

DEVELOPMENTAL AND DEMOGRAPHIC DIFFERENCES IN YOUTH SELF-
EFFICACY FOR FRUIT AND VEGETABLE CONSUMPTION AND PROXY
EFFICACY FOR FRUIT AND VEGETABLE AVAILABILITY

by

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B.A., University of West Florida, 2002

M.Ed., University of Virginia, 2005

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Human Nutrition
College of Human Ecology

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2008

Abstract

Consumption of fruits and vegetables (FV) contributes to healthy growth and development among youth. For effective intervention development, an understanding of the underlying casual influences on consumption is needed. The current dissertation is intended to identify whether influences on youth fruit and vegetable consumption (FVC) vary by age, gender, ethnicity and socioeconomic status (SES). The series of four chapters focus on self-efficacy for FVC and proxy efficacy to influence other adults to provide supportive FV environments.

Chapter One reviews studies examining the influences on youth FVC. Consistently across studies, FV preferences and FV availability influenced youth FVC. Chapter Two and Chapter Three report studies documenting that children's confidence (proxy efficacy) to influence parents to make FV available and to influence other adults (after-school staff) to make FV available are independent but related constructs to self-efficacy to eat fruits and self-efficacy to eat vegetables.

Differences were found in these constructs according to school demographic variables and youth demographic variables. Chapter Two reports that youth attending elementary schools with lower concentrations of racial/ethnic diversity and higher concentrations of high SES were more confident in influencing their parents to make FV available than youth attending schools with higher concentrations of racial/ethnic diversity and higher concentrations of low SES. Although analyses of cross sectional data collected on elementary-aged youth presented in Chapter 3 showed no demographic differences at the school level, Chapter Four examined longitudinal data across sixth-, seventh- and eighth-grade and found demographic differences using youth level variables. Across the middle school years, youth declined in proxy efficacy and racial/ethnic minority youth declined at a significantly faster rate than white youth. Each year, male and lower SES youth were significantly lower in proxy efficacy than females and higher SES youth, respectively. Thus, school or youth demographic differences in

self-efficacy and proxy efficacy may contribute to the understanding of why males and lower SES youth eat less FV than females and higher SES youth.

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Acknowledgements

First and foremost, thank you to my advisor Dr. Dzewaltowski. Thank you for creating a constant learning environment and presenting me with the appropriate challenges. I'm sincerely grateful to have had the opportunity to practice science under your guidance – I truly feel as though I have learned from the best. Also, so many thanks to each of my committee members: Dr. Melissa Bopp, Dr. Mark Haub and Dr. Denis Medeiros. From the classroom to preliminary exams, thanks to each of you for the knowledge and challenges you presented.

Thank you to my all my colleagues at the Youth Health Behavior Research lab, and a special thanks to Dr. Rosenkranz for leading the way in this long journey, Sara Rosenkranz for keeping us all healthy, and Tanis Hastmann for keeping us all smiling.

To my family, I don't know enough pretty words to thank each of you enough, but thanks to all of you for your faithful support and constant love.

Dedication

For my mother and father

I believe I was blessed with the best of both of you.

Thank you mom for my heart and empathy-

Thank you dad for my focus and energetic spirit-

I carry you both with me.

Dissertation Introduction

Diets rich in fruit and vegetables (FV) contribute to healthy growth and development among youth (e.g., healthy bones, skin)¹ and may also aid in the prevention of overweight and obesity.² Unfortunately, results from surveillance and survey data suggest only a small percentage of youth are meeting these recommendations. The 1999-2000 National Health and Nutrition Examination Survey showed that only 1.2% of boys and 3.6% of girls (9-13 years) and 0.7% of adolescent boys and 1.1% of adolescent girls (14-18 years) consumed their recommended servings set by the Dietary Guidelines for Americans.^{3,4} Furthermore, the 2007 Youth Risk Behavior Survey of high school students showed that only 21.4% of adolescents ate five or more FV each day.⁵

In addition to the overall low levels of FVC, differences among youth belonging to different demographic groups have also been reported. For example, as children develop into adolescence there is a linear decrease in FVC.⁶⁻⁷ Furthermore, research has demonstrated that FVC increases with education,⁷⁻⁸ and income.^{7,9-11} Male youth are also reported consuming less FV than girls during both childhood¹¹ and adolescence.^{7,10} Finally, there are mixed results regarding youth of different race/ethnicity. There have been reports of no significant differences¹² and, reports of lower FVC among Hispanics.¹³

In order to develop effective interventions to increase FVC in all youth, an understanding of the influences on consumption and the impact of demographic variables on these influences is needed. Social cognitive theory is a predominant model to understand and positively impact health behaviors, such as FVC. According to social cognitive theory, youth have two ways of exerting control to reach a desired outcome: direct personal agency and proxy agency.¹⁴ Beliefs about personal agency can be assessed through judgments of self-efficacy, which is a child's belief that he or she can execute a behavior at a necessary level in order to obtain a desired outcome.¹⁵ Self-efficacy has shown to be positively associated to FVC among elementary-aged youth¹⁶⁻²¹ and middle school-aged youth.²²

Beliefs about proxy agency can be assessed through proxy efficacy judgments, which is the belief that one can get others to act on their behalf to reach desired outcomes.¹⁴ Because youth are not directly in charge of the social and institutional practices that provide FV opportunities in their environments, they may need to exert proxy agency.²³ When youth proxy efficacy is high, they are more likely to request FV from others, which should result in increased FV opportunities, increased self-efficacy and an increased likelihood of consumption.

The primary focus of this dissertation was to examine youth self-efficacy for FVC and proxy efficacy for FV availability and to examine the effect of demographic group membership on these constructs. More specifically, the current dissertation is composed of four chapters that progressively validate a self-efficacy and proxy efficacy measurement model and evaluate possible differences on these variables between different demographic groups. Although related, each chapter proposes separate aims to investigate youth self-efficacy for FVC and/or proxy efficacy for FV availability.

Chapter One adopts a developmental perspective to examine the FVC literature, reviewing both longitudinal and cross sectional research and pinpointing specific methodological issues. This chapter reviews the most significant influences on youth FVC as they age and offers suggestions for future research and intervention development.

Chapter Two's primary aim was to determine if self-efficacy for FVC and proxy efficacy for FV availability could be measured with reliability and validity in late elementary school-aged children. The secondary aim was to examine possible differences in these constructs between children perceiving different FV opportunities, as well as between children attending schools of different racial/ethnic and SES concentrations. Specifically, group differences were examined between children perceiving FV opportunities in after-school compared to children who did not perceive FV opportunities and between after-school children attending schools with higher concentrations of racial/ethnic diversity and higher concentrations of lower SES compared to lower concentrations of racial/ethnic diversity and higher concentrations of higher SES. Chapter Three aimed to confirm the self-efficacy and proxy efficacy constructs reported in Chapter Two and examine differences based on youth demographic variables (gender, ethnicity, household SES).

Lastly, Chapter Four's primary aim was to investigate middle school youths' proxy efficacy to influence their parents to make FV available. Using data collected over three-years (sixth- to eighth-grade), the specific interest was to investigate this construct among developing adolescents. The secondary aim was to examine the effect of youth demographic variables on their proxy efficacy over time, specifically investigating the moderating effects of gender (male versus female), ethnicity (racial/ethnic minority versus white), and SES (lower versus higher).

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CHAPTER 1 - Review of Longitudinal and Cross Sectional Influences on Youth Fruit and Vegetable Consumption

Diets rich in fruit and vegetables (FV) contribute to healthy growth and development among youth (e.g., healthy bones, skin) and lower the risk of poor health conditions associated with malnutrition (e.g., vitamin/mineral deficiencies, eating disorders).¹ Furthermore, adequate fruit and vegetable consumption (FVC) has been associated with decreases in children's fat and sugar intake² and may also aid in the prevention of overweight and obesity.³ Overweight and obesity has demonstrated associations with children's asthma,⁴⁻⁵ sleep apnea,⁶ and Type 2 diabetes that may lead to advanced complications (e.g., cardiovascular disease, kidney failure).⁷ Increasing FVC may stem a positive trend in the prevalence of obesity, which has more than doubled among children (6-11 years) and more than tripled among adolescents (12-19 years) in the U.S. over the last 20-years.⁸⁻⁹

For this review, we adopt a lifespan development approach to the study of FVC. The Centers for Disease Control and Prevention (CDC) and National Center of Birth Defects and Developmental Disabilities (NCBDD) defined the following age categories associated with developmental milestones: infants and toddlers (0-2 years), preschoolers (3-5 years), middle childhood (6-8 years), late childhood (9-11 years) and early to middle adolescence (12-17 years). It should be noted that different programs and/or research use variations to these age groupings; however, conclusions drawn from the current review are based on these classifications.

Due to these various development categories and youth's escalating nutritional needs, national FVC recommendations have been defined. The U.S. Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA) have developed the Dietary Guidelines for Americans,¹⁰ which are applied in the supporting MyPyramid Food Guidance System.¹ The Dietary Guidelines for Americans¹⁰ recommend varying levels of FV based on age, gender and activity level; thus, recommended amounts are presented here in ranges. For preschoolers (3-5 years),

consumption recommendations range from 1 to 1.5 cups of fruit (2-3 servings) each day and 1 to 2 cups of vegetables (2-4 servings) each day. Middle childhood aged youth (6-8 years) require from 1 to 2 cups of fruit (2-4 servings) and 1.5 to 2.5 cups of vegetables (3-5 servings), and late childhood youth (9-11 years) are recommended to consume from 1.5 to 2 cups of fruit (3-4 servings) and 2 to 3 cups of vegetables (4-6 servings). Finally, adolescents (12-17 years) are recommended to consume between 1.5 and 2.5 cups of fruit (3-5 servings) and 2 to 4 cups of vegetables (4-8 servings). Unfortunately, results from surveillance and survey data suggest only a small percentage of youth are meeting these recommendations.

For children, Guenther and colleagues¹¹ estimated the percentage of youth meeting the most minimal recommendations set by the Dietary Guidelines for Americans.¹⁰ Data were created from a one-time 24-hour recall collected from each participant using the 1999-2000 National Health and Nutrition Examination Survey. Results showed that 48.2% of young children (2-3 years) consumed the minimal recommendation for their age and activity level; however, this proportion severely declines as children age. Specifically, among 4 to 8 year-olds, only 5.3% of boys and 9.8% of girls consumed the minimal recommendation of six and five servings of FV, respectively. Similarly, only 1.2% of boys and 3.6% of girls (9-13 years) consumed their recommended servings. In a separate study using three day examinations of dietary intake among 3,148 youth (2-18 years), Krebs-Smith and colleagues¹² reported that only one in five children consumed five or more servings of FV per day. Thus, it seems the majority of children are following eating patterns that do not meet national recommendations.

Data describing FVC among adolescents parallels the low intake reported among children. The 2007 Youth Risk Behavior Survey of high school youth showed that only 21.4% of adolescents ate five or more FV each day.¹³ Additionally, Guenther and colleagues¹¹ reported that only 0.7% of adolescent boys (14-18 years) and 1.1% of adolescent girls consumed the minimal amount of FV servings recommended by the Dietary Guidelines for Americans.¹⁰ Moreover, several research studies have also reported a linear decrease in FVC as children develop into adolescence and young adulthood.¹⁴⁻¹⁶ Specifically, from cross sectional data, Mensink, Kleiser and Richter¹⁴ reported higher soft drink consumption and lower fruit juice, fresh fruit and raw

vegetable consumption among adolescents (11-17 years) compared to children (1-10 years). Furthermore, in a longitudinal study, Lien and colleagues¹⁵ studied the pattern of FVC over time among 14 to 21 year-old youth from Norway, revealing a 1 to 2.5 time decrease in mean weekly frequency of FVC.

Thus, lack of FVC among children and adolescents is an important public health issue. This paper will adopt a developmental perspective to review the FVC literature, reviewing both longitudinal and cross sectional research. Furthermore, methodological issues are identified that need to be addressed when studying both youth FVC and the influences on their FVC that occur as an outcome of child development. The specific sections of this review are (1) summarized results from longitudinal FV research, (2) summarized results from cross sectional FV research, (3) summary of cross sectional and longitudinal FV research (4) methodological suggestions to future FV research, (5) suggestions for developmental designs that address age, time and cohort effects on FVC, (6) conclusions and (7) recommendations for future research.

Longitudinal FV Research

Longitudinal research studying influences on children's and adolescents' FVC is limited; however, the remaining paragraphs overview the individual and environmental influences on FVC that have been studied, as well as studies involving mediators and moderators. Mediators or intermediate variables are involved in the relations between two separate variables, such that an independent variable causes a mediating variable, which then causes a dependent variable.¹⁷ For example, intervention strategies (independent variable) increase self-efficacy for FVC (mediator), which ultimately increase FVC (dependent variable). A moderator or effect modifier variable is not involved in the casual sequence between two variables;¹⁸ but, rather precedes the variable in which it moderates, possibly suggesting that the casual chain leading from an independent variable to a dependent variable is different at different levels of the moderator.¹⁹ For instance, moderator variables may reflect subgroups of youth (age, gender, ethnic/racial) who are more or less responsive to FVC interventions. Two broad categories of FV longitudinal research discussed here are longitudinal tracking studies and those examining the impact or predictive nature of environmental and personal factors on

future FVC. The next two sections of this paper focus on both types of longitudinal research.

Longitudinal FVC Tracking Studies

To begin, longitudinal research has explored stability of FVC over time (tracking), investigating if FVC at earlier ages predicts FVC throughout later developmental stages (e.g., childhood, adolescence, adulthood). In a U.S. study that tracked FVC patterns over time, Mannino and others²⁰ followed girls from age five to age nine. Researchers averaged nutrient data from 3-days of 24-hour recalls and organized the girls into quartiles relevant to their level of FVC. Following 4-years of data collection, FVC was reported as moderately stable with fruit demonstrating the highest consistency (low consumption stayed low and high stayed high). Beginning in early childhood, Skinner and colleagues²¹ studied FVC tracking indirectly by examining preferences. They reported that the strongest predictor of the number of foods liked at 8-years-old were the number of foods liked at 4-years-old ($R^2=0.74$). Concluded from these results, young children's FVC patterns are moderately stable and preferences for specific foods seem to be developing in children as young as age four.

Other studies investigated FVC patterns from middle childhood into adolescence and eventually into young/middle adulthood. Observing eight provinces in China, Wang and colleagues²² followed the dietary patterns of a group of children ages 9 to 13 years for 6-years, revealing moderate FVC consistency over time. Specifically, 44% of those eating a high FV diet at ages 9 to 13 ate a diet high in FV at ages 15 to 19, and 33% eating a diet low in FV tracked a low FV diet. The moderate stability of a high or low FV diet supports research among a similar age group in the U.S. (6th to 12th grade),²³ as well as research among adolescents in west Scotland between ages 15 and 18²⁴ and Norwegian participants between ages 14 and 21.¹⁵ Finally, te Velde, Twisk and Brug²⁵ studied FVC among Amsterdam participants over a 24-year period, reporting z-scores of FVC patterns as coefficients (ranging from 0 to 1). Results revealed moderate tracking of FVC with pattern coefficients for consumption of fruits (0.33) and consumption of vegetables (0.27).²⁵

Longitudinal Predictors of Youth FVC

A second category of longitudinal FVC research includes examination of influences or predictors of future FVC. In the U.S., Skinner and others²⁶ investigated the possible significance of early life experiences on children's FVC. This longitudinal study measured FV exposure and FVC among children from infancy (2 months) to childhood (8 years). Results demonstrated an association between fruit exposure and fruit variety at infancy and fruit variety 8-years later in early childhood. Additionally, mothers' vegetable preferences were found to be negatively associated with the variety of vegetables they offered to their children. In other words, mothers' dislike for vegetables actually led them to offer more of a variety of vegetables to their children. In conclusion, Skinner and colleagues²⁶ illuminate the significant impact of early FV exposure on future FVC; therefore, to promote habitual FVC, a variety of FV should be introduced to developing children as they begin consuming solid foods.

In a Norwegian longitudinal study, Bere and Klepp²⁷ examined possible effects of the change in specific personal and environmental influences on the change in FVC over a 1-year period. The possible influences measured included: intention to eat 5-FV-a-day, awareness to eat 5-FV-a-day, self-efficacy to eat 5-FV-a-day, modeling, FV availability at home, FV availability at school and FV preferences. Results revealed that change in all the influences significantly impacted change in FVC, explaining 15% of the variance. Furthermore, 11% unique variance was explained by FV availability at home, FV availability at school, preferences and awareness to eat-5-FV-a-day. Lastly, an additional analysis revealed that baseline FV availability at home moderated the relationship between change in preference and change in FVC. Specifically, for youth's FV preference to improve over time and positively impact their consumption, FV need to first be made available to them.

In a separate longitudinal study from Norway, Bere, Brug and Klepp²⁸ pursued measurements for 3-years on adolescents (approximately 12.5 to 15.5 years) and examined the impact of specific influences on future FVC. In this study, the researchers examined the following possible influences on future FVC: intention to eat 5-FV-a-day, awareness to eat 5-FV-a-day, self-efficacy to eat 5-FV-a-day, modeling, FV availability at home and FV preferences. Due to previous reports of higher FVC among adolescent

girls compared to boys,^{15, 24, 29-30} the researchers examined these influences as possible mediator variables that occur in a casual pathway from gender to FVC. First, results supported expectations that FVC was higher among girls at each measurement. Secondly, girls were higher on all hypothesized mediators listed above. Next, in two separate models, the researchers tested each variable as a possible casual pathway, explaining the relationship between gender and FVC.

First, results revealed that each hypothesized mediating variable explained at least a portion of the relationship between gender and future FVC. Preference was the only complete mediator; thus, when preference for FV was included as a casual pathway between gender and FVC, gender no longer had a significant effect on youth's future FVC (81% of the variability in FVC explained). In a second analysis, all hypothesized mediators were tested together, allowing for possible multicollinearity. Inclusion of all variables as a casual pathways explained 91% of the variability in future FVC with preferences and FV availability at home uniquely explaining 25% and 10%, respectively. Finally, in addition to youth's perception of FV availability, Bere, Brug and Klepp²⁸ asked parents to report their perception of FV availability, discovering no gender differences; thus, boys may only perceive less FV availability at home.

