

Examples of foods that are high in fat are (show the pictures and place in a pile in front of the child) potato chips, bacon, cake, doughnuts, and fudge. (Show the cookie) "Look! This is a cookie. Cookies are a high fat food and they are not healthy. Let's look inside! Can you point to the inside? Would you like to see the cookie?" Foods that are not healthy do not give your body what it needs. You should not eat foods with a lot of fat every day. There are many foods that are not healthy that you should not eat a lot of. For example, foods that are high in fat are not healthy foods.

GO OVER THE PILES OF HEALTHY AND NOT HEALTHY FOODS. These foods are healthy foods. They are vegetables. Let's look at them again. They are cucumbers, celery, carrots, broccoli, and corn. But, these are not healthy foods. They are high in fat. Let's look at them again. They are potato chips, bacon, cake, doughnuts, and fudge.
But, some things we do are NOT exercise. Let me show you… (show the pictures and place in a pile in front of the child) watching TV, reading a comic book, typing on the computer, writing a letter, and watching a movie are not exercises. Examples of exercises are (show the pictures and place in a pile in front of the child) playing soccer, canoeing, playing on the jungle gym, playing tag, and riding a bike. (Show the human body that opens to show bones, muscles, and heart) Look! This is a human body. Let's look inside! (open flaps) Can you point to the inside? Would you like to see the body? Exercise is anything that gets your body & muscles moving, your heart working, and keeps your body healthy and fit. You should exercise every day. Exercise is healthy for you.

GO OVER THE PILES OF EXERCISE AND NOT EXERCISE. This pile is for exercises. Let's look at them again. They are playing soccer, canoeing, playing on the jungle gym, playing tag, and riding a bike. But, this pile is not for exercises. Let's look at them again. They are watching TV, reading a book, typing on the computer, writing a letter, and watching a movie.

You should eat vegetables and exercise every day. Today we learned about different things. We learned about healthy foods like vegetables, foods that are not healthy and high in fat, and exercise.

APPENDIX D

Child Consent Form

Invitation to Participate in UNCW Child Development Research

Your child is being invited to take part in a fun 30 minute research study about how children think and learn. The study will take place onsite during regular school hours. Your child will receive a small gift for participating. Please take a moment to complete this permission slip. The slip can be returned to your child's teacher or school director. Thank you very much!

****

Permission

____**Yes,** my child has permission to participate in this research.

____ **No**, my child does not have permission to participate in this research.

****

Child Information

Child's First & Last Name: ____

Child's Birthdate:____

Child's Teacher's Name: ____

Days of Attendance: ____

****

Parent/Guardian Information

Printed name & signature of parent or legal guardian giving permission:_____________

____

____

****

*Simone Nguyen, Ph.D.*______ _____________

Name of person providing information Date

Below is additional information on our research for you to keep

What Is The Research About?
Your child is being invited to take part in a research study about how children think and learn. There will be about a total of 500 participants in this study. We are very pleased to have the cooperation of the staff at your child's school and hope you will offer your support too! Thank you so much for your time and consideration!

Who Is Doing The Study?
The person in charge of this study is **Dr. Simone Nguyen** of the University of North Carolina at Wilmington. **Trained UNCW students, Mary Beth McCullough and Tess Young,** will be assisting in gathering and analyzing the information for the study. Please feel free to visit our website at **http://people.uncw.edu/nguyens/**

What Is The Purpose Of This Study?
By doing this study we hope to discover how children think and learn. In particular, we hope to discover how children develop categories within the areas of health and nutrition, such as vegetables, high-fat foods, and physical activities.

Where Is The Study Going To Take Place And How Long Will It Last?
The research procedures will be conducted at your child's school. Your child's participation in the study will involve a visit with the researcher during regular school hours. Each visit will take about 30 minutes.

What Will My Child Be Asked To Do?
This research has been set up to be a fun game. In this study, children will be asked, one at a time, to categorize colorful pictures of objects. For example, children may see a picture of ice cream and then be asked if it is a healthy or unhealthy food. There are no right or wrong answers in this research; we are simply interested in how children think about different objects. Thus, this research does not involve any evaluative intelligence testing.

What Are The Possible Risks And Discomforts?
To the best of our knowledge, the things your child will be doing in this research have no more risk of harm than he or she would experience in everyday life, particularly since this research has been set up to be fun and game-like.