Additional longitudinal research using self-administered questionnaires has pinpointed other possible influences on children's and adolescents' FVC. For example, Dubois and others³¹ examined problematic eating patterns among Canadian children ages 2.5 to 4.5 years, discovering that picky and irregular eating practices among these young children were negatively associated with their current and future vegetable intake. Lastly, in reference to Norwegian adolescents and young adults, Lien, Jacobs and Klepp²⁹ found that positive relations with parents at age 15 predicted FVC at age 21.

Cross Sectional FVC Research

Influences on the FVC of children and adolescents are described as personal or environmental and summarized in the following sections. Beginning with innate taste preferences, a personal influence, Birch³² discussed that humans are born with predispositions for salty and sugary foods that are usually energy-dense. On the other hand, humans innately avoid bitter and low-energy dense food, which unfortunately

describes taste characteristics of some vegetables. This argument was supported through interviews with 4 to 16-year-olds, reporting high taste preferences for sugary and fatty foods and the lowest preference for vegetables.³³ Considering longitudinal research reports consistency between taste preferences in early childhood to those in later childhood, preferences for high-energy dense foods may remain throughout development.²⁰⁻²¹ However, Birch³² optimistically reports that these predispositions are alterable via repeated exposure to specific foods, which was supported by research that reported changes in children's preferences for a specific food following 10 exposures.³⁴

Directly related to taste is the powerful influence of children's food preferences. Although similar, taste is referred to here as an innate sense, and children's preferences refer to their likes or dislikes for FV that develop from factors beyond genetics (e.g., personal, environmental). Among cross sectional research, numerous studies report FV preferences as the primary influence on children's FVC.³⁵⁻⁴¹ For example, during focus groups, youth reported that preference is among one of three primary influences on their FVC.³⁶ Among several other possible influences of FVC, Domel and colleagues³⁹ found preference as the primary predictor of children's FVC, explaining 3% of fruit consumption, 9% of vegetable consumption and 12% of FVC. This same regression model was repeated in a larger sample size, which again found preferences as the primary predictor of FVC, and along with outcome expectancies, explained 11% of the variance in FVC.⁴⁰

Although FV preference has been most frequently reported as the primary personal influence on children's FVC, cross sectional research has also discovered additional personal influences. For example, Reynolds and colleagues⁴² reported that increases in cognitive/behavioral skills related to FV availability ("asking skills") increased self-efficacy, leading to improved FVC. Furthermore, Domel et al.³⁹ found that self-efficacy for FV at breakfast and lunch was associated with children's FVC. Finally, Baranowski et al.³⁶ reported that having skills to prepare FV dishes was among one of three primary influences on FVC, which was supported by Kirby and colleagues.⁴³

In addition to personal influences, cross sectional research has also examined environmental influences on children's FVC. For consumption to increase, FV needs to be within the reach of the child (available) and pre-prepared for easy consumption

(accessible).⁴⁴ In cross sectional research, FV availability/accessibility has been the most frequently reported environmental influence, resulting in positive associations with children's FVC.^{36-37,41,44-46} For example, Hearn and colleagues⁴⁶ found that FV availability at home accounted for 11% of the variance in children's consumption, and after controlling for socioeconomic status (SES), FV availability during school lunch was significantly correlated with their consumption.

Supplementary cross sectional research has reported interactions between FV accessibility/availability and specific personal influences, causing varying degrees of impact on children's FVC. For example, Cullen and others³⁷ reported that children with high FV preferences only needed FV to be made available in order to increase their FVC, while children with low preferences needed FV availability along with additional positive influences. Additional cross sectional research discovered an interaction of FV knowledge/capability with FV availability, reporting a significantly lower positive impact of knowledge/capability on FVC among children in low FV availability families compared to children in high FV availability families.⁴⁵ Thus, availability, a significant stand-alone influence, may have an even greater positive impact on children's FVC when accompanied with appropriate personal factors (e.g., preference, knowledge/capability).

Similar to FV availability is the significant impact of the school lunch environment on youth FVC. For example, research reports that availability to the school snack cart, typically selling high-fat and high-sugar snacks, led to decreases in children's FVC compared to the previous year when only school lunch was available.⁴⁷⁻⁴⁸ Furthermore, there is evidence that both children's consumption and perceptions of FV are dependent on the day of the week, indicating significantly higher FVC and more positive perceptions during the weekdays compared to the weekend.⁴⁹⁻⁵⁰ Specifically, Baranowski et al.⁴⁹ found that children consumed more FV during the week (just over 1.0 servings) compared to the weekend (approximately 0.4 servings). Thus, in addition to the home, it is apparent that the structured lunch time offered each weekday at school is an ideal environment to provide FV to children.

Additional environmental influences shown to impact children's FVC include family modeling, parental feeding practices, rewards, and television viewing. The significant impact of family modeling on children's dietary habits has been supported by

several cross sectional research studies.⁵¹⁻⁵⁴ Specifically, dietary habits were shown to cluster within families⁵² and the frequency of eating meals as a family was positively associated with children's FVC.^{51,54} This is similar to a longitudinal study, reporting that mothers who expose their infants to FV in infancy positively impact their children's consumption 8-years later.²⁶ In addition to modeling, parental feeding practices can also significantly impact their children's FVC,⁵⁵ such that controlling feeding practices by the parent that attempt to regulate what and how much their children eat actually works counter to their children's FVC.^{32, 56-57}

Relative to rewards, it is suggested that children's preference for a specific food increases when that food is given as the reward, but preference decreases when required to eat a specific food to obtain a different reward (e.g., dessert, television time).³² This argument was supported empirically among 4 to 7-year-olds.⁵⁸ Regarding the influence of television on children's FVC, Story and French⁵⁹ reported that children are exposed to approximately 75 to 100-hours of commercials per year that are devoted to food and snacks traditionally high in fat and/or sugar. Moreover, Cullen and colleagues⁵² reported that children are influenced by what they see on television and Boynton-Jarrett and colleagues⁶⁰ reported a negative relationship between FVC and television viewing among 11-year-olds.

Studies investigating the influences on adolescents' FVC are limited; however, the research available presents an appropriate starting point for future examinations. Through qualitative interviews, adolescents reported that FV availability/accessibility, involvement in food preparation at home and their peers were three primary influences on their FVC.⁶¹ Additional research found that parental consumption was a primary predictor of adolescents' orange juice and potato consumption and preference was the primary predictor of their apple and tomato consumption.⁶²

George and Krondl⁶³ discovered gender differences, reporting that the likelihood of FVC among adolescent girls was associated with higher FV preferences, higher belief in health and higher concern for their body image; however, body image was not related to the FVC of adolescent boys. Finally, Neumark-Sztainer and others⁶⁴ reported from cross sectional data that inadequate FVC among teenagers was among other negative

behavioral patterns (e.g., binge eating, dieting, substance abuse, attempted suicide, disconnectedness from parents), which was replicated in a Native American sample.⁶⁵

Summary of Influences on Children's and Adolescents' FVC

One of the aims of this review was to discuss possible shifts in personal and environmental influences on children's FVC as they develop into adolescents. To meet this aim, we reviewed research reporting specific changes over time (longitudinal) along with research reporting data from one time point (cross sectional) for both children and adolescents. Figure 1.1 illustrates both the unique and the overlapping of influences on FVC among children versus adolescents. Although there is a need for research on several topics, Figure 1.1 illustrates that many influences affecting children's FVC are similar to adolescents. It may be that the influences affecting children's FVC are similar to that of adolescents because adolescent FVC research, and developmental research in general, remains deficient.

Current findings, however, have identified several important FVC influences. From cross sectional research, preference was found as a primary influence on children's FVC^{36, 39-40} and adolescents' FVC,⁶²⁻⁶³ which parallels longitudinal research among children²⁷ and adolescents.²⁸ Knowledge about FV was also shown as a positive influence among children using cross sectional data^{36, 42-43} and longitudinal data.²⁷ In cross sectional research, FV availability/accessibility was demonstrated as a primary positive influence on children's FVC^{36-37,44-46} and adolescents' FVC,⁶¹ which was supported longitudinally among children²⁷ and adolescents.²⁸ Finally, using cross sectional data, negative relationships with parents was found to be negatively associated with adolescents' FVC,⁶⁴⁻⁶⁵ paralleling reports that relations with parents at age 15 predicted their FVC at age 21.²⁹

According to our review, some developmentally sensitive suggestions can be made for future interventions. Interventions to increase FVC need to begin as soon as young children begin eating solid foods and continue over the lifespan, adjusting for developmental milestones. Specifically, young children need early exposure to FV in order to modify their innate taste preference for salty and sugary foods. As children enter into middle and late childhood, exposure to FV needs to increase such that there are

increased opportunities to gain knowledge and preference for a wide variety of available FV at both home and school. FV availability and preferences appear to be the most influential influences on adolescents' FVC as well. However, as children enter their teenage years, research findings suggest a shift from parents being the model and gatekeeper to peers being important models. Furthermore, interventions targeted towards adolescents may need to expand basic awareness and knowledge of FV to specific preparation skills, which supports teenagers' attempts at autonomy.

Methodological Suggestions for Future FVC Research

The following paragraphs outline limitations of the previously discussed longitudinal and cross sectional studies, offering recommendations for future research. See Table 1.1 for a list of these limitations and recommendations, which are summarized throughout the remainder of this section.

Specific to longitudinal tracking studies, there are inconsistencies regarding the statistical analyses used in separate studies, complicating comparisons (e.g., paired t tests, correlation coefficients, Chi-square goodness-of-fit tests, generalized estimating equations analysis (GEE)). Twisk and colleagues⁶⁶⁻⁶⁹ describe GEE analysis as a more sophisticated statistical technique, which is similar to linear regression. This method is superior because it adjusts for correlations among separate observations within the same individual and utilizes all available data collected from participants across time. Additionally, like linear regression, GEE analysis uses regression coefficients of FVC that can be interpreted as coefficients that represent FVC patterns with a maximum value of one. This range of zero to one allows the researcher to report FVC on an interval scale, which can then be used to make direct comparisons across separate studies. Furthermore, using GEE analysis allows for the analysis of covariates, which was employed in a 24-year FVC longitudinal study that controlled for both time-dependent covariates (total energy intake) and time-independent covariates (gender).²⁵

Furthermore, direct comparisons are complicated between studies due to inconsistent data collection procedures. First, there are complicated variations in how participants are grouped on their FVC. The majority of longitudinal tracking studies divided participants into a specified number of groups based on their FVC with each

group containing different proportions of the population. For example, Wang and colleagues²² categorized children as exhibiting either high or low FVC patterns over time, which is not directly compared to the quintile groupings used by Kelder and others.²³ An additional inconsistency relates to the operationalization of these grouping categories. Specifically, varying serving sizes have been used across studies to define levels of children's FVC. For instance, Wang and colleagues²² categorized children based on their ranking among the other sample participants, which is not comparable to group formation based on recommendations from the Dietary Guidelines for Americans.¹⁰ The Dietary Guidelines for Americans¹⁰ and MyPyramid¹ have defined recommendations for youth based on cups; therefore, it may be appropriate to directly categorize FVC groups according to average cups consumed per day or whether or not youth met recommendations for their age, gender and activity level (e.g., below, met, above).

Another measurement limitation relevant to all types of research is the focus on numerous micro- and/or macronutrient intakes (e.g., vitamins, fat, fiber), which limits the amount of information collected on FVC. Future research would benefit by collecting information on both the frequency and amount of the specific types of FV consumed (e.g., orange, sweet potato). Further investigations could then assess possible variations in the types of FV consumed between diverse families (racial/ethnic, SES) and contribute to intervention development. Specific to longitudinal tracking studies, there is also variability in the length of time studied, which results in strong evidence of tracking over a short time frame (e.g., 4-years of data collection)²⁰ and only moderate when measured over longer periods (e.g., 24-years).²⁵ It is expected that additional research will begin to bridge the gap in time frames.

Secondly, a substantial amount of research does not report fruit consumption as an independent behavior from vegetable consumption. Previous cross sectional research has illuminated different perceptions and consumption patterns for fruit versus vegetables.⁷⁰⁻⁷³ For example, using an exploratory factor analysis, Geller and colleagues⁷² identified two independent self-efficacy constructs for FVC among elementary-aged children, one for fruit consumption and the other for vegetable consumption. Additionally, Gibson and others⁷³ discovered children's consumption of fruits are related to different psychosocial and environmental factors compared to their consumption of

vegetables. These results demonstrate that fruit consumption and vegetable consumption are different behaviors involving different antecedents; thus, emphasizing the importance of considering different consumption patterns for fruits versus vegetables.

In addition to measurement, there are methodological limitations relevant to the type of data collection procedures used across all types of research. First, the measurement instruments used are not always applied appropriately to produce valid data. Twenty-four hour food recalls should be performed by highly trained interviewers, insuring accurate portion size estimation; however, these methods are time consuming and expensive. Furthermore, there is evidence of variations in children's diets across different days of the week;⁴⁹ therefore, a 24-hour recall on a single day may not represent children's usual diets accurately. Multiple recalls including both week and weekend days by a trained interviewer would insure reports of accurate FV serving sizes and should be used in future research.

Another standard measure of FVC is a food frequency questionnaire (FFQ). FFQs are self-administered surveys of daily intake, making them inexpensive and useful for large population studies; however, there are considerable validation issues when assessing portion sizes. For example, people are best at estimating well recognized portion sizes (e.g., 12 ounce can of soda), but not consistently accurate when reporting less convenient serving sizes (e.g., 2 servings of vegetables). In addition, many FFQs were created as long as 20-years ago, and need to be altered to better represent current food patterns.²⁶ For an intensive review on FFQs, see Cade and colleagues⁷⁴ for planning and analyzing recommendations that are helpful in optimizing the performance of a FFQ.

Both 24-hour recalls and FFQs rely on self-reports of FVC, which may result in numerous biases, including: recall bias, response bias, reporting bias, selection bias, sampling bias, measurement bias, and/or bias due to withdrawals. A type of recall bias is forgetfulness, which becomes a prominent accuracy problem when asking children to remember and report the type and amount of foods they consumed all day. For example, FV eaten as snacks may not be reported due to evidence that snack foods are more commonly underreported than foods consumed at regular meals.⁷⁵ Asking participants to report their food consumption at the end of each day or throughout the day (e.g., food

diary) may help to reduce recall bias; however, recording all food intake may also function as a regulation tool, possibly influencing participants' consumption patterns.

Another example of bias is reporting bias, which may occur when children report inaccurate levels of their FVC due to social desirability. For instance, children may exaggerate reports of their FVC because they believe this will impress others. Lastly, bias due to withdrawals may possibly bias any generalizations made to the entire population. Thus, dietary differences may exist between participants who maintained participation throughout the entire study and those who dropped-out. When feasible, specific information on participants who drop-out of the study should be compared to those who remain. Overall, future research needs to control for these possible biases as much as possible, and consider the possibility of bias when developing their study design and drawing conclusions from their data.

A final limitation, relevant to most behavioral research, is the possibility of multicollinearity among the independent variables being studied. When examining possible influences on future FVC, multicollinearity among the independent variables makes it difficult to assess which variables predict FVC and by how much. For example, Bere, Brug and Klepp²⁸ discovered that several independent variables explained between 10% and 81% of the variance in youth FVC; however, when including all these variables in the same analysis, the effects of modeling, self-efficacy, intention and knowledge disappeared due to multicollinearity with the other factors. Most of the 91% variance explained in the combined model, aside from 25% from FV preference and 10% from perceived FV availability, was shared variance by two or more factors making it impossible to give any one variable credit.²⁸

Developmental Research Methods

Although both cross sectional and longitudinal research designs depict a decline in youth FVC as they age, changes over the lifespan cannot be fully explained with application of only one of these data designs. For instance, to understand FVC across the lifespan, many studies have attempted to specify age-related developmental progressions. Although age-related progressions may be one source of a person's change, they may not

be the only processes that provide a basis for change. There are at least three components of developmental change: age, time and cohort.⁷⁶⁻⁸⁰

Age refers to personal level developmental variables that are associated with biological age. Therefore, if we were examining the maintenance of FVC across the life-span we could infer from cross sectional studies that biological age is a process of change. For example, cross sectional studies illustrate a decline in FVC among individuals as they develop from childhood to adolescence⁸⁰ and preadolescence to adolescence.⁸¹ However, in these cross sectional studies, age is confounded with birth cohort effects. A birth cohort is a group of persons experiencing some event in common in their history.⁸² Because of membership in a certain birth cohort, people may continue to differ from those of other cohorts, no matter at what age they were measured or what existed in the sociocultural setting at that particular time of measurement.

To compensate for birth cohort effects, longitudinal designs involve following a group of people (cohort) at more than one point in time. Several studies have shown evidence of a decline in FVC after following a cohort of youth over time and observing their FVC as they age into adulthood.^{15,23} The strength of the longitudinal design is that because the same people are studied over time, the similarities or changes in behavior (intraindividual change) across development can be observed directly.

Although longitudinal research captures intraindividual change, data limitations still remain. For example, people willing to participate in longitudinal studies may not be representative of most people, which results in “biased” samples that do not generalize to the population most at risk. Another limitation of longitudinal designs is the confounding of age and time of measurement when only one cohort is studied. For example, following a cohort of children from sixth-grade to seventh-grade does not allow researchers to untangle the influence of development (age) from the influence of changes in the setting. In other words, the sixth grade setting may be different from the seventh grade setting, which confounds age (grade) with time.

Schaie⁷⁶ proposed that a sequential design can solve the problems of the confounding effects of age, time and cohort in cross sectional and longitudinal designs. Specifically, this method of studying between age groups includes the joint use of cross sectional and longitudinal designs in one study.⁷⁶⁻⁸⁰ A sequential design involves re-

measurement (longitudinal assessment) of a group of cross sectional samples of people over time (see Figure 1.2). In a sequential study of adolescent development, Nesselroade and Baltes⁷⁹ identified the historical (personal cohort) and socioenvironmental (time) influences through the sequential design and found that developmental change was influenced more by socioenvironmental changes during this time period than by age-related sequences. In practice, sequential designs have been used to investigate possible changes in influences over specific developmental periods. For example, Duncan and colleagues⁸³⁻⁸⁵ applied a sequential design to investigate the influences of alcohol abuse among developing adolescents. Furthermore, Baer⁸⁶ applied this type of design to investigate shifts in family cohesion as youth develop.

Unfortunately, no studies examining FVC and their influences have adopted a sequential design. To capture true developmental change in FVC, we propose a life-span development methodology^{76, 80, 87} that uses a sequential design strategy to illuminate the multilevel processes that determine maintenance of FVC. An example of this design studying children in late childhood (see Figure 1.2) includes a longitudinal sequence (LS), a cross sectional sequence (CS) and a time-lag sequence (TL). The longitudinal sequence determines FVC in one cohort over time, confounding the effects of FVC with the time of measurement effect. In other words, longitudinal sequence confounds FVC with the different social and physical environmental opportunities for each grade setting at each time point. The cross sectional sequence determines FVC at one time point, which confounds FVC with the sampling of different age groups (cohort). The time-lag sequence provides data on the FVC of youth of the same age, but measured with different time cohorts. Time-lag data clarifies the cohort effect from the longitudinal sequence when applied to each of the grade levels and to each of the measurement years.

Figure 1.2 illustrates that children in grades fourth through seventh would be assessed each year across 4-years of study. The four rows in Figure 1.2 represent the cross sectional methods, examining differences in FVC between youth of different ages but measured at the same time point. The diagonal represents the longitudinal sequence, which identifies age related developmental differences in FVC over time. The final method is the time-lag method, which is represented by the four columns in Figure 1.2. The time-lag method identifies the time cohort or cultural change on the FVC of similar-

aged youth. Overall, the time sequential design includes measures of all ages at all times of measurement.⁷⁶ Specific to Figure 1.2, a time sequential design provides information as to age differences (individual development) from fourth- to seventh-grade, as well as inferences about the environmental or cultural shifts affecting FVC that may occur over the four-years of assessment.⁷⁶

Suggestions for Future Research

There is continued need for research among adolescents and children, especially sequential designs (see Figure 1.2) that incorporate longitudinal, cross sectional and time-lag data. Secondly, future research needs to not only investigate fruit consumption as a separate behavior from vegetable consumption, but also, examine the possibility of clustering within these food groups. For example, children and/or adolescents may prefer specific vegetables in comparison to others, and focusing on these preferred types in FVC interventions may further increase consumption. Furthermore, investigating influences on a more specific dependent variable (e.g., preferred vegetables) should increase the predictability of regression investigations leading to more powerful conclusions.⁴⁴

Next, there are methodological issues warranting continued attention. Currently, both FVC and psychosocial predictor variables are collected via self-report, which is plagued by many biases. Comparisons between parent and youth reports of youth FVC has revealed only modest agreement,⁸⁸⁻⁸⁹ therefore, additional research is needed to determine the more accurate perception, as well as offer viable explanations for the disagreements found between parent and youth report (e.g., variability in serving size perceptions, social desirability). Furthermore, when investigating FVC patterns over time, consistent methods are needed to simplify comparisons across studies.

Finally, statistical analyses examining possible mediating and moderating variables are needed to further understand relationships among separate environmental and/or personal influences on FVC, furthering the effectiveness of future interventions. To improve both children's and adolescents' FVC, interventions may be most successful when tailored to improving the principal influences of consumption.^{44, 90} Thus, future research needs to further investigate possible patterns of the influences on FVC so that

fluctuations over youth's lifetime can be understood and integrated into developmentally appropriate interventions.

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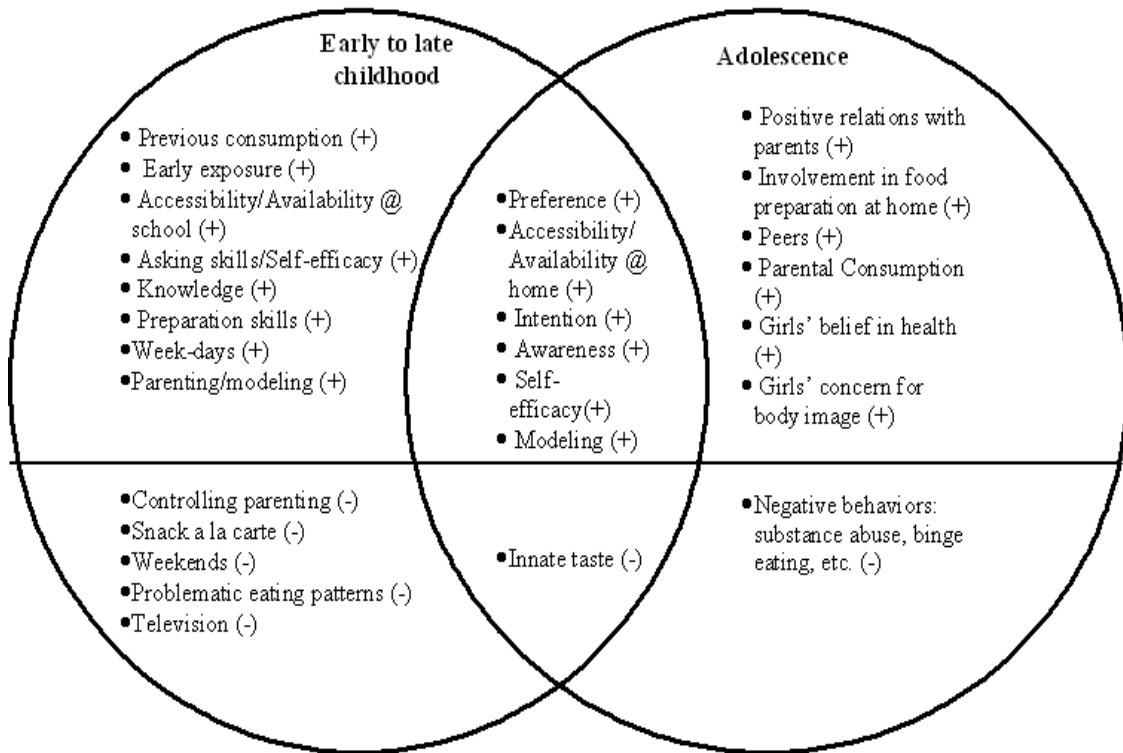
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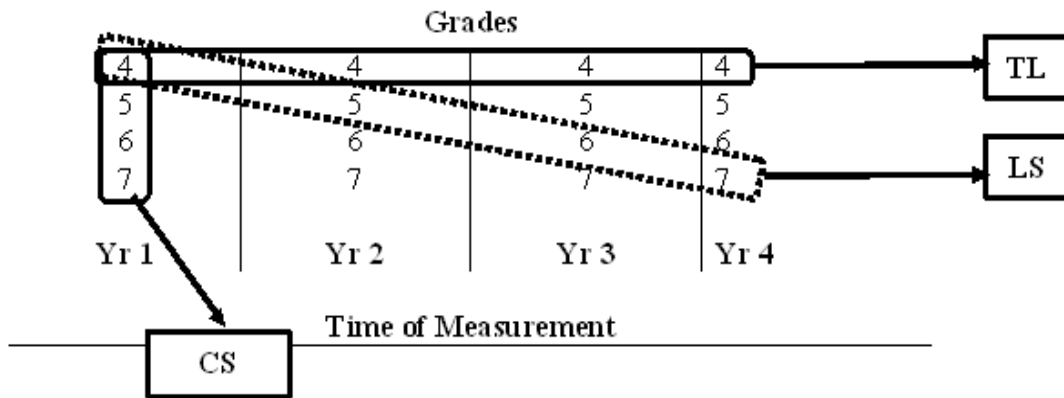
Figures and Tables

Figure 1-1 Proposed Separation and Overlap of Influences on Children’s and Adolescents’ Fruit and Vegetable Consumption: Based on Available Data



Note: Positive (+) associations are located in the upper half and negative associations are in the lower.

Figure 1-2 Sequential Research Design: Longitudinal, Cross sectional and Time-lag



Note: "LS" indicates the longitudinal sequence involved in the design. "TL" indicates one of the four time-lag sequences involved and "CS" indicates one of the four cross sectional sequences involved

Table 1-1 Limitations and Recommendations for FV Longitudinal and Cross Sectional Research

| Specific limitations | Recommendation |
|---|--|
| 1. Statistical procedures in studies tracking changes over time | 1. Analyses based on generalized estimating equations is a superior method: adjusts for correlations among separate observations within the same individual; computes pattern coefficients; results on an interval scale; analysis of covariates is possible |
| 2. Observation time frame in studies tracking changes over time | 2. Additional research should bridge the gap in time frames |
| 3. Limited questions devoted to FVC, leading to a lack of accurate information regarding both frequency and amount of consumption | 3. Focus specifically on fruit and vegetable consumption, allowing for multiple measurement items that assess amount and frequency |
| 4. FV measured as one behavior | 4. Measure fruit consumption separately from vegetable consumption |
| 5. Inconsistent grouping criteria | 5. Future research needs to reach an appropriate consensus for the categorization of varying levels of fruit and vegetable consumption (e.g., high versus low, met or did not meet recommendations). MyPyramid ¹ offers recommendations for children’s consumption according to age, gender and activity level. |
| 6. Measurement procedures (24-hour recall, Food Frequency Questionnaires) | 6. Future research needs to utilized the appropriate consumption measurement(s) and optimize use (e.g., multiple 24-hour recalls, updated Food Frequency Questionnaires) |
| 7. Frequent use of self-report, which is subject to several biases (e.g., recall, response, bias due to withdrawals) | 7. Food diaries help reduce recall bias, study drop-outs to reduce and consider possibility of bias when interpreting results |
| 8. Possible multicollinearity among independent variables | 8. Use validated measures and perform statistical analyses that provide information on the unique effect of each independent variable |

CHAPTER 2 - Measuring Children's Self-Efficacy and Proxy Efficacy Related to Fruit and Vegetable Consumption

Social-cognitive theory (SCT) is one of the predominant models for understanding and impacting health behaviors, having been applied in several studies investigating psychosocial influences on fruit and vegetable consumption (FVC). One influence identified by SCT is self-efficacy, which is defined as a child's belief that he or she can execute a behavior at a level necessary to obtain a desired outcome.¹ Several studies have shown that self-efficacy influences FVC in elementary²⁻⁵ and middle school youth.⁶

Self-efficacy reflects two ways of reaching a desired outcome: direct personal agency and proxy agency.⁷ Direct personal agency has been assessed by having children estimate their confidence in eating fruit and vegetables (FV). Proxy agency is reflected in this self-efficacy judgment, but it can also be assessed directly by measuring children's proxy efficacy. Proxy efficacy is the belief that one can get others to act on their behalf to reach desired outcomes.⁷

Because children are not directly in charge of the social and institutional practices that provide FV opportunities in their environments, they may need to exert proxy efficacy.⁸ When children's proxy efficacy is high, they are more likely to request FV from others they perceive to be proficient enough to act on their behalf. These proxy agency efforts may then result in increased FV opportunities, increased self-efficacy, and an increased likelihood of FVC.

Previous FV research has not adequately distinguished between self-efficacy and proxy efficacy in the measurement of these constructs. For example, Reynolds and colleagues⁹ performed statistical analyses that revealed a single factor for self-efficacy, merging direct personal agency and proxy agency into one construct. However, the 21-item self-efficacy questionnaire had 17-items probing children's perceptions of direct agency ("*I can...*") as well as 4-items investigating perceptions of proxy agency ("*I can ask my mom or dad...*"). Specific attention to the conceptual distinction between direct

personal agency and proxy agency may reveal that these are separate but related constructs. The specific analytical plan and results for concluding that there was a one-dimensional self-efficacy scale was not discussed in Reynolds and colleagues' paper.⁹ A plausible explanation may be the grouping of 17 direct personal agency items with only four proxy efficacy items resulted in weak factor separation.

The primary aim of the present study was to determine if self-efficacy and proxy efficacy could be measured with reliability and validity in late elementary school-aged children. Children's self-efficacy for FVC and proxy efficacy for FV opportunities were examined with a self-report questionnaire. The secondary aim was to investigate whether the present measures could detect differences in direct personal agency and proxy agency between groups of children that theoretically should differ (criterion validity). Group differences were examined between children who perceived FV opportunities after-school compared to children who did not perceive FV opportunities and between after-school children attending schools with higher concentrations of racial/ethnic diversity and higher concentrations of lower-socioeconomic status (SES) compared to lower concentrations of racial/ethnic diversity and higher concentrations of higher-SES.

Overall, the questionnaire was expected to emerge as multidimensional, containing both a self-efficacy scale and proxy efficacy scale. Additionally, the direct personal agency scale was expected to distinguish between direct personal agency for fruit and direct personal agency for vegetable consumption, coinciding with research reporting fruit consumption and vegetable consumption as two separate behaviors.¹⁰⁻¹² Two separate subscales for proxy agency were also expected, one representing proxy agency from parents and the other proxy agency from after-school staff. Finally, the establishment of criterion validity was expected such that there would be differences between groups on the direct personal agency and proxy agency measures based on their perception of opportunities for FVC in their after-school programs and the diversity-SES classification of their school. It was hypothesized that children attending after school environments with greater opportunities for FVC would have higher self-efficacy and proxy efficacy compared to children attending after school environments with fewer opportunities. Also, it was hypothesized that children in high-resource environments

(higher-SES schools) would have greater self-efficacy and proxy efficacy compared to children in low-resource environments (lower-SES schools).

Methods

Subjects

Participants were fourth-, fifth- and sixth-grade children recruited from seven after-school programs located in Lawrence Kansas. Children completed a 61-item questionnaire (approximately 30 minutes) regarding their physical activity and nutritional beliefs and behaviors. Of those enrolled in the after-school program, 74% participated in fall 2005 and 70% in fall 2006. Some children participating in fall 2005 also completed the questionnaire in fall 2006, but were dropped from the fall 2006 database. The final database used for statistical analysis included 54% of children surveyed in fall 2005 and 46% in fall 2006. Of the 187 children, 184 (98%) had complete self-efficacy data (14-items) and complete perceived opportunity for FV data (2 items). All demographic data (i.e., gender, age, lunch status/SES, and ethnicity) were obtained directly from school records.

The 184 children were among an after-school group primarily composed of fourth-graders, but containing other grades of similar age (8% fifth-grade, and 2% sixth-grade). The mean age during the time of questionnaire completion was 9 years, ranging between 8 and 12 years. Forty-seven percent of the sample was female and 41% was lower-SES (i.e., receiving free and reduced meal program assistance). The sample was primarily white (n=131), with some diversity (Black, n = 29; American Indian/Alaska native, n = 15; Hispanic/Latino, n = 6; Asian, n = 2; Native Hawaiian/other, n = 1).

Procedure

The current analysis drew data from the Healthy Opportunities for Physical Activity and Nutrition (HOP'N) project, a school-randomized controlled trial targeting the prevention of obesity. All data were collected during baseline prior to intervention from youth whose parents or guardians provided active informed consent. The Institutional Review Board (IRB) at Kansas State University approved all procedures. During after-school programs at seven elementary school sites, research assistants led

groups of children through a paper-and-pencil survey assessing psychosocial variables related to physical activity and nutrition.

Using a verbatim script, all instructions and questions were simultaneously read aloud to all participating children. Children completed the questionnaire individually, but were asked to wait and follow along as a research assistant read each question aloud to all children in the class. The script included questionnaire instructions and definitions of FV serving sizes. Children were also shown realistic FV food models, functioning as visual aids that insured their understanding of FV serving sizes. Finally, a large poster board displaying written definitions and example questions was presented to the group. Following completion, all children who participated in the survey were privately given small incentives (i.e., colorful pencils, small toys); however, no penalty for non-participation was employed.

Instruments

Direct Personal Agency and Proxy Agency Measures

Four groups of items were developed by the research team based on SCT and FV literature.¹⁰⁻¹¹ The construct of personal agency, labeled in this study as self-efficacy, was assessed with the first group of items (n = 3) for both fruit consumption (SE-FRUIT) as well as a second group of items (n = 3) for vegetable consumption (SE-VEG). A third group of items (n =4) captured proxy agency relevant to parents, which is referred to as proxy efficacy for FV availability from parents (PEFV-P). A final group of items (n =4) captured proxy agency relevant to the after-school staff, labeled here as proxy efficacy for FV availability from staff (PEFV-S).

The SMOG test was chosen for performing readability tests on the entire 14-item questionnaire, as well as each of the four subscales. The SMOG readability analyses gave the 14-item questionnaire a seventh-grade score, and each subscale ranged from third- to eighth-grade (SD= + 1.5). Although these grade-levels exceed that of the present subjects (fourth-, fifth-, and sixth-graders), it should be noted that all instructions and each individual question was read out-loud to the children before they responded. Furthermore, only six different polysyllabic words were included among the questionnaire items including: vegetable(s), favorite, refrigerator, banana, apricots and

applesauce. These words, although polysyllabic, are usually highly recognizable by children when read aloud.