Will My Child Benefit From Taking Part In This Study?
Your child will receive the personal benefit of participating in an enriching and stimulating experience. Your child will be able to interact one on one with a researcher and think about the relationships between different colorful objects. Children typically find this research experience to be very interesting and enjoyable.

Does My Child Have To Take Part In This Study?

If your child decides to take part in the study, it should be because he or she really wants to volunteer. There will be no penalty and if your child chooses not to volunteer he or she will not lose any normal benefits or rights. Your child will not be treated differently by anyone if he or she chooses not to participate in the study. Your child can stop at any time during the study and still keep the same benefits and rights.

What Will It Cost For My Child To Participate?
There are no costs associated with taking part in this study.

Will My Child Receive Any Payment Or Reward For Taking Part In This Study?
Your child will receive a small gift (e.g., stickers, book, pencil, toy) for taking part in this study. If your child should have to stop participating before the study is over, he or she will still receive the small gift.

Who Will See The Information My Child Gives?
Your child's information will be combined with information from others taking part in the study. When we write up the study to share it with other researchers, we will write about the combined information. Your child will not be identified in these written materials.

We will make every effort to prevent anyone who is not on the research team from knowing that your child gave us information or what that information is. Children's names will be initially attached to the response sheets, but to ensure confidentiality, the names will be removed once the data are collected and analyzed. The response sheets will also be kept separate from the consent forms and will be kept in locked cabinets.

However, there are some circumstances in which we may have to show your child's information to other people. We may be required to show information that identifies your child to people who need to be sure that we have done the research correctly, such as the UNCW Institutional Review Board.

Can My Child's Taking Part In The Study End Early?
If your child decides to take part in the study he or she still has the right to decide at any time to stop. There will be no penalty and no loss of benefits or rights if your child stops participating in the study. Your child will not be treated differently by anyone if he or she decides to stop participating in the study.

What If I Have Questions Or My Child Has Questions?
Before you decide whether or not to give permission for your child to take part in the study, please feel free to ask any questions that come to mind. If you have questions about the study, you can contact the investigator, Dr. Simone Nguyen at 910-962-7731 or at nguyens@uncw.edu. If you have any questions about your child's rights or your rights as a research participant, please contact Dr. Candace Gauthier, chair of the UNCW Institutional Review Board, at 910-962-3558.

APPENDIX E

Parent Questionnaire

Parent Questionnaire: *Thank you for taking the time to fill out this form. It should only take about **5-10 minutes**. Your input is very important to us and contributes greatly to the research regarding children's development. Please answer the following questions as accurately as possible and turn it into your child's teacher when you are finished.*

Child's first and last name:____

Please mark your parental status: Mother_____Father ____Guardian___Other(clarify)_______

Please provide your Date of Birth:____

Please provide your current occupation:_______________________________________

Please mark your race/ethnicity:

Hispanic/Latino _________________
Black or African American _________
Hawaiian Native/Pacific Islander____
Other_________________________
Asian American__________________
American Indian/Alaska Native______
White _________________________

Please mark below your household's highest level of education:

Some high school ___________________
High school degree/GED______________
Associate's degree __________________
Bachelor's degree___________________
Master's degree_____________________
Ph.D., M.D. J.D., etc._________________
Technical training____________________
Other______________________________

Please mark if your child has any food allergies or restrictions? No___Yes___ (please list)
____
____

Please circle your answers below:

1) How many servings of vegetables does your child eat each day? (One serving is equal to a deck of cards)
a) 0
b) 1
c) 2
d) 3
e) 4 or more
Comments:____

2) How many servings of high-fat foods does your child eat each day? (One serving is equal to a deck of cards)
a) 0
b) 1

c) 2
d) 3
e) 4 or more
Comments:____

3) How much exercise does your child get in a day (e.g., anything that gets his/her body and muscles moving)?
a) None
b) 5 minutes
c) 10 minutes
d) 15 minutes
e) 20 minutes or more
Comments:____

4) How much time does your child spend doing activities that are not exercise in a day (e.g., anything that does not get his/her body and muscles moving)?
a) None
b) 5 minutes
c) 10 minutes
d) 15 minutes
e) 20 minutes or more
Comments:____

5) Does your child request vegetables?
a) Yes
b) No
Examples:____

6) Does your child request high-fat foods?
a) Yes
b) No
Examples:____

7) Does your child request to exercise?
a) Yes
b) No
Examples:____

8) Does your child request to do activities that are not exercise?
a) Yes
b) No
Examples:____