Self-Efficacy for Fruit Consumption (SE-FRUIT). The self-efficacy for fruit consumption items were generated to correspond to the recommendation of one to three servings of fruit or 100% fruit juice each day.¹³ Serving sizes were established from the food guide pyramid; therefore, one serving of fruit and one serving of fruit juice was defined to the children as “*1 medium piece of fresh fruit, ½ cup of fruit salad, ¼ cup of raisins, apricots or other dried fruit, 6 oz. of 100% orange, apple or grape juice (Do not count fruit punch, lemonade, Gatorade, Sunny Delight or fruit drink).*” Each question began with “*How sure are you that you can eat,*” assessing in three separate questions confidence to eat one, two and three servings of fruit each day (Table 2.1). Children responded using a three-point scale, “*Not sure at all,*” “*Somewhat sure*” and “*Very sure.*”

Self-Efficacy for Vegetable Consumption (SE-VEG). Similar to SE-FRUIT, self-efficacy for vegetable consumption items were generated based on the food guide pyramid (one to three servings each day).¹³ One serving of a vegetable was defined for the children as “*1 medium carrot or other fresh vegetable, 1 small bowl of green salad, ½ cup of fresh or cooked vegetables, ¾ cup of vegetable soup (Do not count French fries, onion rings, potato chips or fried okra).*” These questions were grouped with fruit consumption items, beginning with “*How sure are you that you can eat.*” Three separate questions were included assessing children’s perceived ability to consume one, two and three servings of vegetables. Children responded using the same three-point scale (“*Not sure at all,*” “*Somewhat sure*” or “*Very sure.*”)

Proxy Efficacy for Fruit and Vegetables- Parent (PEFV-P). Proxy efficacy for FV availability was defined as children’s confidence in their skills and abilities to get parents to make FV available. Specifically, PEFV-P assessed children’s confidence in having a parent or guardian provide them with fruits, fruit juices, and vegetables (Table 2.1). An example question was, “*How sure are you that you can get your parents to buy fruit for a snack.*” Children responded to each item using a three-point scale, “*Not sure at all,*” “*Somewhat sure*” and “*Very sure.*”

Proxy Efficacy for Fruit and Vegetables- Staff (PEFV-S). PEFV-S was defined as children’s confidence in their skills and abilities to get the after-school program staff

members to make fruit, fruit juice and vegetables available (Table 2.1). Similar to PEFV-P, children responded to each item using a three-point scale, “*Not sure at all*,” “*Somewhat sure*” and “*Very sure*.” An example question was, “*How sure are you that you can get the teachers or staff members of the after-school program to offer fruit and vegetable snack options.*”

After-School Environment Measures

Perceived School Fruit and Vegetable Opportunity. Two items assessed children’s perceived opportunities for FV during the after-school program. Children responded on a three-point scale choosing among “*yes*,” “*don’t know*,” or “*no*” to “*There are a lot of chances to eat fruit and vegetables at the after-school program*” and “*We are satisfied with the fruits and vegetables offered at the after-school program.*” The sample of children whose response was “*yes*” was categorized as perceiving FV opportunities in after-school. Internal consistency of the two-item scale was 0.65.

School Diversity and SES. Seven schools were grouped into two categories based on the percentage of youth qualifying for free and reduced lunch and percentage of youth who were white or of diverse race/ethnicity. The higher diversity and lower-SES schools (n=4) ranged from 63% of the youth qualifying for free and reduced school meals to 89%. These schools had approximately 50% racial/ethnic diversity with one school having slightly lower diversity (28%). The lower diversity and higher-SES schools (n=3) ranged in free and reduced status from 32% to 4% and in diversity from 13% to 24%.

Data Analysis

Exploratory Factor Analysis (EFA) was performed using SPSS 13.0 with principal axis factor extraction method, followed by direct oblique (oblimin) rotation. This rotation method was used due to hypothesized correlations among the underlying factor structures of self-efficacy. The number of factors retained was determined using the following criteria: (a) Factors with unrotated eigenvalues exceeding 1,¹⁴ (b) a scree test,¹⁵ and (c) factor loadings exceeding 0.40.¹⁶ Item reliability was estimated with Cronbach's alpha (α) and equal-length Spearman-Brown correlation coefficients.

Criterion validity analyses were performed using SAS software (version 9.1; SAS Institute, Cary, NC). Differences in FV self-efficacy and proxy efficacy variables were

evaluated for significance using a mixed-model analysis of covariance (PROC MIXED). To examine between group differences, the model included gender, ethnicity, household SES, and child weight status as fixed effects. Furthermore, children were nested within the after-school program as a random effect to address the possible clustering of children within any one of the seven after-school programs.

Results

Exploratory Factor Analysis

A principal axis factor (PAF) analysis of the 14 self-efficacy questionnaire items extracted four factors with eigenvalues greater than 1. In addition, a scree plot indicated the existence of four factors. The Keiser-Meyer-Olkin test of sampling adequacy coefficient was 0.76, exceeding the 0.60 minimum required for factor analysis. Thus, the four-factor solution met all statistical criteria and accounted for approximately 68.1% of the variability among the 14-items. Following oblique (oblimin) rotation, all items had factor loadings exceeding 0.40 on only one of the four identified factors, confirming the inclusion of all 14-items. Table 2.1 depicts the percent variance accounted for by each factor and the factor pattern coefficients for each item.

The first factor, labeled Self-Efficacy for Vegetable Consumption (SE-VEG), included three items capturing children's confidence in their ability to consume one, two and three servings of vegetables daily. Factor two was labeled Proxy Efficacy for Fruit and Vegetable Availability from After-School Staff (PEFV- Staff), and consisted of four items identifying children's perceptions of their ability to influence after-school staff members to make FV available. The third factor, labeled proxy efficacy for Fruit and Vegetable Availability from the Parent (PEFV-Parent), also consisted of four items and reflected children's perception of their ability to influence their parent(s) to make FV available. Finally, the fourth factor, labeled Self-Efficacy for Fruit Consumption (SE-FRUIT) captured children's confidence in consumption of one, two and three servings of fruit.

Reliability of the questionnaire was quantified using all 184 child responses. There was high internal consistency for the entire 14-item questionnaire (Cronbach's Alpha=0.81), ranging between 0.75 and 0.84 for the four subscales. Additionally, split-

half internal consistency method was employed to determine reliability. The reliability of the 14-item questionnaire was 0.56 (equal-length Spearman-Brown, $n = 184$). The coefficients of the four subscales were acceptably high, ranging between 0.74 and 0.80.

Criterion Validity

Table 2.2 reports the group least squared means and standard errors. Group differences were found such that children perceiving FV opportunities during after-school were significantly greater in SE-FRUIT than children not perceiving these opportunities ($F(1, 176) = 18.25, p = .001$). There were also group differences in SE-VEG scores based on children's perceptions of FV opportunities during after-school ($F(1, 176) = 6.46, P = .01$). Similar to SE-FRUIT, children perceiving FV opportunities during after-school were significantly higher on SE-VEG compared to children not perceiving FV opportunities.

In addition to self-efficacy, differences emerged regarding children's proxy efficacy. Specifically, children in schools with low racial/ethnic diversity and higher-SES were significantly greater on PEFV-P than children in schools with high racial/ethnic diversity and lower-SES ($F(1, 176) = 5.44, P = .02$). Moreover, children who perceived that their after-school environments provided more FV opportunities, were significantly greater on PEFV-S compared to youth not perceiving FV opportunities after-school ($F(1, 176) = 25.46, P = .0001$).

Discussion

The current study supports the global hypothesis that self-efficacy and proxy efficacy are separate but related constructs within the FV context. The 14-item measure had two self-efficacy subscales and two proxy efficacy subscales. The measure demonstrated impressive factorial and criterion validity, as well as acceptable reliability among late elementary-aged children. Contrary to previous studies reporting self-efficacy and proxy efficacy as a one-dimensional construct,⁹ the present measure is consistent with SCT, hypothesizing that children's beliefs for personal agency and proxy agency are based on distinct skills and abilities.¹⁷

Two subscales measured children's self-efficacy for FVC, one self-efficacy scale for fruit consumption and another for vegetable consumption. This finding is consistent with previous research revealing that fruit consumption and vegetable consumption are

independent behaviors.¹⁰⁻¹² For example, Reinaerts and colleagues¹⁰ found the habitual eating behavior among 4-12-year old children explained 13% of the variance for their fruit consumption, but only 3% of the variance for their vegetable consumption.¹¹ Additionally, Gibson et al¹² discovered children's consumption of fruits are related to different psychosocial and environmental factors compared to their consumption of vegetables. These results demonstrate that FVC are different behaviors involving different antecedents; thus, supporting the present employment of separate self-efficacy measurements for each.

Similar to self-efficacy, two separate scales for proxy efficacy were established. One subscale captured children's proxy efficacy to influence parents and another concerned their confidence to influence after-school staff. This finding supports our hypothesis, that children's proxy efficacy varies depending on the authority figure in control of the environmental opportunities for FV (parents versus after-school staff). This finding may contribute to a future explanation for why children's FVC during the weekday at school-lunch differs from FVC at home.¹⁸⁻²⁰

Criterion validity analyses provided further validity for the current measures. The hypothesis that self-efficacy for consumption of both fruits and vegetables would vary across groups was supported. Specifically, those children perceiving FV opportunities in after-school had higher self-efficacy for consuming fruit, higher self-efficacy for consuming vegetables and higher proxy efficacy for influencing after-school staff compared to children who did not perceive FV opportunities during after-school. This suggests that children's perceptions of FV opportunity in after-school may influence their self-efficacy and proxy efficacy, verifying adequacy of the current measure and its ability to capture and distinguish these differences.

Another finding emerging from the current analyses highlights differences in proxy efficacy at the school level. In the present study, the hypothesis that proxy efficacy will vary differently across school classification (diversity and SES) was supported. Specifically, those children attending lower diversity and higher-SES schools were significantly more confident they could influence their parents to make FV more available compared to children attending schools with higher racial/ethnic diversity and lower-SES. Racial/ethnic diversity and lower-SES are expected influences of FV

availability; therefore, the distinction uncovered in this analysis further supports the criterion validity of the current measure and its use in future studies.

The present study offers several specific contributions, extending the FV research literature. There is limited research investigating the direct personal agency and proxy efficacy constructs, and even fewer evaluating measurement of these constructs. The present study not only extends understanding of specific efficacy constructs within the FV context, it also offers a reliable and valid measurement tool that may be applied in future research. Additionally, the measurement evaluation is strengthened with the inclusion of two types of validation as well as two types of reliability tests. Specifically, construct validity (factor analysis) unveiled four measurement constructs that also demonstrated appropriate criterion validity. Furthermore, appropriately high internal consistency was confirmed using both Cronbach's α coefficients and equal-length Spearman-Brown coefficients.

Along with strengths of the present research, the following limitations should also be noted. First, the sample may not represent the national population of elementary-aged children, but does include ethnic variability common in Kansas' public schools. Future research needs to test these self-efficacy constructs in more diverse samples and varying age groups to determine how self-efficacy develops over time, and how FVC is impacted. Secondly, the PEFV-P and PEFV-S subscales did not ask separate questions distinguishing fruit availability from vegetable availability. It may be possible that children's proxy efficacy from staff or parents varies dependent on whether they are requesting fruit versus requesting vegetables. Additionally, test-retest reliability (stability reliability) should be assessed for the scales.

In conclusion, the measure of self-efficacy for FVC and proxy efficacy for FV availability demonstrated acceptable factorial validity, reliability, and criterion validity in late elementary-aged youth. Results illuminate four valid constructs within the FV context, contributing a better understanding of the separate influences of self-efficacy and proxy efficacy. Future investigations are needed to determine if the self-efficacy and proxy efficacy constructs are central variables of the causal process determining changes in children's FVC. Development and evaluation of interventions aimed at increasing children's FVC may be one way to examine this question. Specifically, interventions

targeting self-efficacy for FVC and proxy efficacy for FV availability can examine whether these variables mediate effectiveness of the intervention. Because self-efficacy for fruit consumption is separate from self-efficacy for vegetable consumption, interventions may need to consider separate strategies for improving each. Additionally, proxy efficacy for parents is a separate construct from proxy efficacy for after-school staff; thus, interventions may also need to consider separate strategies for increasing proxy efficacy for FV availability at home versus in the after-school environment.

Acknowledgements

This paper is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Award No. 2005-35215-15418.

We thank Karla Bruggeman, Tanis Hastmann and Sara Rosenkranz for assisting in data collection and data entry.

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Figures and Tables

Table 2-1 Exploratory Factor Analysis Results and Factor Loadings for FV Self-Efficacy and Proxy Efficacy Scales

| Factor Label | Items | Factor Loadings | | | |
|-------------------------|--|-----------------|-------------|-------------|--------------|
| | | 1 | 2 | 3 | 4 |
| 1. SE-Vegetable | One serving (1/2 cup) of vegetables each day | .672 | .004 | .162 | .048 |
| | Two serving (1/2 cup) of vegetables each day | .914 | .050 | -.063 | -.095 |
| | Three serving (1/2 cup) of vegetables each day | .695 | .038 | -.083 | -.264 |
| 2. PEFV- School | Get the after-school staff to offer dried fruit snacks (like raisins, banana chips and apricots) | -.013 | .733 | -.012 | -.018 |
| | Get the after-school staff to offer applesauce cups or fruit cups (like fruit cocktail) | .038 | .823 | -.040 | .158 |
| | Get the after-school staff to offer fruit and vegetable snack options | -.012 | .692 | .112 | -.005 |
| | Get the after-school staff to offer 100% real fruit juice | .019 | .589 | -.042 | -.099 |
| 3. PEFV- Parents | Get your parents to buy fruit for snacks | .063 | -.080 | .711 | .045 |
| | Get your parents to fix your favorite vegetable dish | .238 | .003 | .607 | .152 |
| | Get your parents to keep 100% juice in the refrigerator | -.037 | .075 | .495 | -.234 |
| | Get your parents to fix a fruit and vegetable snack | -.184 | .106 | .766 | -.139 |
| 4. SE-Fruit | One serving (1/2 cup) of fruit each day | .151 | .076 | .088 | -.581 |
| | Two serving (1/2 cup) of fruit each day | .071 | .026 | .040 | -.767 |
| | Three serving (1/2 cup) of fruit each day | .028 | -.061 | -.018 | -.808 |
| Eigenvalues | | 4.23 | 2.12 | 1.81 | 1.38 |
| % Percentage | | 30.19 | 15.15 | 12.94 | 9.85 |
| Cumulative % | | 30.19 | 45.34 | 58.28 | 68.13 |

Table 2-2 Group Least Square Means and Standard Errors for FV Self-Efficacy and FV Proxy Efficacy

| Group | Self-Efficacy | | Proxy Efficacy | |
|--|---------------|--------------|----------------|--------------|
| | Fruit | Vegetable | Parent | Staff |
| Gender | | | | |
| Male (n=97) | 2.65 ± 0.06 | 2.48 ± 0.08 | 2.60 ± 0.06 | 2.10 ± 0.08 |
| Female (n=89) | 2.56 ± 0.06 | 2.39 ± 0.08 | 2.53 ± 0.06 | 2.11 ± 0.08 |
| Ethnicity | | | | |
| Diverse (n=53) | 2.62 ± 0.08 | 2.45 ± 0.10 | 2.59 ± 0.08 | 2.14 ± 0.10 |
| White (n= 132) | 2.59 ± 0.05 | 2.41 ± 0.07 | 2.54 ± 0.05 | 2.07 ± 0.07 |
| Household SES | | | | |
| Not Eligible (n =109) | 2.58 ± 0.07 | 2.38 ± 0.08 | 2.55 ± 0.07 | 2.05 ± 0.09 |
| Eligible (n =73) | 2.63 ± 0.06 | 2.48 ± 0.08 | 2.58 ± 0.07 | 2.16 ± 0.08 |
| Weight Status | | | | |
| Normal (n= 141) | 2.52 ± 0.05 | 2.40 ± 0.06 | 2.50 ± 0.05 | 2.13 ± 0.07 |
| At Risk/Overweight (n= 43) | 2.69 ± 0.08 | 2.46 ± 0.10 | 2.63 ± 0.09 | 2.09 ± 0.10 |
| Perceived School FV Opportunity | | | | |
| Opportunity (n=77) | 2.77 ± 0.07* | 2.55 ± 0.08* | 2.56 ± 0.07 | 2.34 ± 0.09* |
| No-Unsure (n=109) | 2.44 ± 0.06 | 2.31 ± 0.07 | 2.57 ± 0.07 | 1.87 ± 0.07 |
| School Diversity-SES | | | | |
| High Div.-Low SES | 2.53 ± 0.07 | 2.35 ± 0.08 | 2.45 ± 0.07* | 2.17 ± 0.09 |
| Low Div.-High SES | 2.68 ± 0.07 | 2.51 ± 0.09 | 2.68 ± 0.07 | 2.04 ± 0.10 |

Note: *P < .05

CHAPTER 3 - Elementary-Aged Children's Self-Efficacy and Proxy Efficacy for Fruit and Vegetable Consumption are Consistent across Demographic Groups

Social-cognitive theory (SCT) is a predominant model to understand and positively impact health behaviors, such as fruit and vegetable consumption (FVC). The central influence on FVC according to SCT is self-efficacy. Self-efficacy was defined as a child's belief that he or she can execute a behavior at a necessary level in order to obtain a desired outcome.¹ Previous research has demonstrated a positive association between self-efficacy and FVC among elementary-aged youth²⁻⁷ and middle school-aged youth.⁸

According to SCT, children have two ways of exerting control to reach a desired outcome: direct personal agency and proxy agency.⁹ Measurement of children's self-efficacy, or their personal estimate regarding their confidence to consume fruit and vegetables (FV) is primarily a reflection of beliefs about direct personal agency, but children's self-efficacy judgments also tap beliefs about proxy agency. Proxy agency can also be assessed directly by obtaining children's estimates of their belief that they can get others to act on their behalf to reach desired outcomes. To better distinguish between beliefs about these two forms of agency, researchers and practitioners may need to assess both self-efficacy beliefs and beliefs about proxy agency using scales that assess proxy efficacy judgments.

Previous FV research has reported some inconsistency in distinguishing between self-efficacy and proxy efficacy in measurement.^{6, 10} In a research study measuring FV self-efficacy in elementary-aged children, Reynolds and colleagues⁶ performed analyses and demonstrated that self-efficacy was best assessed as a single construct with self-efficacy and proxy efficacy items loading on one factor.

However, a more recent exploratory factor analysis (EFA) illuminated that self-efficacy and proxy efficacy scales can assess independent but related constructs. This previous investigation identified four underlying self-efficacy FV factors: self-efficacy

for fruit consumption, self-efficacy for vegetable consumption, proxy efficacy to influence parents to make FV available, and proxy efficacy to influence after-school staff to make FV available.¹⁰ Perhaps, Geller and colleagues¹⁰ found different results than Reynolds et al⁶ because their scale was based on items generated specifically to assess direct personal agency and proxy agency independently. Thus, the initial objective of the current research is to further investigate if self-efficacy and proxy efficacy are multidimensional and best assessed through independent but related scales.

In addition to determining the underlying structural framework of self-efficacy and proxy efficacy, the second objective was to examine the consistency of these scales across different subgroups of children. For example, Dishman and colleagues¹¹ tested a measure of self-efficacy for physical activity (PA), determining invariance across white and black adolescent girls. Specifically, four questionnaires assessing determinants of PA had equivalent factor structure, factor loadings and factor variance. Similarly, a measure of motivation for sport that included self-efficacy as an underlying construct demonstrated equal factor structure and factor co-variance across gender and grade level among 12 to 18-year olds.¹² Although there is some work for physical activity, there is no research examining the consistency of self-efficacy and proxy efficacy for FV scales across different groups that vary on gender, race/ethnicity, and socioeconomic status (SES).

The consequences of a measurement instrument that does not generalize to all demographic groups of a target population are problematic. For instance, when a measure is valid and accurate for one group but less valid for another, findings may demonstrate demographic differences where none exist. For example, Granner and colleagues¹³ reported no ethnic or gender differences in self-efficacy among 11 to 15-year-old children; however, research has demonstrated lower dietary self-efficacy among lower-SES youth (6 to 18-years-old).¹⁴ Furthermore, Geller and colleagues¹⁰ reported higher proxy efficacy for FV from parents among children attending higher-SES and less racial/ethnically diverse schools compared to children attending lower-SES and more racial/ethnically diverse schools. But, since the measurement invariance across subgroups on the scales utilized in these studies had not been determined, it is unclear if these are

true mean differences between these subgroups or a consequence of changes in measurement validity.

In summary, the current study had two primary aims. First, to confirm that self-efficacy is multidimensional, containing both direct and proxy constructs that can be assessed with independent but related scales. Second, to determine if the factor structure of self-efficacy and proxy efficacy scales were similar across different subgroups from the same population of elementary-aged children (gender, SES and ethnicity), and to identify any subgroup latent mean differences.

Overall, we hypothesized that a multidimensional scale, containing self-efficacy and proxy efficacy items would be confirmed.¹⁰ Specifically, the self-efficacy scale would distinguish between self-efficacy for fruit consumption, self-efficacy for vegetable consumption, proxy efficacy for FV from parents and proxy efficacy for FV from after-school staff. Furthermore, measurement invariance was expected across gender, SES and ethnicity groups, supporting the unbiased generalizability of the current measure to different subgroups of elementary-aged children.

Differences in latent means were not expected for gender, ethnicity and SES subgroups for fruit self-efficacy, vegetable self-efficacy and proxy efficacy from after-school staff due to previous reports of similar means among these subgroups on these constructs.^{10, 13} However, proxy efficacy for FV from parents was expected to be higher among children categorized as higher-SES and less ethnically diverse compared to their counterparts, paralleling previous research.¹⁰

Methods and Procedures

The current analyses drew data from the Healthy Opportunities for Physical Activity and Nutrition (HOP'N) project, a school-randomized controlled trial targeting the prevention of obesity. The Institutional Review Board at Kansas State University approved all procedures. During after-school programs at seven elementary school sites in Lawrence Kansas, children were led through a paper-and-pencil survey in small groups assessing psychosocial variables related to physical activity and nutrition. Research assistants followed a verbatim script, reading each question aloud. Furthermore, written

definitions were displayed on a poster board and food models were shown to clarify serving sizes.

Measures

Four groups of items were developed based on SCT and previous FV literature.¹⁵⁻
¹⁶ The self-efficacy construct was assessed with three items representing self-efficacy for fruit consumption (SEFC) and three items representing self-efficacy for vegetable consumption (SEVC). Proxy efficacy from parents (PEFV-P) and proxy efficacy from after-school staff (PEFV-S) were both captured with four items. The separation of these four latent factors was previously identified through an exploratory factor analysis (EFA), which also reported high internal consistency for the entire 14-item questionnaire ($\alpha=0.81$), as well as for each of the four subscales (α ranging from 0.75 to 0.84).¹⁰

Self-Efficacy for Fruit Consumption (SEFC)

The SEFC items were generated to correspond to the recommendation of one to three servings of fruit or 100% fruit juice each day.¹⁷ Serving sizes were established from the food guide pyramid; therefore, one serving of fruit and one serving of fruit juice was defined to the children as “*1 medium piece of fresh fruit, ½ cup of fruit salad, ¼ cup of raisins, apricots or other dried fruit, 6 oz. of 100% orange, apple or grape juice (Do not count fruit punch, lemonade, Gatorade, Sunny Delight or fruit drink).*” Each question began with “*How sure are you that you can eat,*” assessing in three separate questions confidence to eat one, two and three servings of fruit each day. Children responded using a three-point scale, “*Not sure at all,*” “*Somewhat sure*” and “*Very sure.*”

Self-Efficacy for Vegetable Consumption (SEFV)

Similar to SEFC, SEVC items were generated based on the food guide pyramid (one to three servings each day).¹⁷ One serving of a vegetable was defined for the children as “*1 medium carrot or other fresh vegetable, 1 small bowl of green salad, ½ cup of fresh or cooked vegetables, ¾ cup of vegetable soup (Do not count French fries, onion rings, potato chips or fried okra).*” These questions were grouped with fruit consumption items and began with “*How sure are you that you can eat.*” Three separate questions were included assessing children’s perceived ability to consume one, two and

three servings of vegetables. Children responded using the same three-point scale (“*Not sure at all*,” “*Somewhat sure*” or “*Very sure*”).”

Proxy Efficacy for FV- Parent (PEFV-P)

PEFV-P was defined as children’s confidence in their skills and abilities to get their parent to make FV available. Specifically, PEFV-P assessed children’s confidence in having a parent or guardian provide FV opportunities for them. An example question was, “*How sure are you that you can get your parents to buy fruit for a snack.*” Children responded to each item on three-point scale, “*Not sure at all*,” “*Somewhat sure*” and “*Very sure.*”

Proxy Efficacy for FV – Staff (PEFV-S)

PEFV-S was defined as children’s confidence in their skills and abilities to get the after-school program staff members to provide FV opportunities for them. Again, children responded to each item using a three-point scale, “*Not sure at all*,” “*Somewhat sure*” and “*Very sure.*” An example question was, “*How sure are you that you can get the teachers or staff members of the after-school program to offer fruit and vegetable snack options.*”

Statistical Analyses

Factorial structure of the current measure was evaluated with several confirmatory factor analyses (CFAs) using Mplus 4.2¹⁸ and a Weighted Least-Square with Mean and Variance Correction (WLSMV) estimator function for categorical data. The difference in χ^2 values for models estimated with WLSMV is not distributed as χ^2 ;¹⁹ therefore, the χ^2 Diff test was calculated by comparing the derivatives of the less restricted model (baseline model) with the derivatives of the more constrained model. Multigroup CFAs were conducted to analyze the across-group equivalence (measurement invariance) as well as the group concordance of structural parameters (population heterogeneity) for gender and SES subgroups; however, due to a smaller racial/ethnic minority subgroup (n =91) a multiple indicators, multiple causes model (MIMC) was used to test invariance across ethnicity groups.

For the multigroup CFAs, the baseline model was first tested separately for each subgroup (e.g., males versus females) with no invariance constraints. If manifestly disparate measurement models were obtained, further invariance testing was ceased. The χ^2 Diff test from derivatives was examined to assess possible degradation at each level of model constraint. If a new set of parameters were found to be non-invariant across subgroups, the constraint was lifted and the nonequivalent parameters were located in the model. If parameters were invariant, parameter equality constraints were cumulatively held in place and invariance tests continued.

For tests across ethnicity, the MIMC approach entailed confirming a sound CFA measurement model using a collapsed data set with both ethnicity subgroups (0=racial/ethnic minority youth, 1=white youth). Next, measurement invariance was determined by fixing all direct effects from the racial/ethnic covariate and the indicators to zero and then inspecting modification index (MI) values to determine whether salient direct effects are present. Finally, to examine differences between racial/ethnic minorities and non-whites on the latent factors, latent factors were regressed onto the ethnicity covariate. A significant direct effect of race/ethnicity on any one of the latent variables would represent a significant difference between the groups.

Beyond χ^2 , additional fit indices were used to determine adequacy of each model fit. The comparative fit index (CFI) was adequate at values above 0.90²⁰ and the Tucker-Lewis coefficient (TLI)²¹ at values greater than or equal to 0.95.²² Lastly, following suggestions from Browne and Cudeck,²³ a root mean squared error of approximation (RMSEA) value less than 0.05 was indicative of a close fit, less than 0.08 was considered reasonable and between 0.08 and 1.00 was mediocre. Any model with a RMSEA above 1.00 was rejected.

Results

Participants and Descriptive Statistics

Participants were fourth (88.4%), fifth (9.1%) and sixth grade (2.6%) youth attending seven after-school programs on elementary school sites. Of the 246 youth, 232 (94%) had complete self-efficacy and proxy efficacy FV scores. The mean age of the 232 youth during the time of questionnaire completion was 9 years, ranging from 8 to 12

years. Fifty-one percent were male, 39.2% were racial/ethnic minorities (African American (n=50); Native American/Alaska Native (n=19); Hispanic/Latino (n=16); Asian (n=3); other (n=3) and 52.6% were considered lower-SES (i.e., eligible for free/reduced lunch). Because χ^2 is sensitive to sample size, random samples of males and lower-SES were taken in order to maintain an equal number of subgroup participants for the multigroup CFAs. Specifically, 94% of the male sample was randomly selected to equal the female sample (n=113), and 90% of the lower-SES sample was randomly selected to equal the higher-SES sample (n=110).

Overall Model Fit

Figure 3.1 depicts the complete specification of the baseline model along with the means and standard deviations for the entire sample (N =232) on each of the four latent constructs. The first indicator of each latent construct was used as a marker indicator for their corresponding latent construct (SEFC, SEVC, PEFV-P and PEFV-S, respectively). The measurement model contained no double loading indicators and all measurement error was presumed to be uncorrelated. Accordingly, the model was overidentified with 33 df.

The baseline model fit well, $\chi^2(33) = 69.025$, $p = 0.002$, CFI (= 0.979), TLI (= 0.986) and RMSEA (= 0.062). All freely estimated unstandardized parameters were statistically significant ($ps < .001$). Inspection of residual variances and modification indices indicated no ill fits within the solution and factor loading estimates were strongly related to their supposed latent factors ($R^2s = .456 - .918$). Finally, the four latent constructs were moderately correlated (ranging from .145 to .458). Additional models were analyzed and compared to the baseline model. As depicted in Table 3.1, these models all fit the data poorly, demonstrating inadequate fit indices. Furthermore, χ^2 Diff tests revealed that all additional constraints significantly degraded the fit of the baseline model (all $p < .001$). Latent construct means for the entire sample are depicted.

Baseline Model Fit across Subgroups

Tables 3.2-3.4 depict the baseline model fits for the gender, SES and ethnicity subgroups, respectively. Ethnicity was controlled for in the model fit for SES subgroups and vice versa. As depicted, the baseline models fit well for all subgroups. For the gender

subgroups, all freely estimated factor loadings were statistically significant (all p s < .001) and salient (R^2 s range = .377 - .958), which also resulted for both SES subgroups (R^2 s range = .284 - .933) and for the ethnicity group (R^2 s range = .456 - .916). Lastly, there were no remarkable points of strain noted in any of the models. Thus, results provide strong support for the structure of the baseline model across these different demographic groups.

Measurement Invariance and Population Heterogeneity across Gender Groups

Table 3.2 provides χ^2 values for invariance testing across gender groups. Model One analyzed factor structure equality across gender (equal form), which fit the data well and will serve as the baseline model for subsequent tests of invariance, $\chi^2 = 88.670$, $p = .002$. Next, factor loadings and indicator thresholds were tested for equivalence (Model Two), determining whether the measures had the same meaning and structure for males compared to females. Model Two had an overall good fit to the data and did not significantly degrade fit relative to the equal form solution, $\chi^2 (8) \text{ Diff} = 7.858$, $p = .448$.

To test population heterogeneity, three additional models were analyzed, progressively constraining factor variances, factor co-variances and factor means, respectively. Model Three examined equality of variances among the four constructs across gender and did not degrade the model fit, $\chi^2 (10) \text{ Diff} = 10.686$, $p = .383$. Thus, each latent construct has equal within variance dispersion across gender subgroups. Secondly, Model Four constrained factor co-variances to be equal, testing whether the latent variables are more strongly related to each other in one gender compared to the other. As shown, this constraint did not degrade the model, $\chi^2 (9) \text{ Diff} = 9.112$, $p = .427$. Finally, Model Five constrained the factor means to equality, which again did not degrade model fit, indicating that males and females do not differ in their levels of the four latent constructs, $\chi^2(9) \text{ Diff} = 6.137$, $p = .726$.

Measurement Invariance and Population Heterogeneity across SES Groups

The models tested across SES subgroups are presented in Table 3.3. Model One examined equal form, providing an acceptable fit to the data, $\chi^2 = 92.983$, $p = .001$, CFI = .960, TLI = .973 and RMSEA = .081. Model Two tested equality of factor loadings and indicator thresholds, which demonstrated good fit to the data and did not significantly

degrade fit relative to the equal form solution, χ^2 (8) Diff = 5.490, $p = .704$. Thus, the indicators evidence comparable relationships to the four latent constructs in both SES subgroups.

Concerning population heterogeneity, the equal factor variance constraint did significantly degrade the fit of the model ($p < .05$), indicating that the within group dispersion of one or more of the constructs differs across SES groups, χ^2 (10) Diff = 21.723, $p = .017$. To identify the unequal latent variable(s), constraints on factor variances with the highest modification index (MI) values were released consecutively until the partially unconstrained model did not significantly degrade model fit. The SEVC constraint had the highest MI value, which was released first and led to a non-significant degrade in model fit, χ^2 (9) Diff = 11.544, $p = .240$ (Model Three).

Non-equality of SEVC factor variances did not allow equality of factor co-variance tests for this construct; however, constraints placed on the equality of the remaining three latent variable co-variances did not degrade the fit of the model, χ^2 (7) Diff = 8.666, $p = .278$ (Model Four). This demonstrates equal factor co-variances across SES groups for the latent constructs SEFC, PEFV-P and PEFV-S. Model Five examined equality latent construct means and did not degrade model fit, indicating that higher- and lower-SES children do not significantly differ in their average levels of the four latent factors, χ^2 (10) Diff = 14.285, $p = .160$.

Measurement Invariance and Population Heterogeneity across Racial/Ethnic Groups

The MIMC model, controlling for SES, provided a good fit to the data (Table 3.4), χ^2 (40) = 70.293, $p = .004$, CFI = .980, TLI = .986 and RMSEA=.054. Inclusion of the ethnicity covariate did not alter the factor structure and all items remained significant indicators of their hypothesized latent factor (all $ps < .001$). Next, MI values provided information regarding equality of indicators across race/ethnicity groups. An invariant indicator was determined by fixing all the direct effects between the covariate and the indicators to zero and inspecting MI values. MI values for all fixed effects between ethnicity and each indicator were appropriately low with the highest index equaling .773, demonstrating indicator invariance across ethnicity.

Finally, equality of the four latent factor means was analyzed. Specifically, any significant direct effect of the race/ethnicity covariate on any of the four latent factors would represent population heterogeneity. Table 3.5 provides estimates and significance statistics. Given how ethnicity was coded (0=racial/ethnic minorities and 1=whites), any negative unstandardized estimate indicated a higher latent mean for the racial/ethnic minority subgroup. As depicted, the racial/ethnic minority subgroup demonstrated higher mean scores on all latent variables except for SEVC; however these differences were not significant (all ps >.05).

Discussion

This study supported the hypothesis that self-efficacy is multidimensional among elementary-aged youth, characterized by self-efficacy for fruit consumption (SEFC), self-efficacy for vegetable consumption (SEVC), proxy efficacy to influence parents (PEFV-P) and proxy efficacy to influence after-school staff (PEFV-S). Secondly, the hypothesis that self-efficacy and proxy efficacy would be invariant across different demographic groups was also supported. Specifically, complete invariance was established across gender, SES and race/ethnicity groups. Finally, population heterogeneity did not exist across gender and race/ethnicity groups and existed only minimally between SES subgroups. Several conclusions can be made from these findings.

First, the existence of four underlying factors representing self-efficacy for FVC suggests that self-efficacy can be assessed as an independent but related construct to proxy efficacy. This result supports findings from a previous exploratory factor analysis (EFA)¹⁰ and findings in the physical activity domain,²⁴ but refutes reports of self-efficacy for FVC as a unidimensional construct.⁶ An explanation for this contrast may be the face validity of the different measures used between these separate studies. Specifically, Reynolds and colleagues⁶ used 17 self-efficacy items targeting children's self-efficacy ("*I can...*") and only 4 proxy efficacy items ("*I can ask my mom or dad...*"). Thus, weak factor separation may have resulted from inclusion of more than three times as many self-efficacy items. Previous research¹⁰ and the current study devoted specific attention to the conceptual distinction between self-efficacy and proxy efficacy, illuminating these to be independent but related constructs.

Second, there are additional latent constructs that define self-efficacy and proxy efficacy for FV. First, self-efficacy for fruit consumption is an independent but related construct to self-efficacy for vegetable consumption. This supports previous research, reporting that fruit consumption and vegetable consumption are independent behaviors.^{10, 15-16, 25} Thus, interventions should take into account that these are separate behaviors with different influencing factors. Secondly, two separate scales for proxy efficacy were also confirmed, capturing children's proxy efficacy to influence both their parents and their after-school staff. Thus, children's proxy efficacy to influence others to provide FV varies according to the authority figure in control of their environment.

Third, our findings indicate that the current measure is invariant across gender, SES and racial/ethnic groups; thus, it is completely generalizable to these subgroups. This supports previous research reporting self-efficacy invariant across separate subgroups for PA, a related health behavior to FVC.^{11-12, 26} Furthermore, all latent variable variances were equal for males and females; however, the variance of the self-efficacy for vegetable consumption latent variable (SEVC) was not invariant across SES subgroups. Specifically, the amount of variability in SEVC within the lower-SES subgroup was significantly smaller, indicating more variability in SEVC among higher-SES children. Finally, results also demonstrated that the co-variance between all four of the latent constructs were equal for both genders, as were the relationships between the latent constructs SEFC, PEFV-P and PEFV-S for both SES subgroups.