9) How many times in a day do you provide vegetables to your child?
a) 0
b) 1
c) 2
d) 3
e) 4 or more
Comments:____

10) How many times in a day do you provide high-fat foods to your child?
a) 0
b) 1
c) 2
d) 3
e) 4 or more
Comments:____

11) How many times in a day do you provide opportunities for exercise to your child?
a) 0
b) 1
c) 2
d) 3
e) 4 or more
Comments:____

12) How many times in a day do you provide opportunities for activities that are not exercise to your child?
a) 0
b) 1
c) 2
d) 3
e) 4 or more
Comments:____

Feel free to add any other comments:
____
____
____
____
____

Thank you for your time! It is greatly appreciated!

APPENDIX F:

Pre-test/Post-tests

F1: Pre-test; F2: Post-test; F3: Description of Orders

F1: Pre-test

PRE-TEST: A1
Name: ___________________________
DOB: ____________________________
Today's date:_____________________
School:__________________________
Researcher:______________________
Group:___________________________
Height:____________ Weight__________

Directions: "We are going to play a game today about foods and exercise. There are no right or wrong answers. Are you ready to play?"

1) Are **vegetables** healthy or not healthy for you?

Healthy Not healthy

Why? ____

2) Are **high-fat foods** healthy or not healthy for you?

Healthy **Not healthy**

Why? ____

3) Is **exercising** healthy or not healthy for you?

Healthy Not healthy

Why? ____

4**)** Is **not exercising** healthy or not healthy for you?

Healthy **Not healthy**

Why?____

"Good job! Now I am going to show you some pictures and you can put them in one of these boxes: This box is for healthy foods (researcher's right). You can tell because of the smiley face on the front. And this box is for not healthy foods (researcher's left).You can tell because of the frowny face on the front."

Warm-up: **"Which box is for healthy foods?" "Which box is for not healthy foods?"**

1) This is a **carrot**. Is a carrot healthy or not healthy?

Healthy Not healthy

2) This is **bacon**. Is bacon healthy or not healthy?

Healthy **Not healthy**

3) This is **fudge**. Is fudge healthy or not healthy?

Healthy **Not healthy**

4) This is **celery**. Is celery healthy or not healthy?

Healthy Not healthy

5) This is a **doughnut**. Is a doughnut healthy or not healthy?

Healthy **Not healthy**

6) These are **beans**. Are beans healthy or not healthy?

Healthy Not healthy

*7) This is a **red pepper**. Is a red pepper healthy or not healthy?

Healthy Not healthy

8) These are **potato chips**. Are potato chips healthy or not healthy?

Healthy **Not healthy**

9) This is **corn**. Is corn healthy or not healthy?

Healthy Not healthy

10) This is **cake**. Is cake healthy or not healthy?

Healthy **Not healthy**

11) This is **broccoli**. Is broccoli healthy or not healthy?

Healthy Not healthy

*12) These are **Cheetos**. Are Cheetos healthy or not healthy?

Healthy **Not healthy**

"Good job! We are going to change the boxes now. Now, this box is for exercise (researcher's right)-you can tell because of the smiley face on the front. This box is for not exercise (researcher's left)-you can tell because of the frowny face on the front."

Warm-up: **"Which box is for exercise?" "Which box is for not exercise?"**

13) These are children playing tag. Is **playing tag** an exercise or not exercise?

Exercise Not exercise

14) This is a movie. Is **watching a movie** an exercise or not exercise?

Exercise **Not exercise**

15) This is a computer. Is **typing on the computer** an exercise or not exercise?

Exercise **Not exercise**

*16) These are running shoes. Is **running** an exercise or not exercise?

Exercise Not exercise

17) This is a bike. Is **biking** an exercise or not exercise?

Exercise Not exercise

18) This is a canoe. Is **canoeing** an exercise or not exercise?

Exercise Not exercise

19) This is a TV. Is **watching TV** an exercise or not exercise?

Exercise **Not exercise**

*20) This is a video game. Is **video gaming** an exercise or not exercise?

Exercise **Not exercise**

21) This is a jungle gym. Is **playing on the jungle gym** an exercise or not exercise?

Exercise Not exercise

22) This is a comic book. Is **reading a comic book** an exercise or not exercise?