Established measurement invariance across subgroups allowed us to analyze equality of latent means. In other words, do subgroups differ in their levels of the latent variables? Results demonstrated that males and females had equal latent variable means, supporting our expectations and previous research.¹⁰⁻¹³ Therefore, in consideration of research reporting higher FVC among females compared to males,²⁷⁻³¹ results here suggest that these gender differences in FVC are not resulting from differences in self-efficacy or proxy efficacy at the elementary-age.

Furthermore, no latent mean differences were found between SES subgroups or ethnicity subgroups. This finding contradicts previous research, reporting differences in FV proxy efficacy from parents (PEFV-P) based on the SES and racial/ethnic diversity classification of the children's schools.¹⁰ However, in the current analyses, SES and

race/ethnicity were looked at uniquely by co-varying out the variance of SES in the race/ethnicity model and vice versa; thus, testing only the unique impact of SES and race/ethnicity may have reduced statistical strength. Moreover, the current analysis examined youth level demographic differences, which is not directly comparable to the school level demographic differences found in the previous study.¹⁰

Study Limitations and Strengths

Limitations of this study should be noted. First, analyses relied on self-report data that can result in numerous biases, such as social desirability bias, unwillingness to be truthful and/or misunderstanding. Second, the subgroup sample size for racial/ethnic minorities was not adequate to run a multigroup CFA, limiting invariance tests to equality of indicator loadings and equality of latent means. Lastly, race/ethnicity subgroups were created into dichotomous variables, which may underscore differences existing within collapsed groups (e.g., Asians versus African Americans).

The main strength of the current analyses is the use of CFA to investigate differences in latent variable means. When using these modeling techniques to evaluate psychological measurements, detailed invariance information and population heterogeneity tests are provided that cannot be performed in more simplified analyses (e.g. ANOVA). For example, the incorporation of means in a CFA allows for the analysis of between-group indicator thresholds. Moreover, unlike simple mean comparisons, CFA comparisons are conducted within a measurement model that allows for the incorporation and adjustment of all measurement error.

Implications for Practitioners

A central mechanism of health behavior change according to SCT is children's confidence to exert personal agency and proxy agency to eat FV. Practitioners can assess children's beliefs underlying this behavior change mechanism with FV self-efficacy and proxy efficacy scale items validated in this study. Results demonstrated that the current self-efficacy and proxy efficacy for FVC constructs were assessed consistently among elementary-aged children across gender, ethnicity and SES subgroups, which informs practitioners that these measures can be applied uniformly to all members of these subgroups. For example, a school nutritionist focused on increasing youth FVC using

self-efficacy and proxy efficacy components can apply and/or measure these constructs across gender, ethnicity and SES subgroups without the concern of bias towards any one subgroup. Furthermore, considering that all subgroups demonstrated equal levels of self-efficacy and proxy efficacy (latent means), practitioners can apply self-efficacy and proxy efficacy strategies to members of these different subgroups with the same intensity.

This study illuminated that self-efficacy beliefs and proxy efficacy beliefs are independent and related constructs. Children who lack confidence to eat fruits may be confident to eat vegetables. As depicted in the Figure 3.1, children's overall mean scores on the latent constructs self-efficacy to eat fruit (2.527) and self-efficacy to eat vegetables (2.362) were both high on a scale ranging from 1 to 3. In other words, on average, children are between somewhat sure and very sure that they can consume between 1 and 3 servings of both fruit and vegetables per day. The Dietary guidelines for Americans¹⁷ recommends children ages 9 to 11 years consume 3 to 4 servings of fruit (1.5 to 2 cups) and 4 to 6 servings of vegetables (2 to 3 cups); thus, practitioners are encouraged to continue the development of both children's self-efficacy to consume fruit and their self-efficacy to consume vegetables in order to reach these goals.

Similarly, children's confidence to influence after-school staff is not the same construct as their confidence to influence parents. Also in Figure 3.1 are children's overall mean scores on these latent constructs. As seen, children report higher proxy efficacy from their parents (2.501) in comparison to proxy efficacy from their after-school staff (1.997) on a scale ranging from 1 to 3. This difference reflects children's higher confidence to request FV availability from their parents compared to the authority figures during after-school time. Considering the amount of time children spend in school and the increasing use of after-school programs, practitioners should spend time focusing on increasing children's confidence to request FV from authority figures in control of the environments outside their home.

Conclusion

In conclusion, this research provides evidence supporting the factorial invariance of a theory-derived (SCT) measurement of self-efficacy and proxy efficacy for FVC across gender, SES and race/ethnicity. This sanctions meaningful and truthful comparison

of the latent constructs SEFC, SEVC, PEFV-P and PEFV-S between male and female children, lower- and higher-SES children, and racial/ethnic minority and white children. Research can now utilize these measurements in studies examining the potential impact of self-efficacy and proxy efficacy for FV on some additional variable(s) across subgroups of elementary-aged youth. Future research should apply these latent constructs into structural equation models to evaluate possible effects on children's actual FVC. Lastly, interventions should be employed to investigate if altering these identified latent constructs can cause increases in children's FVC.

Acknowledgements

This study was supported by National Research Initiative Grant no. 2005-35215-15418 from the USDA Cooperative State Research, Education, and Extension Service Human Nutrition and Obesity Program.

We thank Karla Bruggeman, Tanis Hastmann, Sara Rosenkranz and Dr. Richard Rosenkranz for assisting with the development of the questionnaire, data collection and data entry.

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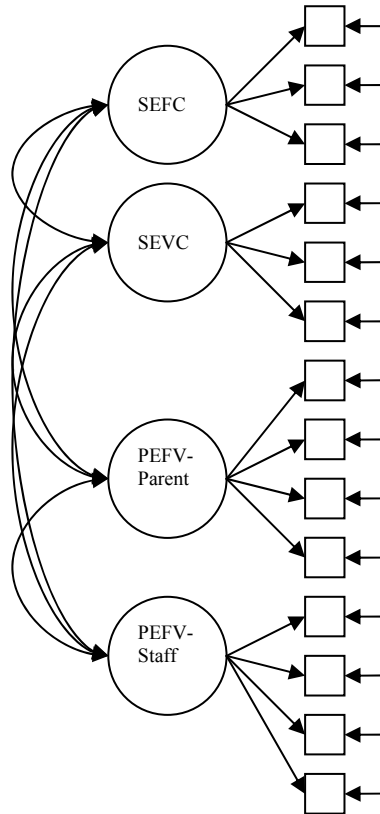
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Figures and Tables

Figure 3-1 Path Diagram, Means and Standard Deviations for Self-Efficacy for Fruit (SEFC), Self-Efficacy for Vegetables (SEVC), Proxy Efficacy from Parent (PEFV-Parent) and Proxy Efficacy from After-School Staff (PEFV-Staff)



| Latent Construct | Mean | SD |
|------------------|-------|------|
| SEFC | 2.527 | .541 |
| SEVC | 2.362 | .648 |
| PEFV-Parent | 2.501 | .555 |
| PEFV-Staff | 1.997 | .647 |

Note: All indicators measured on scales ranging from 1 to 3 (higher scores reflect higher levels of the assessed latent construct); N=232

Table 3-1 Model Fit and χ^2 Difference Tests for One-Factor, Two-Factor, and Three-Factor Models

| | χ^2 | <i>p</i> value | CFI | TLI | RMSEA |
|---|----------|----------------|------|------|-------|
| Four-Factor Baseline | 62.025 | .002 | .979 | .986 | .062 |
| Two-Factor: Factor 1: SEFC, SEVC Factor 2: PEFV-P, PEFV-S | 165.874 | .000 | .898 | .917 | .152 |
| One-factor | 396.215 | .000 | .727 | .751 | .264 |
| Uncorrelated Four-Factor | 283.479 | .000 | .805 | .759 | .260 |

Note: (1) χ^2 , Chi-Square; CFI, comparative fit index; TLI, Tucker-Lewis Index; RMSEA, root mean square error of approximation. (2) All χ^2 values for difference testing are statistically significant ($ps < .001$), indicating that the two-factor, one-factor and uncorrelated four-factor model constraints significantly degrade the fit of the correlated three-factor model. (3) Considering the use of Weighted Least-Square with Mean and Variance Correction (WLSMV) only the p-value should be interpreted; thus, the degrees of freedom and χ^2 are not reported here.

Table 3-2 Goodness-of-Fit and χ^2 Diff Statistics for Test of Invariance across Gender Groups

| | χ^2 | <i>p</i> value | CFI | TLI | RMSEA | χ^2_{Diff} | <i>p</i> value for DIFF test |
|--|----------|----------------|------|------|-------|------------------------|------------------------------------|
| Single Group Solutions | | | | | | | |
| Boys (<i>n</i> =113) | 52.093 | .003 | .962 | .976 | .091 | | |
| Girls (<i>n</i> =113) | 38.512 | .041 | .976 | .982 | .069 | | |
| Measurement Invariance | | | | | | | |
| Model 1: Equal Form | 88.670 | .002 | .972 | .981 | .075 | | |
| Model 2: Equal Factor Loadings and Indicator Thresholds | 90.615 | .003 | .973 | .983 | .072 | 7.858 | .448 |
| Population Heterogeneity | | | | | | | |
| Model 3: Equal Factor Variance | 90.738 | .004 | .973 | .984 | .071 | 10.686 | .383 |
| Model 4: Equal Factor Co-variances | 60.154 | .034 | .985 | .987 | .062 | 9.112 | .427 |
| Model 5: Equal Latent Mean | 73.374 | .027 | .983 | .988 | .060 | 6.137 | .726 |

Note: (1) χ^2 , Chi-Square; CFI, comparative fit index; TLI, Tucker-Lewis Index; RMSEA, root mean square error of approximation, χ^2_{diff} , nested χ^2 difference. (2) Considering the use of Weighted Least-Square with Mean and Variance Correction (WLSMV) only the *p*-value should be interpreted; thus, the degrees of freedom and χ^2 are not reported here.

Table 3-3 Goodness-of-Fit and χ^2 Diff Statistics for Test of Invariance across SES Groups

| | χ^2 | <i>p</i> value | CFI | TLI | RMSEA | χ^2 Diff | <i>p</i> value for DIFF test |
|--|----------|----------------|------|------|-------|---------------|------------------------------|
| Single Group Solutions, controlling for Ethnicity (white, non-white) | | | | | | | |
| Higher SES (<i>n</i> =110) | 51.616 | .004 | .951 | .963 | .088 | | |
| Lower SES (<i>n</i> =110) | 39.043 | .080 | .980 | .984 | .060 | | |
| Measurement Invariance | | | | | | | |
| Model 1: Equal Form | 92.983 | .001 | .960 | .973 | .081 | | |
| Model 2: Equal Factor Loadings and Indicator Thresholds | 91.663 | .002 | .963 | .976 | .076 | 5.490 | .704 |
| Population Heterogeneity | | | | | | | |
| Model 3: Equal Factor Variance: Partial Invariance (SEVC freed) | 94.929 | .001 | .961 | .975 | .078 | 11.544 | .240 |
| Model 4: Equal Factor Co-variance: Partial Invariance (SEVC freed) | 75.527 | .005 | .971 | .978 | .074 | 8.666 | .278 |
| Model 5: Equal Latent Mean: Partial factor variance and Co-variance (SEVC freed) | 76.555 | .004 | .970 | .977 | .076 | 14.285 | .160 |

Note: (1) χ^2 , Chi-Square; CFI, comparative fit index; TLI, Tucker-Lewis Index; RMSEA, root mean square error of approximation, χ^2 diff, nested χ^2 difference. (2) Considering the use of Weighted Least-Square with Mean and Variance Correction (WLSMV) only the p-value should be interpreted; thus, the degrees of freedom and χ^2 are not reported here.

Table 3-4 Fit Indices of Baseline Models for the Collapsed Race/Ethnicity Sample

| | χ^2 | <i>p</i> value | CFI | TLI | RMSEA |
|--|----------|----------------|------|------|-------|
| Ethnicity: (n =232), controlling for SES | | | | | |
| White (n=141) and Non-white (n=91), | 70.049 | .002 | .978 | .985 | .059 |
| With Ethnicity Covariate, controlling for SES | 70.293 | .004 | .980 | .986 | .054 |

Note: (1) χ^2 , Chi-Square; CFI, comparative fit index; TLI, Tucker-Lewis Index; RMSEA, root mean square error of approximation, χ^2 diff, nested χ^2 difference. (2) Considering the use of Weighted Least-Square with Mean and Variance Correction (WLSMV) only the p-value should be interpreted; thus, the degrees of freedom and χ^2 are not reported here.

Table 3-5 Regression Paths Linking Race/Ethnicity to each Latent Factor (SEFC, SEVC, PEFV-P and PEFV-S): Estimates, Standard Errors (S.E.), and Z Scores

| | Unstandardized Estimate | S.E. | z score | Standardized Estimate |
|----------------------------|--------------------------------|-------------|----------------|------------------------------|
| SEFC On Ethnicity | -.127 | .142 | .078 | .013 |
| SEVC On Ethnicity | .051 | .130 | .396 | .065 |
| PEFV-P On Ethnicity | -.201 | .136 | -1.482 | -.267 |
| PEFV-S On Ethnicity | -.106 | .137 | -.772 | -.122 |

Note: Note: (1) S.E., Standard Error; TLI (2) Given how the race/ethnicity variable was coded (0=racial/ethnic minority and 1=white), any negative estimate indicates that racial/ethnic minority youth have a higher mean on that latent construct.

CHAPTER 4 - Adolescents' Proxy Efficacy to Influence Parents to Make Fruit and Vegetables Available Declines Over Time and Varies by Gender, Ethnicity and Socioeconomic Status

Youth fruit and vegetable consumption (FVC) is well below the current U.S. guidelines. The 2007 U.S. Youth Risk Behavior Survey of high school students showed that only 21.4% of adolescents ate five or more servings of fruits and vegetables (FV) each day.¹ In addition, Guenther and colleagues² reported that only 1.2% of boys and 3.6% of girls (9-13 years) consumed the minimal amount of FV servings recommended by the Dietary Guidelines for Americans.³

Several demographic factors appear to impact the prevalence of youth FVC. Specifically, researchers have demonstrated that adolescent boys consumed less FV than girls.^{4,5} Also, FVC has been shown to increase as socioeconomic status (SES) increases.^{4,6} For example, Riediger and colleagues⁴ reported that household education and income independently had a significant impact on Canadian adolescents' FVC. Finally, FVC research examining youth of different ethnicities has had mixed findings. While the 2007 Youth Risk Behavior Survey reported a lower percentage of White adolescents (18.8%) consuming five or more fruits and vegetables a day compared to both Black (24.9%) and Hispanic (24.0%) adolescents,¹ additional research reported no significant difference in FVC between ethnic groups.^{4,7} Moreover, several research studies have also reported a linear decrease in FVC as children develop through adolescence.^{4,8} Specifically, from cross sectional data, Mensink and others⁸ reported lower fruit juice, fresh fruit and raw vegetable consumption among adolescents (11-17 years) compared to children (1-10 years).

In order to develop effective interventions to increase FVC in all youth as they age, an understanding of the underlying casual influences on consumption is needed. The influence of FV availability on youth consumption has been the most frequently reported significant environmental influence on FVC in both cross sectional⁹⁻¹⁴ and longitudinal

studies.¹⁵⁻¹⁶ Therefore, implementing strategies to increase FV availability have clear potential to increase youth consumption.

Additional factors may also contribute to the decline in FVC. As children enter adolescence many developmental changes are occurring. Changes during adolescence include biological changes (e.g., sexual interest, cognitive and physical capabilities), social-contextual changes (e.g., school transitions, family relations) and psychological changes (e.g., social and cognitive maturity).¹⁷ Of central interest to the current research is the social-contextual change relevant to shifts in family relations. More specifically, a consequence of adolescents' attempts at autonomy is the decrease in the time spent interacting with their parents.¹⁷ This decrease in time spent together has important implications for youth FVC. For example, Lien, Jacobs and Klepp⁵ found that adolescents' positive relations with their parents positively influenced their FVC in early adulthood. Moreover, Neumark-Sztainer and colleagues¹⁸ reported that disconnectedness of adolescents from their parents was associated with inadequate levels of FVC. Thus, it may be that as communication and relationships between developing youth and their parents suffer, so do interactions concerning FVC. This lack of communication may result in less FV availability provided by the parent, contributing to the decrease in levels of youth FVC as they age. A gap in the literature exists that documents the processes that may determine adolescent-parent relations that result in decreased FV availability. One important process may be youth requesting FV from their parents, which was the focus of the current research.

Social cognitive theory is a model that addresses the process of health behavior change in which youth request FV from their parents. A central social cognitive theory construct is proxy efficacy, which is defined as the belief that one can get others to act on their behalf to reach desired outcomes.¹⁹ Youth are not directly in charge of the social and institutional practices that make FV available; thus, proxy efficacy may be exerted to help youth receive and consume more FV.²⁰ For example, when youth proxy efficacy from their parent is high, they are more likely to request FV, which may result in increased FV availability and increased consumption.

The role of proxy efficacy to increase FV availability has been studied minimally, and there is limited to no current research investigating this latent factor over time or

between separate demographic groups. Reynolds and colleagues²¹ reported that increases in cognitive/behavioral skills related to FV availability (“asking skills”) lead to increased self-efficacy, leading to improved FVC. In a related study, Young and colleagues²² found that perceived parent support had a positive effect on FVC. Thus, positive changes may be possible through increases in youth’s confidence to request FV from their parents. Additional research related directly to proxy efficacy for FVC found that elementary-aged children attending schools with higher concentrations of high SES and lower concentrations of diversity were more confident they could influence their parents to provide FV compared to children attending lower SES and more diverse schools.²³

The primary aim of the current study was to investigate middle school youth proxy efficacy to influence parents to make FV available. Using data collected over three-years (sixth-, seventh- and eighth-grade), the specific interest was to investigate proxy efficacy among developing adolescents. The secondary aim was to examine the influence of youth level demographic variables on their proxy efficacy over time, specifically investigating the influence of gender (male versus female), ethnicity (racial/ethnic minority versus white) and SES (lower versus higher). For all analyses, latent growth modeling was performed, providing information on youth proxy efficacy in sixth- seventh- and eighth-grade and the rate of change in this latent factor over these three-years.

Overall youth proxy efficacy to influence parents to make FV available was hypothesized to decline linearly over time. This expectation is consistent with the linear decline seen in youth FVC^{4, 8} as they age, as well as the decrease in communication and time spent between adolescents and their parents.¹⁷ Secondly, considering reports of lower FVC among males,⁴⁻⁵ proxy efficacy from parents was expected to be lower in males compared to females. Lastly, to parallel results from the investigation of parent proxy among elementary-aged children,²³ racial/ethnicity and SES youth variables were expected to influence youth proxy efficacy from their parents, depicting lower proxy efficacy among racial/ethnic minority youth and lower SES youth.

Methods

Participants were 1,506 youth recruited from 8 middle schools located in urban, suburban and rural areas of Kansas that were randomly selected as the control sites for the Healthy Youth Places Project, a randomized control trial to promote nutrition and physical activity.²⁴⁻²⁵ The Healthy Youth Places Project evaluated the health behaviors of a cohort of adolescents during sixth-, seventh- and eighth-grade.²⁶ Among the youth, 660 (43.8%) had both complete demographic data and complete data on the proxy efficacy items during sixth- and eighth-grade. Of the 660 youth (mean age 12 years in sixth-grade), 51.8% of the sample was female and 30.5% of the youth households were classified as low income (i.e., receiving free or reduced meal program assistance). The sample was primarily white (89.5%) with some racial/ethnic diversity (Black, n = 31; Hispanic, n = 22; American Indian, n = 11; Asian, n = 4; other, n = 1).

Measures

Youth proxy efficacy targeted school lunch and was measured on a 0 to 5 scale, indicating youth's confidence that they could influence their parents to make FV available. Specifically, measurement items assessed youth's confidence in having a parent or guardian help provide them with fruits, fruit juices, and vegetables in their school lunch. The three measurement items used to assess this latent factor included: (1) *How sure are you that you can get your parents to help you include your favorite fruits in your lunch?*; (2) *How sure are you that you can get your parents to help you include cut-up vegetables with dressing (like carrot sticks and ranch dressing) in your lunch?*; (3) *How sure are you that you can get your parents to help you include 100% fruit juice with your lunch instead of soda?*

Data Analyses

The factor structure was first examined for longitudinal factorial invariance. Following confirmation of longitudinal invariance, longitudinal growth modeling (LGM) analyses were conducted, which included a multiple indicators, multiple causes (MIMC) model²⁶⁻²⁷ to examine the impact of youth level demographic variables on proxy efficacy over time. Specifically, the latent factor representing youth proxy efficacy was regressed onto the covariates that represented group membership to specific demographic

subgroups (gender, ethnicity and SES). For inclusion in all analyses, participants had complete data during the sixth- and eighth-grade assessment points; however, missing responses were allowed in seventh-grade and estimated using full-information maximum likelihood (FIML) estimation. FIML estimation is generally regarded as the best method for handling missing data in most confirmatory factor analysis (CFA) and structural equation modeling (SEM) applications.²⁸⁻²⁹

Longitudinal Factor Invariance

Longitudinal invariance provides information about the stability of the proxy efficacy latent factor across time and should precede applications of SEM procedures (e.g., LGM).³⁰⁻³¹ The model for the proxy efficacy latent factor included three indicator items, which contained no cross loading across assessment years. The first indicator of the latent factor at each assessment year was used as a marker indicator. The measurement error terms were allowed to covary due to the expectation that some systematic variance unaccounted for by the latent factor should be the same over time. Accordingly, the model was overidentified with 25 df.

The invariance steps involved testing and comparing four models that imposed subsequent restrictions on model parameters. Model One examined equal form of the factor structure over three years. Model Two included restrictions from Model One in addition to equality constraints of the factor loadings over the three assessment points. Model Three included restrictions from the previous models plus equality constraints on the indicator intercepts. Model Four included all previous restrictions plus constraints on the equality of the indicators' error variances.

Latent Growth Modeling (LGM)

For hypothesis testing, LGM analyses were performed using Mplus 4.2.³² LGM analysis is essentially a multilevel model for change, applying CFA to variables measured longitudinally.³³ LGM provided information on the level or status (intercept) and rate of change over time (slope), offering extensive implications for designing future intervention studies. Specific to the current analysis, LGM was used to examine change over three-years in youth proxy efficacy for their parent to make FV available.

Multiple Indicators, Multiple Causes (MIMC) Modeling

MIMC modeling was used to examine the possible effects of youth level demographic variables on youth proxy efficacy. The model mirrored that from the LGM with inclusion of youth level covariates (gender, ethnicity, SES). The covariates were simultaneously added to the model to examine their direct effects on youth's initial status in sixth-grade (intercept) and rate of change over time (slope) on the latent factor. In addition, covariate effects on the latent factor in seventh- and eighth-grade were examined by defining each grade as the intercept in two additional models. A significant direct effect indicated different intercept means and/or different rates of change over time at different levels of the covariate. MIMC modeling was chosen due to small subgroup sample sizes and its less cumbersome use when examining multiple covariates.³⁴

Model Fit

In addition to assessing absolute fit with the χ^2 statistic,³⁵ model fit was assessed with multiple indices. The comparative fit index (CFI) was adequate at values above 0.90³⁶ and the Tucker-Lewis coefficient (TLI)³⁷ at values greater than or equal to 0.95.³⁸ Root mean squared error of approximation (RMSEA) values of less than 0.08 and less than 0.06 (and the 90% confidence interval) indicated acceptable and close fit, respectively.³⁹ The standardized root mean square error (SRMR) reflected good fit at values less than 0.08.³⁹ Finally, significance of factor loadings and modification indices were closely examined.

Results

Longitudinal Factor Invariance

Invariance results are presented in Table 4.1. Results from Model One demonstrate that a unidimensional measurement model of parent proxy is viable at all three assessment periods, such that each of the overall goodness-of-fit indices suggested excellent fit, $\chi^2 (15) = 12.257$, $p = 0.660$, CFI= 1.00, TLI= 1.00 and RMSEA= 0.00 (90% CI=0.00 to 0.030), SRMR=0.012. Furthermore, at all assessment periods, the model reflected no areas of strain (e.g., all modification indices < 3.5) and all indicators were found significantly (all $ps < .001$) and strongly related (R^2 s range from 0.567 to 0.873) to

the latent factor. The next analysis tested equal factor loadings across time (Model Two) and determined if these constraints significantly degrade model fit. As shown in Table 4.1, the χ^2 of the Model Two solution is 15.114 (df= 19, $p = 0.715$), resulted in a nonsignificant χ^2 difference test, $\chi^2\text{diff}(4) = 2.857$, ns; [critical value of $\chi^2(4) = 9.49$, $\alpha = .05$].

Model Three placed additional equality constraints on the indicators' intercepts, resulting in a nonsignificant reduction in model fit, $\chi^2\text{diff}(10) = 24.257$, ns; [critical value of $\chi^2(10)=29.59$, $\alpha = .001$]. Finally, Model Four tested for the equality of the indicators' error variances, which resulted in a significant decrease in model fit, $\chi^2\text{diff}(15) = 143.221$, s; [critical value of $\chi^2(15) = 37.70$, $\alpha = .001$]. Thus, each indicator's error variance is temporally non-invariant; however, equality of error variances rarely holds in realistic data sets⁴⁰ and is commonly due to temporal fanspread of indicator variances.³⁴

Latent Growth Modeling

The first stage of LGM examined linear change in youth proxy efficacy by assigning a regression weight to each of the three time points (0, 1, 2), which were modeled as an intercept latent variable (sixth-grade status) and a slope latent variable (rate of change over three-years). Overall, the model presented a close fit to the data [$\chi^2(23) = 35.756$, $p = 0.058$, CFI= 0.997, TLI= 0.996 and RMSEA= 0.027 (90% CI=0.000 to 0.045), SRMR=0.020]. The variance estimates of initial status (1.195) and rate of change (0.311) were both statistically significant ($p < .001$). Model results demonstrate a linear decline from sixth- to eighth-grade; however, the parameter estimate for rate of change (-0.031) was not statistically significant ($p > .001$). Rate of decline on the latent factor was significantly related to initial status ($r = -0.380$); thus, participants with a higher initial status on the latent factor declined at a slower rate than participants with a lower initial status.

Multiple Indicators, Multiple Causes (MIMC) Modeling

In the second stage of LGM, all covariates were added to the initial LGM model by regressing the intercept and slope latent factors onto each of the covariate variables. The addition of gender, race/ethnicity and SES as covariates yielded a close fit to the model [$\chi^2(45) = 65.762$, $p = 0.023$, CFI= 0.995, TLI= 0.993 and RMSEA= 0.026 (90%

CI=0.010 to 0.040), SRMR=0.021]. Rate of change was still significantly related to initial status ($r = -0.393$). Figure 4.1 illustrates the specified MIMC model, including standardized regression estimates for each covariate on the slope and the sixth-, seventh- and eighth-grade intercept.

Gender

The regression path of gender to the initial status of the latent factor was significant ($z = 4.706, p < .001$). Given how the gender covariate was coded (0 = males, 1 = females) and the positive sign of the parameter estimate (0.473), males had a significantly lower initial status in sixth-grade on the latent factor; more specifically, females were .473 standardized scores higher than males. This result was consistent in seventh-grade ($z = 4.551, p < .001$) and eighth-grade ($z = 4.851, p < .001$); specifically, females were .573 standardized scores higher than males in seventh-grade and .458 standardized scores higher in eighth-grade. The regression path of gender to the rate of change was not significant ($z = 0.328, p > .001$); thus, there was no difference on rate of decline in the latent factor between males and females.

Race/Ethnicity

The regression path of race/ethnicity to the initial status of the latent factor was not significant ($z = -1.672, p > .001$). The race/ethnicity covariate was coded 0 = racial/ethnic minority youth and 1 = white youth; therefore, the negative sign of the parameter estimate (-0.283) indicated that white youth have a lower status on the latent factor in sixth-grade. Although not significant, the latent factor mean for racial/ethnic minority youth was .283 standardized scores higher than the mean for white youth. Similarly, there was no significant difference in seventh-grade ($z = -1.477, p > .001$). In eighth-grade there was also no significant mean difference ($z = 1.045, p > .001$); however, the latent factor mean for white youth became higher than the racial/ethnic minority youth by .166 standardized units. The regression path of ethnicity to the rate of change was significant ($z = 2.177, p > .001$); thus, racial/ethnic minority youth declined in the latent factor at a significantly faster rate compared to white youth. More specifically, on average racial/ethnic minority youth decreased .139 standardized units more each year compared to white youth.

Socioeconomic Status (SES)

Similar to gender, the regression path of SES to the initial status of the latent factor was significant ($z = 4.581, p < .001$). The ethnicity covariate was coded 0 = lower SES youth, 1 = higher SES youth and the parameter estimate was positive (0.516); thus, lower SES youth has significantly lower initial status on the latent factor. Specifically, the latent factor mean for higher SES youth was .516 standardized scores higher than the mean for lower SES youth. This result was consistent in seventh-grade ($z = 4.204, p < .001$) and eighth-grade ($z = 4.482, p < .001$); specifically, higher SES youth were .600 standardized scores higher than lower SES youth in seventh-grade and .474 standardized scores higher in eighth-grade. The regression path of SES to the rate of change of the latent factor was not significant ($z = 0.123, p > .001$); thus, there was no difference on rate of decline between lower and higher SES youth.

Discussion

This study examined the change in youth proxy efficacy to influence their parents to make FV available across early adolescence (sixth-, seventh- and eighth-grade). Furthermore, the effects of youth demographic variables (gender, ethnicity, SES) on proxy efficacy were examined over time. Several conclusions can be drawn from the results of this study that are comparable to past research.

First, the decrease in proxy efficacy with age is not due to changes in the validity of the measure with development. The proxy efficacy scale demonstrated consistent measurement across three-years of early adolescence. More specifically, both the structure of the proxy efficacy latent factor and the relationships of each individual item to the latent factor were equal and consistent over sixth-, seventh- and eighth-grade. Furthermore, the items location parameters were found equal at each assessment period. Overall, the confirmation of measurement invariance provides evidence that differences found in proxy efficacy over time can be attributed to true change in the construct rather than change in the validity of the measure.

Second, although not significant, there was a negative linear trend in youth proxy efficacy to influence their parents to make FV available. This finding supports our hypothesis and corresponds to research reporting a linear decline in youth FVC during

this same period of development.^{4, 8} As children develop into adolescence they seek more independence and autonomy, which leads to distancing in adolescent-parent relationships.¹⁷ Although adolescents' strive for independence fosters healthy maturity, disconnect from parents can lead to declines in communication regarding health behaviors. Thus, the gradual linear decline in proxy efficacy from parents as youth enter adolescence may be a component of the overall decline in adolescent-parent communication.

Third, there appears to be social disparities in proxy efficacy to influence parents. First, male youth expressed significantly lower proxy efficacy compared to females at sixth-, seventh- and eighth-grade, which supports our expectation and parallels reports of lower levels of FVC among males.⁴⁻⁵ Thus, there is a significant gap in communication between male adolescents and their parents regarding FV availability compared to females, which supports similar research. Specifically, Bere, Brug and Klepp¹⁵ found that adolescent girls' perceived significantly higher amounts of FV availability compared to adolescent boys; however, when parents of these same youth were asked to report FV availability, no gender differences were found. This result is comparable to the current research in that adolescent-parent communication regarding FV availability seems to have a more negative effect on adolescent boys. Additional research examining this gender difference is warranted; however, interventions should focus on improving communications regarding FV availability among all developing adolescents and their parents.

Furthermore, lower SES youth demonstrated significantly lower proxy efficacy compared to higher SES youth at each assessment point, which corresponds to both FVC research⁴⁻⁶ and a similar investigation among elementary-aged children.²³ The rate of decline in proxy efficacy was not different between SES groups, which indicates that there is no developmental impact contributing to the differences found. Thus, in this study, the difference in proxy efficacy between lower and higher SES youth may be attributed to characteristics associated with youth household SES. In a comparable study, Lien, Jacobs and Klepp⁵ examined the impact of gender and SES on several youth level variables, finding that lower SES girls reported significantly less positive relations with their parents. In general, there is some evidence that SES has the potential to impact

family relations and adolescent-parent communications regarding FVC, which may partially explain the lower levels of FVC among lower SES youth.⁴⁻⁶

Finally, youth proxy efficacy to influence their parents to make FV available was not significantly different between races/ethnicities at the sixth-, seventh- or eighth-grade assessment year. This finding was not consistent with our hypothesis and similar research on younger children,²³ but may relate to research reporting similarity in FVC between ethnicities.^{4,7} Interestingly, the racial/ethnic minority youth did decline in proxy efficacy at a significantly faster rate from sixth- to eighth-grade compared to white youth, resulting in a switch from higher scores in sixth-grade to lower scores in eighth-grade. Thus, there is a developmental impact on the proxy efficacy of racial/ethnic minority youth compared to white youth, causing a more rapid decline in their confidence to attain FV from their parent. Previous research has documented disproportionately higher rates of broken family structure (e.g., single-parent homes) among racial/ethnic minority groups,⁴¹ which may be contributing to the accelerated rate of decline in proxy efficacy found in the current study.

There are specific strengths and limitations of the current study that should be noted. A major strength is the use of LGM analyses, providing information on status and decline of the proxy efficacy latent factor over time. A limitation of analyses completed with ordinary least squares (e.g., correlation analyses, multiple regression analyses) is the assumption that variables have been measured without error,^{34, 40} however, the current analysis accounted for measurement error, which confirms that differences reflect true change in proxy efficacy. Although the sample size was large, the youth were predominantly white preventing tests between different racial/ethnic minority groups (e.g., Blacks, Hispanics). In a recent focus group study, differences between different racial/ethnic minority populations regarding the barriers and facilitators of FVC were illuminated;⁴² thus, additional research is needed among a more diverse population.

Implications for Research and Practice

Collectively, this study provides novel information regarding youth proxy efficacy for parents to make FV available and this finding may be useful in future intervention development. The influence of FV availability on youth consumption is

supported in numerous research studies,⁹⁻¹⁴ and we believe the increase in youth's confidence to influence their parent to make FV more available may facilitate positive changes in actual availability and consumption. In consideration of this expectation, the linear decline of proxy efficacy in the current study and consistent other reports of a decline in FVC as youth age^{4, 8} suggests that proxy efficacy from parents for FV availability may be an important construct to consider when developing intervention strategies. Furthermore, interventions targeting youth proxy efficacy need to overemphasize this skill development among male and lower SES youth. For example, parents of male and lower SES youth should be informed of their child's disadvantage and given strategies to improve positive communications regarding FVC. Finally, racial/ethnic minority youth demonstrated accelerated declines in proxy efficacy over early adolescence, suggesting developmental differences between ethnicities on this construct. The developmental factors that are advancing racial/minority youth's decline warrant further investigations; however, interventions emphasizing proxy efficacy from parents should consider the youth's family structure.

Acknowledgements

This study was supported by RO1 HD37367 co-funded by the National Institute of Child Health and Human Development, the National Institute of Nursing Research, the Office of Disease Prevention, National Institute of Allergy and Infectious Diseases, and the Office of Dietary Supplements (NICHD, NINR, ODP, NIAID, ODS).