Exercise **Not exercise**

23) This is a soccer ball. Is **playing soccer** an exercise or not exercise?

Exercise Not exercise

24) This is a letter. Is **writing a letter** an exercise or not exercise?

Exercise **Not exercise**

Preference Directions: "Close your eyes! (put boxes away) Now I want to know what kinds of foods you would like to eat and what kinds of things you would like to do to have a healthy body."

1) To have a healthy body, would you eat a **carrot**?

Yes No

2) To have a healthy body, would you eat **bacon**?

Yes **No**

3) To have a healthy body, would you eat **fudge**?

Yes **No**

4) Is this a **cat**?

Yes **No**

5) To have a healthy body, would you eat **celery**?

Yes No

6) To have a healthy body, would you eat **a doughnut**?

Yes **No**

7) To have a healthy body, would you eat **beans**?

Yes No

*8) To have a healthy body, would you eat a **red pepper**?

Yes No

9) To have a healthy body, would you eat **potato chips**?

Yes **No**

10) Is this a **circle**?

Yes **No**

11) To have a healthy body, would you eat **corn**?

Yes No

12) To have a healthy body, would you eat **cake**?

Yes **No**

13) To have a healthy body, would you eat **broccoli**?

Yes No

*14) To have a healthy body, would you eat **Cheetos**?

Yes **No**

15) To have a healthy body, would you **play tag**?

Yes No

16) To have a healthy body, would you **watch a movie**?

Yes **No**

17) To have a healthy body, would you **type on the computer**?

Yes **No**

*18) To have a healthy body, would you **run**?

Yes No

19) To have a healthy body, would you **bike**?

Yes No

20) To have a healthy body, would you go **canoeing**?

Yes No

21) Is this the color blue?

Yes No

22) To have a healthy body, would you **watch TV**?

Yes **No**

*23) To have a healthy body, would you do **video gaming**?

Yes **No**

24) To have a healthy body, would you **play on the jungle gym**?

Yes No

25) To have a healthy body, would you **read a comic book**?

Yes **No**

26) To have a healthy body, would you **play soccer**?

Yes No

27) To have a healthy body, would you **write a letter**?

Yes **No**

F2: Post-test

<u>POST-TEST: A1</u>
Name: ___________________________
DOB: ____________________________
Today's date:______________________
Days in between pre and post:________
School:___________________________
Researcher:_______________________
Group:____________________________

Directions: "We are going to play a game today about foods and exercise. There are no right or wrong answers. Are you ready to play?"

1) Are **vegetables** healthy or not healthy for you?

Healthy Not healthy

Why? ____

2) Are **high-fat foods** healthy or not healthy for you?

Healthy **Not healthy**

Why? ____

3) Is **exercising** healthy or not healthy for you?

Healthy Not healthy

Why? ____

4**)** Is **not exercising** healthy or not healthy for you?

Healthy **Not healthy**

Why?____

"Good job! Now I am going to show you some pictures and you can put them in one of these boxes: This box is for healthy foods (researcher's right). You can tell because of the smiley face on the front. And this box is for not healthy foods (researcher's left).You can tell because of the frowny face on the front."

<u>Warm-up:</u> "Which box is for healthy foods?" "Which box is for foods that are not healthy?"

1) This is a **carrot**. Is a carrot healthy or not healthy?

Healthy Not healthy

2) This is **bacon**. Is bacon healthy or not healthy?

Healthy **Not healthy**

3) This is **fudge**. Is fudge healthy or not healthy?

Healthy **Not healthy**

4) This is **celery**. Is celery healthy or not healthy?

Healthy Not healthy

5) This is a **doughnut**. Is a doughnut healthy or not healthy?

Healthy **Not healthy**

6) These are **beans**. Are beans healthy or not healthy?

Healthy Not healthy

*7) This is a **red pepper**. Is a red pepper healthy or not healthy?

Healthy Not healthy

8) These are **potato chips**. Are potato chips healthy or not healthy?

Healthy **Not healthy**

9) This is **corn**. Is corn healthy or not healthy?

Healthy Not healthy

10) This is **cake**. Is cake healthy or not healthy?

Healthy **Not healthy**

11) This is **broccoli**. Is broccoli healthy or not healthy?

Healthy Not healthy

*12) These are **Cheetos**. Are Cheetos healthy or not healthy?

Healthy **Not healthy**

"Good job! We are going to change the boxes now. Now, this box is for exercise (researcher's right)-you can tell because of the smiley face on the front. This box is for not exercise (researcher's left)-you can tell because of the frowny face on the front."

Warm-up: **"Which box is for exercise?" "Which box is not for exercise?"**

13) These are children playing tag. Is **playing tag** exercise or not exercise?

Exercise Not exercise

14) This is a movie. Is **watching a movie** exercise or not exercise?

Exercise **Not exercise**

15) This is a computer. Is **typing on the computer** exercise or not exercise?

Exercise **Not exercise**

*16) These are running shoes. Is **running** exercise or not exercise?

Exercise Not exercise

17) This is a bike. Is **biking** exercise or not exercise?

Exercise Not exercise

18) This is a canoe. Is **canoeing** exercise or not exercise?

Exercise Not exercise

19) This is a TV. Is **watching TV** exercise or not exercise?

Exercise **Not exercise**

*20) This is a video game. Is **video gaming** exercise or not exercise?

Exercise **Not exercise**

21) This is a jungle gym. Is **playing on the jungle gym** exercise or not exercise?

Exercise Not exercise

22) This is a comic book. Is **reading a comic book** exercise or not exercise?

Exercise **Not exercise**

23) This is a soccer ball. Is **playing soccer** exercise or not exercise?

Exercise Not exercise

24) This is a letter. Is **writing a letter** exercise or not exercise?

Exercise **Not exercise**

Preference Directions: "Close your eyes! (put boxes away) Now I want to know what kinds of foods you would like to eat and what kinds of things you would like to do to have a healthy body."

1) To have a healthy body, would you eat a **carrot**?

Yes No

2) To have a healthy body, would you eat **bacon**?

Yes **No**

3) To have a healthy body, would you eat **fudge**?

Yes **No**

4) Is this a **cat**?

Yes **No**

5)To have a healthy body, would you eat **celery**?

Yes No

6) To have a healthy body, would you eat **a doughnut**?

Yes **No**

7) To have a healthy body, would you eat **beans**?

Yes No

*8) To have a healthy body, would you eat a **red pepper**?

Yes No

9) To have a healthy body, would you eat **potato chips**?

Yes **No**

10) Is this a **circle**?

Yes **No**

11) To have a healthy body, would you eat **corn**?

Yes No

12) To have a healthy body, would you eat **cake**?

Yes **No**

13) To have a healthy body, would you eat **broccoli**?

Yes No

*14) To have a healthy body, would you eat **Cheetos**?

Yes **No**

15) To have a healthy body, would you **play tag**?

Yes No

16) To have a healthy body, would you **watch a movie**?

Yes **No**

17) To have a healthy body, would you **type on the computer**?

Yes **No**

*18) To have a healthy body, would you **run**?

Yes No

19) To have a healthy body, would you **bike**?

Yes No

20) To have a healthy body, would you go **canoeing**?

Yes No

21) Is this the color blue?

Yes No

22) To have a healthy body, would you **watch TV**?

Yes **No**

*23) To have a healthy body, would you do **video gaming**?

Yes **No**

24) To have a healthy body, would you **play on the jungle gym**?

Yes No

25) To have a healthy body, would you **read a comic book**?

Yes **No**

26) To have a healthy body, would you **play soccer**?

Yes No

27) To have a healthy body, would you **write a letter**?

Yes **No**

F3: Description of Orders

Each child received one of four orders of the pre-test and post-test. These orders are described below. Fifteen children were randomly assigned to each of these orders (5 children in each of the three groups).

1) *A1*: the information is presented from front to back (e.g., foods items 1-12, activity items 13-24), children are asked if the foods are “healthy or not healthy” and if the activities are “exercise or not exercise”, the smiley box is on the child’s left and the frowny box is on the child’s right.

2) *A2*: the information is presented from back to front within each category (e.g., foods items 12-1, activity items 24-13), children are asked if the foods are “healthy or not healthy” and if the activities are “exercise or not exercise”, the smiley box is on the child’s left and the frowny box is on the child’s right.

3) *B1*: the categories are switched and the information is presented from front to back within each category (e.g., activity items 12-24, food items 1-12), children are asked if the foods are “not healthy or healthy” and if the activities are “not exercise or exercise”, the smiley box is on the child’s right and the frowny box is on the child’s left.

4) *B2*: the information is presented from back to front (e.g., activity items 24-13, food items 12-1), children are asked if the foods are “not healthy or healthy” and if the activities are “not exercise or exercise”, the smiley box is on the child’s right and the frowny box is on the child’s left.

APPENDIX G:

Coding Category Document

Coding categories:

1) Health-related correct

a. Health-related correct (nutrients/outcome on body)
   - Vegetables: “have vitamins/good things inside” “they are good for your heart” “they don’t make you fat” “Make you bigger & stronger” “B/c they are good (for you)” “*make* you healthy”
   - “High fat foods are not healthy b/c they do not help you get stronger” “make you tubby/fat”
   - “Exercise is healthy b/c it makes you stronger and is good for your body” ”helps you not get tubby”
   - “Not exercising is not healthy b/c it is not good for your body” “does not make you stronger” ”makes you get tubby/bigger”

b. Use of health terms
   - “Vegetables are healthy b/c they are healthy” “B/c they are”
   - “High-fat foods are not healthy b/c they are not healthy” “b/c they are not”
   - “Exercise is healthy b/c it is healthy”
   - “Not exercise is not healthy b/c it is not healthy”

c. Example-based correct
   - “Vegetables are healthy b/c carrots are good for you” “I eat carrots and broccoli”
   - “High-fat foods are not healthy b/c cookies & cake are bad for you”
   - “Exercise is healthy b/c it makes you run really fast”
   - “Not exercise is not healthy b/c it means you are not running and not playing”

d. Parent-modeling correct
   - “Vegetables are healthy b/c mommy eats them”
   - “High-fat foods are not healthy b/c daddy says they are bad for you”
   - “Exercise is healthy b/c my mommy is always exercising”
   - “Not exercising is not healthy b/c my daddy says that you should exercise”

2) Health-related incorrect

a. Health-related incorrect
   - Vegetables: “do not have vitamins/good things inside” “they are not good for your heart” “don’t make you bigger, stronger” ”make you fat” doesn’t make you healthy” “B/c it is not good (for you)”
   - High fat foods: “are good for you” “ make you stronger” “good for your heart” “make you not fat”
   - Exercise: “it does not make you stronger” “is not good for your body” “makes you get fat”
   - Not exercising: “good for your body” “makes you stronger” “does not make you get fat”

b. Use of health terms
   - Vegetables: “b/c they are not healthy” “b/c it’s not..”
   - High-fat foods: “b/c they are healthy” “b/c they are”
   - Exercise: “b/c it is not healthy”

- Not exercise: “b/c it is healthy”

c. Example-based incorrect
   - Vegetables :”b/c cookies are good for you” “ I like to eat apples and grapes” “carrots are bad for you”
   - High-fat foods: “cookies and cake are good for you”
   - Exercise: “b/c it makes you not run” “running and playing are not good for you”
   - Not exercise: “healthy b/c running and playing are good for you” “b/c not exercising like playing videos is good for you”

d. Parent-modeling incorrect
   - Vegetables: “mommy says they are bad” “mommy doesn’t eat them”
   - High-fat foods: “b/c daddy says they are good”
   - Exercise: is not healthy b/c my mommy doesn’t exercise”
   - Not exercising: is healthy b/c my daddy says that you shouldn’t exercise”

3) Uncertainty:

a. Don’t Know:
   - “I don’t know”, shrugging, “because...”

b. Repeating:
   - Exercise: “B/c it is exercise, “b/c get exercise”
   - Vegetables: “B/c they are vegetables” “get vegetables”

4) Miscellaneous

a. Preference
   - Vegetables & High-fats: “b/c I eat them” “b/c people eat them” “b/c I like to”, “b/c I want to eat them” “ b/c I don’t want to eat them”
   - Exercise & not exercise: “b/c I don’t like to exercise” “b/c I like to exercise” “b/c I exercise”

b. Taste
   - Vegetables & High-fats: “b/c they taste good” “b/c they don’t taste good” “b/c they are yummy” “b/c they are yucky”

c. Appearance
   - Vegetables & high-fats: “b/c they look healthy”, “b/c they look good for you” “b/c they look like they are not healthy”

d. Box related
   - “Because I am going to put in smiley box” “b/c frowny face” “b/c I am putting it in this box”

e. Irrelevant/Off-task
   - Exercise” b/c people eat them” “b/c I like your hair”
   - Vegetables: “b/c have all that exercise”

f. Ambiguous
   - “B/c ask your mom”