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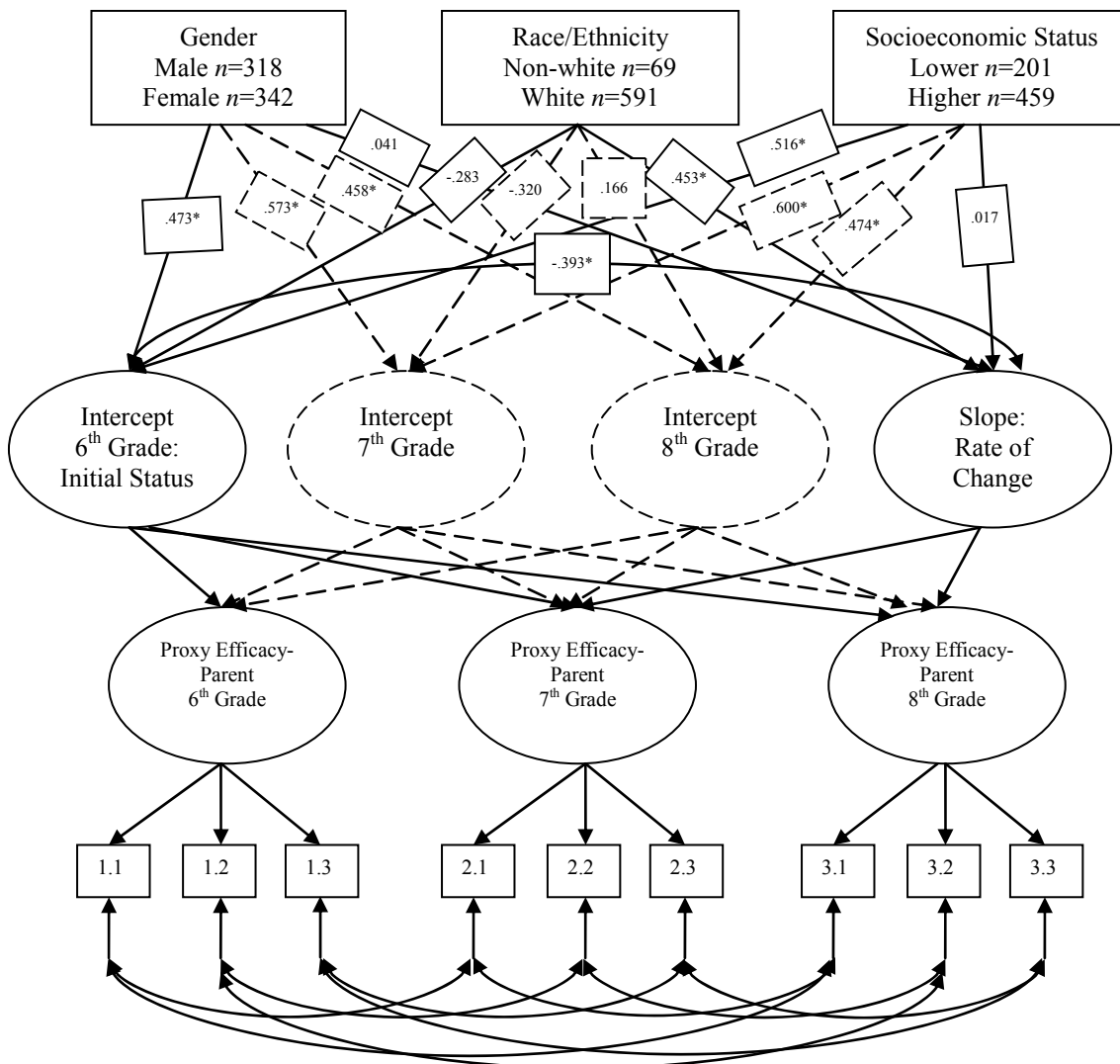
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Figures and Tables

Figure 4-1 Specified Latent Growth Model for Proxy Efficacy from Parent for Fruit and Vegetable Availability



Note: Path from group membership covariates are presented in completely standardized units. Regressions on the seventh- and eighth-grade intercepts, specified with dashed lines, were performed in separate analyses.

Table 4-1 Longitudinal Invariance of a Measurement Model of Proxy Efficacy from Parent for Fruit and Vegetable

Availability (N=660)

| | χ^2 | <i>df</i> | <i>p</i> Value | χ^2_{diff} | Δdf | RMSEA (90% CI) | CFit | SRMR | CFI | TLI |
|--|----------|-----------|----------------|-----------------|-------------|---------------------|-------|-------|-------|-------|
| Model One: Equal Form | 12.257 | 15 | 0.660 | | | 0.000 (0.00-0.030) | 0.999 | 0.012 | 1.000 | 1.000 |
| Model Two: Equal Factor Loadings | 15.114 | 19 | 0.715 | 2.857 | 4 | 0.000 (0.00-0.026) | 1.000 | 0.017 | 1.000 | 1.000 |
| Model Three: Equal Indicator Intercepts | 36.514 | 25 | 0.064 | 24.257 | 10 | 0.026 (0.00-0.044) | 0.989 | 0.021 | 0.997 | 0.996 |
| Model Four: Equal Indicator Error Variances | 155.478 | 30 | 0.000 | 143.221* | 15 | 0.080 (0.067-0.092) | 0.000 | 0.053 | 0.968 | 0.962 |

Note: (1) χ^2 , Chi-Square; *df*, degrees of freedom, χ^2_{diff} , nested χ^2 difference; RMSEA, root mean square error of approximation; 90% CI, confidence interval for RMSEA; CFit, test of close fit (probability RMSEA \leq .05); SRMR, standardized root mean square residual; CFI, comparative fit index; TLI, Tucker-Lewis Index. (2) **p* < .001, significantly degrades the model.

Dissertation Conclusions

The current dissertation investigated the influences on youth reported fruit and vegetable consumption (FVC) and focused specifically on youth self-efficacy for FVC and proxy efficacy for fruit and vegetable (FV) availability. Chapter One reviewed both cross sectional and longitudinal FVC research. Chapters Two and Three progressively validated a measurement model for self-efficacy and proxy efficacy, and analyzed possible differences among children due to school demographic variables and youth demographic variables. Lastly, Chapter Four focused on proxy efficacy to influence parents to provide FV in a sample of young adolescents over the middle school years, and also examined discrepancies between different youth demographic variables. Overall, self-efficacy is a multidimensional construct that is measurable among youth and generalizable across gender, ethnicity and household socioeconomic status (SES). Furthermore, self-efficacy for FVC and proxy efficacy for FV availability varied by school level and individual level demographic variables.

Chapter One reviewed FVC research and discussed the possible shifts in personal and environmental influences on children's FVC as they age. From both cross sectional and longitudinal research, FV preference was found to be the primary personal influence on children's and adolescents' FVC. Also, according to both types of research designs, FV availability was the primary environmental influence on children's and adolescents' FVC. Although research on adolescents is limited, some developmentally sensitive conclusions were identified. First, introduction to FV needs to begin as soon as young children begin eating solid foods and continue over their lifespan. As young children develop into older childhood, they need to be taught knowledge about FV benefits and FV recommendations, as well as introduced to a wide variety of available FV. As children develop into adolescents, preferences for FV and FV availability remain influential; however, as adolescents' strive for autonomy they should be taught specific FV preparation skills and, in addition to parent modeling, be exposed to positive peer models of FVC.

Chapter Two sought to identify the underlying dimensions of self-efficacy for FVC and to determine if these dimensions could be measured with reliability and validity

among elementary-aged children. Four independent but related constructs were identified, which supports the global hypothesis that self-efficacy is a multidimensional construct within the FV context. Specifically, two subscales measured children's self-efficacy for FVC. The first measured children's self-efficacy for fruit consumption the other measured children's self-efficacy for vegetable consumption, which corresponds to previous research also reporting these as independent behaviors.¹⁻³ In addition, two separate proxy efficacy constructs were identified. The first scale captured children's proxy efficacy to influence parents to make FV available and the other concerned their confidence to influence after-school staff. Thus, children's proxy efficacy for FV availability varies according to the authority figure controlling their environment.

Also in Chapter Two, group differences were found based on school level characteristics, which provided further validity for the measure and important information for future research. Specifically, those children perceiving FV opportunities in after-school had higher self-efficacy for consuming fruit, higher self-efficacy for consuming vegetables and higher proxy efficacy for influencing after-school staff to make FV available compared to children who did not perceive these opportunities. Also, those children attending schools with lower concentrations of racial/ethnic diversity and higher concentrations of higher SES were significantly more confident they could influence their parents to make FV available compared to children attending schools with higher concentrations of racial/ethnic diversity and higher concentrations of lower SES. Overall, these differences support the criterion validity of the measure and depict social inequalities at the school level that may have negative impacts on children's confidence to consume FV and confidence to influence authority figures to make FV available.

The primary aim of Chapter Three was to confirm the self-efficacy and proxy efficacy scales reported in Chapter Two and further examine differences based on youth level demographic variables. A four construct model was tested using confirmatory analysis (CFA) and demonstrated excellent fit; thus, the four-factor model of self-efficacy reported in Chapter Two was confirmed. Additionally, Chapter Three tested these constructs for invariance and heterogeneity across different gender, ethnicity and household SES groups. Results demonstrated complete invariance across all demographic groups, providing support for the generalizability of the four factor model and subscales.

Although measurement invariance insured that any discrepancies found between groups can be attributed to true differences, results revealed no meaningful differences between youth demographic groups.

Chapter Four focused on early adolescents' proxy efficacy to influence their parents to make FV available and examined possible changes in this construct over three-years and across different demographic groups. Overall, the proxy efficacy model demonstrated excellent fit and invariance over time; thus, changes in youth proxy efficacy over sixth-, seventh- and eighth-grades can be attributed to true changes in the construct. Furthermore, a gradual linear decrease in youth proxy efficacy as they age into adolescence was found, paralleling the linear decrease in youth FVC reported over this same developmental period.⁴⁻⁵

Although analyses of cross sectional data collected on elementary school students presented in Chapter 3 showed no demographic differences, analyses of longitudinally data among middle school youth in Chapter Four found group differences. Specifically, male and lower SES youth expressed significantly lower proxy efficacy compared to their female and higher SES counterparts at each assessment year. This finding mirrors reports of lower levels of FVC among males⁵⁻⁷ and lower SES.^{5, 7-10} Secondly, the rate of decline in proxy efficacy was significantly greater for racial/ethnic minority youth compared to white youth. In other words, racial/ethnic minority youth proxy efficacy to request FV from their parents is more negatively impacted as they age into adolescence.

Two common themes throughout this dissertation have been the establishment of reliable and valid scales for self-efficacy for FVC and proxy efficacy for FV availability and the examination of these constructs based on both school demographic variables and youth demographic variables. Self-efficacy was supported as a multidimensional construct within the FV context and the scales demonstrated measurement consistency across demographic groups. Research can now utilize these measurement instruments in studies examining the potential impact of self-efficacy and proxy efficacy on some additional variable(s) across different demographic groups of elementary-aged children. Furthermore, differences were found in these constructs according to school demographic variables, which highlight further concerns for youth attending schools with higher concentrations of racial/ethnic diversity and higher concentrations of lower SES.

From a developmental perspective, novel information was reported on youth proxy efficacy as they develop into early adolescence. A gradual linear decline in proxy efficacy to influence parents to make FV available was found, suggesting that this may be an important construct to consider when developing FVC intervention strategies. Additionally, male and lower SES youth were at an increased risk for low proxy efficacy, and racial/ethnic minority youth's accelerated decline in proxy efficacy suggests developmental differences between ethnicities.

There is a continued need for FVC research among adolescents and children, especially research examining developmental and demographic differences. Self-efficacy, an influence on FVC that has been the focus of this dissertation, has the potential to positively impact FVC and warrants further investigations. Future research needs to continue examining possible moderating and mediating variables that alter the impact of self-efficacy on youth FVC, which is suggestive to interventions aimed at increasing FVC. Specifically, interventions targeting self-efficacy and proxy efficacy skills can investigate if altering these constructs causes increases in youth FVC and examine whether these constructs mediate effectiveness of the intervention. Lastly, interventions may be most successful when tailored to improving the principle influences on consumption; thus, more understanding of how and why discrepancies occur between different ages and groups of children on these constructs is essential.

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Appendix A - Healthy Opportunity for Physical Activity and Nutrition (HOP’N) Informed Consent

(Date)

Dear Parent/Guardian:

Our elementary school has agreed to participate with other Lawrence area elementary schools in the Healthy Opportunities for Physical Activity and Nutrition (HOP’N) After School Project. This project is directed by K-State Community Health at Kansas State University and K-State Research and Extension-Douglas County, and is funded by a grant from the United States Department of Agriculture. This project aims to promote healthy eating and physical activity in elementary students.

I believe that this project will enhance your child’s experience with our after school program while helping to provide valuable information on helping our children live healthier and happier lives. Please help us make this project a success by completing the attached permission slip immediately. You may have your son or daughter return it as soon as possible, no later than (Date). My goal is to have as many eligible students in the after school program take part in the project as possible. Feel free to contact me if you have any questions or concerns.

Thank you for your consideration.

Sincerely,

After School Program Manager

PARENTAL PERMISSION SLIP

HEALTHY OPPORTUNITIES FOR PHYSICAL ACTIVITY AND NUTRITION (HOP'N) AFTER SCHOOL PROJECT

Project Information. The HOP'N After School Project is a multi-site study designed to promote healthy eating and physical activity in children. The project is directed by Community Health Institute at Kansas State University and K-State Research and Extension-Douglas County, and is funded by a grant from the United States Department of Agriculture. Results from this project will be used to improve the health of youth by creating environments that provide options for and encourage healthy eating and physical activity in students.

What is involved? At the beginning of the program (Fall) and at the end of the program (Spring), children will complete a survey and be measured on height and weight in a private setting by trained research assistants. The survey should take about 20 to 30 minutes. Parents will also be asked to complete a survey. The surveys ask about physical activity and dietary habits, and attitudes towards physical activity and nutrition. In addition, about once a month, a research assistant will observe the after school program. At this time, students will be asked to wear an accelerometer during after school program time. An accelerometer is a small device that measures physical activity and is worn on the hip like a beeper or pedometer. School records will be used to link height and weight with demographic information (age, sex, ethnicity, free and reduced lunch status).

Information is confidential. Student names and parent names will be replaced with ID numbers. No one will be allowed to connect student names with their height and weight or answers on the surveys.

Potential benefits and concerns. As stated above, your son or daughter's answers to the survey will be kept completely confidential. The benefit of being in this project is an opportunity for your son or daughter to become more informed about being healthy, eating good foods, being active, and creating opportunities for healthy eating and physical activity.

Participation is voluntary. Your son or daughter's participation in this study is completely voluntary. There will be no penalty if you do not wish for your son or

daughter to participate in either the project or the evaluation survey. They may withdraw at any time during the study and refuse to answer any of the questions.

Questions/comments? This project was approved by your son or daughter's school, after-school program and the Institutional Review Board at Kansas State University (Dr. Rick Scheidt, Chair, 785-532-3224); they can answer any questions you may have about the rights of participants in research. If you have any other questions about the project, please feel free to call Dr. David Dzewaltowski (785) 532-7750 or K-State Research and Extension-Douglas County (Susan Krumm; 785-843-7058). We can arrange for you to see the surveys in advance.

- Please check one box, sign, and return to the program as soon as possible:
- I will allow my child to participate in having their height and weight measured and completing a survey.
- I do not want my child to participate.

Parent Name _____
(Please print) (Date)

Parent Signature _____

Child's Name: _____

Child's Signature: _____

(Date)

Dear Parent/Guardian:

Lawrence Public Schools are participating in the Healthy Opportunities for Physical Activity and Nutrition (HOP’N) After-School Project. This project is directed by the Community Health Institute at Kansas State University and K-State Research and Extension-Douglas County, and is funded by a grant from the United States Department of Agriculture. This project aims to promote healthy eating and physical activity in elementary students.

This project will provide resources to our school and the other schools in the district while providing information on the health of children in our elementary schools. Please help us make this project a success by completing the attached permission slip and having your child return it as soon as possible. Our goal is to have as many students in 4th grade participate in the project as possible. Feel free to contact either of us if you have any questions or concerns. Please return the consent form by (Date).

Thank you for your consideration.

Sincerely,

4th Grade Teacher

Principal

Appendix B - Survey Items: Self-Efficacy for Fruit and Vegetable Consumption and Proxy Efficacy for Fruit and Vegetable Availability

Instructions: Read this information on servings, then answer questions by filling in the circle that goes with your answer

A serving of fruit is equal to:

- 1 medium piece of fresh fruit
- ½ cup of fruit salad
- ¼ cup of raisins, apricots or other dried fruit
- 6 oz. of 100% orange, apple or grape juice
- (Do not count fruit punch, lemonade, Gatorade, Sunny Delight or fruit drink.)

A serving of vegetables is equal to:

- 1 medium carrot or other fresh vegetable
- 1 small bowl of green salad
- ½ cup of fresh or cooked vegetables
- ¾ cup of vegetable soup
- (Do not count French fries, onion rings, potato chips or fried okra.)

| How sure are you that you can eat... | Not at all sure | Somewhat sure | Very Sure |
|---|-----------------------|-----------------------|-----------------------|
| <u>One</u> serving (1/2 cup) of fruit each day? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <u>Two</u> servings (1 cup) of fruit each day? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <u>Three</u> serving (1 1/2 cup) of fruit each day? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <u>One</u> serving (1/2 cup) of vegetables each day? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <u>Two</u> servings (1 cup) of vegetables each day? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <u>Three</u> serving (1 1/2 cup) of vegetables each day? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Instructions: Please mark how sure you are that you can do these things.

| How sure are you that you can get your parents to: | Not at all sure | Somewhat sure | Very Sure |
|---|----------------------------|--------------------------|-----------------------|
| • buy fruit for snacks? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| • fix your favorite vegetable dishes for dinner? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| • keep 100% fruit juice in the refrigerator? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| • fix a fruit and vegetable snack? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Instructions: Please mark how sure you are that you can do these things.

| How sure are you that you can get the teachers or staff members of the after-school program to: | Not at all sure | Somewhat sure | Very Sure |
|--|----------------------------|--------------------------|-----------------------|
| • offer dried fruit snacks (like raisins, banana chips and apricots)? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| • offer applesauce cups or fruit cups (like fruit cocktail)? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| • offer fruit and vegetable snack options? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| • offer 100% real fruit juice? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |