Fall 12-2011

Development of an Instrument Measuring the Perceived Attributes of Using a Healthy Diet Innovation

Holly Ann Federico Huye
University of Southern Mississippi

The University of Southern Mississippi

DEVELOPMENT OF AN INSTRUMENT MEASURING THE PERCEIVED ATTRIBUTES OF USING A HEALTHY DIET INNOVATION

By

Holly Ann Federico Huye

Abstract of a Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

December 2011

ABSTRACT

DEVELOPMENT OF AN INSTRUMENT MEASURING THE PERCEIVED ATTRIBUTES OF USING A HEALTHY DIET INNOVATION

by Holly Ann Federico Huye

December 2011

The Lower Mississippi Delta (LMD) is a rural region that is rich in agricultural resources but is one of the most impoverished areas in the US. Prior research has indicated LMD adults as having higher rates of obesity and diet-related chronic diseases as compared to US adults. While the need for dietary intervention in the LMD is evident, the first step in designing effective interventions is the assessment of one's perceptions of dietary behaviors. The purpose of this research was to develop a valid and reliable instrument to assess individuals' perceived attributes of using a healthy diet. Using the Diffusion of Innovations (DOI) theory as a conceptual framework, this descriptive study employed qualitative and quantitative research methods and consisted of three phases. Phase 1 and 2 included qualitative research methods consisting of group panel discussions and card sorts to assist in the initial development of the instrument. Phase 2 included pilot and field testing of the instrument followed by quantitative analyses of the data. Data analyses techniques included content analysis and identification of common themes of group discussions; analysis of face and content validity of the items; and descriptive statistics, item and factor analyses, and reliability estimates of pilot and field test survey data. The DOI attributes *relative advantage, compatibility, complexity, trialability,* and *observability* of a healthy diet were explored in phase 1. As a result, *portability*, *protective*, and *generational* attributes of a healthy diet were identified. All

attribute definitions were established and verified. Sixty nine items were created for the card sorts, which resulted in 37 remaining items. Item evaluation and pilot testing of the instrument resulted in the 39-item field test instrument. Thirty five of the 39 items were subjected to factor analysis, resulting in a four-factor solution with 21 items that accounted for 45% of the shared variance. This instrument can be used to assess individuals' perceptions of a healthy diet. Furthermore, knowing which attributes of a healthy diet that have the greatest influence on adoption and implementation can be valuable when planning nutrition interventions and key educational messages.

The University of Southern Mississippi

DEVELOPMENT OF AN INSTRUMENT MEASURING THE PERCEIVED ATTRIBUTES OF USING A HEALTHY DIET INNOVATION

by

Holly Ann Federico Huye

A Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

Approved:

Elaine F. Molaison
Director

Carol Connell

Laura Downey

Michael Madson

Jamie Zoellner

Susan A. Siltanen
Dean of the Graduate School

December 2011

ACKNOWLEDGMENTS

First and foremost, I would like to give thanks to God, *"...my refuge and fortress, my God, in whom I trust"* (Ps. 91:2). His unfailing love was and is always a comfort, for when in distress *"...I cried out to the Lord…He heard me from His sanctuary, my cry reached His ears"* (1 Samuel 22:7). I give praise and thanksgiving to the One who takes care of me.

I give thanks for my husband Jay, my tower of strength, who has never lost faith in me and is a constant source of encouragement and comfort. I am also grateful for my mom and dad who have always been supportive in my decision to change my career and encouraging of this educational endeavor. Many friends and family are also appreciated, as they have been my personal pep squad, cheering me on throughout this challenge.

I especially would like to thank my committee chair, Dr. Elaine Molaison, who has been a friend, mentor, and inspiration to me during this journey. Her great confidence in me helped me get through many a fretful day. I am also appreciative of the other committee members, Dr. Carol Connell, Dr. Laura Downey, Dr. Jamie Zoellner, and Dr. Michael Madson for their advice and support throughout the duration of this project. Special thanks go to Dr. Kathy Yadrick, chair of the Nutrition and Food Systems (NFS) department, and my colleagues in the department, as I could not have completed this project without their support.

TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGMENTS iv

LIST OF TABLES vii

LIST OF ILLUSTRATIONS viii

LIST OF ABBREVIATIONS ix

CHAPTER

I. INTRODUCTION 1

Research Objectives
Conceptual Framework

II. REVIEW OF RELATED LITERATURE 8

The Lower Mississippi Delta
Diffusion of Innovations Theory
Existing Scales Measuring the Perceived Attributes of an Innovation
Conclusion

III. METHODOLOGY 49

Research Design
Process of Test Construction
Human Subjects Protection Approval
Phase 1: Item Creation
Phase 2: Scale Development
Phase 3: Instrument Testing

IV. MANUSCRIPT I: FORMATIVE RESEARCH METHODS USED IN THE DEVELOPMENT OF A HEALTHY DIET INNOVATION (HDI) INSTRUMENT 69

Background and Significance
Method
Data Analysis
Findings and Interpretation
Discussion
Conclusion

V. MANUSCRIPT II: PSYCHOMETRIC EVALUATION OF A HEALTHY DIET INNOVATION (HDI) SCALE MEASURING THE PERCEIVED ATTRIBUTES OF A HEALTHY DIET 99

Phases 1 and 2 Background
Phase 3 Pilot and Field Testing of the HDI Scale
Results
Discussion of Psychometric Evaluation
Discussion of Factors
Conclusion

VI. CONCLUSION.....129

Summary of Findings
Strengths and Limitations
Implications and Application
Recommendations for Future Research

APPENDIXES 137

REFERENCES 159

LIST OF TABLES

Table

1. Identified and Defined Attributes of a Healthy Diet Based on the 2005 Dietary Guidelines for Americans 82

2. Attribute and Related Participant Responses 83

3. Percent Placement Agreement of Items in Open and Closed Sorts 87

4. Identified and Defined Attributes of a Healthy Diet Based on the 2005 Dietary Guidelines for Americans 102

5. Items Written and Retained per Attribute by Phase 106

6. Demographic Profile of Pilot Participants 107

7. Demographic Profile of Field Test Participants 109

8. Chronbach's Alpha of Grouped Items by Attribute 114

9. Factor Loadings for Exploratory Factor Analysis with Oblimin Rotation 116

10. Factor Correlations and Factor Alpha Coefficients 119

LIST OF ILLUSTRATIONS

Figure

1. S-shaped Curve: Rate of Adoption by Adopter Categories 28

2. Card Sorting Instructions Example.....77

3. Open Sort: Summary of Participants Category Labels.....79

4. Open Sort: Summary of Standardized Category Labels.....80

5. Selected Frequencies of Item Placement in Closed Sort Using Spreadsheet Template 104

LIST OF ABBREVIATIONS

ARS: Agricultural Research Service

CFSII: Continuing Survey of Food Intakes by Individuals

CATCH: Child and Adolescent Trial for Cardiovascular Health

CBPR: Community-based Participatory Research

CHARP: Community Health Advisors and Research Partner

CPPE: Comprehensive Participatory Planning and Evaluation

DASH: Dietary Approaches to Stop Hypertension

DOI: Diffusion of Innovations

DRI: Dietary Reference Intakes

EFA: Exploratory Factor Analysis

FOODS: Foods Of Our Delta Survey

HDI: Healthy Diet Innovation

HEI: Healthy Eating Index

KMO: Kaiser-Meyer-Olkin

LMD: Lower Mississippi Delta

MCHL: Mississippi Communities for Healthy Living

NHANES: National Health and Nutrition Examination Survey

NIRI: Nutrition Intervention and Research Initiative

OPRU: Obesity Prevention Research Unit

PAF: Principal Axis Factoring

RD: Registered Dietitian

SOC: Stages of Change

SOFAS: Solid Fats and Added Sugars

SPSS: Statistical Package for the Social Sciences

TTM: Transtheoretical Model

USDA: US Department of Agriculture

USM: University of Southern Mississippi

CHAPTER I

INTRODUCTION

The Lower Mississippi Delta (LMD) is a rural region that is rich in agricultural resources but is one of the most impoverished areas in the U.S. (Delta State University [DSU], 2011). The LMD includes counties in Arkansas, Louisiana, and Mississippi, is predominantly African American, and is characterized by high levels of poverty and low levels of educational attainment, both of which are predictors of poor health **(**Feinstein, 1993; National Institutes of Health [NIH], 1998). The Delta Nutrition Intervention Research Initiative [NIRI] Consortium (2004) reported LMD adults as having higher rates of obesity and diet-related chronic diseases as compared to U.S. adults. Specifically, self-reported health conditions such as diabetes, high cholesterol and hypertension in the LMD indicated a higher prevalence of these conditions compared to national data. Of these states, Mississippi ranked highest in the nation for prevalence of overweight and obesity at 34.3% and 34.5% respectively in 2010 (Centers for Disease Control and Prevention [CDC], Behavioral Risk Factor Surveillance System [BRFFSS], 2010). Poor dietary quality may be a contributing factor to the chronic health conditions among this population. Prior research has indicated a need for improving the overall dietary quality in the LMD (McCabe-Sellers et al., 2007; Thomson et al., 2011). However, there is a lack of theory-driven, rigorously evaluated research on the implementation of effective nutrition interventions in the LMD. With limited research reported and poor health conditions among the LMD population, opportunities for nutrition intervention exist.

In 1994, the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA) was directed by Congress to study the impact of nutrition

interventions on the health of the LMD, and thus the Lower Mississippi Delta Nutrition Intervention and Research Initiative (Delta NIRI) was established (Champagne, Bogle, McGee, Yadrick, Allen, Kramer, et al., 2004). Under this initiative, the Foods Of Our Delta Survey 2000 (FOODS 2000) was the first study that evaluated food and nutrient intakes of LMD residents and compared it to national data (i.e., Continuing Survey of Food Intakes by Individuals [CFSII] 1994-1996, 1998) and the Dietary Reference Intakes (DRIs) to assess nutrient adequacy, establishing baseline data for this population and future research (Champagne, Bogle, McGee, Yadrick, Allen, Kramer, et al., 2004). With this baseline data, further dietary intake and quality in the LMD region that was assessed indicated dietary patterns in the LMD differed from the greater U.S. population and may be contributing to the prevalence of obesity and chronic diseases in this region (McCabe-Sellers, Bowman, Stuff, Champagne, Simpson, & Bogle, 2007; Thomson et al., 2011). Also different in the LMD population compared to the U.S. population were the types of foods consumed. Tucker and colleagues (2005) found at least 24 regional foods that contributed to a high percent to energy intake and were uncommon in U.S. diets. Recognition of food sources and preparation methods contributing to poor diets, and consequently, the associated morbidities, can inform the design of culturally appropriate nutrition interventions to improve adherence to the 2005 Dietary Guideline for Americans (DGAs) and to further prevent obesity and chronic disease.

Dietary quality and nutritional implications in the LMD indicate a need for culturally appropriate interventions in these communities. While the literature supports health education and health promotion programs at the individual level, recent participatory research informs the need to focus on community-level change when

addressing health issues (McKinlay & Marceau, 2000b; Orleans, Gruman, Ulmer, Emont, & Hollendonner, 1999; Smedley & Syme, 2000). A central theme in participatory research is engaging community members to actively participate in defining their health issues and needs and setting priorities for their community (Israel et al., 1998). In the planning phase of nutrition intervention research, barriers and facilitators to dietary change must be explored so that effective interventions can be designed with positive behavioral outcomes. Qualitative findings in the LMD indicated a need for nutrition and health interventions to focus on increasing self-efficacy related to nutrition knowledge and cooking methods using culturally appropriate foods; increasing awareness of the relationship between diet and health, specifically risks associated with obesity; and utilizing the social interaction at the community and family levels as a means for emphasizing social support. Additionally, program designers should consider the socioeconomic status of the target population as well as food access and availability.

The Delta Obesity Prevention Research Unit (Delta OPRU) was formed by the ARS of the USDA in response to the prevalence of obesity and poor dietary quality in the LMD. The mission of Delta OPRU is to "enable rural Lower Mississippi Delta individuals and families to adopt food and physical activity guidelines for sustaining healthy weights, preventing obesity, and reducing risk factors for obesity related chronic diseases" (U.S. Department of Agriculture [USDA], Agricultural Research Service [ARS], 2010). Long-term goals of the Delta OPRU include promotion of the adaptation of the dietary patterns of the LMD to the 2005 DGAs and evaluate the effectiveness of the adaptations in the maintenance of healthy weight and prevention of obesity. Seven institutions collaborate under this cooperative agreement initiating research projects

throughout the LMD to achieve this goal. The University of Southern Mississippi (USM) is one such collaborator. The focus of USM's research project, *Effectiveness of Mississippi Delta Women's Social Club Members Adopting Dietary Guidelines Eating Patterns Adapted from FOODS 2000*, was to identify food substitutions that, if consumed, would positively influence Healthy Eating Index-2005 (HEI-2005) scores among adult women in the Delta. Upon identifying these food substitutions, the research team developed a nutrition education intervention promoting the food substitutions that included emphasis on the advantages of making such dietary changes, as well as, self-efficacy and social support components. The nutrition education program was named Mississippi Communities for Healthy Living (MCHL) and a feasibility test was conducted in the spring of 2011.

Women were chosen as the primary target of this intervention, as findings from focus groups in the LMD found that women act as gatekeepers of nutrition for their families and the greater community (Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999; McIntosh & Zey, 1998). Additionally, women participating in social and civic clubs typically have higher educational attainment and social status and are considered opinion leaders in their circles. These characteristics are indicative of early adopters of new ideas and practices, and because early adopters are considered as a trusted resource in their communities, they will have a greater influence on those who are slower to adopt new ideas and practices (Rogers, 2003). Utilizing early adopters within these social and civic organizations is an attempt to diffuse the DGAs to their families and communities to promote healthy eating patterns. Therefore, the diffusion of

innovations (DOI) theory was chosen as a conceptual framework to design the intervention.

There are several reasons for conducting the present research project. First, obesity has become a national public health concern with Mississippi leading the nation with the highest prevalence of obesity in adults. Second, overall dietary quality in the LMD is in need of improvement or rated as *poor* according to HEI-2005 scores, which may be contributing to chronic health conditions among this population. And lastly, little research is available related to nutrition intervention in the LMD, signifying a need for intervention and even more so for assessment. Assessment of one's perceptions of adopting and implementing dietary behaviors is an essential step in crafting effective interventions and promoting diffusion in the greater community. Therefore, a culturally appropriate instrument based on the DOI theory constructs is necessary to measure the perceived characteristics of the adoption and implementation of the DGAs in the LMD to be used as part of the assessment of the research project *Effectiveness of Mississippi Delta Women's Social Club Members Adopting Dietary Guidelines Eating Patterns Adapted from FOODS 2000.*

Research Objectives

1. To develop an instrument that demonstrates adequate validity.
2. To develop an instrument that demonstrates adequate reliability.
3. To develop an instrument that demonstrates predictive validity.

Conceptual Framework

Diffusion of Innovations Theory

Everett Rogers first summarized the research on diffusion in 1962 with the first edition of *Diffusion of Innovations* in which he conceptualized the diffusion process. *Diffusion* is defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system", where "innovation" is considered as a new idea, practice or object (Rogers, 2003, p. 5). The process involves two or more individuals exchanging information to move toward or apart from a common point of acceptance. In the diffusion of new ideas, this process could repeat over several cycles as one individual seeks further information. Rogers identifies diffusion as a social change. Such change in structure or function of a social system occurs as a result of a new idea that was diffused, adopted or rejected and leads to certain consequences.

Diffusion research has included many components of the theory, including how the perceived attributes of an innovation can influence its adoption. Although an innovation can have many attributes, there are five in particular that contribute most to the rate of adoption according to Rogers (1995): *relative advantage, compatibility, complexity, trialability, and observability*. In a review of the literature, Rogers notes that these five attributes explain about 49 to 87% of the variance in the rate of adoption of an innovation. Although different elements of the DOI theory have been used to plan, implement and evaluate many health- and nutrition-related interventions and programs, little research related to the program innovation characteristics and their perceived influence on the rate of adoption has been published in the public health and nutrition disciplines. The USM research project includes intervention components based on these

key attributes. In other words, the innovation is the DGAs – or a healthy diet based on the DGAs, and the education sessions are designed to position the innovation focusing on the key attributes within the format of the education sessions. For example, trialability is promoted through interactive food demonstrations and tastings. Additionally, the intervention includes other diffusion elements that enhance adoption such as the utilization of various communication channels as vehicles for social support.

While the DOI theory may be helpful in understanding health and nutrition behaviors, at the time of this study, there were no instruments found in the nutrition or public health literature that measured the perceived attributes of a dietary innovation to assess nutrition interventions. Therefore, the purpose of this research was to develop an instrument to assess the perceived attributes of using a healthy diet based on the 2005 DGAs by individuals participating in a nutrition education program.

CHAPTER II

REVIEW OF RELATED LITERATURE

Obesity continues to be a public health dilemma in the United States. Obesity prevalence over the last 10 years in the U.S. has escalated, exceeding 30%; however, rates for women have begun to stabilize. Recent data analysis from the 2007-2008 National Health and Nutrition Examination Survey (NHANES) showed an overall prevalence of obesity of 33.8% among U.S. adults (Flegal, Carroll, Ogden, & Curtin, 2010). For adult men obesity prevalence was 32.2%, showing a significant linear trend over the last 10 years, but no significant differences between the last three survey cycles 2003-2004, 2005-2006, and 2007-2008). For adult women, prevalence of obesity was 35.5%, showing no significant differences since the 1999-2000 NHANES. However, analyses over the last 10 years of survey cycles indicated a significantly higher possibility of being obese in both the older age groups men and women (40-59 years and 60 years or older) as compared to younger adults in the age group 20-39 years. Additionally, the likelihood of being obese was significantly higher in non-Hispanic black adults and for Mexican American women compared to non-Hispanic white adults.

Obesity is a risk factor for many chronic diseases including diabetes, high cholesterol, hypertension, heart disease, stroke, and certain cancers (Malnick & Knobler, 2006). Of these conditions, the risk of developing diabetes may be most closely associated with obesity as the incidence of diabetes significantly increased in the US, between 1988 and 2006 (McKinlay & Marceau, 2000a.) However, diabetes prevalence increased significantly only among non-Hispanic blacks (Cowie, et al., 2009). Parallel to the rising prevalence of obesity prevalence and associated morbidities are the rising costs

of healthcare. Projection models show an increase of obesity prevalence among U.S. adults of 51% by the year 2030, with black women (projected obesity prevalence 76%) and Mexican-American men (projected obesity prevalence 45%) being most affected (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). Based on these projections, Wang et al. estimated total healthcare costs related to obesity and overweight could escalate to a range of $860 to $965 billion, accounting for 15.8-17.6% of total health care expenditures as compared to $78.5 billion in 1998 in a report by Finkelstein, Trogdon, Cohen, and Dietz (2009). The researchers noted that this may be a gross underestimation due to onset of obesity and complications occurring more frequently in younger adults and rising costs in health care services.

The Lower Mississippi Delta

The Lower Mississippi Delta (LMD) is a rural region that is rich in agricultural resources but is one of the most impoverished areas in the U.S. (Delta State University [DSU], 2011). The LMD includes counties in Arkansas, Louisiana, and Mississippi, is predominantly African American, and is characterized by high levels of poverty and low levels of educational attainment, both of which are predictors of poor health (National Institutes of Health [NIH], 1998; Feinstein, 1993). The Delta Nutrition Intervention Research Initiative [NIRI] Consortium (2004) reported LMD adults as having higher rates of obesity and diet-related chronic diseases as compared to U.S. adults. Specifically, self-reported health conditions such as diabetes, high cholesterol and hypertension in the LMD indicated a higher prevalence of these conditions compared to national data. Of these states, Mississippi ranked highest in the nation for prevalence of overweight and obesity at 34.3% and 34.5% respectively in 2010 (CDC, BRFFSS, 2010). Self-reported

prevalence of diabetes in 2010 was 12.4% while self-reports of high cholesterol and hypertension in 2009 was 41.4% and 37.4% respectively.

Dietary Trends in the LMD

The NHANES and the Continuing Survey of Food Intakes by Individuals (CFSII) have provided data that represent the typical diet and health of a national representative sample of Americans. However, regional sub-samples of these surveys are considered to be too small to adequately represent the health status in rural areas across the U.S. (LMD Delta NIRI Consortium, 2004). As the LMD is generally more rural than the U.S. population as a whole and has high rates of poverty, and consequently, chronic diseases, the Agricultural Research Service of the U.S. Department of Agriculture (USDA) was directed by Congress to study the impact of nutrition interventions on the health of the LMD. In 1994, the Lower Mississippi Delta NIRI was established. Since 1994, several studies have assessed dietary intake and quality in the LMD region (Champagne et al., 2004; McCabe-Sellers, Bowman, Stuff, Champagne, Simpson, & Bogle, 2007; Thomson et al., 2011). The Foods Of Our Delta Survey 2000 (FOODS 2000) was the first study that evaluated food and nutrient intakes of LMD residents and compared it to national data (i.e., CSFII 1994-1996, 1998) and the Dietary Reference Intakes (DRIs) to assess nutrient adequacy (Champagne, Bogle, McGee, Yadrick, Allen, Kramer, et al., 2004). The FOODS 2000 study established baseline data to use for future research and intervention in the LMD.

FOODS 2000 was a cross-sectional telephone survey that included dietary intake of 1,751 adults and 485 children representing 36 Delta counties across the three states of Arkansas, Louisiana, and Mississippi using the USDA 24-hour recall multiple pass

method. Survey results indicated that energy intake was consistent with the U.S. population data, but fat intakes were higher while protein, fiber, and micronutrients (vitamins A and E, and calcium) intakes were lower, particularly in LMD low income and African American adults. More specifically, LMD adults consumed 20% less fruits and vegetables than U.S. adults, demonstrating poor adherence to Food Guide Pyramid recommendations, and LMD children had significantly lower intakes of dietary fiber, vitamin A, carotene, riboflavin, vitamin B-6, vitamin C, calcium and iron than their U.S. counterparts. While these data exhibit dietary inadequacy among LMD residents, caution should be taken when interpreting. Results are based on a one-day, self-reported recall of dietary intake that may be underreported and thus, may not adequately reflect typical intakes.

McCabe-Sellers et al. (2007) assessed diet quality of LMD adults using the Health Eating Index (HEI). Data from the FOODS 2000 were used to compare to national data from the NHANES 1999-2000. The HEI is a tool that scores dietary intake based on 10 components of the Dietary Guidelines for Americans (DGAs), including intake of the five food groups (meat, fruit, vegetables, grains, and dairy products), total fat, saturated fat, and cholesterol intake, sodium intake, and dietary variety. Each component is scored from 0 to 10, where 10 means guidelines are fully met and 0 means total lack of adherence to the guidelines. The overall diet quality is then based on a summed score of the components for a total score ranging from 0 to 100. An HEI score >80 is rated as good diet while a score of <51 is considered a poor diet. Results of this comparison showed that LMD adults had significantly lower mean overall HEI scores than NHANES adults (60.0 versus 63.1, $P < 0.0001$). Scores were also significantly lower for vegetable,

fruit, dairy products, and variety components ($P < 0.0001$). For example, only 41.9% of LMD adults met variety recommendations, 35.0% met meat recommendations, <25% met vegetable recommendations, and <16% met the fruit, dairy, and grain recommendations. Although not significantly different, 6.6% of LMD adults' diets were rated as good compared to 10.1% of NHANES adults, and somewhat surprisingly, 68.6% of LMD adults' diets were in need of improvement compared to 71.5% NHANES adults. A significantly higher percentage (24.8%) of LMD adults' diets were rated as poor compared to 18.3% of the NHANES adults ($P < 0.001$). Furthermore, low income adults with less than a college education were less likely to have a good diet compared to higher income adults completing high school, suggesting that such demographic variables have an influence on overall diet quality. Results of this research also were limited due to the use of FOODS 2000 data consisting of a one-day, self-reported dietary recall.

Thomson and colleagues (2011) also used the FOODS 2000 data to assess dietary quality of LMD adults, determine dietary modifications necessary to improve HEI scores, and examine demographic differences associated with leading food source intakes. Like the HEI tool used in McCabe-Sellars et al. (2007), Thomson used the HEI-2005, the subsequent version of the HEI updated to reflect the 2005 DGAs. The overall scores for the HEI-2005 are still based on a range from 0 to 100, but instead of 10 components there are 12 components, which include total fruit (including 100% fruit juices), whole fruit, total vegetables, dark green and orange vegetables and legumes (GOV&L), total grains, whole grains, milk, meat and beans, oils, saturated fats, sodium, and kcalories from solid fats, alcoholic beverages, and added sugars (SoFAAS). Each component is scored according to nutrient density, that is, as a percent of calories per 1000 kcalories in each

food group with higher scores reflecting better adherence to the DGAs. Additionally, MyPyramid equivalents consumed per 1000 kcalories are used to calculate scores for fruit, vegetable, meat and bean, and milk components; for oil and sodium, scores are based on grams consumed per 1000 kcalories. For saturated fat and SoFAAS, scores are based on the percent of energy intake that these sources contribute.

The FOODS 2000 data analysis showed overall HEI-2005 scores were lower for Delta adults than NHANES adults, although not significant (54 versus 55) (Onufrak et al., 2010). However, when sodium was excluded from the total HEI-2005 score, Delta adults did score significantly lower than the NHANES adults ($p = 0.0006$). Sodium was excluded from the score because FOODS 2000 data did not include salt used in recipes or at the table. Onufrak et al. determined this inadequacy was due to significantly lower component scores for whole fruit, total vegetables, GOV&L, and milk ($p < 0.0001$). These findings support previous studies' results, indicating diet quality among Delta adults is lower when compared to U.S. adults with individual component scores in need of improvement. Limitations noted for this research included those previously mentioned with regards to self-reported dietary intake, as well as, intakes related to seasonal differences, as the FOODS 2000 data were collected between January and June.

The aforementioned studies showed dietary patterns in the LMD differ from the greater U.S. population and may be indicative of the higher prevalence of obesity and chronic diseases in this population. Additionally, Tucker and colleagues (2005) found at least 24 regional foods that contributed to a high percent of energy intake that were uncommon in U.S. diets. Examples included okra, mustard, turnip, and collard greens; jambalaya and dirty rice (rice recipes with sausage and specific seasonings); fried

potatoes, meats, and fish; smoked or pickled foods such as sausages, neck bones, ham hock, and pig's feet; high fat foods like sweet potato pie, cracklings (fried pig skin), and cheesy casseroles, and high sugar beverages including fruit drinks (orangeade and lemonade) and sweet tea. Recognition of food sources and preparation methods contributing to poor diets, and consequently, the associated morbidities, can inform the design of culturally appropriate nutrition interventions to improve adherence to the DGAs and to further prevent obesity and chronic disease.

Planning Community-driven Nutrition Interventions in the LMD

Dietary intake and nutritional implications in the LMD indicate a need for culturally appropriate interventions in these communities. While the literature supports health education and health promotion programs at the individual level, recent participatory research informs the need to focus on community-level change when addressing health issues (McKinlay & Marceau, 2000b; Orleans, Gruman, Ulmer, Emont, & Hollendonner, 1999; Smedley & Syme, 2000). A fundamental principle in participatory research is engaging community members to actively participate in all facets of the research process in order to enhance the overall health of community members (Israel et al., 1995). In the planning phase of nutrition intervention research, barriers and facilitators to dietary change must be explored so that effective interventions can be designed with positive behavioral outcomes. The following studies used a combination of interviews, workshops and focus group discussion with Delta residents to determine nutrition and health needs of adults, as perceived by community members in the Delta population.

One of the first steps taken in the Delta NIRI project was the assessment of community needs in LMD by exploring community members' perceptions of nutrition and health in these communities. Yadrick et al. (2001) conducted 490 key informant interviews with a group of individuals representing various sectors of the community in 36 counties in Arkansas, Louisiana, and Mississippi. A survey was developed and administered in person to identify food and nutrition issues, contributors to those issues, resources, and common health problems and resources found in their respective county. Key findings revealed that food choices, lack of nutrition education and information, lack of time for healthy food preparation, and unwillingness to change traditional food preferences or preparation methods to improve diet and health were the major food and nutrition issues, contributors, and resources to health problems in the LMD. The major health issue perceived by key informants was hypertension. Yadrick et al. found that this finding was consistent with high prevalence rates of hypertension in the LMD at the time of the study. However, it was unexpected to find the exclusion of obesity as a major health issue. A possible explanation for this exclusion may be that obesity is considered more of a risk factor than a life-threatening disease. In light of this finding and the fact that obesity is a risk factor for hypertension, nutrition interventions should focus efforts to increase awareness of obesity as an important health issue. Findings from this study should be considered when planning community nutrition interventions for the Delta population. Effective and sustainable interventions should be tailored to the community's needs and specifically, should address education related to food choices and preparation methods that are based on cultural and environmental factors.

Engaging members of the community to participate in the planning of an intervention allows researchers to gain insight to possible causes of a community's nutrition and health problems (Lyons, Smuts, & Stephens, 2001). One of the primary goals of the Delta NIRI initiative was to design, implement, and evaluate interventions in the LMD using community participatory methodology (USDA, ARS, 2010). One such method used to accomplish this goal is the Comprehensive Participatory Planning and Evaluation (CPPE) model. The CPPE is a five-phase model in which community members are actively engaged to a) assess problems, b) identify and select interventions to address the problems, c) design the interventions, d) establish monitoring and evaluation systems, and e) develop a proposal to implement the first four phases (Lefevre, Kolsteren, De Wael, Byekwaso, Beghin, 2000). Nidirangu et al. (2007) used the first two phases of the CPPE model to identify nutrition problems in a rural Delta community. Workshops with the community members and researchers revealed similar findings of the previous research of Yadrick et al. (2001). The top three identified problems were unhealthy food choices, lack of nutrition education, and lack of physical activity. Interventions identified by participants to address these problems included nutrition education that consisted of food preparation, purchasing, and growing vegetables and food label education. Additionally, participants identified environmental factors that could be implemented to promote a healthier community such as working with local groceries to have specials on healthy foods, disseminating nutrition information on billboards and television, at church services, and on city information boards, and to have safe venues for indoor and outdoor physical activity. Results of this study indicate community involvement in problem and solution identification activities

can aid researchers in the development of appropriate and acceptable programs that may be more sustainable.

Outside of the Delta NIRI project, Parham and Scarinci (2007) explored perceptions and attitudes related to dietary habits and physical activity among low income African Americans in the Mississippi Delta and recommended strategies for interventions in this high risk population. The researchers conducted focus groups with community health advisors and research partners (CHARPs) in the Delta as well as members from Delta communities to accomplish their goals of the study. When asked about the causes of obesity among this population, overeating was the most common theme among CHARPs with reasons for overeating ranging from low self-esteem and a coping mechanism for depression or loneliness to social and family occasions and easy accessibility to buffets. Food stamps were also identified as a reason to overeat, as participants stated that food stamps provide food but they do not teach recipients how to cook, shop, or prepare foods. An interesting theme that emerged from the discussion was that obesity is not perceived as a health concern as long as one is capable of doing their routine activities. This regard for obesity also emerged from key informant interviews conducted by Yadrick et al. and has also been suggested by Christakis and Fowler (2007), described later, that perhaps social norms related to obesity are changing among social networks. The CHARPS identified barriers to healthy cooking as food prices, family structure regarding behavioral rules on eating, lack of parenting skills, and lack of assistance from health care providers.

Parham and Scarinci (2007) then conducted 10 focus groups with members of a Delta community (N=89). One of the goals of the discussions was to examine

participants' perceptions of health and factors related to their eating habits. Common themes regarding good health and healthy living included good diet, stress-free living, independent living, and having a positive self-image. Overeating was also identified as a common eating pattern, supporting the CHARPs perceptions. Barriers to healthy cooking included family influence on food preferences and cooking methods, cost of food, and lack of knowledge.

Based on these findings, nutrition and health interventions should include aims to increase self-efficacy related to nutrition knowledge and cooking methods using culturally appropriate foods; increase awareness of the relationship between diet and health, specifically risks associated with obesity; and utilize the social interaction at the community and family levels as a means for emphasizing social support. Additionally, program designers should consider the socioeconomic status of the target population as well as food access and availability.

Nutrition Intervention in the LMD

Community-based participatory research (CBPR) is a research approach in which the community and program designers work in partnership to establish and implement health priorities in populations. This research method was used in Hollandale, MS as part of the Delta NIRI in the *Fit for Life* Steps intervention (Zoellner et al., 2007). *Fit for Life* Steps was a six month walking intervention that focused on increasing physical activity of community members and improving anthropometric and biologic measures, including BMI, waist circumference, percent body fat, blood pressure, glucose, cholesterol, and triglycerides. Walking groups were recruited by community members designated *coaches* who were trained as group leaders to contact group members and document intervention

activities. Participants wore pedometers to track their steps and reported steps weekly as recorded on a walking log. Participants were also encouraged to walk with their groups, but this was not a requirement to participant in the intervention. Additionally, five one-hour education sessions were given on the topics of goal setting and motivation, healthy BMI and calorie needs, food label reading and portion control, beverage consumption, and recipe modification. A sixth and final session was held as a celebration.

The *Fit for Life* Steps Final analyses were based on 66 participants including coaches (Zoellner et al., 2007). The sample was primarily African American (99%) women (97%) with an average age of 46 years ($\pm$ SD=12.8). Outcome measures were assessed at baseline, three months, and six months. Significant improvements among participants included waist circumference (-1.4 inches) systolic blood pressure (-4.3 mmHG), and HDL-C (+7.9 mg/dL) from baseline to six months. From baseline to three months, there was a nonsignificant mean increase of reported walking minutes of +31.76 min/day, and a mean decline at three to six months of -10.7 min/day, netting an increase of +21.06 min/day.

A social support conceptual framework along with the Transtheoretical Model (TTM) was used for planning, implementing, and evaluating the *Fit for Life* Steps intervention components, both of which are highly recommended in the CDC's *Guide to Community Preventive Services* described above (CDC, 2006; Zoellner et al., 2007). Social support was assessed on the basis of how often friends and family provided support for exercise in different situations in the *Fit for Life* Steps intervention. Zoellner and colleagues assessed participants' readiness to change based on the TTM's constructs stages of change (SOC), self-efficacy (confidence in their ability to exercise), and

decisional balance (pros and cons to exercise). Previously validated instruments were used to assess these psychosocial measures at baseline, three months, and six months. Results showed 57% of the participants made a positive shift in SOC with 20% making a negative shift and 23% remained in the same stage. There were no significant positive changes in social support, self-efficacy, or decisional balance related to physical activity behaviors. The researchers cited several reasons why no positive changes were made as a result of the intervention including socially desirable responses; waning realization of benefits of exercise; and possibly little room for improvement related to social support due to the incorporation of social support in the intervention. However, it was unclear if findings were actually due to lack of improvement or perhaps, use of an instrument that was not culturally appropriate for this population. Unique environmental and psychosocial factors among minority populations living in rural areas may warrant the need to develop valid and reliable, theory-based, culturally-appropriate instruments to assess health-related behavior change.

With the high prevalence of obesity and chronic disease in the LMD, nutrition intervention is appropriate. However, there is limited dietary intervention research available with this population and no known research available related to the adoption and/or implementation and maintenance of dietary practices as a result of theory-based interventions. While behavioral research plays a key role in the development of theory, theories must be tested in real world settings to assess their effectiveness (Rosenstock, 1990). The DOI theory is a useful theory for developing nutrition interventions or programs as well for assessing the adoption, implementation and maintenance of healthy dietary practices. Outcomes of such an intervention can be used to refine nutrition- and

health-related programs to achieve the best fit between the program and end user, and ultimately enhance their overall health.

Diffusion of Innovations Theory

Key Concepts and Definitions

Everett Rogers first summarized the research on diffusion in 1962 with the first edition of *Diffusion of Innovations* in which he conceptualized the diffusion process. Over the course of five editions of the book, Rogers presented the research evidence, conveying the vast growth of diffusion research and continued to update the theoretical framework based on new concepts introduced in the supporting literature. Rogers (2003) defined *diffusion* as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (p. 5), where *innovation* is considered as a new idea, practice or object. The process involves two or more individuals exchanging information to move toward or apart from a common point of acceptance. In the diffusion of new ideas, this process could repeat over several cycles as one individual seeks further information. Rogers identified diffusion as a social change. Such change in structure or function of a social system occurs as a result of a new idea that was diffused, adopted or rejected and leads to certain consequences. Diffusion is composed of four key concepts that can be recognized in every diffusion research study, campaign, or program. The four key concepts include:

1. *The innovation:* an idea, practice, or object that is perceived as new by the potential adopter.
2. *Communication channels:* the means by which messages are exchanged between individuals.

3. *Time:* the length of time involved in making an innovation adoption decision.
4. *A social system:* a group of interconnected individuals engaged in problem-solving efforts to achieve a common goal.

History of Diffusion Theory

Rogers (2003) credits the rural sociology discipline with forming the basic model for diffusion research, as this discipline has produced the largest amount of diffusion studies. Specifically, Rogers noted the Iowa hybrid seed corn study conducted by Ryan and Gross (1943) as being most influential in forming the methodology and theoretical framework for diffusion research. Hybrid seed corn was one of the first agricultural technologies that led to more productive farming, an agriculture revolution. Ryan and Gross found that although using hybrid seed corn would lead to profitable crops, the rate of adoption – how quickly an innovation is adopted – was slow, requiring 13 years for the diffusion process to occur in two Iowa farming communities. Additionally, Ryan and Gross found that the rate of adoption formed an S-shaped curve. For example, within the first five years, only 10% of the Iowa farmers adopted the hybrid seed corn innovation. Over the next three years, the rate of adoption quickly rose to 40%. Eventually, the rate of adoption leveled off as fewer farmers adopted the innovation. Since 1943, diffusion research has expanded across many disciplines including anthropology, general and rural sociology, education, marketing and management, and more recently, public health and health promotion and continues to be an active field of research.

Planning for Innovation Diffusion

Recent research in the public health domain used diffusion theory to study health behavior changes through program implementation, including smoking cessation, school

health, and worksite health programs (Dino et al., 2001; Hoelscher et al., 2001; Simpson et al. 2000; Wiecha et al., 2004). This body of diffusion theory research investigated program adoption patterns, where the program is considered the innovation, and what characteristics, or perceived attributes, of the program affect the rate of its adoption. When developing a program, key characteristics that may influence program adoption should be considered. In his review of various adoption studies, Rogers (1995) identified five attributes that have the most influence on the adoption of an innovation:

1. *Relative advantage* – the extent to which an innovation is perceived as beneficial to the adopter.
2. *Compatibility* – the extent to which an innovation is perceived as a good fit with the adopter's values, experiences, or standards.
3. *Complexity* – the extent to which an innovation is perceived as hard or complicated to identify with or implement.
4. *Trialability* – the extent to which an innovation can be sampled or tried before adoption.
5. *Observability* – the extent to which the innovation and its consequences can be viewed in other adopters.

Diffusion research has historically looked at how an innovation spreads among members of a social system and the characteristics of these members (Deutschmann & Fals Border, 1962; Greenberg, 1964; Ryan & Gross, 1943; Rogers, 1961). Later, diffusion research focused on the rate of adoption of different innovations in a social system based on the perceived innovation characteristics or attributes. Fliegel and Kivlin (1966) investigated dairy farmers' perceptions of 15 attributes of 33 dairy innovations.

They found that innovations perceived as financially rewarding with little risk, or having relative advantage, and were compatible with the farmers' values were adopted faster. An innovation's complexity, observability, and trialability had less influence on the rate of adoption. In a meta-analysis, Tornatzky and Klein (1982) identified 10 most frequently measured attributes: compatibility, relative advantage, complexity, cost, communicability, divisibility, profitability, social approval, trialability, and observability. Of these 10 attributes, only three – compatibility, relative advantage, and complexity – were consistently and significantly related to innovation adoption.

Although not considered as part of the specific attributes of an innovation, *re-invention* occurs when adopters want to customize the fit of an innovation (Rogers, 2003). Re-invention demonstrates that adoption is not a passive process; adopters may value the flexibility of an innovation and want to take an active role in tailoring it to a specific situation. Additionally, re-invention may play a part in the sustainability of an innovation. Although re-invention is seen more often at the organizational level, as in curriculum adoption in educational institutions or health outreach programs in churches, it could be influential at the individual level for preventive innovations (Ammerman et al., 2002; Emrick, Peterson, & Agarwala-Rogers, 1977). A preventive innovation is an innovation an individual adopts to avoid possible undesired consequences in the future (Rogers, 1995). For example, adoption of a healthy diet innovation to prevent weight gain or high blood sugar to which an individual can customize the diet according to his food preferences may result in the maintenance of healthy dietary behaviors. In summary, it is proposed that innovations with the above five perceived attributes and innovations that

can be re-invented will be adopted faster than innovations that are lacking in these attributes. A more detailed review of each attribute is discussed later.

Communication channels. Communication is a necessary component if an innovation is to spread. Rogers cited two types of communication channels: 1) Mass media channels that include means of transmission via a medium such as radio, television, newspapers, and so forth, enabling an individual or organization to reach a larger audience; and 2) Interpersonal channels that involve one-on-one interaction between two or more individuals. The Internet has more recently been viewed as an interactive communication channel. Illustration of these two concepts can be seen in the Child and Adolescent Trial for Cardiovascular Health (CATCH) (Hoelscher et al. 2001). The CATCH trial was a multi-centered, randomized, controlled trial assessing outcomes of health behavior interventions implemented in the elementary school setting. Results indicated positive changes in health behaviors and in the school environment and thus program dissemination was initiated. Communication channels included media consisting of print and video materials and an internet Web site as well as interpersonal channels consisting of networking opportunities with decision makers at conferences, group meetings, or personal visits. The CATCH personnel realized that although interpersonal channels were the most time-intensive and costly of the dissemination efforts, the media channels were less effective without interpersonal channel support.

Innovation-decision process. Diffusion research indicates individuals make a series of choices and actions when evaluating an innovation, and thus, go through a process when making an innovation decision. The process consists of gaining knowledge about the innovation, forming an opinion, making a decision to adopt or reject the

innovation, using or practicing it, and seeking support for the decision (Beal & Rogers, 1960; LaMar, 1966). Rogers (2003) proposed a five-stage model depicting the innovation-decision process: 1) *knowledge,* which is gained when the potential adopter learns of the innovation; 2) *persuasion,* which occurs when the potential adopter develops a positive or negative attitude about the innovation; 3) *decision,* which occurs when the potential adopter chooses to accept or reject the innovation; 4) *implementation,* which takes place when the adopter uses the innovation (re-invention is most likely to occur at this step); and 5) *confirmation,* which occurs when the adopter seeks support for the decision made or a reverse decision can be made if given conflicting messages about the innovation. Most of the innovation-decision process research regarding the specific stages took place in the 1960s. Recent research focuses more on what variables, such as interpersonal communication channels, influence the individual at each stage, increasing likelihood of adoption.

The persuasion stage in the innovation-decision process is especially important as it pertains to the innovation's perceived relative advantage, compatibility, and complexity (Rogers, 2003). It is within this stage where the individual starts to mentally apply the innovation's attributes to his situation before deciding whether or not to try the innovation. At the persuasion stage, as well as the decision stage, the individual seeks information to evaluate the innovation and to reduce uncertainty related to expected consequences. This stage is where the individual also weighs the advantages and disadvantages of using the innovation. Additionally, an individual may seek reinforcement from others in his social network to confirm initial beliefs about the innovation. Thus, the psychosocial constructs decisional balance and social support are

expected to positively correlate with the attributes relative advantage, compatibility, and complexity. Supporting this expectation, Segaar, Willemsen, Bolman, & de Vries (2007) found adopters (head nurses) of a smoking cessation protocol in a cardiology ward had favorable attitudes toward the protocol. Adopters significantly perceived the protocol's relative advantage, complexity, and compatibility as advantages and were convinced the advantages outweighed the disadvantages versus non-adopters ($p < .05$). Moreover, the researchers found significant positive relationships between adopters and social support as well as self-efficacy ($p < .05$).

Knowing the stages one passes through when making an innovation-decision and what occurs in each stage can be helpful when planning for diffusion. Program and intervention planners should consider the appropriate communication channels, innovation attributes, re-invention and psychosocial constructs during the planning phase. Clear knowledge of these determinants of diffusion before implementation may help increase the rate and levels of adoption.

Adopter categories. Patterns of adoption can be seen in a normal bell-shaped curve when plotted over time on a frequency basis and in an S-shaped curve when plotted cumulatively (Deutschmann & Fals Borda, 1962). Deutschmann and Fals Borda (1962) studied the adoption of six farming innovations among 71 peasant farmers in Saucio, Colombia over a 30-plus year period. Using a composite score that represented the farmers' *innovativeness*, a characteristic representing the timing of the adoption, for the six innovations, the researchers found an S-shaped cumulative distribution that approached normality (see Figure 1). Based on the mean and standard deviation of the scores, the farmers were classified into five adopter categories that describe this timing

characteristic: 1) *innovators,* two farmers with the highest scores; 2) *early adopters*, 10 farmers with the next highest scores; 3) *early majority*, 23 farmers with the next highest scores; 4) *late majority*, 23 farmers with the next highest scores; and 5) *laggards*, 13 farmers with the lowest scores. Deutschmann and Fals Borda proceeded to identify the characteristics of each category and compare to another farmers' study in Ohio (Rogers, 1961). In both studies, innovativeness was related to farm size, formal education, mass media exposure, and knowledge about agricultural innovations. Thus, innovators differed most from laggards based on their socioeconomic status and communication characteristics, indicating that members in each category have homophilous characteristics.

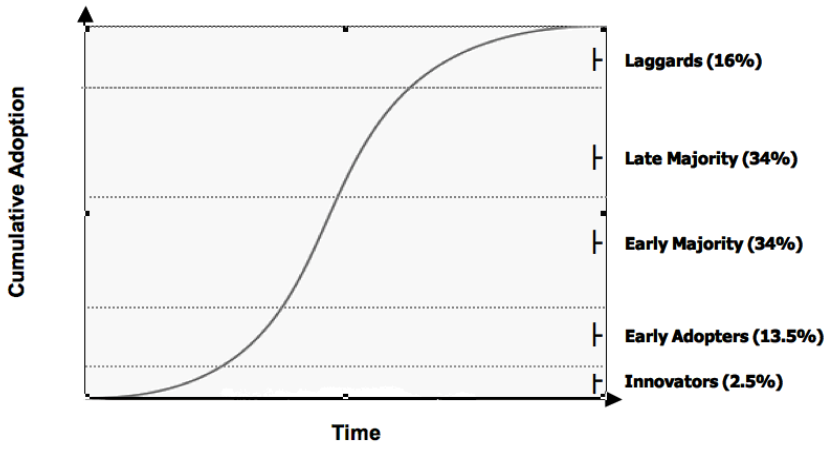

Figure 1. S-shaped curve: Rate of adoption by adopter categories.
Garritty, C., & El Emam, K. (2006). Who's using PDAs? Estimates of PDA use by health care providers: A systematic review of survey. *Journal of Medical Internet Research, 8*(2*).* doi:10.2196/jmir.8.2.e7

In general, Rogers (2003) characterized innovators as adventurous, being the first to adopt an innovation. Early adopters are characterized as having a high degree of respect with potential adopters in their social system looking to them for advice or information about an innovation. The early majority are characterized as deliberate,

taking longer to completely adopt an innovation. The early majority frequently interact with their peers, although Rogers considers them as followers rather than leaders. On the other hand, the late majority is characterized as skeptical and adoption of an innovation is most likely the result of peer pressure. Lastly, the laggards, being the last to adopt an innovation within the social system, are characterized as traditional and extremely cautious in adopting innovations. Resistance to innovations may be due the laggard's economic situation and with whom they associate with, namely other laggards.

Identification of adopter categories and the corresponding characteristics can provide a foundation for designing and targeting programs or intervention strategies. For example, an emphasis on cognitive intervention strategies may be most appropriate for early adopters versus strategies based on overcoming barriers for later adopters (Green, Gottlieb, & Parcel, 1987). Early adopters are more integrated in the social system and have a high degree of opinion leadership. That is, the early adopter has the ability to influence another's attitude in a desired way; they are often looked to for advice and information on an innovation by potential adopters and hence, can influence the speed of the diffusion process (Rogers, 2003).

Social networks and social support. When planning for diffusion, program and/or intervention planners should consider the individual's social network – or his "web of social relationships" (Heaney & Israel, 2002). Social support is usually a function or provision within the social network. There are four types of social support, including emotional (empathy, love, trust, and caring), instrumental (tangible aid and services), informational (advice, suggestions, and information), and appraisal (constructive feedback and affirmation). Enhancing existing network ties is a suggested intervention

strategy that can be used to change attitudes and behaviors (Heaney, 1991). For example, when an individual decides to adopt an innovation, they most likely do so because of how *they* perceive the innovation (perception of innovation attributes) and because of how *others* perceive the innovation (Dearing, 2004). The latter illustrates the emphasis of social influence communicated through informal networks on the diffusion process. When diffusion occurs, it means that the influential people within the social system in which members are connected to each other either interpersonally, or by common demographic, environmental, or behavioral characteristics, have given their stamp of approval on the innovation (Katz & Lazarsfeld, 1995; Mayer & Davidson, 2000).

Social relationships can be instrumental in facilitating health behavior change**.** Israel (1985) suggested the use of natural helpers for behavioral change interventions. Natural helpers are respected members of the social network on which other members rely for advice or support. Additionally, natural helpers assist social network members in finding resources within and outside the network. Natural helpers in community interventions have been conducted to promote positive health behavior by providing information, advice, emotional support and access to resources (Eng & Hatch, 1991). This idea is compatible with the diffusion theory concept of the *champion*. A champion is the person in the social network that supports the innovation, encouraging adoption and implementation (Rogers, 2003). Identification of natural helpers or champions who currently fill this role already in the network can contribute to the success of the diffusion of the new idea or practice.

Ample evidence suggests the positive relationship between social networks and social support and health (Berkman & Glass, 2000; Cohen & Wills, 1985; Thoits, 1995).

However, while the evidence indicates social support as a positive influence on one's health, there may be instances where one's social network and consequently, perceived social support, could negatively influence health behaviors. Such might be the case with the prevalence of obesity significantly increasing over the last decade (Flegal, Carroll, Ogden, & Curtin, 2010).

Obesity spans across all socioeconomic groups, indicating that genetics alone cannot explain the obesity epidemic (Christakis & Fowler, 2007). Therefore, an investigation of social and environmental factors is warranted to determine the spread of obesity. An offspring cohort (n = 5,124) from the Framingham Heart Study was used to conduct a social-network analysis during the study period 1971 to 2003) to determine if weight gain in one person (*ego*) was associated with weight gain in their social connections, which may have included friends, siblings, spouse, or neighbors (*alter*). Fifty-three percent of the cohort was women at the mean age of 38 years and mean educational level of 13.6 years. The social network, and thus analysis, included a total of 12,067 people. Mutual friendship (each ego and alter stated the other was a friend), the ego's chance of becoming obese increased to 171% (95% CI, 59 to 326) if the alter was obese. Furthermore, same-sex ties increased ego's probability of becoming obese by 71% (95% CI, 13 to 145), if the alter was obese. Findings suggest people are influenced by those with whom they are most similar. This is not to say that the spread of obesity is due to behavioral imitation, but perhaps, change in attitudes toward the social norm of what constitutes a healthy body weight. However, Christakis and Fowler (2007) conclude that if obesity can spread among social networks, so might this same social influence be used to diffuse healthy behaviors, and as a result, slow down the spread of obesity.

People are connected through social networks in which both good and bad behaviors can spread and affect health outcomes (Christakis & Fowler, 2007). Many behavior change programs that include a social support component such as smoking and alcohol cessation and weight loss interventions have been successful in participant behavior change versus those that do not. Understanding the impact of social ties and the communication of new ideas and practices on health behavior change can contribute to effective interventions. For example, social networks and social support concepts can be used to design effective interventions and programs in which family or friends are used to promote behavior change. Furthermore, using a combination of existing ties and natural helpers within social network communities to achieve a common goal or to promote problem-solving efforts binds the system together and can promote diffusion.

In summary, there are many factors that can influence the diffusion of an innovation. From the innovation attributes and communication channels, to adopters' categories and social networks, all play key roles in the development and planning of the diffusion process. Use of formative research methods and utilization of effective intervention strategies described heretofore can lead to successful diffusion.

Innovation Attributes

As mentioned previously, much of the diffusion research has focused on adopter characteristics with less focus on variables that predict innovation adoption and their affect on the rate of adoption. Although an innovation can have many attributes, there are five in particular that contribute most to the rate of adoption. In a review of the literature, Rogers (1995) noted that the following attributes explain about 49 to 87% of

the variance in the rate of adoption of an innovation. The following section describes the measurement of each in detail.

Relative advantage. Relative advantage is defined as the extent to which an innovation is perceived as beneficial to the adopter and as better than the preceding idea (Rogers, 1995). It does not matter whether the advantages are economic or financial, prestigious, or convenient, as long as the adopter views it as advantageous. However, past diffusion research indicated this attribute as being too broad, lacking conceptual strength and reliability (Tornatzky & Klein, 1982). Tornatzky and Klein (1982) questioned advantages like cost or efficiency in the studies they reviewed; if these were considered advantages, why call it relative advantage rather than cost or efficiency? Another issue found in determining the predictability of innovation adoption concerning this attribute was the difference in the way researchers measured – or not measured it. Some researchers inferred the relative advantages of an innovation and lumped them into the one category of relative advantage, while other studies asked potential adopters or respondents to rate an innovation's advantages.

Relative advantage and compatibility appear to be perceived as one attribute. Findings from factor analysis revealed the two attributes loading on the same factor (Holloway, 1977; Moore and Benbasat 1991; Pankratz, Hallfors, & Cho 2002). One explanation for this may be that respondents might perceive an innovation that is compatible as also advantageous. Nevertheless, in general, the attribute tends to be positively related to adoption, and the more weight this attribute carries for the innovation, the faster the innovation will be adopted (Rogers, 2003; Tornatzky & Klein,

1982). Further investigation on perceptions of the two attributes is necessary to determine if they are truly two different attributes.

Rogers (2003) recommended emphasizing the relative advantage of an innovation as individuals pass through the innovation-decision process, as this is when they seek information regarding the innovation's advantages. This is especially important with preventive innovations where the relative advantage is not always clear to individuals. With at preventative innovation, benefits and desired consequences of adopting this type of innovation may not be immediately seen, and thus, motivation to adopt an innovation is low. For example, maintaining a healthy weight to avoid chronic disease later is not tangible, and an individual may not see the benefits of such behavior. Therefore, to emphasize the relative advantage of a preventive innovation, it is recommended to establish a communication campaign, activate peer networks, and encourage peer support within the target population (Keller, & Galanter, 1999; Martin, Herie, Turner, & Cunninghanm, 1998; Rogers & Storey, 1988). Implementing these strategies may be viable ways to increase motivation to adopt a preventative innovation.

Compatibility. Compatibility is defined as the extent to which an innovation is perceived as a good fit with the adopter's values, experiences, or standards (Rogers, 1995). If an innovation is incompatible with these aspects of the adopter or social system, it will most likely not be adopted unless the value system or standards change. Not only should an innovation be perceived as compatible with cultural values, but it should also be perceived as compatible with previously adopted innovations, inducing familiarity and reducing uncertainty (Rogers, 2003). Previous innovations provide standards for or comparisons to new innovations, which can either, speed up or hinder the rate of adoption

of the innovation. Thus, naming and positioning an innovation based on previous compatible innovations, may increase adoption rates.

Many of the studies in Tonatzky and Klein's, (1982) meta-analysis inferred compatibility, rather than actually measuring it as a perception with the potential adopter, leading to interpretational issues. Researchers assumed the attribute was compatible based on characteristics of the potential adopters and consequently, there was no actual measure of how the innovation was perceived. For example, Tornatzky and Klein found studies that concluded that an innovation was compatible if it was compatible with how an individual *thinks* or with what an individual *does*. Either and sometimes both definitions were used to describe this attribute, which was found to be positively related, but not always significantly related, to innovation adoption as well as implementation. Furthermore, Tornatzky and Klein concluded that the results of the studies were limited because of the differences among the operational definitions and what was being measured. Nonetheless, findings of the meta-analysis revealed compatibility as the most cited attribute in the literature.

As explained above, compatibility and relative advantage were often found not to be experimentally different, although conceptually different (Holloway, 1977; Moore and Benbasat 1991; Pankratz, Hallfors, & Cho 2002). However, it was not clear to researchers whether this was due to the insensitivity of the scales to detect differences or the type of innovation, which could have resulted in the convergence of the two attributes. Researchers concluded that this issue warranted further investigation.

Complexity. Complexity is defined as the extent to which an innovation is perceived as hard or complicated to identify with or to implement (Rogers, 1995).

Innovations that are simple and less complex will be adopted more quickly than innovations that require new skills or have multiple components. For some new innovations, complexity could be a barrier to adoption. Perceptions of innovation complexity appears to be clearly distinguishable, as study analyses indicate high reliability statistics for this attribute and show a negative relationship between an innovation's complexity and its adoption (Hurt and Hibbard, 1987; Moore and Benbasat, 1991; Tornatzky & Klein, 1982).

A good example of an innovation with low complexity was the Coordinated Approach to Child Health (CATCH) program materials (Hoelscher et al., 2001). The *CATCH* program is a comprehensive school-based health promotion program designed to decrease cardiovascular risk factors in children. The program included classroom curriculum, physical education curriculum, foodservice, and family components. The *CATCH* designers developed curriculum materials complete with lesson plans, scripts, transparencies and student worksheets. The materials could be easily adapted for different class sizes or lengths of time. Emphasizing the low complexity of using an innovation (i.e., materials that are not burdensome for teachers) can decrease this attribute as a barrier to adoption.

Trialability. Trialability is defined as the extent to which an innovation can be sampled or tried before adoption (Rogers, 1995). If a potential adopter can try the innovation for a limited time, they are more likely to adopt it, because the trial period decreases uncertainty about an innovation. It is during this trial period that the innovation might be tailored, or re-invented to the individual's situation or preference. Therefore, trialability is positively related to the adoption of an innovation. Additionally, both Gross

(1942) and Ryan (1948) found that trialability is perceived to be more important to early adopters than later adopters. This is logical as earlier adopters have no example to follow, whereas the later adopters follow the advice and example of the earlier adopters. Thus, targeting an innovation initially to early adopters and using them as models can encourage innovation adoption in later adopter categories.

Adequate training to increase user competency regarding an innovation, facilitates adoption, implementation, and maintenance (Rogers, 2003). When designing programs, particularly preventive programs (innovations), providing training for potential innovation adopters is often considered trialability. Training was an essential factor for successful implementation of the school nutrition programs *Planet Health* and *CATCH* (Hoelscher et al., 2001; Wiecha et al., 2004). Training for these programs included a comprehensive guide for staff containing the curriculum and program delivery and allowed for exposure to the program on a trial basis. With regards to a dietary innovation, interactive food demonstrations and tastings may be beneficial in increasing adoption rates, especially if the adopter can tailor a recipe to his or her food preferences and adapt it to cultural norms.

Observability. Observability is defined as the extent to which the innovation and its consequences can be viewed by others (Rogers, 1995). An innovation's visibility stimulates discussion among peer networks (friends, neighbors, similar organizations) and can potentially increase the rate of adoption. However, Tornatzky and Klein (1982) found that this attribute may not easily be differentiated from an innovations' other characteristics. For example, a respondent may perceive low cost or compatibility as positive results of using an innovation rather than the consequences of the innovation

itself. A study by Hurt and Hibbard (1989) also found that observability did not differentiate from trialability. They concluded that the items were either poorly written and did not discriminate between the two attributes or respondents perceived these attributes as one. Furthermore, consequences of some innovations are evident, while some are difficult to observe or may occur in the distant future, negatively influencing adoption rates. For instance, preventive innovations, as previously described have slower adoption rates due to the lack of immediate, observable results.

Innovations that are visible and easily described or communicated are positively related to adoption (Rogers, 2003). These two concepts, visibility and communicability, emerged as two constructs during scale development for Moore and Benbasat (1991). Thus, two separate scales were developed for observability: v*isibility* and r*esult demonstrability*. The innovation for Moore and Benbasat's as well as Hurt and Hibbard's (1989) investigations was technology related, and therefore, reasons for unclear perceptions of this attribute may be based on the tangibility of the innovation. When considering the promotion of a dietary innovation, observability could be demonstrated through testimonials of early adopters related to their feelings of overall well-being or actual clinical manifestations of previous adopters, such as decreases in blood pressure, blood sugar, or weight loss.

Additional attributes. In addition to the aforementioned attributes, other innovation attributes that have been explored include flexibility, reversibility, profitability, cost, and voluntariness. (Kolbe & Iverson, 1981; Moore & Benbasat, 1991; Tornatzky & Klein 1982). The attribute voluntariness may be of particular interest with regards to a dietary innovation. Moore & Benbasat (1991) measured voluntariness, which

refers to the degree to which use of an innovation is optional. At the organizational level, an optional innovation-decision is made and those who are part of the organization may have an option to use or not use the innovation. However, at the individual level, this attribute may have implications relative to a dietary innovation. A dietary innovation may be related to diet compliance, which could be considered *mandatory* adoption. Rogers (2003) describes mandates for adoption as vehicles through which an external factor exerts pressure on the individual to see the relative advantage of the innovation. If a dietary innovation is prescribed by a doctor, and thus not perceived as voluntary, what is the likelihood of adoption? In other words, is a healthy diet more likely to be adopted if it is perceived as voluntary? This attribute may call for further exploration when investigating dietary innovations or other preventive or behavioral innovations.

Rogers encourages researchers to use formative research methods to obtain additional attributes of innovations prior to measuring attributes as predictors to rate adoption. For example, Kearns (1992) grouped eight innovations and used an expert panel to determine differences among them in triplet. Each innovation with a description was printed on a 3-by-5 inch index card; respondents were asked to compare the like characteristics of two and how it differed from the third. Respondents then did the same task with another set of triplet cards until all eight innovations were compared and contrasted. Kearns elicited 25 additional attributes for the eight innovations, which came from the respondents, not the researcher. Gathering information from potential adopters regarding an innovation's characteristics that make it similar or dissimilar to other innovations is important when positioning an innovation to maximize its speed of

adoption. Results of such methods can give the researcher, or marketer, valuable information when planning a diffusion campaign for an innovation.

Research indicates innovations with the five key attributes described herein explain most of an innovation's rate of adoption. Each is fairly well correlated with the other four, but they are not always perceived as conceptually different. However, it is most important for researchers to realize that it is the potential adopters' perceptions of the innovation's attributes that affects adoption rates, not the attributes identified by the researcher or innovation developer (Rogers, 2003). Researchers should make note of the potential problem with measuring these specific five attributes, as they may not be the most important characteristics perceived by a particular sample of a population. Therefore, qualitative exploration regarding an innovation's characteristics with a representative sample of the population should be the first step in measuring attributes as predictors of innovation adoption.

Existing Scales Measuring Perceived Attributes of an Innovation

Innovation attributes have been studied extensively in an array of disciplines but most heavily in the marketing of technology. Although diffusion constructs have been used to plan, implement and evaluate many health- and nutrition-related interventions and programs, little research related to innovation characteristics and their perceived influence on the rate of adoption has been published in the public health and nutrition disciplines. Additionally, there are few studies with valid and reliable measurements of innovation attributes in the literature, and even fewer studies related to the health literature and none known to the present author related to nutrition at the time of this literature review. The reason for this gap may be that most research studies in health and

nutrition are by nature *preventive innovations*. Rogers (2003) describes preventive innovation as an idea or practice that an individual adopts in the present to decrease the risk of an unwanted event in the future. Such innovations have a slower rate of adoption because the difficulty in perceiving its relative advantage. Thus, researchers may find these attributes difficult to measure due to the time and funding restraints, and study outcomes may appear to be ineffective using such a measure. However, as discussed previously, use of formative research methods, positioning strategies, and interpersonal and mass communication channels will increase the rate of adoption of preventive innovations. The following section presents a review of the existing measures of DOI attributes in the literature.

Issues with Reliability

It is evident, based on the extensive diffusion research, that the perceived attributes of an innovation play a key role in its adoption; however, there are few valid and reliable instruments designed to measure these attributes and/or psychometrics have not been reported. One of the first researchers to explore the perceived attributes of an innovation was Ostlund (1969) studying the adoption of new consumer products. Ostlund's scale was based on the five attributes posited by Rogers with the addition of another, *perceived risk*. The scale had only two items per attribute and no reliability data were reported. Later, Bolton (1981) used Ostlund's scale but increased the number of items per attribute. Psychometrics reported were below the desired levels and only 4 out of 31 items had a Cronbach's alpha above 0.80, indicating poor reliability of the remaining items and thus, the scale.

Issues with Construct Validity

The diffusion literature also indicates issues in distinguishing between the perceived attributes. In an education innovation, Holloway (1977) developed a new scale to measure high school principles' perceptions of innovative educational ideas based on the five key attributes. Results of the factor analysis indicted no clear distinction between items measuring relative advantage and items measuring compatibility, indicating problems with these constructs. Hurt and Hibbard (1989) also had issues with construct validity when assessing perceptions of microcomputers. High reliability was reported for complexity and compatibility subscales (Cronbach's alpha = 0.93 and 0.86, respectively), but factor analysis results showed items related to trialability and observability collapsing to one factor. Furthermore, the items indicating relative advantage did not factor at all. Hurt and Hibbard reported that it was unclear whether these were issues related to the instrument development process or actual perceptions of the respondents regarding the innovation. Whether instrument development processes or adopter perceptions, data indicated the resulting solution was not reflective of the classic diffusion theory.

Priority should be given to test developmental processes starting at the item level (Downing & Haladyna, 1997). Focusing on construct validity at the item level can be valuable contribution to the interpretation of results of the instrument versus depending solely the statistical evidence. In a more recent study, Moore and Benbasat (1991) also found issues with some of the diffusion constructs, even with rigorous methods used to develop the scale. A card sorting method was used to assess construct validity of an informational technology innovation. Several rounds of judging panels consisted of potential adopters to categorize instrument items. The researchers pooled 94 new and

existing items based on seven attributes (including Rogers' classification scheme) pertinent to the innovation and subjected the items to four rounds of sorting by four different sets of judging panels. Judges sorted items into categories labeled and defined by the judges themselves. Those items that were ambiguous or did not fit into a specific category were thrown out of the pool. The sorting rounds resulted in eight scales with 75 items.

Moore and Benbasat (1991) conducted two rounds of pilot testing to refine the instrument and reduce number of items, resulting in a 44-item instrument. Exploratory and confirmatory analysis of the final field test of the instrument revealed seven factors accounting for 63% of the variance. All of the factors emerged separately with the exception of compatibility. Items for compatibility loaded with relative advantage. Run as an eight factor solution, confirmatory factor analysis showed a high correlation (0.99) between the two constructs. Although sorting procedures consistently showed the item as unique to the constructs, survey respondents perceived them to be identical. Moore and Benbasat explained that it could be that the technology innovation would not be considered to have relative advantage if it was not considered compatible. Therefore, they concluded that although conceptually different, the two constructs were viewed as the same, warranting further investigation.

Atkinson (2007) developed a 30-item scale to measure the perceived attributes of a technology-based health education undergraduate course supplement. Items were adapted from Bolton's (1981) scale to measure innovation perceptions based on the five key attributes. Reliability testing and factor analysis was based on 193 returned surveys. Only four of the five attributes had items demonstrating acceptable reliability

(Cronbach's alpha > 0.70) and indicated factors. Compatibility did not emerge as a factor in this study, once again indicating that this attribute was not perceived as a unique attribute of this innovation, or the items were not sensitive enough in the measurement of the attribute. This study had several limitations. Limitations included lack of pilot testing the instrument; the sampling strategy, which consisted of a convenience, self-selected sample that may have introduced bias. Additionally, the low response rate could have led to misleading results. Overall, the instrument appears to an invalid measure for this innovation.

Three-factor Solutions

With 95% of American children and adolescents spending the majority of their waking hours in schools, the school setting is an appropriate vehicle for the promotion of various health programs. Steckler and colleagues (1992) developed six instruments to measure different aspects of diffusion and implementation of a health promotion and tobacco prevention curricula designed for junior high schools. One of the six instruments was based on Rogers' classification scheme of innovation attributes; however, the researchers chose only three of the five key attributes: relative advantage, complexity, and observability. It was proposed that the innovation would be adopted if perceived to be better than the previous idea, easy to use, and had observable results. Teachers and administrators were asked to review the curricula and then complete the questionnaire prior to adoption. The instrument consisted of 20 items for the three scales. All three attributes emerged as distinctive constructs with high factor loadings (ranging from .684 to .850) and reliability estimates (Cronbach's alpha > .77). Measuring the innovation attributes prior to adoption was considered a limitation to the instrument, as Tornatzky

and Klein (1982) suggested innovation attribute studies should focus on both adoption and implementation as dependent variables. When the extent of implementation is known, it may better explain the differences in adopters' behavior.

Another school health program was assessed by Pankratz, Hallfors, and Cho (2002) who developed a scale to assess the perceived attributes of a federal drug prevention policy. Adapting scale items from previous diffusion research, the final instrument consisted of 17 items intended to measure the five key attributes of relative advantage, compatibility, complexity, trialability, and observability. Pankratz et al. conducted reviews of the scale with experts in diffusion and drug prevention as well as cognitive response interviews with a sample representative of their target population before final testing. Final analysis including reliability testing and factor analysis was performed on 107 surveys. Results of the factor analysis revealed only three of the five attributes with relative advantage and compatibility loading as one factor and complexity and observability as the second and third. Cronbach's alphas ranged from 0.71 to 0.89 for the 14 items representing these constructs. The collapsing of the two constructs relative advantage and compatibility is consistent with Moore and Benbasat's (1991) and Holloway's (1977) findings. The researchers agreed that more research was needed to determine if the five attributes are distinct, and if so, to establish a more accurate scale of measurement.

Reasons for a three factor solution versus five may be because of the nature of the innovation, which was the case for the federal drug prevention policy, a mandated policy with financial incentives. First, financial incentives are most likely always perceived as an advantage to an organization. Second, if the policy is required, compatibility may be

considered as fulfilling a need with an added benefit of financial incentive. As a result, compatibility and relative advantage may be perceived as one. Trialability was not considered a useable construct in the Pankratz et al. (2002) or Steckler et al. (1992) studies. An innovation's trialability may be difficult to measure when the innovation is related to a process (steps in the program implementation); on the other hand, trialability may be more useful when assessing more concrete innovations.

Of further interest are the results of Tornatzky and Klein's (1982) meta-analysis, which showed only 3 of the 10 attributes to be consistently related to innovation adoption. Both relative advantage and compatibility were found to be positively related to adoption ($p < .05$). However, further conceptualization is warranted to distinguish the relationship between both of these attributes. Tornatzky and Klein also recommended researchers specify the criteria for evaluating relative advantage. The third attribute consistently related to innovation adoption was complexity, which was negatively related to adoption, but not significantly ($p = .062$). Nonetheless, they suggested complexity requires further investigation as to what about the innovation makes people perceive it as complex and to distinguish it from subjective perceptions and the objective perceptions. An example of an objective perception of complexity may be the lack of technical knowledge related to using an innovation, compared to the subjective perception, which may be one's uncertainty about the innovation's complexity. Tornatzky and Klein advised considering the scale of the attribute relative to other variables of interest related to the potential adopter. For instance, researchers should consider the magnitude of an innovation's cost (attribute) relative to the adopter's resources. Making this distinction between the perceptual and the objective will make the examination of the relationship

between innovation perception and adoption and implementation more useful. It should be noted, however, that the results of the meta-analysis were hindered by the small number of studies actually reporting correlation data related to the attribute-adoption relationship.

For successful innovation diffusion, diffusion researchers should understand the perceptions of potential adopters and how they make decisions about adopting a behavior, practice, or new idea (Rogers, 2003). Rogers was an advocate for developing measures for each unique study and avoiding the use of existing scales. Moreover, Tornatzky and Klein (1982) suggested systematically measuring innovation attributes using multi-item scales for each attribute obtained by potential adopters rather than inferring the existence of an innovation attribute. This will give meaningful and generalizable results. Additionally, they recommended assessing both adoption and implementation of an innovation using repeated measures, which will account for the diffusion process and not just the adoption decision.

Conclusion

In order to improve behavioral outcomes, it is important to know how and why interventions and/or behavioral programs work. Diffusion research related to the perceived characteristics of the program may determine why a program or behavior was or was not adopted. Use of theory-based, valid and reliable instruments that are culturally appropriate to measure activities related to the diffusion process may help measure the success of a program (Steckler et al., 1992). Furthermore, qualitative methods used before, during, and after program implementation can assist program developers in understanding why behavioral changes may not have occurred or if the instrument did not

detect a change. Improving programs based on the results of such research can encourage the adoption of effective programs for promoting community health. Suggestions for unique measures for innovation attributes, as well as the limited availability of valid and reliable scales related to health or nutrition innovations, indicates the need for the development of a new scale to measure the adoption of a healthy diet innovation.

CHAPTER III

METHODOLOGY

Research Design

The research design for the development of this instrument was descriptive using qualitative and quantitative research methods. Qualitative research is an inductive approach in which the researcher starts with a specific observation and moves toward a general conclusion or broad theory (Ulin, Robinson, & Tolley, 2005). The researcher may see a pattern for which a tentative hypothesis and subsequent theory may be formed. This approach can assist the researcher in understanding the attitudes and perceptions of the target population regarding a topic under exploration, or more specifically, why or why not individuals perform a particular behavior (Patten, 2002; Ulin et al., 2005). Ulin et al. (2005) describe the qualitative research framework as a "theoretical and methodological focus on complex relations between (1) personal and social relations, (2) individual and cultural practices, and (3) the material environment or context" (p. 4). Therefore, qualitative researchers may seek to answer questions about how a social event is created or the significance of the event within a particular population. Qualitative methods such as group discussion or one-on-one interviews give the researcher a deeper insight to experiences or trends in a way that quantitative methods alone cannot (Strauss & Corbin, 1990). Specifically, group discussions can provide valuable information for research studies that focus on social norms, perspectives, values, and beliefs related to a particular behavior. Individuals' attitudes, values, and beliefs would be more difficult to extract from numerical data. Group discussions are also helpful when the researcher is interested in understanding how groups may experience issues differently. Furthermore, qualitative

methods can help the researcher understand facilitators and barriers to the implementation of health programs as well as program outcomes (Ulin et al., 2005).

Quantitative research uses a deductive approach to test hypotheses, usually based on theory and previous literature, seeking for insight into causal relationships between variables (Patten, 2002). Results of quantitative analyses are interpreted for statistical significance and inference. Quantitative researchers use instruments that can quickly be analyzed for results expressed in numbers compared to qualitative researchers who use loosely structured instruments in the form of a discussion question topic guide. Results of qualitative analysis are usually express in words, usually in a narrative format, whereas quantitative results are reported in statistical terms expressed as numbers. Oftentimes, however, researchers will use qualitative methods to gather information to develop a quantitative instrument (Strauss & Corbin, 1990).

While the main focus of this research was to test the psychometric properties and assess construct validity of the instrument, there were specific steps that were taken first to assist in development process. Taking the proper and necessary steps to develop an instrument will hopefully lead to a reliable and valid instrument that can be used for its intended purpose. Therefore, it is appropriate to discuss the process associated with constructing an instrument.

Process of Test Construction

Crocker and Algina (1986) discussed the basic terminology relevant to test theory and construction. They defined constructs as “hypothetical concepts” (p. 4) that attempt to explain human behavior. Constructs act as a label for a number of similar behaviors that cannot be measured directly, but rather indirectly, as they can only be observed

through an individual's behaviors. In order to measure a construct, it is necessary to operationally define the construct by specifying which behaviors indicate the construct. To collect information based on the specified behavior, an instrument or *test* must be developed to record the observations about the construct. The authors defined test as "a standard procedure for obtaining a sample of behavior from a specified domain." (p. 4). Measurement of the behaviors is therefore the assignment of a quantitative value to the behaviors that indicate a construct when using a test. Finally, a conclusion can be made about the construct's representation in an individual based on the measurement.

Social scientist use constructs to categorize similar behaviors and build theories (Crocker & Algina, 1986). In turn, theories help explain the relationships between constructs or between a behavior and a construct and may be able to explain or predict behavioral patterns when such theories are tested. In order to substantiate theory, behavioral observations indicating a construct must be quantified.

The term *scale*, *instrument*, and *test* sometimes appear synonymously in the literature. When the researcher creates a measurement as defined above, it is known as *scaling* (Crocker & Algina, 1986). Crocker and Algina (1986) explained scales like the Math Anxiety Scale as an instrument that is actually a test that systematically collects information about a certain behavior. The following section uses the term *test* to describe the systematic approach to test construction suggested by Crocker and Algina.

1) Specifying the purpose of the test scores and how they will be used. For example, test scores may be used as an evaluation to improve a program. This step helps to establish priorities and ensures that the test will be used accordingly.

2) Identification of the behaviors or practices that represent the construct. This step ensures adequate coverage of the construct and is accomplished through one or more of the following activities: content analysis (open-ended questions to individuals about the construct), review of the literature, critical incidents (list of behaviors characterizing extremes of the construct), direct observations of the behaviors related to the construct of interest, expert judgment (input from individuals with firsthand experience with the construct), or instruction objectives (review of materials to form achievement objectives by subject experts).
3) Specifying the proportion of items that represent the behaviors in step 2. A plan must be developed to specify the content or processes to be covered by the items. This step ensures that there is a balance of items based on what the test developer believes is important to the representation of the construct.
4) Composing a pool of test items. This step includes choosing an item format to write the items. For example, elements of an item may include the behavior, the target at which the behavior is directed, the context the behavior is used in the time frame of performing the behavior, such as in the present or in the future.
5) Reviewing items and revising if needed. This step can be accomplished with an expert panel to consider accuracy, relevance, technical quality, grammar and general appearance and readability of the items. This step enables the test developer to make any necessary revisions before field testing.

6) Pre-testing items and revising if needed. Similar to step five but with a small group representative of the target population for which the test is designed.
7) Field testing the final draft form of items. This step is accomplished by administering the final draft to a large sample that is representative of the target population for which the test is designed.
8) Analyzing item scores for statistical properties such as item-to-item correlations. This step assists the test developer to eliminate items that do not meet specified criteria.
9) Conducting validity and reliability studies for the final form of the test. Such studies may include construct validation using factor analytic methods and estimates for reliability using test-retest or internal consistency methods. This step ensures that items accurately reflect the content being measured and if hypothesized relationships predicted by a theory can be confirmed through the test measuring the relevant construct(s).
10) Developing guidelines for future administration and scoring procedures. This step ensures that the test is used according to its main purpose and correct interpretation of test scores.

Crocker and Algina suggested taking these steps as the minimum requirements for test construction so that test scores will be considered as useful measurements of the intended constructs of interest. Methods for the construction of the instrument were guided by these recommended steps.

The purpose of the instrument was to measure the perceived attributes of using a healthy diet innovation based on the 2005 DGAs by individuals participating in a

nutrition intervention. The research was conducted in four phases. Study participants, research and data collection procedures, and data analysis is discussed accordingly for each phase.

Human Subjects Protection Approval

This project was approved by the Institutional Review Board at The University of Southern Mississippi. Informed consent was obtained from all participants before data collection procedures began.

Phase 1: Item Creation

The objective of this phase was to create items for the instrument and to ensure its content validity. Content validity is the degree to which the instrument accurately reflects and includes all elements of the construct being measured (Burns & Grove, 2005; Orcher, 2005). In addition to adapting items from the diffusion literature, new items were developed to establish content validity of the instrument. A content analysis was conducted through expert and community panel group discussions. The purpose of the group discussions was to 1) identify and define other attributes of the DGAs that may not include the five key attributes (relative advantage, compatibility, complexibility, trialability, and observability) identified by Rogers (1995); and 2) define Rogers' five key innovation attributes as they relate to a healthy diet. It was intended to define attributes a priori, which assisted in the assessment of construct validity (Moore & Benbasat, 1991). It should be noted that the phrase, *healthy diet innovation* (HDI), will be used hereafter in reference to the DGAs that include recommendations for fruits, vegetables, whole grains, lean protein and limiting solid fats and added sugars.

Study Participants

The expert panel consisted of a purposeful sample of nutrition experts with the credentials of registered dietitian (RD). The intention for using nutrition experts was to ensure accuracy of the subject matter being discussed as well as adequate content coverage. The community panel consisted of a convenience sample reflective of women in the LMD as well as diverse backgrounds. The intention for using individuals from the community with diverse backgrounds was to ensure a range of perspectives on the topic is captured (Moore & Benbasat, 1991).

Recruitment. Participants for panel discussions were recruited from a pool of local RDs who were members of the local professional organization or who were working in local facilities in the Hattiesburg, MS area. Participants were identified through the professional organization's membership directory and/or professional contacts of the researcher. Community panel participants in phase one were recruited by referral of expert panel participants and/or professional and personal contacts of the researcher living in the Hattiesburg, Mississippi area. Participants were contacted by phone or email to request participation. All panel members received lunch or light refreshments as a token of appreciation for their time.

Research and Data Collection Procedures

In phase 1, a qualitative approach was used to identify and define new attributes related to using an HDI, establish operational definitions of the proposed innovation attributes identified by Rogers (1995) and develop items for the instrument. Three panel group discussions composed of experts in the nutrition field and individuals without

expertise in nutrition, but who may have participated in nutrition or health-related programs or activities, were conducted.

Panel members were asked to identify and define other attributes that would promote the adoption *and* implementation of the 2005 DGAs as a healthy diet. Tornatzky and Klein (1982) suggested that an ideal study should measure both adoption and implementation processes as dependent variables to fully capture the innovation-decision process, not just the adoption decision. Furthermore, Rogers (2003) recommended that researchers obtain additional attributes of innovations to ensure that the target population's perceptions of an innovation are adequately captured. Based on Rogers' five key attributes and the identified attributes of the 2005 DGAs in this phase, instrument items were developed to generate an initial pool of statements for which respondents would indicate agreement. Statements were written in a format that was either clearly positive or clearly negative (Likert, 1932). Additionally, Ajzen and Fishbein (1980) suggested specifying the elements of the behavior in question to obtain an accurate indication of participant responses. Therefore, the item format included the following components: the behavior (using an HDI), the target at which the behavior is directed (the HDI), the context the behavior is used in (in one's daily eating patterns), and the time frame of performing the behavior (in the present or in the future). In addition to the new items created as a result of these panel discussions, existing items found in the literature reviewed herein were adapted to develop the instrument.

Open-ended questions were asked regarding the healthy diet innovation attributes and corresponding definitions. The question guide was framed according to the DOI theory and Rogers' (1995) taxonomy of innovation attributes and previous literature

regarding DOI theory and related constructs. Each panel discussion was audio recorded to provide an accurate record of the conversation as recommended by Creswell (2005). A note taker was also there to capture observations among the participants and to take notes pertinent to the discussion in the event the recorder malfunctioned.

Data Analysis

Phase 1 addressed the first research objective of this research project, which was to develop a scale that demonstrates adequate validity. Validity is the degree to which the instrument accurately measures what it is designed to measure (Burns & Grove, 2005). The focus of phase 1 was to ensure content validity of the instrument. For this objective, phase 1 data were analyzed for content validity based on the DOI theory and the diffusion research literature.

Panel discussions were transcribed and then analyzed or coded for common themes and definitions between the two groups. Coding procedures consisted of pre-determined codes based on the five key attributes previously discussed. Additionally, transcripts were reviewed for unintended codes or themes related to the healthy diet innovation that emerged.

After data analysis, a *member checking* strategy with a subset of the participants from the panel group discussions was implemented. Member checking is a strategy used in qualitative research to assist in establishing *interpretive validity* (Lincoln & Guba, 1985). Interpretive validity is the extent to which the researcher accurately understood what the participants' said about the study subject (Johnson, 1997). It is a verification of the meaning the researcher assigned to the data. This strategy was used to reach consensus of attribute definitions that emerged from the discussions. An instrument was

developed for the member checking strategy in which a random selection of 20% of the participants from each panel was asked to indicate their agreement (yes/no) with the created definitions; panel members were asked to make recommendations for revising the definitions if they did not agree with the listed definition. The instrument was emailed to panel members who were asked to return the completed instrument within a two-week timeframe. The results of the analysis assisted the researcher in creating items for the instrument.

Phase 2: Scale Development

The objective of this phase was to assess the face and content validity of the items. Participants in this phased sorted items created in phase 1 into categories based on similarities and differences of the items. This method is known as *card sorting* and was used by Moore and Benbasat (1991) to develop a scale measuring perceived attributes of an informational technology innovation. This instrument development method may help refine construct definitions of the innovation as well as help clarify any construct issues previously found in the literature, such as the collapsing of relative advantage and compatibility sub-scale items. Further explanation of the card sort methodology is described below. At the end of this phase, items and an initial instrument were drafted for which face and content validity were assessed using an expert panel for item review and a convenience sample for instrument mechanics review.

Study Participants

A different convenience sample of individuals participated in the card sorts. Participants consisted of individuals in the general population, representing diverse backgrounds, as well as individuals representative of the target population (individuals

who have participated in nutrition- or health-related programs). Using participants with diverse backgrounds ensured that a range of perceptions was included in the analysis and helped to avoid potential bias of the results (Moore & Benbasat, 1991). The final number of participants in this phase was determined by the card sort patterns and the similarity of the categories created by the participants (Spencer, 2009). If patterns were consistent among participants after a number of sorts and data saturation was reached, additional sorts were not necessary. After the card sorts, the remaining instrument items were evaluated for clarity, redundancy, and construct coverage by a purposeful panel of reviewers consisting individuals who have expertise in nutrition, diffusion theory, and/or instrument development. Once the final items were determined, an initial instrument was drafted and assessed for instrument mechanics using a convenience sample to comment on the instructions, wording, and length.

Recruitment. Participants for the card sorts were recruited from the faculty and staff members of the university and/or individuals who were participating in or who may have previously participated in nutrition- or health-related programs. The item review panel and participants for the instrument mechanics assessment were identified and recruited through referral by dissertation committee members or professional and personal contacts of the researcher.

Research and Data Collection Procedures

The research procedures for phase 2 included open and closed card sorting techniques to assess face validity of the items and to eliminate any items that may be ambiguous. Face validity is an evaluation of how the instrument appears to measure the content (Burns & Grove, 2005). Although not considered a strong indicator for

instrument validity, the assessment of the mechanics and appearance as it relates to clarity of instructions, clarity of the wording, and the length of the instrument is still considered useful information for instrument development and is advisable (Crocker & Algina, 1986). Information obtained regarding the face validity of the instrument was used to draft the instrument for the pilot test.

In the open sort, index cards with the instrument items printed on them were shuffled randomly for presentation to the participants. Before the sort began, instructions were read to the participant and a smaller trial sort was conducted using a set of 10 card samples unrelated to the present study to assess understanding of the instructions. Additionally, the trial sort was done to ensure that the participant understood the idea of sorting the cards based on an underlying construct for each category and to sort the items into categories that best reflected that construct. Furthermore, the trial sort was to make the participant aware of items that may be ambiguous or do not fit into any category. After giving instructions and a trial card sort, the participant began the sort. Participants worked independently and sorted items into categories based on similarities. Blank cards were given to the participant to label and briefly describe created categories. Having the participants provide labels for the categories was an attempt to verify the face validity of the items.

The researcher was the facilitator of the card sort and was available during the sort to answer questions and clarify content listed on the cards, as well as take notes to capture any interesting observations. When each participant was finished sorting, the cards were collected and bundled by category, put in a zippered plastic bag, and labeled by a participant identification number to keep track of each participant's unique sort. A

digital photograph was taken to capture the participant's layout of the cards in case cards became misplaced or out of sequence. The titles of the created categories by each participant, as well as item placement within each category, were entered into a Microsoft Excel spreadsheet template designed for card sorting analysis (Spencer, 2009). Items were eliminated as described below under the *Data Analysis* section.

Another set of participants performed the closed card sort in which key attributes and definitions created in phase 1 were provided as categories; a *Too Ambiguous/Doesn't Fit* category was also included. Instructions and the trial sort were repeated as in the open sort with the exception of giving the participants the created categories. The sorting procedures were the same as for the open sort as well as the data collection procedures described above. Participants sorted the remaining items from the open card sort accordingly for each category. The closed sort was conducted to assess face validity of the items based on the percent agreement of item placement among participants.

Face and content validity of the initial items and the resulting instrument was assessed by composing a list of items for each construct based on the results of the card sorts. An expert review panel was asked to evaluate the items using the following criteria:

1. Is the item worded clearly?
2. Is the item relevant to the construct being measured?
3. Is the item redundant? If so, which item is it redundant with?
4. Is there any item and/or construct that may be missing with regards to the innovation? If so, please identify and explain the reason why it should be added.

Revisions were made as necessary and the instrument was drafted. The drafted instrument was self-administered to a convenience sample to comment on the mechanics of the instrument related to instructions, wording, and length. Comments and suggestions were collected and changes were made accordingly.

Data Analysis

This phase addressed the first research objective of this research project, which was to develop a scale that demonstrates adequate validity. The focus for phase 2 was to establish face and content validity of the instrument.

In phase 2, the card sorting activity was used to assess face validity the items to ensure the items were adequately describing the construct for which it was written. Additionally, a measure of the frequency of items placed in the target construct was assessed. Data from each card sort were analyzed using the card sorting spreadsheet template. Item placement by category was analyzed for frequency (i.e., ≥75% of the judges placed an item in the intended construct/category).

Phase 2 also addressed the second objective of this research project, which was to develop a scale that demonstrates adequate reliability. One type of reliability is inter-rater reliability, which is the comparison of two or more observations (Burns & Grove, 2005). In phase 2, reliability was assessed by calculating the percentage of items placed in the target construct by all participants; the higher the percentage, the higher the degree of agreement (Moore & Benbasat, 1991). Moore and Benbasat (1991) described this technique as more qualitative since there are no established guidelines for good placement. However, Spencer (2009) considered 75% as a high agreement score. Additionally, Newton et al. (unpublished manuscript) in a similar sorting procedure for

item reduction used a 75% agreement standard for item elimination. Therefore, items with 75% or more agreement was used as the cut point for retaining an item; items with medium agreement (<43% but >75%) were retained if the item was strongly reflected in group panel discussion in phase 1. Items perceived as ambiguous were considered for elimination.

Phase 3: Instrument Testing

The objective of this phase was to assess reliability and construct validity of the scale. This phase included a pilot test and a field test. Crocker and Algina (1986) recommended pilot testing items on a small sample to review items for necessary revisions. After instrument administration of each test, psychometric analyses were performed to measure properties of the item scores to establish internal consistency. Construct validity is the degree to which instrument scores reflect the construct that the instrument is intended to measure. Internal consistency is a method that estimates how consistently respondents performed across items within a construct in the scale (Crocker & Algina, 1986).

Study Participants

Phase 3 pilot test participants consisted of a purposeful sample adults participating in the MCHL feasibility study. Field test participants consisted of a purposeful sample of adults participating in the MCHL main study. The number of participants of the field test was determined based on the final number of instrument items, or approximately 10 participants per item (Nunnally, 1978).

Recruitment. Phase 3 pilot test participants were recruited from the MCHL feasibility study. Phase 3 field test participants were recruited from the MCHL main study in the LMD.

Research and Data Collection Procedures

The instrument was drafted as a result of the formative methods used in phases 1 and 2. It consisted of statements to which respondents indicated degree of agreement or disagreement in a 4-point continuum ranging from *Strongly Disagree* to *Strongly Agree* suggested by Likert (1932). Points were assigned to each level of strength with 1 indicating the lowest level of positive support and 4 indicating the highest level (e.g., 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly Agree*). The initial self-administered instrument was pilot tested with MCHL feasibility study participants at the final data collection. Item analysis was conducted for internal consistency and revisions were made as necessary. A field test of the revised instrument was self-administered to MCHL main study participants at the initial study enrollment and data collection. Informed consent was obtained from all participants before survey administration. All participant responses were entered into SPSS version 17 for analysis.

Data Analysis

Phase 3 addressed the first and second objective of this research project, which was to develop a scale that demonstrates adequate validity and reliability. Data analysis for the pilot test as well as the field test is described.

Pilot test. The main focus of the pilot test was to assess for difficulty and length of time in completing the instrument. Additionally, the instrument was assessed for internal consistency reliability. Reliability is a measure of consistency of test scores when

administering an instrument to the same individuals at two different times (Crocker & Algina, 1986). Reliability can also be described as an indicator of random error of the measurement method. Instruments that are reliable with little random error are important to researchers because they have the power to enhance power of the study and detect significant differences among the target population (Burns & Grove, 2005).

When a single test administration is the chosen method, internal consistency procedures are used (Crocker & Algina, 1986). An instrument is considered to have *item homogeneity* when individuals score consistently across items. The common statistic used to measure internal consistency reliability is Cronbach's alpha coefficient that ranges from 0.00 (no consistency) to 1.00 (perfect consistency) (Burns & Grove, 2005). Alpha coefficients ranging from .50 to .60 are considered acceptable in the early stages of research (Nunnally, 1967). Since the internal consistency of an instrument or its sub-scales can be affected by poorly written items and flawed test construction, the procedure used to estimate reliability of the pilot instrument was Cronbach's alpha coefficient set in the range of .50 to .70. Items that were negatively worded were re-coded prior to analysis. Inter-item correlations, the item-total correlations, and the effects on alpha if the item were deleted were used to determine which items were candidates for deletion from the scale. Items with an inter-item correlation < .30 and > .80 and item-total correlation < .25 and > .70 were considered candidates for elimination, as well as, items that would increase Cronbach's alpha if the item was deleted (Holcomb, 2009; Nunnally & Bernstein, 1994). To ensure adequate content for each construct, construct coverage was assessed before any items were deleted. Pilot test data were analyzed using SPSS Version

17. Based on the results of the reliability testing, the instrument was revised for the field test.

Field test. Exploratory factor analysis (EFA) is an analysis procedure used to establish preliminary construct validity (Burns & Grove, 2005; Moore & Benbasat, 1991). Exploratory factor analysis aims to measure latent variables, otherwise known as constructs, dimensions, or *factors* (Kline, 1994). A factor is defined as a construct that is defined by the factor loadings (Royce, 1963). In turn, a factor loading is the correlation between variables that account for the factor (Kline, 1994). Items that are closely related will load into one or more various factors. Conversely, items that do not load or have low loadings may be because they do not correlate with the other items that indicate the factor or they are poorly written. These items should be considered for elimination or rewritten. Therefore, an EFA was used for analyzing field test data to detect the underlying constructs as well as to reduce number of items.

Exploratory factor analysis was performed to determine the underlying factors with the fewest number of items that would adequately explain the correlations among participant responses. Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were calculated to assess if the correlations among the items were adequate and to determine if the data were factorable. Larger values of the Barlett's test of sphericity are preferable, indicating sufficient, but not significant, correlations between items.

Principal axis factoring (PAF) was used for factor extraction with oblique rotation, as it was assumed that the constructs of interest were correlated (Rogers, 2003). PAF extraction was the method of choice since it was considered to be a more accurate

indicator of model fit for instruments that are theory-driven (Nunally & Bernstein, 1994; Tabachnick & Fidell, 2001). In an attempt to obtain the simple structure solution, the criteria used for factor retention included a) theoretical basis; b) amount of cumulative percentage of variance explained by the factors; c) a visual examination of a scree plot to determine the best model represented by the data; and d) at least three items loaded on a factor. Criteria for item retention included a) items with substantive loading (>.35); b) items did not load substantively on more than one factor (>.35); and c) items made theoretical sense relative to the factors (Comrey & Lee, 1992; Pedahzur and Schmelkin, 1991). Internal consistency reliability of the resulting sub-scales was estimated using Cronbach's alpha coefficient set in the range of .50 to .70.

The final objective of this research project was to assess the predictive validity of the scale. Predictive validity is a type of criterion-related validity that determines if test scores predict a future behavior based on a performance criterion. Field test data were used to determine which of the sub-scales (i.e., *relative advantage, compatibility, complexity, trialability, observability*) resulting from the EFA had the greatest influence on HEI-2005 scores. HEI-2005 scores were calculated from participants' self-report of intake using a food frequency questionnaire. Regression analysis techniques were performed to determine the relationship between the independent variables and the dependent variable. Independent variables included sub-scale scores from the final EFA solution. The dependent variable was the HEI-2005, which indicates diet quality. Overall diet quality is based on a total score ranging from 0 to 100. An HEI score >80 is rated as good diet while a score of <51 is considered a poor diet.

The field test addressed the first objective of this research, which was to develop a scale that demonstrates adequate validity. Field test data were analyzed using SPSS Version 17 for item analysis, factor analytic and regression techniques, and internal consistency.

CHAPTER IV

MANUSCRIPT I: FORMATIVE RESEARCH METHODS USED IN THE DEVELOPMENT OF A HEALTHY DIET INNOVATION (HDI) INSTRUMENT

Formative research assists researchers in examining factors that influence how a study population perceives its environment and behaviors related to the research question or topic of study (Gittelsohn, Evans, Story, Davis, Helitzer, et al., 1999). Qualitative methods, such as focus groups, interviews and review of intervention materials, used in the formative research process can aid in the development of intervention components and measurement tools. While there is a large amount of literature on using formative research methods to develop interventions and related materials, there is much less reported on using formative research in instrument development (Gittelsohn, Steckler, Johnson, Pratt, Grieser, et al (2006). In the present study, qualitative research methods were used to inform the development of a quantitative instrument measuring the perceptions of adopting and implementing a healthy diet. The objective of this paper is to describe the formative phases of research for the development of an instrument to be used in a nutrition intervention in the Lower Mississippi Delta (LMD). The instrument will be used to assess individuals' perceptions of using a healthy diet based on the 2005 Dietary Guidelines for Americans (DGAs). The development of the instrument was guided by the Diffusion of Innovations (DOI) theory. Research has indicated the use of theory-based, valid and reliable instruments that are culturally appropriate to measure activities related to the adoption and implementation of health behaviors may help measure the success of a program (Steckler, Goodman, McLeroy, Davis, & Koch, 1992).

The DOI theory provides a useful conceptual framework for behavioral interventions. *Diffusion* is defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system," where *innovation* is considered as a new idea, practice or object (Rogers, 2003, p. 5). The theory posits that there are certain "attributes" that influence the adoption of a health behavior – or – *innovation*. Although an innovation can have many attributes, according to Rogers (1995), there are five in particular that contribute most to the rate of adoption: *relative advantage, compatibility, complexity, trialability, and observability.* The attributes are defined as:

- Relative advantage: Degree to which an innovation is better than previous idea, practice, object
- Compatibility: Degree to which an innovation is perceived as being consistent with current values, experiences, needs
- Complexity: Degree to which an innovation is perceived as difficult to understand and use
- Trialability: Degree to which an innovation can be experimented with on a limited basis
- Observability: Degree to which the results of an innovation are visible to others or can be easily communicated

While this theory may be helpful in understanding health and nutrition behaviors, at the time of this study, there were no instruments found in the nutrition or public health literature that measured the perceived attributes of a dietary innovation to assess nutrition interventions. Most of the instruments found were related to measuring the perceived

attributes of technology innovations or attributes related to the adoption of a policy, program or curriculum (Atkinson, 2007; Hoelscher, 2001; Hurt & Hibbard, 1989; Moore & Benbasat, 1991, Pankratz, Hallfors, & Cho, 2002; Steckler, Goodman, McLeroy, Davis, & Koch, 1992). Additionally, different innovations will have various and distinctive attributes perceived by potential adopters that would influence innovation adoption. Therefore, Rogers (2003) suggested formative research with potential adopters to determine innovation attributes for the development of unique instruments pertinent to the study.

Background and Significance

The Delta Obesity Prevention and Research Unit Project

The LMD is a rural region that is rich in agricultural resources but is one of the most impoverished areas in the U.S. (Delta State University [DSU], 2011). The LMD includes counties in Arkansas, Louisiana, and Mississippi, is predominantly African American, and is characterized by high levels of poverty and low levels of educational attainment, both of which are predictors of poor health **(**Feinstein, 1993; National Institutes of Health [NIH], 1998). The Delta Nutrition Intervention Research Initiative [NIRI] Consortium (2004) reported LMD adults as having higher rates of obesity and diet-related chronic diseases as compared to U.S. adults. Specifically, self-reported health conditions such as diabetes, high cholesterol and hypertension in the LMD indicated a higher prevalence compared to national data. Of these states, Mississippi ranked highest in the nation for prevalence of overweight and obesity at 34.3% and 34.5% respectively in 2010 (Centers for Disease Control and Prevention [CDC], Behavioral Risk Factor Surveillance System [BRFFSS], 2010). Poor dietary quality may be a contributing factor

to the chronic health conditions among this population. Prior research has indicated a need for improving the overall dietary quality in the LMD (McCabe-Sellers et al., 2007; Thomson et al., 2011). However, there is a lack of theory-driven, rigorously evaluated research on the implementation of effective nutrition interventions in the LMD. With poor dietary quality, as well as poor health conditions among the LMD population, opportunities for nutrition intervention exist. The Delta Obesity Prevention Research Unit (Delta OPRU) was formed by the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA) in response to the prevalence of obesity and poor dietary quality in the LMD. The mission of the Delta OPRU is to "enable rural Lower Mississippi Delta individuals and families to adopt food and physical activity guidelines for sustaining healthy weights, preventing obesity, and reducing risk factors for obesity related chronic diseases" (US Department of Agriculture [USDA], Agricultural Research Service [ARS], 2010). Seven institutions collaborate under this cooperative agreement initiating research projects throughout the LMD to achieve this mission.

One of the projects that emerged from the Delta OPRU was the Mississippi Communities for Healthy Living (MCHL) nutrition intervention. The overall goal of the MCHL intervention is to develop and implement a nutrition educational program to promote the adoption of the DGAs using culturally appropriate foods. A specific objective of the intervention is to identify appropriate food substitutions that, if consumed, would positively influence Healthy Eating Index-2005 (HEI-2005) scores among adult women in the LMD; the HEI-2005 is a measure of dietary quality. The MCHL intervention includes strategies for recognizing the advantages of making dietary changes, as well as, increasing self-efficacy, and providing social support for positive

changes. Six education sessions have been uniquely designed for the MCHL intervention using the DOI theory as a conceptual framework. The instrument described herein will be utilized as an assessment tool for the nutrition education intervention. Rogers' five key attributes, as well as new attributes identified as a result of this formative research, were used to develop the MCHL intervention components in an effort to influence the adoption and implementation of a healthy diet.

Women were chosen as the primary target of the MCHL intervention, as women are often regarded as the gatekeepers of nutrition for their families and the greater community (Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999; McIntosh & Zey, 1998). Additionally, women participating in social and civic clubs typically have higher educational attainment and social status and are considered opinion leaders in their circles. These characteristics are indicative of early adopters of new ideas and practices, and because early adopters are considered as a trusted resource in their communities, they are likely to have a greater influence on those who are slower to adopt new ideas and practices (Rogers, 2003). Utilizing early adopters within these social and civic organizations is an attempt to diffuse the DGAs to their families and communities, ultimately promoting healthy eating patterns.

The discussion of the formative phases of the research project is the main focus of this paper. This two-phase study included item creation and scale development, and had four main objectives: a) to identify and define attributes of a healthy diet; b) to redefine Rogers' five key attributes of innovations relative to a healthy diet; c) to develop initial instrument items that will be used to evaluate perceptions of implementing a healthy diet; and d) to assess face validity of the items. This study was approved by the Institutional

Review Board; informed consent was obtained from all participants before proceeding with study methods.

Method

Phase 1 Item Creation: Identification and Defining of Attributes

Phase 1 of the study included a content analysis of the DGAs. The purpose of the content analysis was to identify and define attributes. As Rogers (2003) suggested using potential adopters of an innovation to identify its attributes, expert and community panel group discussions were conducted to identify characteristics of the DGAs that would influence individuals participating in a nutrition intervention to adopt and implement the DGAs as part of their daily eating patterns. Questions were asked to elicit responses that could be used as items for the instrument that would be empirical indicators of the attributes (Knapp, 1998; Morse & Field, 1995). The objectives of the group discussions were to a) identify and define attributes of the DGAs that may not include the five key innovation attributes (relative advantage, compatibility, complexity, trialability, and observability) identified by Rogers (1995); and b) define Rogers' five key innovation attributes as they relate to a healthy diet. It should be noted that the phrase, *healthy diet innovation* (HDI), will be used hereafter in reference to the DGAs that include recommendations for fruits, vegetables, whole grains, lean protein, solid fats, and added sugars.

Panel group discussion procedures were guided by the DOI theory. The group discussion facilitator used a topic guide that specifically explored Rogers' five key attributes of a healthy diet for both panels. Background information about the research project was explained at all panel discussions. Participants received handouts that listed

the 2005 DGAs, noting that they reflected a healthy diet. Additionally, participants received a handout that listed Rogers' five key attributes and the corresponding definitions. For each of Rogers' attributes, the facilitator asked how the definition could be adapted for a nutrition innovation. For example, panel participants were asked, "*How would you define relative advantage as it relates to the DGAs? How is the adoption of the DGAs better than someone's current eating patterns?"* Lastly, panel participants were asked how any new characteristics or attributes different from Rogers' that emerged from the discussions might be defined.

Phase 2 Scale Development: Assessment of Face Validity of the Items

Items were written with the defined attributes in mind, with some items adapted from the diffusion literature (Hurt & Hibbard, 1989; Moore & Benbasat, 1991). Phrases and concepts from the panel discussions transcripts were used to develop the items. The item format included behavior (using an HDI), the target at which the behavior is directed (the HDI), the context of the behavior is used in (in one's daily eating patterns), and the time frame of performing the behavior (in the present or in the future) (Azjen & Fishbein, 1980).

Following the procedures used by Moore and Benbasat (1991), the research procedures for phase 2 included *open* and *closed* card sorting techniques to assess face validity of the items, determining if the items are describing the theorized attribute for which it was intended. Card sorting is a method in which participants are provided a set of cards that has the topic of study written on each, in this case, the instrument items. Cards are numbered for tracking purposes and has one item printed on each; the cards are shuffled in random order before they are given to the participants. In an open sort,

participants are asked to categorize the cards based on the similarities of the card topic. After the sorting, participants are asked to label or describe their categories. In a closed sort, predetermined categories are provided and the participants sort the cards accordingly based on how they perceive the cards relate to a given category. This method is also useful for eliminating any items that are perceived as ambiguous.

For both the open and closed sort, all participants worked independently. Each item was printed on a numbered 3 x 5-inch card and shuffled randomly for presentation to each sorting participant. The facilitator read the sorting instructions to each participant and conducted a trial sort to assess understanding of the instructions and to ensure that the participant understood the concept of ambiguous items (see Figure 2). The trial sort used a set of 10 card samples unrelated to the present study. The participant was asked to sort the trial cards into categories and to identify and label any cards they perceived as ambiguous or that didn't fit in any of the other categories. Once instructions were clarified, each open sort participant was asked to sort the 69 instrument items into categories based on item similarities and to briefly describe the category on blank cards. Each participant was instructed to categorize items they thought didn't fit as *Ambiguous*. After each sort, cards and the respective categories were recorded. At the conclusion of the open sorts, cards were analyzed for overall placement frequencies. Any items that were considered as ambiguous or didn't meet desired placement frequency (see Data Analysis), were eliminated from the card set before conducting the closed sort.

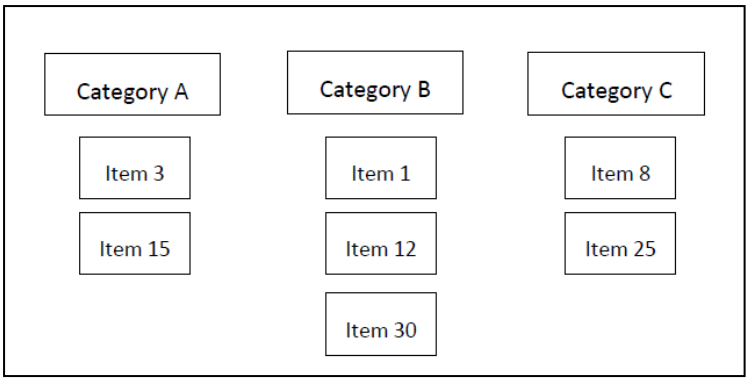

Figure 2. Card sorting instructions example.

Different participants performed a closed card sort in which key attributes and definitions created in phase 1 were provided as pre-determined categories; a *Too Ambiguous/Doesn't Fit* category was also included. Instructions and the trial sort were repeated as in the open sort with the exception of giving the participants the pre-determined categories. Participants sorted the remaining items from the open card sort accordingly for each category. As in the open card sort, cards were recorded for each category and analyzed for desired placement frequencies.

Participants for phase 1 panel discussions. A purposive sample of registered dietitians (n = 6) were identified from the state and local dietetics organizations and invited to participate as content experts on an expert panel. A convenience sample was used for two community panels (n = 13) that included professional contacts of the researcher and referrals from participating panel members. Most participants were between the age of 26 and 40 years (n =10), had a college or graduate/professional degree (n = 16), and all belonged to some type of social or civic organization. Participants were asked if they belonged or participated in any community outreach programs, as the target population for MCHL included women in social and civic organizations.

Participants for phase 2 card sorts. A convenience sample of 16 participants was used for the open and closed card sort (n = 7, n = 9, respectively). Participants were recruited from professional and personal contacts of the researcher and referrals, representing diverse backgrounds. The majority were female (n = 14) and between the ages of 31 and 50 (n = 10), had some college or college degree (n = 10), and most belonged to a civic or social organization (n = 13). The same demographic questionnaire for panel discussion participants was used for card sort participants to ensure representation of the target population.

Data Analysis

Phase 1 Panel Discussions

Panel discussions were audio-recorded. The researcher transcribed and analyzed the data based on pre-determined codes representing the relative advantage, compatibility, complexity, trialability, and observability attributes. Additionally, transcripts were reviewed for unintended codes or themes related to the HDI. After transcript analysis, the researcher established and verified definitions for the five key attributes and any new attributes that emerged from the discussions using a *member checking* strategy. Member checking is used in qualitative research to ensure that the researcher accurately understood and represented what the participants said about the study subject (Johnson, 1997). This strategy was used to reach consensus of attribute definitions. The process of member checking began by randomly selecting 20% of the participants from each panel. Once selected, these participants were provided a form and asked to indicate their agreement (yes/no) with the created definitions. Participants were

also asked to make recommendations for revising the definitions if they disagreed with the listed definition.

Phase 2 Card Sorts

Placement of items in respective categories for each sort was entered into a Microsoft Office Excel 2007 spreadsheet designed specifically for card sorting analysis (Spencer 2009). As this was a formative exploratory analysis, the sorting spreadsheet allowed the researcher to identify key patterns in the data as well as capture words participants used to describe their categories.

The researcher standardized the categories created by each participant. As shown in Figures 3 and 4, two participants labeled the item, *When I eat a healthy diet, it makes me feel better,* as "Benefits of a Healthy Diet" and "Benefits of Eating a Healthy Diet"; these two categories were standardized to "Benefits." The researcher determined the standardized name for the category based on the basic concept of the category label. This step was done to give a shorter and consistent name to participants' category labels and to easily identify overall schemes of item placement (Spencer, 2009).

Card #	Item	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant7
6	When I eat a healthy diet it makes me feel better.	Benefits of a Healthy Diet	Benefits of Eating a Healthy Diet	Physical and Mental Energy	Perceptions of Healhty Eating	Health Benefits of a Healthy Diet	Personal Benefits	Benefits of a Healthy Diet
31	I try healthy meals at restaurants when they are offered.	Actively Eating Healthy	Steps to a Healthier Diet	Eating Healthy Out	Opportunity to Try	Healthy Eating While Eating Away from Home	Helping othes to be healthy	Personal Choices Related to a Healthy Diet
53	There are a variety of healthy foods that are convenient to prepare.	Convenience of Healthy Foods	Convienience & Affordability	Convenient	Healthy Food Availability, Convenience	Convenience of a Healthy Diet	Convenience of Healthy Foods	Convenience/ Access to Healthy Food
57	When I eat a healthy diet it helps me avoid chronic diseases like high blood pressure, high blood sugar, obesity, etc	Benefits of a Healthy Diet	Benefits of Eating a Healthy Diet	Disease Prevention	Knowledge of Healthier Eating	Health Benefits of a Healthy Diet	Personal Benefits	Benefits of a Healthy Diet
66	Eating a healthy diet sets and example for future generations.	Educating Others	Educating Youth	Model to Others	Leading the way to healthier eating	Role Modeling	Healthy diet is ____.	Influence on Others

Figure 3. Open sort: Summary of participants' category labels.

Card #	Item	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant7
6	When I eat a healthy diet it makes me feel better.	Benefits	Benefits	Benefits	Perceptions	Benefits	Benefits	Benefits
31	I try healthy meals at restaurants when they are offered.	Implementation	Steps	Eating Out	Implementation	Eating Out	Model	Implementation
53	There are a variety of healthy foods that are convenient to prepare.	Convenience	Convenience	Convenience	Convenience	Convenience	Convenience	Convenience
57	When I eat a healthy diet it helps me avoid chronic diseases like high blood pressure, high blood sugar, obesity, etc	Benefits	Benefits	Disease Prevention	Knowledge	Benefits	Benefits	Benefits
66	Eating a healthy diet sets and example for future generations.	Education	Education	Model	Model	Model	Perceptions	Model

Figure 4. Open sort: Summary of standardized category labels.

Items were considered for the closed sort and the pilot instrument based on high agreement (≥75%) amongst participants for placement in a common category. An item with medium agreement (≥43% and <75%) amongst participants was considered for the closed sort if it was strongly reflected in the panel discussions and resulting attribute definitions and/or the literature. If an item would diminish construct coverage if omitted or if the item was strongly reflected in the group panel discussions, it was retained even if there was less than 43% agreement amongst participants. Although item placement frequencies were analyzed, this analysis is considered qualitative, as it is not as rigorous an analysis method as other quantitative methods (Moore & Benbasat, 1991). Moreover, at the time of the present study, there was no literature to support acceptable levels of agreement by card sorting participants. However, ≥ 75% was the "high" agreement level used in Spencer's (2009) analysis template and Newton et al. (unpublished manuscript) in a similar sorting procedure for item reduction used a 75% agreement standard for item elimination. Therefore, ≥ 75% was used as the high agreement level in the present study.

Findings and Interpretation

Phase 1 Panel Discussions

Guided by the DOI theory, the facilitator asked the panel participants questions that would help identify attributes of using an HDI. For example, *"What are some characteristics about the DGAs that would promote using one or more of the recommendations?"* and *"What are some characteristics that make the recommendations easy to incorporate into someone's daily eating patterns?"* The expert and community panel discussions resulted in a total of eight attributes of an HDI, including Rogers' five key attributes (see Table 1). All attributes were defined relative to adopting and implementing an HDI. Two to four panel participants selected randomly from each group discussion received the member check form listing the eight attributes and corresponding definitions. All participants agreed that the definitions were reflective of the discussion and minor revisions were suggested.

Table 1

Identified and Defined Attributes of a Healthy Diet Based on the 2005 DGAs

Attribute	Attribute Definition
Relative Advantage	The degree to which implementing components of a healthy diet is better than previous eating patterns, increasing one's overall well-being (identifiers of RA include: balanced nutrition, not restrictive, less expensive, and increased energy levels)
Compatibility	The degree to which components of a healthy diet are adaptable to one's dietary needs and/or cultural food preferences
(Low) Complexity	The degree to which components of a healthy diet are easy to incorporate into one's diet
Trialability	The degree to which components of a healthy diet can be gradually incorporated into one's lifestyle to make small and sustainable changes
Observability	The degree to which components of a healthy diet can be modeled or shared and positive outcomes are evident
Portability	The degree to which components of a healthy diet are convenient and readily available for today's "on the go" lifestyle
Protective	The degree to which components of a healthy diet can help in preventing and/or managing chronic disease (i.e. high blood pressure, high blood sugar, obesity, etc)
Generational	The degree to which healthy lifestyle behaviors are passed on to younger generations

The three additional attributes identified to promote the adoption and implementation of a healthy diet were *portability*, *protective, and generational*. Participants found that a healthy diet could be convenient and appropriate for an "on the go" lifestyle. For example, one participant said, *"They are very accessible to modern living, acceptable for on the go women."* There were numerous comments about the portability of fruits and vegetables and "*There are so many on the go products"* was

noted by another participant. Participants also remarked on the protective effects of a healthy diet and the prevention or management of chronic disease. Several participants stated that individuals could also stop taking medications. *"If you have diabetes, controlling blood sugar and getting off medication is an advantage,"* one participant said. Lastly, a common theme threaded throughout all three panel discussion groups was the desire for lifestyle changes starting in the family so that it becomes part of the culture and passed on to future generations. *"The DGAs become incorporated into the family and becomes a behavior, becomes generational,"* said one panel participant when asked about advantages of the DGAs. Other examples of this theme include comments like, *"becomes a trend of healthier eating, like generational,"* and *"we need to start somewhere to start to change the culture…."* Table 2 summarizes participants' responses as they relate to each attribute. Pairing the expert panel responses with community panel responses shows a consistency of their responses across the groups.

Table 2

Attribute and Related Participant Responses

Attribute	Summary of Selected Responses	
	Expert Panel	Community Panel
Relative Advantage	Well balanced. Does not exclude any food groups. Energy level is better. They Just feel better. It's free.	Balanced nutrition. Nothing is prohibited, limited, but not prohibited. Energy overall. When you eat better, you feel better. One would feel good physically if they followed the guidelines. Moods might improve as a result of the diet. Pre-packaged diets are expensive.

Table 2 (continued).

Attribute	Summary of Selected Responses	
	Expert Panel	Community Panel
Compatibility	Specific foods are not used; could be fit into other cultures. Seems more multicultural than traditional American diet. Familiar food preparation methods with these foods. No cultures that it would not be compatible—vegan, high meat intake; non-exclusive.	Beans can go in the crock pot and cook while you are working. There are choices within the categories to meet cultural religious preferences. Catfish in the delta—industry could provide the healthy foods.
Complexity	Time issue – steam packs – cooks quickly. Straight forward/not complicated; simple to follow.	It is how it is prepared that makes it easy. Measurements are recognizable by individuals; they know what a cup is.
Trialability	Do it in steps, not try it all at once. Not that they could not do it, but need to take the steps. Will get benefits with each step. Make small goals.	1-2 changes from the DGAs will result in the benefits that were listed in the beginning. This diet would promote the small changes. May not do them all every day, but want the overall benefits Gradual, all change should be gradual.
Observability	See that their friends are healthier and able to be more active. When they talk about feeling better, having energy, seeing their toes, stop taking their medication, saving money as a result of being on the diet.	Appearance in general—people start noticing that you are healthier. Higher energy levels Communicate through modeling your behavior. Lose a couple of pounds Communicate through modeling your behavior—serve fruits and vegetables rather than other high fat foods.

Table 2 (continued).

Attribute	Summary of Selected Responses	
	Expert Panel	Community Panel
Portability	Convenient. Portable and affordable. Just as easy to grab a bag of grapes vs. a bag of chips. More healthy convenience foods available for those that are too busy to eat healthy.	Some (foods) do not need to be cooked. Wash & eat – preparation is minimal. Fruits and vegetables are portable. Very accessible to modern living (100 cal snack packs, 100% juice, etc.) - acceptable for on the go women.
Protective	It's heart healthy. Reduce cancer risk. Lower cholesterol and blood pressure.	If you are a diabetic you can control blood sugar and get off of the medication. Can control cholesterol levels if limiting solid fats. Less health issues and susceptibility to things like colds.
Generational	Becomes incorporated into the family and becomes a behavior – becomes generational. These are lifestyle changes, not quick fixes.	Trend of healthier eating, like generational. The future generations like our children… if parents adopt this diet then it can roll downward Model healthy behaviors and healthy lifestyles.

Analysis of the panel discussions assisted the researcher in developing 69 items for the instrument. Common themes emerging from the discussion related to each attribute were used for writing items with each of the respective attributes in mind. Items from the diffusion literature were also adapted for an HDI and included in the item pool (Hurt & Hibbard, 1989; Moore & Benbasat, 1991). In the present study, items were written to reflect perceptions of *use*, *trial*, and *observations* of the HDI. Moore and Benbasat (1991) recommended writing items that reflect one's actual use of an innovation because diffusion of an innovation occurs when adopters *use* it, not just because of how the innovation is perceived.

Phase 2 Card Sorts

The open card sort resulted in 48 remaining items. Six of the items had high agreement (>75%) and 42 had medium agreement (>43% and < 75%). There were no items labeled as ambiguous in either agreement level. Categories created by participants were broad, but were reflective of the discussion of HDI attributes and definitions established in phase 1. The remaining items were most often placed under four standardized categories: Benefits (indicative of relative advantage), Convenience (indicative of complexity/portability), Model (indicative of compatibility/observability/generational), and Implementation (indicative of trialability); no new categories – or attributes – were created from the open sort.

The closed sort resulted in 37 remaining items. The majority of items (n = 26) were retained based on high agreement (>75%) amongst participants for placement in the targeted construct (attributes). Items (n = 11) with medium agreement (>43% and < 75%) were retained for the initial instrument if it was strongly reflected in the panel discussions or if it had high-medium agreement under a different construct. However, these items were re-written to better reflect the target construct or considered for the construct in which it was placed as a better indicator of that construct. Table 3 exhibits the list of items and the percent placement agreement among participants. In an effort to have at least five items per construct for the initial instrument, some new items were written and some items were written in a negative format to reduce acquiescence for a total of 45 items. The 45 items were reviewed for redundancy, content, and construct coverage by an expert review panel (n = 5). Revisions were made to the items and an initial instrument

consisting of 40 items was drafted using a 4-pt Likert scale ranging from 1, *Strongly Disagree* to 4, *Strongly Agree.*

Table 3

Percent Placement Agreement of Items in Open and Closed Sorts.

Item ($N = 48$)	Targeted Construct	Open Sort Agreement (%)	Standardized Construct Placement	Closed Sort Agreement (%)	Construct Placement
Eating a healthy diet is affordable.[a]	RA	71	Convenience	33/33[d]	RA/C
A healthy diet is less expensive than other commercial diets.[a]	RA	57	Convenience	44	RA
It is good for my body when I eat a healthy diet.[b]	RA	57	Benefits	56	RA
When I eat a healthy diet it helps me lose weight.	RA	71	Benefits	67	PR
When I eat a healthy diet, it makes me feel better.	RA	86	Benefits	78	RA
When I eat a healthy diet I have more energy.[b]	RA	71	Benefits	89	RA
A healthy diet does not restrict any foods.[a]	RA	43	Perceptions	56	Ambig uous
A healthy diet includes all types of foods for balanced nutrition.	RA	43	Knowledge	56	RA
When I eat a healthy diet it helps me reach my health goals.[a]	RA	86	Benefits	44/44[d]	RA/PT
I know how to adjust the way I cook to include healthy foods that are culturally acceptable during celebrations and traditional events.	CP	43	Preparation	100	CP
A healthy diet can be incorporated into my cultural food traditions.[b]	CP	43	Model	86	CP

Table 3 (continued).

Item ($N = 48$)	Targeted Construct	Open Sort Agreement (%)	Standardized Construct Placement	Closed Sort Agreement (%)	Construct Placement
I am able to find healthy foods that are consistent with my food preferences.[a]	CP	43/43[d]	Convenience/ Implementation	67	CP
I can adapt a healthy diet to my cultural beliefs and traditions.[b]	CP	43	Model	100	CP
I serve healthy versions of traditional foods during celebrations and traditional events.	CP	43	Model	67	CP
It is easy for me to prepare healthy foods.[b]	CX	29/29[d]	Convenience/ Preparation	78	CX
Following a healthy diet does not take a lot of effort.	CX	43	Convenience	78	CX
It is easy to find healthy foods that taste good to me.	CX	71	Convenience	78	CX
It is easy to eat a healthy diet when I do not have a lot of time.[a]	CX	71	Convenience	56	PO
Foods for a healthy diet are readily available where I live.[b]	CX	100	Convenience	56	PO
I try healthy foods when I have the opportunity.	TR	43	Implementation	78	TR
I try new healthy recipes at home to serve myself, friends and/or family.	TR	57	Model	56	TR
I try healthy meals at restaurants when they are offered.[a]	TR	57	Implementation	56	TR
Making small changes to my diet has made a positive impact on my health.[b]	TR	57	Benefits	56	TR

Table 3 (continued).

Item ($N = 48$)	Targeted Construct	Open Sort Agreement (%)	Standardized Construct Placement	Closed Sort Agreement (%)	Construct Placement
Incorporating healthy foods into my diet can be done at my own pace.[a]	TR	43	Implementation	44/44[d]	CX/TR
I show my friends and family how to eat healthy by example.[b]	OB	86	Model	78	OB
People usually make a comment to me when I eat a healthy meal.[a]	OB	57	Model	89	OB
I tell people how I feel when I eat a healthy diet.[a]	OB	86	Model	44	OB
I can explain to someone how to eat healthy.[c]	OB	57	Model	56	OB
Since I have been eating a healthy diet, others have noticed a difference in me.	OB	43	Model	100	OB
People who eat a healthy diet appear to have more energy.[b]	OB	43	Benefits	78	RA
I see positive results when people eat a healthy diet.	OB	43	Model	78	OB
Healthy foods are convenient.[a]	PO	71	Convenience	44/44[d]	CX/PO
Healthy foods are easy to take with me when I am traveling.	PO	57	Convenience	100	PO
There are a variety of healthy foods that are convenient to prepare.	PO	100	Convenience	44	CX
There are healthy food choices available at fast food restaurants.[b]	PO	57	Convenience	78	PO
When I am in a hurry, healthy foods are quick and easy for me to grab.[b]	PO	57	Convenience	89	PO

Table 3 (continued).

Item ($N = 48$)	Targeted Construct	Open Sort Agreement (%)	Standardized Construct Placement	Closed Sort Agreement (%)	Construct Placement
Eating a healthy diet helps me manage my health condition(s).	PR	57	Benefits	78	PR
When I eat a healthy diet it helps me avoid chronic diseases like high blood pressure, high blood sugar, obesity, etc.	PR	71	Benefits	89	PR
Eating a healthy diet is good for the whole body.[b]	PR	57	Benefits	67	RA
Eating a healthy diet offers protection against some diseases.[b]	PR	57	Benefits	100	PR
Eating a healthy diet helps keep me from having to take medications.[b]	PR	57	Benefits	100	PR
I pass down healthy recipes to my children.[b]	GN	71	Model	100	GN
I eat a healthy diet so the young people in my life can learn from me.	GN	71	Model	89	GN
I make healthy lifestyle choices so the young people in my life might also make healthy lifestyle choices.	GN	71	Model	100	GN
Healthy foods are convenient.[a]	PO	71	Convenience	44/44[d]	CX/PO
Healthy foods are easy to take with me when I am traveling.	PO	57	Convenience	100	PO
There are a variety of healthy foods that are convenient to prepare.	PO	100	Convenience	44	CX
There are healthy food choices available at fast food restaurants.[b]	PO	57	Convenience	78	PO

Table 3 (continued).

Item ($N = 48$)	Targeted Construct	Open Sort Agreement (%)	Standardized Construct Placement	Closed Sort Agreement (%)	Construct Placement
When I am in a hurry, healthy foods are quick and easy for me to grab.[b]	PO	57	Convenience	89	PO
I cook healthy for my family so they can make healthy food choices.	GN	57	Model	67	GN
A healthy diet can be passed on to younger generations.	GN	57	Model	89	GN
Eating a healthy diet sets an example for future generations.	GN	57	Model	100	GN
Healthy foods have become part of our family's tradition.[b]	GN	57	Model	56	CP

[a] Omitted from initial pilot instrument for redundancy or ambiguity after content, construct coverage, and mechanical reviews
[b] Rewritten after content, construct coverage, and mechanical reviews
[c] Rewritten in a negative format
[d] Agreement was split among the participants

Results of the card sort were also used to refine the attribute definitions. The open sort analysis revealed that some items may not have been accurately portraying the target construct. For example, participants perceived the item *Foods for a healthy diet are readily available where I live,* as "convenient". This item was originally written for the complexity construct, but as a result of the card sorts, this item was identified as an indicator of portability, and therefore, the portability definition was revised to include the words "readily available".

Participants also perceived items written for the protective and relative advantage constructs as benefits of a healthy diet in the open sort. For instance, participants placed the protective item, *When I eat a healthy diet it helps me to avoid chronic diseases like*

high blood pressure, high blood sugar, obesity, etc, and the relative advantage item, *When I eat a healthy diet it helps me lose weight,* in the standardized category "Benefits". This is understandable as these items could be perceived as positive outcomes and participants did not make a distinction between relative advantage and protective items per se, but rather grouped similar items under one overarching category. When participants received the constructs categories and definitions in the closed sort, the analysis confirmed that these two items did not conceptually fall in the two different constructs, but instead both items were perceived as protective. A possible explanation may be that weight loss ultimately is protective, and could prevent chronic disease or illness. Similarly, items written for observability and generational were grouped together in the standardized category Model. Example items include, *I show my friends and family how to eat a healthy diet* (78% agreement for observability) and *I pass down healthy recipes to my children* (100% agreement for generational). However, the closed sort participants did perceive these two items as written for the two respective constructs.

Discussion

Formative methods used to inform the development of an instrument measuring the perceived attributes of adopting and implementing a healthy diet included panel discussion groups and card sorting. Group discussions and card sorting were used to identify and define attributes of an HDI, develop instrument items, and assess face validity of the items. This qualitative, iterative process allowed for revision and refinement of instrument items and attribute definitions throughout all phases, clearly an advantage of formative research. In addition, knowledge of how the DGAs are perceived

and what attributes are important in promoting their adoption and implementation can provide a useful framework for developing targeted nutrition education programs or consumer messages.

Phase 1 Panel Group Discussions: Attributes of the DGAs

Rogers' five key attributes. The nutrition literature supports four of the five resulting definitions of Rogers' attributes adapted for an HDI. Eikenberry and Smith (2004) found *feeling good/better* and *maintaining health* were motivators to eating healthy, which are indicative of the relative advantage of an HDI. With regards to the compatibility of an HDI, research indicated that consumers want dietary guidelines that are consistent with their personal food preferences and lifestyles (King & Gibney, 1999; Welsh, Davis, & Shaw, 1992). Observability can also be paired with role models seen in the family meal literature, however, actual observations of positive outcomes shared or seen in others as an influence on adopting and implementing an HDI was not supported in the literature. Pertaining to the trialability of an HDI, it has been suggested that dietary changes should be achieved in increments as a lifestyle change (Sahyoun, Pratt, & Anderson, 2004). Lastly, the literature does not support specifically the definition for low complexity of an HDI. This is somewhat plausible with the high prevalence of obesity currently in the US. If eating a healthy diet was "easy", perhaps there would be a much lower prevalence. Although the definition of complexity does not specifically refer to food preferences, one item was written to address taste: *It is easy to find healthy foods that taste good to me.* It is well documented in the literature that if a food is tasty, people are more likely to eat it (Glanz, Hewitt, & Rudd, 1992; Lewis, Sims, & Shannon, 1985; Stewart & Tinsley, 1995). Furthermore, Glanz, Basil, Maibach and Goldberg

(1998) found taste to be the most important consideration and influence of food choices. However, healthy foods are not often perceived as tasty. In summary, tips and easy strategies for incorporating healthful foods should be included in nutrition education strategies as well as food demonstrations and taste tests of foods that are considered healthy to possibly reverse negative perceptions of healthy foods.

Portability. In reviewing the DGAs and recognizing the busy lifestyle of women today, portability was identified as a new attribute. Panel participants frequently expressed the convenience of the foods indicated in the DGAs and the ease of "taking it with you." In contrast, findings in the literature have shown fast-foods to be closely associated with the attribute of convenience. Glanz, Basil, Maibach, and Goldberg (1998) examined the importance of a variety of factors on food selections. Findings indicated a positive association between the importance of convenience and fast-food consumption and a negative association between importance of convenience and fruit and vegetable consumption. This is understandable as lack of time to prepare foods has been cited as a significant influence on food choices. Sixty percent of women reported a desire to spend less than 15 minutes on meal preparation, as they have to manage their time between work and family (Food Marketing Institute, 1999). Recent demands for more nutritious food in the market have prompted manufacturers to increase production of functional foods that provide enhanced quality and nutritional value (American Dietetic Association [ADA], 2006). However, caution must be emphasized with regards to functional foods. Consumers may increase their intake of these foods thinking more is better if it is good for them while also increasing their energy intake, which could lead to weight gain. Nutrition education strategies should focus on the convenience – and portability – of

fresh fruits and vegetables as well as minimally processed foods as healthier food choices (Monteiro, 2009).

Protective. The connection between diet and health has been well documented. Overconsumption of energy dense foods can lead to overweight and obesity, which increase risk of chronic diseases such as diabetes, hypertension, high cholesterol, and stroke (French, Story, & Jeffery, 2001; Malnick & Knobler, 2006). The DGAs recommend balancing healthy foods such as, fruits and vegetable, lean protein, low/no fat milk, and whole grains, with foods that are low in solid fats and added sugars to achieve healthful dietary patterns (Welsh, Davis, & Shaw, 1992). Additionally, findings from a meta-analysis of epidemiological research indicated fruits and vegetables have a protective effect on some cancers (Riboli & Norat, 2004). Thus, it was not surprising that protective emerged as an attribute of the DGAs. Participant responses strongly reflected the consequences of implementing, and *not* implementing, an HDI. These responses support the findings from the Shopping Health 2004 study that indicated nearly 6 in 10 consumers try to avoid future health problems by eating healthy (Food Marketing Institute, 2004). Food shoppers in the Shopping Health study also strongly agreed that eating healthy is better than having to take medication for managing illness. Promoting the importance of a healthy diet in the prevention of chronic disease should be a key message in nutrition interventions.

Generational. There is something to be said for the family dinner. Research focusing on family meals has indicated an association between frequency of family dinner and higher intakes of fruits and vegetables and lower intakes of fried food and soda (Gillman, et al., 2009). Furthermore, Larson, Neumark-Sztainer, Hannan, & Story,

(2007) found that family meals promote healthy eating patterns in early adult years. A possible explanation for this may be that family meals provide opportunities for modeling healthy food choices as well as establishing cultural and family traditions. The focus on future generations and cultural change appeared to be an important issue among panel participants. Focusing on family meals should be a nutrition education strategy for adopting and implementing the DGAs.

Phase 2 Card Sorts

The card sorts were used as an item reduction technique, but also to confirm whether an item was perceived as the attribute for which it was written. Card sorting gives the researcher an inside view of how different individuals perceive and categorize items. This technique is often used in information architecture field in which users give input of organizational content of Web site designs (Faiks & Highland, 2000; Paul, 2008). Participants worked independently, however the facilitator was in the room in the event there were questions. There were few questions related to the sorting procedures or the items themselves, however, it was found that some items were not reflective of the respective attributes. The open card sort was particularly useful for exploring how participants described their categories. Words the participants used in their categories as well as categories items were placed were helpful for refining attribute definitions and re-writing some of the items. Moore and Benbasat (1991) also found this technique useful in refining construct definitions related to the adoption of an information technology innovation.

Card sorting can be used as an exploratory method that informs the researcher during the instrument development process of problematic items or constructs before

pilot and field testing the instrument. This step in the process provides the opportunity to rewrite an item or consider the item for a more appropriate construct. Of course, only statistical methods like factor analysis will show which items are indicators of the constructs and demonstrate construct validity. Although instrument development can be a lengthy process, formative methods such as card sorting can help in creating items that better indicate the constructs of interest for a more precise measure and may assist in additional testing.

Limitations

There are several limitations to this study. First, this research took place in southern Mississippi and may not reflect perceptions of adults living in other areas. Second, the qualitative methods used consisted of small sample sizes and information relayed could be subject to misinterpretation; however, interpretive strategies were employed for the panel group discussions. Lastly, the panel group discussion participants were all women with the card sort including only two men. This decision was made because the intervention target population for which the instrument was designed was women in social and civic organizations. In retrospect, it may have been advantageous to include a community group discussion with men to capture their perspective with regards to an HDI. Two men were included in the card sorts with this intention.

Conclusion

In conclusion, formative research methods used in the instrument development process provide rich information related to the study population and topic. As obesity continues to be a national public health concern, there is a need for nutrition intervention

and intervention assessment. Assessment of one's perceptions of adopting and implementing dietary behaviors is an essential step in designing effective interventions. With no available instruments assessing dietary innovations using Rogers' attributes, the subsequent instrument based on the findings from this study can be used to assess individuals' perceptions of a healthy diet based on the eight attributes identified herein.

CHAPTER V

MANUSCRIPT II: PSYCHOMETRIC EVALUATION OF A HEALTHY DIET INNOVATION (HDI) SCALE MEASURING THE PERCEIVED ATTRIBUTES OF A HEALTHY DIET

Obesity continues to be a national public health concern, indicating a need for nutrition intervention and valid and reliable scales measuring intervention effectiveness. Instruments demonstrating parsimony, validity, and reliability should be selected or developed for a specific purpose and targeted population for interventions (Contento, Randell, Basch, 2002). As part of a larger project, the instrument described in the present study was developed to assess women's perceptions of adopting and implementing a healthy diet based on the 2005 Dietary Guidelines for Americans (DGAs). The purpose of this paper is to report the results of the development of a new scale designed to measure the perceived attributes of a healthy diet.

The diffusion of innovations (DOI) theory was used as the conceptual framework for the development of the scales described herein. *Diffusion* is defined as "the process in which an innovation is communicated through certain channels over time among the members of a social system," where *innovation* is considered as a new idea, practice or object (Rogers, 2003, p. 5). The theory suggests that once the innovation is adopted among early adopter, later adopters will follow suit. Women were chosen as the primary target population for this project, as they are considered to be the gatekeepers of nutrition for their families and the greater community (Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999; McIntosh & Zey, 1998). Additionally, women participating in social and civic clubs (e.g., sororities, junior auxiliaries, church circles, etc.) typically

have higher educational attainment and social status and are considered opinion leaders in their circles. These characteristics are indicative of early adopters of new ideas and practices, and because early adopters are considered as a trusted resource in their communities, they are likely to have a greater influence on those who are slower to adopt new ideas and practices (Rogers, 2003).

In his theoretical conceptualization, Rogers identified five attributes that influence adoption of an innovation:

- Relative advantage: Degree to which an innovation is better than previous idea, practice, object
- Compatibility: Degree to which an innovation is perceived as being consistent with current values, experiences, needs
- Complexity: Degree to which an innovation is perceived as difficult to understand and use
- Trialability: Degree to which an innovation can be experimented with on a limited basis
- Observability: Degree to which the results of an innovation are visible to others or can be easily communicated

While there is evidence that the perceived attributes of an innovation by potential adopters are useful in quicken the rate of adoption, measuring the attributes appears to be problematic (Bolton, 1981; Holloway, 1977; Ostlund, 1969; Rogers, 2003). Hurt and Hibbard (1989) also reported issues with attribute measurement due to post-adoption interview techniques leading to response and interviewer biases. Presently, there is a lack of valid and reliable instruments assessing the perceived attributes of innovations, and

specifically, there are no instruments measuring the perceived attributes of a healthy diet, hereafter referred to as a healthy diet innovation (HDI).

Rogers (2003) suggested the development of unique scales based on formative research with potential adopters to identify innovation attributes. The purpose of this research project was to estimate the internal consistency reliability and determine the underlying constructs of the HDI scale. The DOI theory attributes and new attributes identified by potential adopters during the formative phases of the research were the constructs of interest for the scale. This study was conducted in three phases. Phases 1 and 2 included formative research methods and are described briefly below. Discussion of the phase 3 pilot and field testing and the exploratory factor analysis is the main focus of this paper.

Phases 1 and 2 Background

This study was approved by the Institutional Review Board for the Protection of Human Subjects of The University of Southern Mississippi. Informed consent was obtained from all participants prior to each phase.

Formative Research: Instrument Development Process

The objectives of Phases 1 and 2 were to identify and define attributes of a healthy diet, generate an item pool, and establish face validity of the items. Complete details of phases 1 and 2 are described elsewhere (Huye, Molaison, Connell, Downey, Zoellner, & Madson, 2011). In brief, formative research methods included group panel discussions in phase 1 and card sorts in phase 2.

Phase 1 Panel discussions. Three group panel discussions with registered dietitians (n = 6), and community members (n = 13) in south Mississippi resulted in eight

attributes of a healthy diet, including the previously describe attributes identified by Rogers. All definitions were defined relative to a healthy diet, as shown in Table 1. The group panel discussions assisted the researcher in the development of items for the HDI scale. A total of 69 items were written with the defined attributes in mind with some adapted from the diffusion literature (Hurt & Hibbard, 1989; Moore & Benbasat, 1991). Number of items for each attribute are shown in Table 4.

Table 4.

Identified and Defined Attributes of a Healthy Diet based on the 2005 DGAs

Attribute	Attribute Definition
Relative Advantage	The degree to which implementing components of a healthy diet is better than previous eating patterns, increasing one's overall well-being (indicators of RA include: balanced nutrition, not restrictive, less expensive, and increased energy levels)
Compatibility	The degree to which components of a healthy diet are adaptable to one's dietary needs and/or cultural food preferences
(Low) Complexity	The degree to which components of a healthy diet are easy to incorporate into one's diet
Trialability	The degree to which components of a healthy diet can be gradually incorporated into one's lifestyle to make small and sustainable changes
Observability	The degree to which components of a healthy diet can be modeled or shared and positive outcomes are evident
Portability	The degree to which components of a healthy diet are convenient and readily available for today's "on the go" lifestyle
Protective	The degree to which components of a healthy diet can help in preventing and/or managing chronic disease (i.e. high blood pressure, high blood sugar, obesity, etc)
Generational	The degree to which healthy lifestyle behaviors are passed on to younger generations

Phase 2 Card sorts. To assess how individuals perceive the meaning of the items as written for the aforementioned attribute and to reduce the number of items, open and closed card sorting techniques were conducted. Card sorting is a technique in which scale items are printed on index cards, shuffled randomly, and presented to participants to *sort* the cards into categories based on similarities of the items. The open sort allows individuals to create their own categories, whereas in a closed sort, categories are provided based on the created categories from the open sort and/or pre-determined categories.

Two men and 14 women (open sort: $n = 7$; closed sort: $n = 9$) participated independently in card sorting activities. To ensure a wide range of backgrounds, card sorting participants included university faculty and staff, professional and personal contacts of the researcher, and individuals representing the target population. Participants were instructed to sort similar items together and to create a category to describe those items. Categories created by participants in the open sort were representative of the eight attributes identified and defined in phase 1, thus no new categories were created. Forty-eight items were retained from the open sorts based on medium to high agreement amongst participants (i.e., 44% to 75% of participants placed an item in a particular category). Frequencies were analyzed using a Microsoft Excel 2007 spreadsheet (see Figure 5) designed specifically for card sorting analysis (Spencer, 2009).

Item origin	Card name	Ambig-uous	RA	CP	CX	TR	OB	PB	PT	GN
RA	It is good for my body when I eat a healthy diet.		56%						44%	
RA	When I eat a healthy diet it helps me lose weight.		22%				11%		67%	
RA	When I eat a healthy diet it makes me feel better.		78%				22%			
RA	When I eat a healthy diet I have more energy.		89%				11%			
RA	A healthy diet does not restrict any foods.	56%	22%			11%		11%		
RA	A healthy diet includes all types of foods for balanced nutrition.	11%	56%	11%	22%					
CP	I know how to adjust the way I cook to include healthy foods that are culturally			100%						
CP	A healthy diet is can be incorporated into my cultural food traditions.			89%						11%
CP	I am able to find healthy foods that are consistent with my food preferences.			67%	22%			11%		
CP	I can adapt a healthy diet to my cultural beliefs and traditions.			100%						
CP	I serve healthy versions of traditional foods during celebrations and traditional events	11%		67%	11%					11%

Figure 5. Selected frequencies of item placement in closed sort using spreadsheet template. Note: Not all items are shown. RA= Relative Advantage, CP=Compatibility, CX= (low) Complexity, TR=Trialability, OB=Observability, PO=Portability, PR=Protective, GN=Generational.

The closed sort participants received eight attribute definitions for which the items were written as pre-determined categories. Participants were instructed to sort items they thought belonged in each pre-determined category. As in the open sort, items from the closed sorts were retained based on item placement frequencies in common categories. Items that had equally split agreement between two attributes were eliminated from the item pool, as it was not perceived as being clearly distinguishable between attributes. The closed card sorts resulted in 37 remaining items.

Upon completion of the closed sort, the items were reviewed for construct coverage. Eight new items were written to have at least five items per attribute and some items were written in a negative format to reduce acquiescence. The items were reviewed for redundancy, content, and construct coverage by an expert review panel (n = 5). Revisions were made to the items and an initial scale consisting of 45 items in random order was drafted. The instrument instructions directed respondents to choose the level of agreement for each statement that best reflected their opinion of a healthy diet. Healthy diet was defined as including one or more of the following dietary guidelines:

- 2 to 3 cups of *vegetables* per day, including dark green and orange vegetables
- 1 ½ to 2 cups of *fruits* per day (can include fresh, frozen or canned in juice or water)
- Making half of the grains consumed *whole grains*
- Using *lean meats, fish, and beans* for protein
- *Limiting added sugars* to 3 to 12 teaspoons/day
- *Limiting solid fats* found in high fat meats, butter, whole fat dairy products, etc

A convenience sample (n = 7) was used to review the instrument again for mechanics including instructions, clarity of wording, and appropriate response categories consisting of a 4-pt. Likert scale ranging from 1, *Strongly Disagree* to 4, *Strongly Agree.* Revisions were made based comments and a "*Does Not Apply To Me*" column was added as a response. The initial instrument for the pilot test included 40-tems. Table 5 shows number of items for each attribute at each phase.

Table 5

Items Written and Retained per Attribute by Phase

Construct	Number of Items					
	Phase 1: Created for Open Sort	Phase 2: Retained from Open Sort	Phase 2: Retained from Closed Sort	Added Items	Phase 3: Pilot Test	Phase 3: Field Test
Relative Advantage	13	9	5	1	6	6
Compatibility	9	5	5	0	4	4
Complexity	8	5	4	2	6	5
Trialability	10	5	4	2	5	5
Observability	11	7	4	1	5	5
Portability	6	5	4	1	4	4
Protective	5	5	5	0	5	5
Generational	8	7	6	1	5	5
Total	69	48	37	8	40	39

Phase 3 Pilot and Field Testing of the HDI Scale

Two rounds of instrument testing were performed on the HDI scale. The first round was a pilot test to estimate the internal consistency of the scale as well as to correct any issues with clarity of the items or instructions; the second round included a larger field testing of the instrument with the target population to assess construct validity using exploratory factor analysis (EFA) as well as the internal consistency of the resulting sub-scales. Sample selections and testing procedures for both rounds of testing are described.

Pilot Test Sample Selection and Procedures

The self-administered instrument was pilot tested with individuals participating in a feasibility study for a nutrition intervention. Participants attending the final data collection of the feasibility study were directed to complete the questionnaire by indicating their level of agreement with the 40 items. The feasibility study took place in south Mississippi and included 58 participants. Demographic characteristics of the pilot test participants are shown in Table 6.

Table 6

Demographic Profile of Pilot Participants (N = 58)

Characteristic	*n*
Gender	
Female	54
Male	4
Age range	
20-30	3
31-40	6
41-50	14
51-60	13
61-65	2
>65	22
Ethnicity	
American Indian or Alaska Native	2
Black or African American	14
White	43
More than two of the above	1
Educational attainment	
< High School Degree	4
High School Degree	10
Trade or Vocational School	2
Some College	17
College Degree	9
Some Graduate or Professional School	2
Graduate or Professional Degree	14

Table 6 (continued).

Characteristic	*n*
Marital Status	
Now Married	36
Widowed	3
Divorced	11
Separated	2
Never Married	6
Income	
Less than $19,999	10
$20,000-24,999	3
$25,000-29,999	1
$30,000-34,999	7
$35,000-39,000	5
$40,000-44,999	2
$45,000-49,999	3
$50,000-54,999	1
>55,000	18
Don't know	8

Field Test Sample Selection and Procedures

Field test participants were drawn mostly from individuals participating in a nutrition intervention (n = 307) in the Lower Mississippi Delta (LMD). Although the primary target population for the intervention was women, men were not excluded from enrolling. One item was eliminated from the pilot test for a 39-item questionnaire, which was self-administered as part of the enrollment procedures of the intervention. Participants were read the informed consent document and then were directed to complete the questionnaire, indicating their level of agreement for each item. In addition to the HDI scale, participants in the intervention had to complete additional instruments that included a medical history survey and another diet-related questionnaire.

In an attempt to reach sufficient sample size for the EFA, a purposive sample was used obtain additional surveys (n = 24). The instrument was self-administered to individuals participating in a health and nutrition program and a fitness class at a local

university recreation center. The researcher explained the project and read the informed consent to the participants before beginning the survey administration. Participants were instructed to indicate there level agreement with each item and complete the demographic section of the questionnaire.

Demographic information was obtained from all participants. The majority of the sample consisted of African American women who were over the age of 41 and had a college degree or higher. Demographic characteristics of the field test participants are shown in Table 7.

Table 7

Demographic Profile of Field Test Participants. (N = 331)

Characteristic	*n*[1]	Percent[1]
Gender		
Female	292	88.2
Male	39	11.8
Age range		
18-21	4	1.2
22-25	8	2.4
26-30	10	3.0
31-40	38	11.5
41-50	71	21.5
51-60	100	30.3
61-65	39	11.8
66-70	30	9.1
>71	30	9.1
Ethnicity		
American Indian or Alaskan Native	6	1.8
Hawaiian Native or Pacific Islander	2	.6
Black or African American	292	23.2
White	31	73.2
Educational attainment		
Less than High School	29	.3
Trade or VOC School	63	19.0
High School Degree	9	2.7
Some College	62	18.7

Table 7 (continued).

Characteristic	*n*[1]	Percent[1]
College Degree	67	20.2
Some Graduate or Professional School	30	9.1
Graduate or Professional Degree	69	20.8
Marital Status		
Single	152	45.9
Now Married	40	12.1
Divorced	56	16.9
Separated	18	5.4
Never Married	64	19.3
Income		
Less than $9,999	40	12.1
$10,000-14,999	50	15.1
$15,000-19,999	19	5.7
$20,000-24,999	18	5.4
$25,000-29,000	23	6.9
$30,000-34,999	19	5.7
$35,000-39,999	22	6.6
$40,000-44,999	14	4.2
$45,000-49,000	13	3.9
$50,000-54,999	17	5.1
>55,000	61	18.4
Don't know	1	.3

[1]Numbers and percents do not always add up to 331 or 100%, respectively, due to missing data

Data Analyses

Pilot test. The common statistic used to measure internal consistency reliability is the Cronbach's alpha coefficient that ranges from 0.00 (no consistency) to 1.00 (perfect consistency) (Burns & Grove, 2005). Alpha coefficients ranging from .50 to .60 are considered acceptable in the early stages of research (Nunnally, 1967). Since the internal consistency of an instrument or its sub-scales can be affected by poorly written items and flawed test construction, the procedure used to estimate reliability of the pilot instrument was Cronbach's alpha coefficient set in the range of .50 to .70. Items that were negatively worded were re-coded prior to analysis. For each sub-scale, inter-item correlations, the

item-total correlations, and the effects on alpha if the item were deleted were used to determine which items were candidates for deletion from the scale. Items with an inter-item correlation < .30 and > .80 and item-total correlation < .25 and > .70 were considered candidates for elimination, as well as, items that would increase Cronbach's alpha if the item was deleted (Holcomb, 2009; Nunnally & Bernstein, 1994). To ensure adequate content for each construct, construct coverage was assessed before any items were deleted.

Field test. Factor analysis was used to explore the underlying factors that explained the interrelationships of variables. More specifically, Royce (1963) described a factor as a construct that is operationally defined by the factor loadings of the items. The aim of the present factor analysis was to evaluate the latent structure of the instrument.

Before factor analyzing the data, an item analysis was conducted on the 39 statements related to individuals' perceptions of using a healthy diet for frequencies, descriptive statistics, and inter-item correlations, and item-total correlations. Items were omitted from the factor analysis if there were items that correlated too high ($r \geq .70$) or too low ($r < .30$) with other items in the matrix, item-total correlations were < .25 or > .70, and/or Cronbach's alpha showed an increase ($\alpha \geq .70$) if item was deleted (Holcomb, 2009; Nunnally & Bernstein, 1994).

Exploratory factor analysis was performed to determine the underlying structure with the fewest number of items that would adequately explain the correlations among participant responses. Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were calculated to assess if the correlations among the 39 items were adequate and to determine if the data were factorable. Larger values of the

Barlett's test of sphericity are preferable, indicating sufficient, but not significant, correlations between items.

Principal axis factoring (PAF) was used for factor extraction with oblique rotation, as it was assumed that the constructs of interest were correlated (Rogers, 2003). PAF extraction was the method of choice since it was considered to be a more accurate indicator of model fit for instruments that are theory-driven (Nunally & Bernstein, 1994; Tabachnick & Fidell, 2001). In an attempt to obtain the simple structure solution, the criteria used for factor retention included a) theoretical basis; b) amount of cumulative percentage of variance explained by the factors; c) a visual examination of a scree plot to determine the best model represented by the data; and d) at least three items loaded on a factor. Criteria for item retention included a) items with substantive loading (>.35); b) items did not load substantively (>.35) on more than one factor; and c) items made theoretical sense relative to the factors (Comrey & Lee, 1992; Pedhazur and Schmelkin, 1991).

SPSS Version 17 was used to analyze both the pilot and field tests data for descriptive statistics, internal consistency reliability, and exploratory factor analysis.

Results

Pilot Test

The alpha coefficient for the instrument was .92, indicating a high level of internal consistency. For exploratory purposes, the internal consistency of the items representing the attributes was examined. The Chronbach's alphas for the attributes observability, compatibility, protective, complexity, portability, and relative advantage were above the acceptable levels according to Nunnally's (1967) standards of .50 to .60.

However, generational, had an unacceptable level of .47. Table 8 shows Chronbach's alphas for the eight attributes. Upon further examination, recoded items in those subscales were consistently the items that increased Chonbach's alpha if deleted. It was decided to retain these items because they were emphasized in group panel discussions, and thus, were rewritten to reflect a positively worded statement for further testing. For example, the item, *I do not like trying new foods*, was rewritten to, *I like trying new foods*. Other items that would increase Chronbach's alpha if deleted were also retained but were cognitively tested with a small sample of individuals; items were re-written according to their suggestions. One example included, *Buying healthy foods at the grocery is less expensive than belonging to a program in which you have to buy special foods*, changed to, *Buying healthy foods at the grocery store is less expensive than buying special foods for a diet plan, such as Weight Watchers™ or Jenny Craig™*. A total of 14 items were rewritten for the final instrument. One item, *It is difficult for me to explain why a healthy diet is beneficial for one's overall wellbeing*, was not included in the final instrument, as it had the most impact on the complexity subscale's Chronbach's alpha if deleted, although the scale was still not to an acceptable level.

Table 8

Chronbach's Alpha of Grouped Items by Attribute

Sub-scale	A
Observability	.82
Compatibility	.78
Protective	.73
Complexity	.59
Portability	.59
Relative Advantage	.52
Trialability	.50
Generational	.47
Total	.92

Field Test

Revisions to the pilot instrument were made based on reliability estimates of the eight subscales and cognitive testing of selected items, resulting in a 39-item instrument. Data from 331 questionnaires were included in the final analysis.

*Item analysis***.** On a 4-pt scale, where 1 = *Strongly Disagree* to 4 = *Strongly Agree*, item means ranged from 2.7 (*SD* = .520) for Item 25, *I serve healthy versions of traditional foods/recipes during celebrations,* to 3.8 (*SD* = .839) for Item 1, *When I eat a healthy diet, it helps me avoid health conditions like, high blood pressure, high blood sugar, obesity, etc.* Examination of the correlation matrix indicated all but four items were correlated ($r > .30$) with at least three other items in the matrix. These four items were withdrawn from the analysis. No inter-item correlations exceeded .66,

demonstrating no multicollinearity problems. Corrected item-total scale correlations ranged from .26 to .68 were considered to be acceptable (Nunnally & Bernstein, 1994)

*Factor analysis***.** The KMO measure of sampling adequacy and Bartlett's test of sphericity were calculated to assess the strength of the linear association among the 39 items in the correlation matrix and appropriateness for factor analysis. With 331 cases, the KMO was fairly large at .869, which is deemed "meritorious" by Kaiser's (1974) (p. 35) standards. Bartlett's test of sphericity was significant (2768.734, $p = .001$).

Thirty-five items were submitted for the PAF extraction method with oblique rotation analysis, resulting in a seven-factor solution, although examination of the scree plot indicated a three- or four-factor solution was the model that could best represent the data. Using the aforementioned criteria, the data were analyzed until a simple structure solution was obtained. Based on the strength of the item load, number of items per factor, and theoretical relevancy, a four-factor solution with 21 items provided a simple structure solution and was selected for interpretation. The four factors accounted for 45% of the shared variance. Communalities ranged from .26 to .67.

*Factor interpretation and labeling***.** Factor labeling rational was guided by DOI theory and the formative phases of the instrument development process, in which new attributes of an HDI were identified. In an effort to stay consistent with the initial conceptualization, the constructs for which the items were written were considered in the overall naming of the factors. Table 9 shows the factor loadings for the rotated four-factor solution based on the responses to items in the instrument.

Table 9

Factor Loadings for Exploratory Factor Analysis with Oblimin Rotation

Items	Item Origin	Factor			
		1	*2*	*3*	*4*
Compatibility/Generational					
Eating healthy foods has become part of my family's routine.	CP	**.828**	.034	-.170	-.006
I show my friends and family how to eat healthy by being an example and eating healthy myself.	OB	**.743**	-.034	-.021	.093
I cook healthy meals for my family so they will learn to make healthy food choices.	GN	**.739**	-.023	.027	.054
I try new healthy recipes at home to serve to myself, friends, and/or family.	TR	**.584**	-.116	.163	.099
I eat a healthy diet so the young people in my life can learn from my example.	GN	**.577**	-.007	.087	.113
I encourage my family to eat a healthy diet.	GN	**.574**	.210	-.107	.059
I know how to adjust the way I cook to include healthy foods that are culturally acceptable during celebrations and traditional events.	CP	**.544**	.002	.165	-.139
I serve healthy versions of traditional foods/recipes during celebrations.	CP	**.498**	.011	.236	-.105
Protective					
Eating a healthy diet provides better nutrition for a healthier body.	RA	.034	**.838**	.052	-.093

Table 9 (continued).

Items	Item Origin	Factor			
		1	*2*	*3*	*4*
Eating a healthy diet may keep me from having to take medications.	PR	-.110	**.540**	.024	.106
Establishing healthy eating patterns can influence future generations.	GN	.095	**.480**	.078	.135
Complexity					
There are a variety of healthy foods that are easy to prepare.	CX	.071	.080	**.670**	.027
Healthy foods are not difficult to find when I am away from home.	CX	-.014	.002	**.525**	.146
I can find foods for a healthy diet in the area where I live.	PO	.008	.141	**.461**	-.030
It is easy to find healthy foods that taste good to me.	CX	.264	-.005	**.377**	.003
Relative Advantage					
When I eat a healthy diet, it helps me lose weight.	PR	-.003	-.061	.093	**.725**
I see positive results when people eat a healthy diet.	OB	.059	.062	-.064	**.652**
When I eat a healthy diet I have more energy throughout my day.	RA	.065	.093	.230	**.555**
When I eat a healthy diet it helps me avoid health conditions like high blood pressure, high blood sugar, obesity, etc.	PR	.019	.329	-.096	**.395**
Eating a healthy diet helps me manage my health condition(s).	PR	.143	.238	.043	**.380**

Note: Factor loadings > .30 are in boldface. CP = Compatibility; OB = Observability; GN = Generational; TR = Trialability; RA = Relative Advantage; PR = Protective; CX = Complexity

Factor 1 (eigenvalue = 6.41) accounted for 28% shared variance and had eight of the 21 items loading substantively above .30. Items loading on this factor focused on healthy eating with friends, family, and cultural traditions and celebrations and were written for the constructs of compatibility, generational, and observability. However, most of the items emphasized friends and family celebrations and therefore was labeled "compatibility/generational."

Factor 2 (eigenvalue = 2.57) accounted for 9.7% shared variance and had four items that loaded above .30. Most of the items loading on this factor were related to the healthy diet and its influence on future generations, health conditions and a healthy body, indicating the protective effects of a healthy diet. This factor was labeled "protective."

Only four items loaded substantively above .30 on Factor 3 (eigenvalue = 1.40), which accounted for 4% shared variance. These items reflected ease and convenience of a healthy diet, and therefore, Factor 3 was labeled "complexity", although it is the inverse relationship of complexity and the innovation that impacts its adoption and implementation. That is, the less complex the innovation is to use, the more likely it will be adopted.

Factor 4 (eigenvalue = 1.14) was composed of five items and accounted for 3% shared variance. Items loading > .30 on this factor reflected the benefits of a healthy diet contributing to the overall well being of an individual and were was most closely associated with the constructs relative advantage and protective. Factor 4 was labeled "relative advantage" because of the emphasis on healthy diet benefits. However, some of the identifiers of the relative advantage (balanced nutrition, not restrictive, and less expensive) did not load on any of the factors.

Factor correlations and reliability. Table 10 presents the descriptive statistics, correlations between factors, and the alpha coefficients for the four subscales. As depicted in the correlation matrix, all factors show low to moderate correlations. In particular, Factor 1 (compatibility/generational) is moderately correlated with Factor 3 (complexity) (.478), and likewise, Factor 2 (protective) is moderately correlated with Factor 4 (relative advantage) (.528). However, Factors 1 and 2 and Factors 3 and 4 have low correlations ranging from .213 to .295. Factors were subjected to internal consistence reliability testing. As shown in Table 10, all factors with the exception of Factor 3 demonstrated an acceptable level of internal consistency. Among the four factors, corrected item-total correlations ranged from .40 to .71 and Chronbach's alpha coefficients ranged from .65 (complexity) to .88 (compatibility/generational).

Table 10

Factor Correlations and Factor Alpha Coefficients

Factor	*M* [a]	*SD*	*1*	*2*	*3*	*4*
1. Compatibility/ Generational (*n = 8*)	3.01	.65	(.88)			
2. Protective (*n = 4*)	3.55	.56	.261	(.73)		
3. Complexity (*n = 4*)	3.10	.66	.478	.284	(.65)	
4. Relative Advantage (*n=5*)	3.57	.56	.295	.528	.213	(.77)
Total scale (*n = 21*)	3.28	.61				(.88)

a. Range: 1.00 to 4.00. Note: Reliability estimates appear in the parentheses on the diagonal

Discussion of Psychometric Evaluation

Construct Validity

In an effort to establish construct validity, exploratory factor analysis was used to explain the interrelations among the items on the HDI scale. The results of this analysis support the proposition that there are various dimensions related to the perceptions of

using a healthy diet. Although it was hypothesized that eight attributes would factor as underlying constructs, it is not uncommon in the diffusion literature to see less than five of the theoretical attributes emerge as factors. In an education innovation, Holloway (1977) developed a new scale to measure high school principles' perceptions of innovative educational ideas based on the five key attributes. Holloway found no clear distinction between sub-scales measuring relative advantage and sub-scales measuring compatibility**.** Similarly, Hurt and Hibbard's (1989) found only three factors in their assessment of college students' perceptions of microcomputers. Only two of the five subscales were independent with items for complexity and compatibility loading on separate factors; trialability and observability emerged as one factor and relative advantage did not emerge at all. In a more recent study by Pankratz, Hallfors, and Cho (2002), comparable results were found for a new scale assessing the perceived attributes of a federal drug prevention policy. Supporting Holloway's results, the factor analysis revealed the sub-scales for relative advantage and compatibility emerging as one factor and complexity and observability as two separate factors. Possible explanations for this may be that the items were not clearly written as two distinct concepts, or respondents considered the characteristics of the innovation as the same concept (Hurt & Hibbard, 1989). Another explanation may be the respondent's stage of adoption; pre-adoption innovation perceptions may differ from post-adoption perceptions. For example, the relative advantage – *the degree to which an innovation is better than its predecessor* – may not be perceived until after the innovation has been adopted and implemented.

Trialability and observability did not emerge as separate factors for the HDI scale. Possible explanations for this may be that respondents had not had opportunities to try

foods considered healthy nor had they seen positive outcomes of a healthy diet because they did not eat healthy, which was the very reason they were participating in the LMD nutrition intervention. The intervention participants completed the HDI questionnaire at the intervention enrollment; this may have limited their responses to "Does Not Apply To Me" for some items, as participants had not experienced the intervention yet.

Internal Consistency Reliability

Internal consistency of an instrument refers to how well the items that make up the instrument or within a subscale of the instrument correlate together. When a set of items are homogeneous, it is expected that the items are strongly correlated, and thus, have high internal consistency. The overall internal consistency of the scale in the present study was considered as acceptable ($\alpha \geq .70$) (Nunnally & Bersntein, 1994). Three of the four factors had adequate levels of reliability, but the complexity factor was less than the desired standards ($\alpha = .65$). However this factor only had four items and higher levels of internal consistency are, to a certain extent, a function of the number of items in scale. Future testing of this sub-scale would include the development of new items to strengthen the low complexity dimension.

Discussion of Factors

Although the closed card sort participants indicated that all of the constructs were conceptually distinct, only four emerged as factors. The compatibility/generational factor was the strongest factor and explained the greatest percentage of variance. Items for this factor included items written for the attributes observability and trialability and the two for which it was labeled. However, the underlying theme among the items was the incorporation of a healthy diet framed around friends and family, demonstrating the

social nature of eating behaviors. Research focusing on family meals has indicated frequency of family dinner was associated with higher intakes of fruits and vegetables and lower intakes of fried food and soda (Gillman, et al., 2009). Furthermore, Larson, Neumark-Sztainer, Hannan, & Story, (2007) found that family meals promote healthy eating patterns in early adult years. A possible explanation may be that family meals provide opportunities for modeling healthy food choices as well as establishing cultural and family traditions.

The connection between diet and health has been well documented. Overconsumption of energy dense foods can lead to overweight and obesity, which increase risk of chronic diseases such as diabetes, hypertension, high cholesterol, and stroke (French, Story, & Jeffery, 2001; Malnick & Knobler, 2006). Items in the protective factor depict the protective nature of a healthy diet. Although the item, *Establishing healthy eating patterns can influence future generations,* was originally written for the generational construct, it does appear to be a good fit with the protective factor as establishing healthy eating patterns in the present will offer protection of our children in adulthood. This item further supports Larson's and colleagues (2007) findings related to family meals and their promotion of healthy eating patterns in early adult years.

The complexity factor was composed of items written for the attributes complexity and portability. The notion of healthy foods being convenient and portable makes healthy foods easy to incorporate into one's diet and therefore, it was expected that these two constructs would collapse onto one factor; however, only one portability item loaded. These items represent the basic concepts of food consumption: easy to find, easy to prepare, and it tastes good. It is well documented in the literature that if a food is

tasty, people are more likely to eat it (Glanz, Hewitt, & Rudd, 1992; Lewis, Sims, & Shannon, 1985; Stewart & Tinsley, 1995). Furthermore, Glanz and colleagues (1998) found taste to be the most important consideration and influence of food choices. However, healthy foods are not often perceived as tasty, which may account for the low factor loading (.377) for the item, *It is easy to find healthy foods that taste good to me*. In addition, this factor had the lowest reliability score and needs further testing.

Relative advantage has not consistently been found to emerge as a factor in the overall diffusion literature, but it is considered as one of the attributes with the most influence on innovation adoption. Moreover, failure to perceive relative advantage of an innovation slows down the adoption of preventative innovations (Rogers, 2003). However, relative advantage did emerge as a separate factor, albeit, and as expected, with items from the protective sub-scale. It was somewhat anticipated that items illustrating the protective effect of a healthy diet would be conceptualized as a health benefit or contributing to one's overall wellbeing. Tornatzky and Klein (1982) suggested specifying indicators of relative advantage. As part of the relative advantage definition from the formative research phase, indicators of the relative advantage of a healthy diet included balanced nutrition, not restrictive, less expensive, and increased energy levels. The only item that loaded that included one of these indicators was, *When I eat a healthy diet I have more energy throughout my day.* Items related to indicators of relative advantage that did not load on any factors may be because participants do not distinguish these items as indicators of the relative advantage of an HDI, or the items were poorly written. Nevertheless, further refining of the relative advantage definition is needed.

In summary, the HDI scale described herein is a new scale that measures the perceived attributes of using a healthy diet. The concept of a healthy diet as an innovation is quite different than the innovations found in the literature. The innovations found in the diffusion literature include information technology, program, and school curricula, whereas the HDI is a *preventive* innovation. Rogers (2003) describes a preventive innovation as an idea or practice that an individual adopts in the present to decrease the risk of an unwanted event in the future. Such innovations have a slower rate of adoption because of the difficulty in perceiving its relative advantage. Thus, researchers may find these innovations difficult to measure due to the time and funding restraints, and study outcomes may appear to be ineffective using such a measure. However, use of formative research methods and innovation positioning strategies could increase the rate of adoption of preventive innovations. At the time of this study, there were few scales in the health literature that measured the perceived attributes of a preventive innovation. Because of the lack of scales measuring preventive dietary innovations, the HDI scale was developed. While four of the eight subscales showed acceptable reliability estimates, the scale needs further development as several items had low loadings, demonstrating weak correlation with the factor.

Limitations

There are several limitations to this research. First, the scale was designed to assess participant perceptions of the healthy diet innovation post nutrition intervention once they were exposed to the innovation. However, the field testing of the HDI scale took place at the enrollment of the LMD nutrition intervention, which was pre-intervention and hence, pre-innovation adoption. Therefore, respondents may have

chosen the "Does Not Apply To Me" option because they had not yet been exposed to the innovation. In addition, the enrollment procedures took over an hour to complete and included three lengthy survey instruments including the HDI scale. A cognitive burden may have been imposed, as participants completed multiple surveys with up to 53 items on each. This part of the enrollment may have contributed to participant fatigue, resulting in participants answering questions at random or identically (i.e., all "Agree") without consideration of the statement. Moreover, this level of participant burden may have also influenced respondents to leave items blank or to choose the "Does Not Apply To Me" option. With regards to the response categories, a 4-pt Likert scale was chosen to force respondents to choose whether they agree or disagree and not give them the option to remain neutral, however, having a "Does Not Apply To Me" option for all items may have negated this intention. Scales with only *agreement* response levels may not have been the appropriate response categories and therefore, may have also inadvertently imposed a limitation to participants' responses.

Self-report of sensitive issues or certain behaviors such as alcohol consumption, smoking, sexual behavior, and diet, tends to induce social desirability bias (Hebert et al., 1997). Social desirability is the tendency of a respondent to choose the response that presents themselves in a way that they believe would be most pleasing to the researcher (Bowling, 2005). This can result in over-reporting desirable behaviors and under-reporting of undesirable behaviors. With regards to diet, women tend to be more influenced by social desirability than men (Hebert, Clemow, Pbert, Ockene, & Ockene, 1995). As women were the majority of the respondents (n = 292), social desirability may have played a key role in responses. Although the items did not specify certain foods,

they were written to represent an overall diet as "healthy." The word "healthy" in and of itself insinuates something positive or may be leading the respondent to answer in a socially acceptable way. Social desirability can be reduced with self-administration and stressing anonymity. While the scale was self-administered, research staff was present, which may have also contributed to respondents choosing to agree in a socially desirable direction.

Another limitation to this study may be the target population for whom the items were written. Items were written for working women with families with a higher educational attainment (college degree or higher) and income as the original target population. Recruitment issues resulted in groups with varying levels of educational attainment and income. This factor may have contributed to non-response. Lastly, while every effort was made to include well-written and tested items for the target population, cultural, social, and language differences may have influenced respondents' interpretation of the statements. In summary, socially desirability, random/identical response, and non-response most likely contributed to the small variance in the item responses (M = 2.7 to 3.8), which leans in the positive direction.

Conclusion

The purpose of this study was to develop a scale and evaluate the underlying structure in an effort to establish construct validity. Although findings indicated four factors with sufficient reliability, the instrument is in need of further refinement. It was not clear whether the items that loaded on a particular factor are actually good indicators of that factor, or if the factors were interpreted and labeled correctly. This study was only the beginning for determining the construct validity of the HDI scale as a whole.

Exploratory factor analysis was useful in determining the internal structure for the set of items used to make up the HDI scale; however, further validity testing is warranted, especially in light of the study limitations.

Future research should include development of new items, especially for the complexity construct, as the existing items were few in number and had low loadings. In addition, items may need to be re-worded so not to indicate socially desirable responses, and all items should undergo cognitive testing with the target audience. Furthermore, response categories should not only be revised to exclude the "Does Not Apply to Me" option, but also, different response categories may need to be explored to include healthy diet *implementation* levels, as well as agreement levels. Utilizing responses to assess actual use of a healthy diet may indicate adoption rates; a regression analysis could be performed to examine which of the perceived attributes predicted adoption. The perceptions of the trialability, observability, and the portability of a healthy diet, which did not factor, should also be explored further to determine if these are considered important attributes in other populations and could be used for nutrition intervention assessment. And lastly, as adoption characteristics may differ between pre- and post-adoption of an innovation, all attributes of a healthy diet identified by potential adopters should be studied to determine their influence on *pre-* and *post-*adoption of an HDI.

Results of this study provide preliminary information regarding the measurement of the underlying dimensions of a healthy diet. Knowing which dimensions – or attributes – of a healthy diet have the greatest influence on adoption and implementation can be valuable information when planning nutrition interventions. A valid and reliable assessment tool can provide interventionists a focus to target key educational messages.

For example, low baseline scores in relative advantage may indicate a need to emphasize the benefits of a healthy diet. Likewise, the tool can be used to measure change related to the attributes. Ultimately, the tool could be used to predict which attributes have the greatest influence on adopting an HDI or any therapeutic diet (i.e., DASH [dietary approaches to stop hypertension], diabetes, renal, etc.). Utilization of the scale in this manner could be valuable in determining the overall effectiveness of a nutrition intervention.

CHAPTER VI

CONCLUSION

Summary of the Findings

Phases 1 and Phase 2

Formative research methods used in the instrument development process provided rich information related to the study population and topic. In phase 1, group panel discussions were used to explore attributes of a healthy diet. Three new attributes of a healthy diet were identified and Rogers' five key attributes were defined relative to nutrition. The eight attributes provided the initial framework for the HDI scale. In phase 2, the open and closed card sorts resulted in 37 items for the initial instrument. Findings from phases 1 and 2 provided key information to develop culturally appropriate items and refine attribute definitions.

Phase 3

The field testing results showed four of the eight attributes emerging as factors, although the closed card sort participants indicated that all of the constructs were conceptually distinct. The compatibility/generational factor was the strongest factor and explained the greatest percentage of variance. Items for this factor included items written for the attributes observability and trialability and the two for which it was labeled. However, the underlying theme among the items was the incorporation of a healthy diet framed around friends and family, demonstrating the social nature of eating behaviors. Research focusing on family meals has indicated frequency of family dinner was associated with higher intakes of fruits and vegetables and lower intakes of fried food and soda (Gillman, et al., 2009). Furthermore, Larson, Neumark-Sztainer, Hannan, & Story,

(2007) found that family meals promote healthy eating patterns in early adult years. A possible explanation may be that family meals provide opportunities for modeling healthy food choices as well as establishing cultural and family traditions.

The connection between diet and health has been well documented. Overconsumption of energy dense foods can lead to overweight and obesity, which increase risk of chronic diseases such as diabetes, hypertension, high cholesterol, and stroke (French, Story, & Jeffery, 2001; Malnick & Knobler, 2006). Items in the protective factor depict the protective nature of a healthy diet. Although the item, *Establishing healthy eating patterns can influence future generations,* was originally written for the generational construct, it does appear to be a good fit with the protective factor as establishing healthy eating patterns in the present will offer protection of our children in adulthood. This item further supports Larson's and colleagues (2007) findings related to family meals and their promotion of healthy eating patterns in early adult years.

The complexity factor was composed of items written for the attributes complexity and portability. The notion of healthy foods being convenient and portable makes healthy foods easy to incorporate into one's diet and therefore, it was expected that these two constructs would collapse onto one factor; however, only one portability item loaded. These items represent the basic concepts of food consumption: easy to find, easy to prepare, and it tastes good. It is well documented in the literature that if a food is tasty, people are more likely to eat it (Glanz, Hewitt, & Rudd, 1992; Lewis, Sims, & Shannon, 1985; Stewart & Tinsley, 1995). Furthermore, Glanz and colleagues (1998) found taste to be the most important consideration and influence of food choices. However, healthy foods are not often perceived as tasty, which may account for the low

factor loading (.377) for the item, *It is easy to find healthy foods that taste good to me*. In addition, this factor had the lowest reliability score and needs further testing.

Relative advantage has not consistently been found to emerge as a factor in the overall diffusion literature, but it is considered as one of the attributes with the most influence on innovation adoption. Moreover, failure to perceive relative advantage of an innovation slows down the adoption of preventative innovations (Rogers, 2003). However, in the present study, relative advantage did emerge as a separate factor, albeit, and as expected, with items from the protective sub-scale. It was somewhat anticipated that items illustrating the protective effect of a healthy diet would be conceptualized as a health benefit or contributing to one's overall wellbeing. Tornatzky and Klein (1982) suggested specifying indicators of relative advantage. As part of the relative advantage definition from the formative research phase, indicators of the relative advantage of a healthy diet included balanced nutrition, not restrictive, less expensive, and increased energy levels. The only item that loaded that included one of these indicators was, *When I eat a healthy diet I have more energy throughout my day.* Items related to indicators of relative advantage that did not load on any factors may be because participants do not distinguish these items as indicators of the relative advantage of an HDI, or the items were poorly written. Nevertheless, further refining of the relative advantage definition is needed.

In an effort to assess the predictive ability of the resulting scale, a linear regression analysis was performed to determine which factors had the most influence on HEI-2005 scores of individuals participating in the MCHL main study (n = 304). The overall model was statistically significant (F (4) = 9.597, p = 001) and explained 11.4%

of the variability (r^2 = .114). The factor with the greatest influence on HEI-2005 scores was the compatibility/generational factor ($t(4) = 4.833$, p =.001), indicating that a one point increase in the factor score could result in a 6.317 increase in the HEI-2005 score. While the model was overall significant, it only explained 11.4% of the variability. This finding may suggest that the model does not fit well with the data. A possible explanation may be that other common cause variables known to have influence on the diet quality, such as self-efficacy, social support, or taste preferences, were not included in the analysis. Therefore, other common cause variable should be considered when exploring the relationship between perceptions of using a healthy diet and HEI-2005 scores.

Strengths and Limitations

Results of this study provide preliminary information on the underlying dimensions of a healthy diet. This is the first scale of its kind known to the present author that measures the perceived attributes of adopting and implementing a healthy diet innovation. Both qualitative and quantitative methods used in the study provided valuable information for the development of the HDI scale. Every effort was made to develop a culturally appropriate instrument, which may be utilized in the measurement of healthy dietary behavior and its diffusion among adults residing in the LMD. However, there are several limitations to this research.

The first limitation was that the scale was designed to assess participant perceptions of the healthy diet innovation post nutrition intervention once they were exposed to the innovation. However, the field testing of the HDI scale took place at the enrollment of the LMD nutrition intervention, which was pre-intervention and hence, pre-innovation adoption. Therefore, respondents may have chosen the “Does Not Apply

To Me" option because they had not yet been exposed to the innovation. In addition, the enrollment procedures took over an hour to complete and included three lengthy survey instruments including the HDI scale. A cognitive burden may have been imposed, as participants completed multiple surveys with up to 53 items on each. This part of the enrollment may have contributed to participant fatigue, resulting in participants answering questions at random or identically (i.e., all "Agree") without consideration of the statement. Moreover, this level of participant burden may have also influenced respondents to leave items blank or to choose the "Does Not Apply To Me" option. With regards to the response categories, a 4-pt Likert scale was chosen to force respondents to choose whether they agree or disagree and not give them the option to remain neutral, however, having a "Does Not Apply To Me" option for all items may have negated this intention. Scales with only *agreement* response levels may not have been the appropriate response categories and therefore, may have also inadvertently imposed a limitation to participants' responses.

Self-report of sensitive issues or certain behaviors such as alcohol consumption, smoking, sexual behavior, and diet, tends to induce social desirability bias (Hebert et al., 1997). Social desirability is the tendency of a respondent to choose the response that presents themselves in a way that they believe would be most pleasing to the researcher (Bowling, 2005). This can result in over-reporting desirable behaviors and under-reporting of undesirable behaviors. With regards to diet, women tend to be more influenced by social desirability than men (Hebert et al., 1995). As women were the majority of the respondents (n = 292), social desirability may have played a key role in responses. Although the items did not specify certain foods, they were written to

represent an overall diet as "healthy." The word "healthy" in and of itself insinuates something positive or may be leading the respondent to answer in a socially acceptable way. Social desirability can be reduced with self-administration and stressing anonymity. While the scale was self-administered, research staff was present, which may have also contributed to respondents choosing to agree in a socially desirable direction.

Another limitation to this study may be the target population for whom the items were written. Items were written for working women with families with a higher educational attainment (college degree or higher) and income as the original target population. Recruitment issues resulted in groups with varying levels of educational attainment and income. This factor may have contributed to non-response. Lastly, while every effort was made to include well-written and tested items for the target population, cultural, social, and language differences may have influenced respondents' interpretation of the statements. In summary, socially desirability, random/identical response, and non-response most likely contributed to the small variance in the item responses (M = 2.7 to3.8), which leans in the positive direction.

Implications and Applications

As obesity continues to be a national public health concern, there is a need for nutrition intervention and intervention assessment. Assessment of one's perceptions of dietary behaviors is an essential step in designing effective interventions and promoting diffusion in the greater community. With no available instruments assessing dietary innovations using Rogers' attributes, the HDI scale can be used to assess individuals' perceptions of a healthy diet. Furthermore, knowing which dimensions – or attributes – of a healthy diet have the greatest influence on adoption and implementation can be

valuable information when planning nutrition interventions, or providing a focus to target key educational messages. For example, low baseline scores in relative advantage may indicate a need to emphasize the benefits of a healthy diet. Likewise, the tool can be used to measure change related to the attributes. Ultimately, the tool could be used to predict which attributes have the greatest influence on adopting an HDI or any therapeutic diet (i.e., DASH [dietary approaches to stop hypertension], diabetes, renal, etc.). Utilization of the scale in this manner could be valuable in planning an intervention and determining the overall effectiveness of a nutrition intervention. For example, the regression analysis in the present study indicated the compatibility/generational factor as having the greatest influence on the adoption and implementation of a healthy diet. An intervention focusing on family and modeling healthy dietary behaviors would be appropriate with the use of the compatibility/generational sub-scale as a pre- post-test to evaluate behavior change.

Recommendations for Future Research

The purpose of this study was to develop a scale and evaluate the underlying structure in an effort to establish construct validity. Although findings indicated four factors with sufficient reliability, the instrument is in need of further refinement. It was not clear whether the items that loaded on a particular factor are actually good indicators of that factor, or if the factors were interpreted and labeled correctly. This study was only the beginning for determining the construct validity of the HDI scale as a whole. Exploratory factor analysis was useful in determining the internal structure for the set of items used to make up the HDI scale; however, further validity testing is warranted, especially in light of the study limitations.

Future research should include development of new items, especially for the complexity construct, as the existing items were few in number and had low loadings. In addition, items may need to be re-worded so not to indicate socially desirable responses, and all items should undergo cognitive testing with the target audience. Furthermore, response categories should not only be revised to exclude the "Does Not Apply to Me" option, but also, different response categories may need to be explored to include healthy diet *implementation* levels, as well as agreement levels. Utilizing responses to assess actual use of a healthy diet may indicate adoption rates; a regression analysis could be performed to examine which of the perceived attributes predicted adoption. The perceptions of the trialability, observability, and the portability of a healthy diet, which did not factor, should also be explored further to determine if these are considered important attributes in other populations and could be used for nutrition intervention assessment. And lastly, as adoption characteristics may differ between pre- and post-adoption of an innovation, all attributes of a healthy diet identified by potential adopters should be studied to determine their influence on *pre-* and *post*-adoption of an HDI.

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **10102601**
PROJECT TITLE: **Development of an Instrument Measuring the Perceived Attributes of Using a Healthy Diet**
PROPOSED PROJECT DATES: **11/01/2010 to 11/01/2011**
PROJECT TYPE: **Dissertation**
PRINCIPAL INVESTIGATORS: **Holly Federico**
COLLEGE/DIVISION: **College of Health**
DEPARTMENT: **Nutrition and Food Systems**
FUNDING AGENCY: **N/A**
HSPRC COMMITTEE ACTION: **Exempt Approval**
PERIOD OF APPROVAL: **10/26/2010 to 10/25/2011**

Lawrence A. Hosman
Lawrence A. Hosman, Ph.D.
HSPRC Chair

10-27-2010
Date

APPENDIX B

INFORMED CONSENT FOR GROUP PANEL PARTICIPANTS

Authorization to Participate in Research Project
Development of an Instrument Measuring the Perceived Attributes of Using a Healthy Diet

Welcome to the panel group discussion to review and discuss nutrition education sessions developed for women's social or civic clubs. We are going to be identifying and defining characteristics of the Dietary Guidelines for Americans (DGAs) that promote their adoption and implementation. This panel is one in a series of panel discussions and is part of a research project to develop a questionnaire that assesses individuals' perceptions of adopting and implementing the DGAs as part of their daily eating habits after participating in a nutrition education program. This panel discussion will last approximately 1 to 2 hours and we have light refreshments for you during the discussion. There are no direct benefits to you for participating in this panel group discussion. Risks are minimal with only the potential of inconvenience of your time. We will be audio-taping the group session so that we do not miss any important feedback that you give us.

Your participation in the panel group discussion is completely voluntary and you may leave the group or refuse to answer any questions without penalty. Your personal information will be kept confidential and not used when reporting results of this panel group discussion. Information gathered during the panel group discussion will only be used to develop the questionnaire. Any information gathered during the panel group discussion will be kept confidential in a locked file cabinet in the primary researcher's office and only those involved in the project will have access to the information. Once the research has been completed all transcripts and audio-tapes from the groups will be destroyed.

This project has been reviewed by the Human Subjects Protection Review Committee, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board at 601-266-6820. Participation in this project is completely voluntary, and participants may withdraw from this study at any time without penalty, prejudice, or loss of benefits. Any questions about the research should be directed to Holly Federico at 601-266-6023.

I have been given a copy of this consent form and the researchers have answered any questions that I have concerning my participation in this panel group discussion.

_____

Signature of Participant

_____

Signature of Person Explaining Study

APPENDIX C

INFORMED CONSENT FOR CARD SORTING PARTICIPANTS

Authorization to Participate in Research Project
Development of an Instrument Measuring the Perceived
Attributes of Using a Healthy Diet

Welcome to the card sort. You will be categorizing card statements related to characteristics of a healthy diet into common groups. Your participation in this research project will help in the development of a questionnaire that assesses individuals' perceptions of adopting and implementing a healthy diet.

The card sort should take approximately one hour to complete, however, you may have more time as needed. There are no direct benefits to you for participating in this card sort. Risks are minimal with only the potential of inconvenience of your time. The card sort will be audio-taped so that any important questions or clarification needed is captured.

Your participation in the card sort is completely voluntary and you may leave the sort at any time or refuse to participate without penalty. Your personal information will be kept confidential and not used when reporting results of this card sort. Information gathered during the card sort will only be used to develop the questionnaire. Any information gathered during the card sort will be kept confidential in a locked file cabinet in the primary researcher's office and only those involved in the project will have access to the information. Once the research has been completed all audio-tapes from the sort will be destroyed.

This project has been reviewed by the Human Subjects Protection Review Committee, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board at 601-266-6820. Participation in this project is completely voluntary, and participants may withdraw from this study at any time without penalty, prejudice, or loss of benefits. Any questions about the research should be directed to Holly Federico at 601-266-6023.

I have been given a copy of this consent form and the researchers have answered any questions that I have concerning my participation in this panel group discussion.

_____

Signature of Participant

_____

Signature of Person Explaining Study

APPENDIX D

EXPERT PANEL INVITATION LETTER

November 11, 2010

Ms. Suzy Q, RD
1234 Any Road Dr.
Any Town, XX 12345

Dear Ms. Q,

I would like to invite you to serve on an expert panel to identify and define characteristics of the Dietary Guidelines for Americans (DGAs) that promote their adoption and implementation. This panel is one in a series of panel discussions, and it is part of a research project to develop a questionnaire that assesses individuals' perceptions of adopting and implementing the DGAs as part of their daily eating habits after participating in a nutrition education program. As a content expert in the field of nutrition, you are being asked to participate in **one** of the panel discussions.

The expert panel will consist of about 8 to 10 nutritional professionals like you. The group discussion will last approximately 2 hours and will focus on the DGAs that address vegetable, fruit, whole grain and lean protein intakes as well as added sugars. You will be asked to identify characteristics of these DGAs that would promote their adoption among the general population in comparison to other popular diets. After the series of discussions have taken place, I will compose a summary of the discussions and the characteristics that were identified. A random selection of participants will be notified by email to confirm, comment, and make suggestions regarding the overall summary of the discussions.

The meeting will take place on **Wednesday, December 1st at 5:15 pm** at the LiveWell Center in the Cloverleaf Medical Plaza, 5909 Highway 49, Suite 40. Light refreshments will be available. If you can participate in this expert panel discussion, please contact me by Monday, November 22, 2010 by email at holly.federico@usm.edu or by telephone at 601-266-6023. I look forward to hearing from you, as your contribution will be a valuable asset to the project.

Sincerely,

Holly Federico, MS, RD
Project Manager
Mississippi Communities for Healthy Living
The University of Southern Mississippi

APPENDIX E

COMMUNITY PANEL INVITATION LETTER

November 8, 2010

Patty Maker
1111 Any Road Dr.
Any Town, XX 12345

Dear Ms. Maker,
I would like to invite you to participate in a community panel discussion to identify and define characteristics of the Dietary Guidelines for Americans (DGAs) that promote their adoption and implementation. This panel is one in a series of panel discussions, and it is part of a research project to develop a questionnaire that assesses individuals' perceptions of adopting and implementing the DGAs as part of their daily eating habits after participating in a nutrition education program. Because of your participation in previous health and wellness programs, you are being asked to participate in **one** of the panel discussions.

The community panel will consist of about 8 to 10 adults. The group discussion will last approximately 2 hours and will focus on the DGAs that address vegetable, fruit, whole grain and lean protein intake as well as added sugars. You will be asked to identify characteristics of these DGAs that would promote adoption among the general population in comparison to other popular diets. After the series of discussions have taken place, I will compose a summary of the discussion and the characteristics that were identified. A random selection of participants will be notified by email to confirm, comment, and make suggestions regarding the overall summary of the discussions.

The meeting will take place on Tuesday, November 23, 2010 at 4:30 pm at The University of Southern Mississippi in the Fritzche Gibbs Building, Room 110. Light refreshments will be available. If you can participate in this community panel discussion, please contact me by Wednesday, November 17, 2010 by email at holly.federico@usm.edu or by telephone at 601-266-6023. I look forward to hearing from you, as your contribution will be a valuable asset to the project.

Sincerely,

Holly Federico, MS, RD
Project Manager
Mississippi Communities for Healthy Living
The University of Southern Mississippi

APPENDIX F

EXPERT AND COMMUNITY PANEL TOPIC GUIDE

The DGAs recommend adults to consume a variety of foods from and within various food groups, including:

- 2 to 3 cups of vegetables that include dark green and orange vegetables per day
- 1 ½ to 2 cups of fruits per day
- Making half of the grains consumed whole grains (servings vary)
- Using lean meats, fish, and beans for protein (servings vary)
- Limiting added sugars to 3 to 8 teaspoons/day (based on calorie level)
- Limiting solid fats (found in high fat meats, butter, etc)

- What are some characteristics about this "diet" that would promote its adoption and implementation in the general population?
    - What are the benefits of the DGAs?
        - Do the benefits outweigh the cons?
- What about compatibility? What are some characteristics that make this diet compatible with various cultures?
- What are some characteristics that make this diet easy to incorporate into someone's daily eating patterns?
    - Would they need to incorporate all aspects of the DGAs to reap the benefits?
- What are some ideas that would encourage someone to try incorporating the DGAs into their daily eating patterns?
- What might be some consequences of incorporating the DGAs into one's daily eating patterns?
    - What might be some consequences of *not* incorporating the DGAs into one's daily eating patterns?
- How might someone communicate the advantages and/or positive consequences of incorporating the DGAs into their daily eating patterns to others – like their friends and family?
- What are some advantages of this diet versus other diets, such as Weight Watchers or the Atkins or South Beach diet?

[INSERT WT WATCHERS FLEX PLAN AND ATKINS DIET OUTLINES]

- Can you identify three characteristics of the DGAs that are different from the Weight Watchers Flex Plan?
- Can you identify three characteristic of the DGAs that are different from the Atkins diet?

Now, I would like to discuss some specified characteristics that are considered to be indicative of adoption and implementation of new ideas or practices (also called an "innovation"). In other words, if a new idea, practice, or perhaps, a new technology, has

these five characteristics, they are more likely to be adopted by an individual. The five characteristics include:

- **Relative advantage (RA)** – degree to which innovation is better than previous idea, practice, object
- **Compatibility (CP)** – degree to which innovation is perceived as being consistent with current values, experiences, needs
- **Complexity (CX)** – degree to which innovation is perceived as difficult to understand and use
- **Trialability (T)** – degree to which an innovation can be experimented with on a limited basis
- **Observability (O)** – degree to which the results of an innovation are visible to others or can be easily communicated

As these are pretty generic definitions, I would like us to look at each of the five characteristics and define them from a nutrition perspective and specifically how they might be defined based on the DGAs.

- For example, how would you define RA as it relates to the DGAs? How is the adoption of the DGAs better than someone's current eating patterns?
  - We have already discussed what the advantages of the DGAs as compared to other diets; now, let's see if we can attach an umbrella definition for those characteristics.
- How would you define compatibility for the DGAs?
- How would you define complexity as it relates to nutrition and the DGAs? What makes the DGAs easy to use?
- How would you define trainability as it relates to nutrition and the DGAs? If you wanted someone to try the DGAs before they adopted it, how would we encourage this?
- How would you define observability as it relates to nutrition and the DGAs? Can the results of using the DGAs be seen? Can using the DGAs be easily communicated to others – their friends and family?

[If previously identified characteristics are not included among these five, ask panel to define those as well.]

APPENDIX G

MEMBER CHECKING FORM

February 10, 2011

Ms. Suzy Q, RD
1234 Any Road Dr.
Any Town, XX 12345

Dear Ms Q,

Thank you for participating in the panel discussion in December or January to identify and define characteristics of the Dietary Guidelines for Americans (DGAs) that promote their adoption and implementation. You have been randomly selected to help confirm and/or make recommendations for revision to the definitions that emerged as a result of our discussions.

As a reminder, the DGAs include:

- 2 to 3 cups of vegetables per day that include dark green and orange vegetables
- 1 ½ to 2 cups of fruits per day, preferably whole
- Making half of the grains consumed whole grains (servings vary per calorie level)
- Using lean meats, fish, and beans for protein (servings vary per calorie level)
- Limiting added sugars to 3 to 12 teaspoons/day (varies as per calorie level from 1600 cals up to 2400 cals)
- Limiting solid fats found in high fat meats, butter, etc

We discussed the positive characteristics of the DGAs as they relate to a healthy diet, including overall advantages (*relative advantage*), consistent dietary needs and food preferences (*compatibility*), ease of incorporating (*low complexity*), how it could be sampled or tried on a limited basis (*trialability*), and how the consequences of incorporating could be seen be communicated or seen by others (*observability*). In addition, other characteristics emerged across panels. Attached is a table that specifies the characteristics and their definition. Please take a moment to complete the attached form by indicating your agreement (Agree/Disagree/Agree with Changes) and making recommendations as necessary.

If possible, please return the completed form by February 24, 2011. You can return to me by email at holly.federico@usm.edu or mail to 118 College Dr. Box 5172, Hattiesburg, MS 39406. If you have any questions, please do not hesitate to contact me by email or by telephone at 601-266-6023.

Thank you,
Holly Federico, MS, RD
Project Manager, Mississippi Communities for Healthy Living
The University of Southern Mississippi

Healthy Diet Characteristics and Definitions Agreement Form

Please indicate your agreement of the characteristic and its corresponding definition identified in the panel discussions with a check (✓). If you agree with the definition as is, check "Agree." If you do not think the characteristic reflects the DGAs at all or is not an accurate representation of the discussion, check "Disagree" and specify your reason in the *Comments and/or Recommended Changes* column. If you agree with the definition but think it needs some minor changes, check "Agree with Changes" and write your recommendation in the *Comments and/or Recommended Changes*. Additional comments may be added below this table.

Characteristic of the DGAs and Definition	Agree	Disagree	Agree but needs Changes	Comments and/or Recommended Changes
Relative Advantage (RA): The degree to which components of a healthy diet increase one's overall well-being (identifiers of RA include: balanced nutrition, not restrictive, affordability, and increased energy levels)				
Compatibility (CP): The degree to which components of a healthy diet are consistent with one's dietary needs and cultural food preferences				
(Low) Complexity (CX): The degree to which components of a healthy diet are easy and readily available to incorporate into one's diet				
Trialability (T): The degree to which components of a healthy diet can be gradually incorporated into one's lifestyle to make small changes				
Observability (O): The degree to which components of a healthy diet can be modeled to, or shared with others, and positive outcomes are evident				

Continues on next page.

Healthy Diet Characteristics and Definitions Agreement Form

Characteristic of the DGAs and Definition	Agree	Disagree	Agree with Changes	Comments and/or Recommended Changes
Portability (P): The degree to which components of a healthy diet are convenient and appropriate for today's "on the go" lifestyle				
Protective (PT): The degree to which components of a healthy diet help in preventing and/or managing chronic disease (i.e. high blood pressure, high blood sugar, obesity, etc)				
Generational (G): The degree to which healthy lifestyle behaviors are passed on to younger generations				

Please use this space for additional comments regarding the definitions or add any new thoughts, ideas, or characteristics that you may have thought of after the meeting or as a result of completing this form.

APPENDIX H

SURVEY EVALUATION FORM

Developing A *Perceptions Of Adopting And Implementing A Healthy Diet* Instrument For Individuals Participating In Nutrition and/or Health And Wellness Program

Thank you for volunteering your time to assist us in the development of this survey. We want to be sure that the instructions are clear and survey statements are easy to respond to before beginning our research project. Please assist us by answering the following questions. Revisions will be made based on your suggestions.

Start time: _____ End time: _____

Survey Instrument	Yes	No	Recommendations for improvement
Were instructions for completing the survey clear? If not, suggest improvement.			
Did you understand the meaning of the statements? If not, suggest improvement for each statement that was not clear.			
Were there statements in the survey that you would exclude? If yes, indicate statement(s) you would exclude.			
Were there any other statements that you would add in this survey? If yes, indicate statement(s) you would add.			
Were the response categories understandable? If not, suggest improvement.			
Was the overall survey layout and flow clear and easy to understand? If not, suggest improvement.			
Did you find the length of the survey to be appropriate?			
Did you find the amount of time to take the survey to be appropriate?			

Please indicate any additional suggestions for improvement of the survey on the back of this page.

Thank you for your assistance!

APPENDIX I
PILOT TEST INSTRUMENT

Perceptions of Adopting and Implementing a Healthy Diet Questionnaire

Hello:

The attached questionnaire is part of a research study in which the primary researcher is exploring individuals' perceptions of using a healthy diet after participating in a nutrition and/or health and wellness program. As part of the research, I would like you to complete the attached questionnaire. It should take no longer than 20 minutes to complete the questionnaire.

There are no known risks to you for participating in this study. A benefit of your participation will be helping me to develop better nutrition education programs and materials.

Participation is voluntary, and you may stop filling out the questionnaire at any time without penalty. You may refuse to answer any question. All information obtained from the questionnaire is confidential and will be kept in a locked file and destroyed at the end of the study. A completed questionnaire will serve as your consent to participate in this research project. This project has been reviewed by the Human Subjects Protection Review Committee at the University of Southern Mississippi, Box 5147, Hattiesburg, MS 39406, 601-266-6820.

Thank you for your participation!

Holly F. Huye, MS, RD

Perceptions of Adopting and Implementing a Healthy Diet Questionnaire

I. The statements in this questionnaire pertain to perceptions of following a **healthy diet.** A healthy diet may include **one or more** of the following:

- 2 to 3 cups of **vegetables** per day, including dark green and orange vegetables
- 1 ½ to 2 cups of **fruits** per day (can include fresh, frozen or canned in juice or water)
- Making half of the grains consumed **whole grains**
- Using **lean meats, fish, and beans** for protein
- **Limiting added sugars** to 3 to 12 teaspoons/day
- **Limiting solid fats** found in high fat meats, butter, whole fat dairy products, etc

Directions: For the following statements, please provide your opinion of a healthy diet. There is no right or wrong answer. For each statement, circle the number that best reflects your opinion:
1: Strongly Disagree; 2: Disagree; 3: Agree; or 4: Strongly Agree. If you feel like a statement does not apply to you, please check the last column.

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Does Not apply to Me
1. When I eat a healthy diet it helps me avoid health diseases like high blood pressure, high blood sugar, obesity, etc.	1	2	3	4	
2. Passing down healthy recipes to my children, family, or others is important to me.	1	2	3	4	
3. Since I have been eating a healthy diet, others have noticed a difference in me.	1	2	3	4	
4. Eating a healthy diet helps me manage my health condition(s).	1	2	3	4	
5. Healthy foods are convenient to take with me when I am traveling.	1	2	3	4	
6. When I am in a hurry, healthy foods are quick and easy for me to grab.	1	2	3	4	
7. I have gradually added healthy foods into my diet.	1	2	3	4	
8. When I eat a healthy diet, it helps me lose weight.	1	2	3	4	
9. I do not like trying new foods.	1	2	3	4	
10. Buying healthy foods at the grocery is less expensive than belonging to a program in which you have to buy special foods.	1	2	3	4	
11. It is easy to find healthy foods that taste good to me.	1	2	3	4	
12. When I eat a healthy diet I have more energy for daily activities.	1	2	3	4	

Continued on next page.

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Does Not apply to Me
13. I try new healthy recipes at home to serve to myself, friends, and/or family.	1	2	3	4	
14. A healthy diet does not exclude any foods or food groups.	1	2	3	4	
15. I find it difficult to convince my family to eat a healthy diet.	1	2	3	4	
16. Eating healthy foods has become part of my family's routine.	1	2	3	4	
17. I show my friends and family how to eat healthy by being an example and eating healthy myself.	1	2	3	4	
18. A healthy diet includes all types of foods for balanced nutrition.	1	2	3	4	
19. It is difficult for me to eat a healthy diet on a daily basis.	1	2	3	4	
20. There are a variety of healthy foods that are easy to prepare.	1	2	3	4	
21. Eating a healthy diet sets an example for future generations.	1	2	3	4	
22. I cook healthy for my family so they will learn to make healthy food choices.	1	2	3	4	
23. Foods for a healthy diet are readily available in the area where I live.	1	2	3	4	
24. Eating a healthy diet may keep me from having to take medications.	1	2	3	4	
25. I serve healthy versions of traditional foods/recipes during celebrations.	1	2	3	4	
26. It is difficult for me to explain why a healthy diet is beneficial for one's overall wellbeing.	1	2	3	4	
27. Healthy foods are difficult to find when I am away from home.	1	2	3	4	
28. I try healthy foods when I have the opportunity.	1	2	3	4	
29. A healthy diet can be a part of my cultural beliefs and traditions.	1	2	3	4	
30. I eat a healthy diet so the young people in my life can learn from me.	1	2	3	4	
31. It seems that other people feel better when they eat a healthy diet.	1	2	3	4	
32. Following a healthy diet does not take a lot of effort.	1	2	3	4	
33. I choose healthy food options at fast food restaurants when available.	1	2	3	4	
34. Eating a healthy diet may help me avoid getting sick.	1	2	3	4	

Continued on next page.

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Does Not apply to Me
35. Eating a healthy diet is good for my body.	1	2	3	4	
36. I have made small changes to my diet over time to improve my health.	1	2	3	4	
37. I know how to adjust the way I cook to include healthy foods that are culturally acceptable during celebrations and traditional events.	1	2	3	4	
38. I see positive results when people eat a healthy diet.	1	2	3	4	
39. I notice that people who eat a healthy diet appear to have more energy for daily activities.	1	2	3	4	
40. When I eat a healthy diet, it makes me feel better.	1	2	3	4	

II. Demographic Information

Please take a moment to answer the following questions by placing a checkmark (✓) for the best choice.

1. What is your gender?

_____ Male
_____ Female

2. What is your age range?

_____ 18-21
_____ 22-25
_____ 26-30
_____ 31-40
_____ 41-50
_____ 51-60
_____ 62-65
_____ 66 years of age or older

3. How would you describe your ethnicity? Select one or more of the following.

_____American Indian or Alaska Native
_____ Asian
_____ Black or African American
_____ Hispanic or Latino
_____Native Hawaiian or Other Pacific Islander
_____White
_____ More than two of the above

Continued on next page.

4. What was the last level of school you have completed?

_____ High School Degree or GED
_____ Some College
_____ College Degree
_____ Some Graduate or Professional School
_____ Graduate Level or Professional Degree
_____ Other not listed (please specify _____)

5. Do you belong to any social or civic organizations that participate in community outreach? Select one or more of the following.

_____Church Group
_____ Sorority
_____ Jr. League
_____ Garden Club
_____ Group or Club associated with your work (please describe _____)
_____Christian Services or other volunteer organization
_____ Other not listed (please describe _____)

6. Do you currently participate in any nutrition, health and wellness programs like Weight Watchers, Curves, Body and Soul, etc.? Please list the programs you participate in:

_____

This is the end of the questionnaire. Thank you!

APPENDIX J

FIELD TEST INSTRUMENT

Perceptions of Adopting and Implementing a Healthy Diet Questionnaire

Hello:

The attached questionnaire is part of a research study for which the primary researcher is exploring individuals' perceptions of using a healthy diet after participating in a nutrition and/or health and wellness program. As part of the research, I would like you to complete the attached questionnaire. It should take no longer than 10 minutes to complete the questionnaire.

There are no known risks to you for participating in this study. A benefit of your participation will be helping me to develop better nutrition education programs and materials.

Participation is voluntary, and you may stop filling out the questionnaire at any time without penalty. You may refuse to answer any question. All information obtained from the questionnaire is confidential and will be kept in a locked file and destroyed at the end of the study. A completed questionnaire will serve as your consent to participate in this research project. This project has been reviewed by the Human Subjects Protection Review Committee at the University of Southern Mississippi, Box 5147, Hattiesburg, MS 39406, 601-266-6820.

Thank you for your participation!

Holly F. Huye, MS, RD

Perceptions of Adopting and Implementing a Healthy Diet Questionnaire

I. The statements in this questionnaire pertain to perceptions of following a **healthy diet.** A healthy diet may include **one or more** of the following:

- 2 to 3 cups of **vegetables** per day, including dark green and orange vegetables
- 1 ½ to 2 cups of **fruits** per day (can include fresh, frozen or canned in juice or water)
- Making half of the grains consumed **whole grains**
- Using **lean meats, fish, and beans** for protein
- **Limiting added sugars** to 3 to 12 teaspoons/day
- **Limiting solid fats** found in high fat meats, butter, whole fat dairy products, etc

Directions: For the following statements, please provide your opinion of a healthy diet. There is no right or wrong answer. For each statement, circle the number that best reflects your opinion: **1: Strongly Disagree; 2: Disagree; 3: Agree; or 4: Strongly Agree. If you feel like a statement does not apply to you, please check the last column.**

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Does Not apply to Me
1. When I eat a healthy diet, it helps me avoid health conditions like high blood pressure, high blood sugar, obesity, etc.	1	2	3	4	
2. It is important to me to pass down healthy recipes to my children, family, and others.	1	2	3	4	
3. Since I have been eating a healthy diet, others have noticed a difference in me.	1	2	3	4	
4. Eating a healthy diet helps me manage my health condition(s).	1	2	3	4	
5. Healthy foods like fruit, whole grain crackers, or nuts are easy to take with me when I am traveling.	1	2	3	4	
6. I see positive results when people eat a healthy diet.	1	2	3	4	
7. I have gradually added healthy foods into my diet.	1	2	3	4	
8. When I eat a healthy diet, it helps me lose weight.	1	2	3	4	
9. I like trying new foods.	1	2	3	4	
10. Buying healthy foods at the grocery store is less expensive than buying special foods for a diet plan, such as Weight Watchers™ or Jenny Craig™.	1	2	3	4	
11. It is easy to find healthy foods that taste good to me.	1	2	3	4	
12. When I eat a healthy diet, I have more energy throughout my day.	1	2	3	4	
13. I try new healthy recipes at home to serve to myself, friends, and/or family.	1	2	3	4	

Continued on next page.

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Does Not apply to Me
14. A healthy diet includes foods from all of the food groups.	1	2	3	4	
15. I encourage my family to eat a healthy diet.	1	2	3	4	
16. Eating healthy foods has become part of my family's routine.	1	2	3	4	
17. I show my friends and family how to eat healthy by being an example and eating healthy myself.	1	2	3	4	
18. A healthy diet includes all types of foods for balanced nutrition.	1	2	3	4	
19. It is not difficult for me to eat a healthy diet on a daily basis.	1	2	3	4	
20. There are a variety of healthy foods that are easy to prepare.	1	2	3	4	
21. Establishing healthy eating patterns can influence future generations.	1	2	3	4	
22. I cook healthy meals for my family so they will learn to make healthy food choices.	1	2	3	4	
23. I can find foods for a healthy diet in the area where I live.	1	2	3	4	
24. Eating a healthy diet may keep me from having to take medications.	1	2	3	4	
25. I serve healthy versions of traditional foods/recipes during celebrations.	1	2	3	4	
26. Healthy foods are not difficult to find when I am away from home.	1	2	3	4	
27. I try healthy foods when I have the opportunity.	1	2	3	4	
28. A healthy diet can be a part of my cultural beliefs and traditions.	1	2	3	4	
29. I eat a healthy diet so the young people in my life can learn from my example.	1	2	3	4	
30. I can tell that other people feel better when they eat a healthy diet.	1	2	3	4	
31. Following a healthy diet does not take a lot of effort.	1	2	3	4	
32. I choose healthy foods at fast food restaurants if they are available.	1	2	3	4	
33. Eating a healthy diet may help me avoid getting sick.	1	2	3	4	

Continued on next page.

Statement	Strongly Disagree	Disagree	Agree	Strongly Agree	Does Not apply to Me
34. Eating a healthy diet provides better nutrition for a healthier body.	1	2	3	4	
35. I have made small changes to my diet over time to improve my health.	1	2	3	4	
36. I know how to adjust the way I cook to include healthy foods that are culturally acceptable during holidays and celebrations.	1	2	3	4	
37. When I am in a hurry, healthy foods like fruit or nuts are quick and easy for me to grab.	1	2	3	4	
38. I notice that people who eat a healthy diet appear to have more energy for daily activities.	1	2	3	4	
39. I feel good when I eat a healthy diet.	1	2	3	4	

II. Demographic Information

Please take a moment to answer the following questions by placing a checkmark (✓) for the best choice.

1. Are you male or female?

_____ Male

_____ Female

2. What is your age range?

_____ **18-21**

_____ 22-25

_____ 26-30

_____ 31-40

_____ 41-50

_____ 51-60

_____ 62-65

_____ 66-70

_____ Over 71

3. What is your occupation? If you are retired, what was your previous occupation? Please write below

_____

Continued on next page.

4. Do you consider yourself to be Hispanic or Latino?

   A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

   _____ Yes, Hispanic or Latino

   _____ Not Hispanic

5. What race do you consider yourself to be? Select one or more of the following.

   _____ American Indian or Alaska Native

   _____ Asian

   _____ Black or African American

   _____ Native Hawaiian or Other Pacific Islander

   _____ White

   _____ More than two of the above

   _____ Don't Know

6. What is your marital status?

   _____ Now Married

   _____ Widowed

   _____ Divorced

   _____ Separated

   _____ Never Married

7. What was the last level of school you have completed: _____

   _____ Less than High School

   _____ 12th Grade (High School Grad or GED)

   _____ Trade or VOC School

   _____ Some College

   _____ College Degree

   _____ Some Graduate or Professional School

   _____ Graduate Level or Professional Degree

Continued on next page

8. Are you participating in any of the following nutrition programs right now?

[CHECK ALL THAT APPLY]

_____ The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

_____ Body and Soul

_____ Weight Watchers

_____ Food Stamps (EBT/Supplemental Nutrition Assistance Program)

_____ Supplemental Nutrition Assistance Program Education (SNAP-Ed)/The Food Stamp Nutrition Education (FSNEP) Program (education program for Food Stamp recipients)

_____ Others, please give name_____

_____ None of these

9. In general, would you say that your health is:

_____ Excellent

_____ Very good

_____ Good

_____ Fair

_____ Poor

10. Of these income groups, please check (✓) which number best represents your household's total income in the last 12 months?

_____ Less than $9,999

_____ 10,000- $14,999

_____ 15,000-19,999

_____ 20,000-24,999

_____ $25,000-29,999

_____ $30,000-34,999

_____ $35,000-39,999

_____ $40,000-44,999

_____ $45,000-49,999

_____ $50,000-54,999

_____ More than $55,000

_____ Don't Know

This is the end of the questionnaire. Thank you!

REFERENCES

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting behavior*. Englewood Cliffs, NJ: Prentice-Hall Inc.

American Dietetic Association. (2006). Position of the American Dietetic Association: Agricultural and food biotechnology. *Journal of the American Dietetic Association, 106,* 285-293.

Ammerman, A., Washington, C., Jackson, B., Weathers, B., Campbell, M., Davis, G. …Switzer, B. (2002). The PRAISE! Project: A church-based nutrition intervention designed for cultural appropriateness, sustainability, and diffusion. *Health Promotion Practice, 3,* 286-301.

Atkinson, N. L. (2007). Developing a questionnaire to measure perceived attributes of ehealth innovations. *American Journal of Health Behavior, 31,* 612-621.

Beal, G. m., & Rogers, E. M. (1960). The adoption of two farm practices in a Central Iowa community. *Special Report – Agricultural and Home Economics Experiment Station*, *Iowa State University of Science and Technology.*

Berkman, L. F., & Glass, T. (2000). Social integration, social networks, social support, and health. In Berkman, L. F., & Kawachi, I. (Eds.) *Social epidemiology*. New York: Oxford, Press.

Bolton, T. (1983). Perceptual factors that influence the adoption of videotex technology: Results of the channel 2000 field test. *Journal of Broadcasting, 27*, 141-153.

Bowling, A. (2005). Mode of questionnaire administration can have serious effects on data quality. *Journal of Public Health.* Advance online publication. doi:10.1093/pubmed/fdi031

Burns, N., & Grove, S. K. (2005). Concepts of measurement. In *The practice of nursing research: Conduct, critique, and utilization* (5th ed.) (pp. 374-380). St. Louis, MO: Elsevier

Campbell, M. K., Honess-Morreale, L., Farrell, D., Carbone, E., & Brasure, M. (1999). A tailored multi-media nutrition education pilot program for low-income women receiving food assistance. *Health Education Research, 14,* 257-267.

Centers of Disease Control and Prevention. (2006). *Guide to community preventive services*. Atlanta: U. S. Centers for Disease and Prevention. Retrieved from http://www.thecommunityguide.org.

Centers of Disease Control and Prevention, Behavioral Risk Factor Surveillance System. (2010). Prevalence and Trends Data. Retrieved from http://apps.nccd.cdc.gov/brfss

Champagne, C. M., Bogle, M. L., McGee, B. B., Yadrick, K., Allen, H. R., Kramer, T. R., Simpson, P., Gossett, J., & Weber, J. (2004). Dietary intake in the Lower Mississippi Delta region: Results from the Foods of Our Delta Study. *Journal of the American Dietetic Association, 104,* 199-207.

Cohen, S., & Wills, T. (1985). Stress, social support, and the buffering hypothesis. Psychological Bulletin, 98, 310-357.

Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis*. Hillsdale, NJ: Lawrence Erlbaum.

Contento, I. R., Randell, J. S., Basch, C. E. (2002). Review and Analysis of Evaluation Measures Used in Nutrition Education Intervention Research. *Journal of Clinical Nutrition, 34,* 2-25.

Cowie, C. C., Rust, K. F., Ford, E., Eberhardt, M. S., Byrd-Holt, D. D., Li, C., et al. (2009). Full accounting of diabetes and pre-diabetes in the US population in 1988-1994 and 2005-2006. *Diabetes Care, 32,* 287-294.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a social network over 32 years. New *England Journal of Medicine, 357,* 370-379.

Creswell, J. W. (2005). Collecting qualitative data. In *Educational research: Planning, Conducting, and evaluating quantitative and qualitative research* (2nd ed.) (pp. 214-216). Upper Saddle River, NJ: Pearson Education, Inc.

Crocker, L., & Algina, J. (1986). Procedures for estimating reliability. In *Introduction to classical and modern test theory*, (134-135). New York: CBS College Publishing.

Dearing, J. W. (2004). Improving the state of health programming by using diffusion theory. *Journal of Health Communication, 9,* 21-36.

Delta Nutrition Intervention Research Consortium (2004). Self-reported health status of residents of the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi. *Journal of Health Care of the Poor and Underserved, 15,* 645-662.

Delta State University. (2011). The Lower Mississippi Delta Development Commission papers. Retrieved from http://www.deltastate.edu/pages/1317.asp

Deutschmann, P. J., & Fals Border, O. (1962). Communication and adoption patterns in an Andean village. *Programa Interamericano de Informacion Popular*, San Jose, Costa Rica.

Dino, G. A., Horn, K. A., Goldcamp, J., Kemp-Rye, L., Westrate, S., & Monaco, K. (2001). Teen smoking cessation: Making it work through school and community partnerships. *Journal of Public Health Management Practice, 7,* 71-80.

Downing, S. M., & Haladyna, T. M. (1997). Test item development: Validity evidence from quality assurance procedures. *Applied Measurement in Education, 10,* 61-82. doi:10.1207/s15324818ame1001_4

Eikenberry, N., & Smith, C. (2004). Healthful eating: Perceptions, Motivattions, Barriers, and Promoters in low-income Minnesota communities. *Journal of the American Dietetic Association, 104,* 1158-1161.

Emrick, J. A., Peterson, S. M., & Agarwala-Rogers, R. (1977). *Evaluation of the national diffusion network.* Menlo Park, California: Stanford Research Institute.

Eng, E., & Hatch, J. W. (1991). Networking between agencies and black churches: The lay health advisor model. *Prevention in Human Services, 10,* 123-146.

Faiks, A., & Hyland, N. (July 2000). Gaining user insight: A case study illustrating the card sort technique. *College and Research Libraries, 61,* 349-357.

Feinstein J. S. (1993). The relationship between socioeconomic status and health: A review of the literature. *Milbank Quarterly, 71,* 279–322.

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W., & Dietz, W. (2009). Annual medical spending attributable to obesity: Payer and service-specific estimates. *Health Affairs,* 28, w822-w831. doi:10:1377/hlthaff.28.5w822

Flegal, K. M., Carroll, M. D., Ogden, C. L., & Curtin, L. R. (2010). Prevalence and trends in obesity among US adults, 1999-2008. *Journal of the American Medical Association, 201,* 235-241.

Fliegel, F. C., & Kivlin, J. E. (1966). Attributes of innovations as factors in diffusion. *American Journal of Sociology, 72,* 235-248

Food Marketing Institute. (1999). *Trends in the United State: Consumer attitudes & the supermarket, 1999.* Washington DC: Food Marketing Institute.

Food Marketing Institute. (Summer 2004). *SuperMarket Research, 6*(2). Available at: http//www.fmi.org/newsletters/uploads/SupermarketResearch/SMRSummer04.pdf

French, S. A., Story, M., & Jeffery, R. W. (2001). Environmental influences on eating and physical activity. *Annual Review of Public Health, 22,* 309-335.

Garritty, C., & El Emam, K. (2006). Who's using PDAs? Estimates of PDA use by health care providers: A systematic review of survey. *Journal of Medical Internet Research, 8*(2). doi:10.2196/jmir.8.2.e7

Gillman, M. W., Rifas-Shiman, S. L., Frazier, A. L., Rockett, H. R., Camargo, C. A., Field, A. E. Berkey, C. S, & Colditz, G. A. (2009). Family dinner and diet quality among older children and adolescents. *Archives of Family Medicine, 9,* 235-240.

Gittelsohn, J., Evans, M., Story, M., Davis, S. M., Metcalfe, L., Helitzer, D. L., et al. (1999). Multisite formative research for the Pathways study to prevent obesity in American Indian school children. *American Journal of Clinical Nutrition, 69,* 767S-772S.

Gittelsohn, J., Steckler, A., Johnson, C. C., Pratt, C., Grieser, M., Pickerel, J., Stone, E. J. Conway, T., Coombs, D., Staten, L. K. (2006). Formative research in school and community-based health programs and studies: "State of the Art" and the TAAG approach. *Health Education and Behavior, 33,* 25-39.

Glanz, K., Basil, M., Maibach, E., & Goldberg, J. (1998). Why Americans eat what they do: Taste, nutrition, cost, convenience, and weight control concerns as influences on food consumption. *Journal of the American Dietetic Association, 98,* 1118-1126.

Glanz, K., Hewitt, A. M., & Rudd, J. (1992). Consumer behavior and nutrition education: An integrative review. *Journal of Nutrition Education, 24,* 267-277.

Green, L. W., Gottlieb, N., & Parcel, G. (1987). Diffusion theory extended and applied. In W. B. Ward (Ed.). *Advances in Health Education and Promotion*. Greenwich, CT: JAI.

Greenberg, B. (1964). Diffusion of news about the Kennedy assassination. *Public Opinion Quarterly, 28,* 225-232.

Gross, N. C. (1942). The diffusion of a culture trait in two Iowa Townships. Iowa State College (Unpublished master's thesis). Iowa State College, Ames.

Heaney, C. A. (1991). Enhancing social support at the workplace: Assessing the effects of caregiver support program. *Health Education Quarterly, 18,* 447-494.

Heaney, C. A., & Israel, B. A. (2002). Social networks and social support. In Glanz, K. Rimer, B. K., & Lewis, F. M. (Eds.), *Health behavior and health education*, 3rd ed., Chapter 11. San Francisco, CA: John Wiley & Sons, Inc.

Hebert, J. R., Clemow, L. Pbert, L., Ockene, I. S., & Ockene, J. K. (1995). Social desirability bias in dietary self-report may compromise the validity of dietary intake measures. *International Journal of Epidemiology, 24,* 389-398.

Hebert, J. R., Yunsheng, M., Clemow, L., Ockene, I. S., Saperia, G., Stanek, E. J., … Ockene, J. K. (1997). Gender differences in social desirability and socal approval bias in dietary self-report. *American Journal of Epidemiology, 146,* 1046-1055.

Hoelscher, D. M., Kelder, S. H., Murray, N., Cribb, P. W., Conroy, J., & Parcel, G. S. (2001). Dissemination and adoption of the Child and Adolescent Trial for Cardiovascular Health (CATCH): A case study in Texas. *Journal of Public Health Management and Practice, 7,* 90-100.

Holcomb, Z. C. (2009). Chapter 10 Correlation coefficients: The Pearson *r* and Spearman's *rho* In *SPSS Basics* (2nd Ed.) (pp. 109-115). Glendale, CA: Pyrczak Publishing.

Holloway, R. E. (1977). Perceptions of an innovation: Syracuse university project advance (Doctoral Dissertation, Syracuse University). Retrieved from ERIC. (Publication No. AAT 7811656).

Hurt, H. T., & Hibbard, R. (1989). The systematic measurement of the perceived characteristics of information technologies I: Microcomputers as innovations. *Communication Quarterly, 37,* 214-222.

Huye, H. F., Molaison, E. F., Downey, L. H., Connell, C. L, Zoellner, J. M., Madson, M. B. (2011). Formative research methods used in the development of a healthy diet innovation (HDI) instrument. Manuscript in preparation.

Israel, B. A. (1985). Social networks and social support: Implications for natural helper and community level interventions. *Health education & Behavior, 12,* 65-80. doi: 10.1177/109019818501200106

Israel, B. A., Cummings, K. M., Dignan, M. B., Heaney, C. A., Perales, D. P., Simmons-Morton, B. G., & Zimmerman, M. A. et al. (1995). Evaluation of health education programs: Current assessment and future directions. *Health Education Quarterly, 22,* 364-389.

Israel, B. A., Schulz, A. J., Parker, E. A., & Becker, A. B. (1998). Review of community-based research: Assessing partnership approaches to improve public health. *Annual Review of Public Health*, *19*, 173-202.

Johnson, R. B. (1997). Examining the validity structure of qualitative research. *Education, 118,* 282-292.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 35,* 32-36.

Katz, E., & Lazarsfeld, P. F. (1995). *Personal influence: The part played by people in the flow of mass communications.* New York: Free Press.

Kearns, K. P. (1992). Innovations in local government: A sociocognitive network approach. *Knowledge and Policy, 5,* 45-60. doi:10.1007/BF02692805

Keller, D. S., & Galanter, M. (1999). Technology transfer of network therapy to community-based addictions counselors. *Journal of Substance Abuse Treatment, 16,* 183-189.

King, S. & Gibney, M. (1999). Dietary advice is to reduce fat intake is more successful when it does not restrict habitual eating patterns. *Journal of the American Dietetic Association, 99,* 685-689.

Kline, P. (1994). *An easy guide to factor analysis.* New York: Routledge.

Knapp, T. R. (1998). Quantitative nursing research. Thousand Oaks, CA: Sage.

Lamar, R. V. (1966). In-service education needs related to diffusion of an innovation (Unpublished doctoral dissertation). University of California, Berkeley.

Larson, N. I., Neumark-Sztainer, D., Hannan, P. J., & Story, M. (2007). Family meals during adolescence are associated with higher diet quality and healthful meal patterns during young adulthood. *Journal of the American Dietetic Association, 107,* 1502-1510.

Lefevre, P., Kolsteren, P., De Wael, M., Beyekwaso, F., & Beghin, I. (2000). Comprehensive participatory planning evaluation. Retrieved from http://www.ifad.org/pub/bsf/cppe/ cppe.pdf

Lewis, C. J., Sims, L. S., & Shannon, B. (1985). Examination of specific nutrition/health behaviors using a social cognitive model. *Journal of the American Dietetic Association, 89,* 194-202.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology, 140*, 44-53.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage Publications, Inc.

Lyons, M., Smuts, C., & Stephens, A. (2001). Participation, empowerment and sustainability: How do the links work? *Urban Studies, 38*, 1233-1251.

Malnick, S. D., & Knobler, H. (2006). The medical complications of obesity. *Quarterly Journal of Medicine, 99,* 565-579.

Martin, G. W., Herie, M. A., Turner, B. J., & Cunningham, J. A. (1998). A social marketing model for disseminating research-based treatments to addictions treatment providers. *Addiction, 93,* 1703-1715.

Mayer, J. P., & Davdison, W. S. (2000). Dissemination of innovation as social change. In J. Rappenport & E. Seidman (Eds.), *Handbook of community psychology* (pp. 421-438). New York: Kluwer Academic/Plenum.

McCabe-Sellers, B. J., Bowman, S., Stuff, J. E., Champagne, C. M., Simpson, P. M., & Bogle, M. L. (2007). Assessment of the diet quality of US adults in the Lower Mississippi Delta. *American Journal of Clinical Nutrition, 86,* 697-706.

McIntosh, W. A., & Zey, M. (1998). Women as gatekeepers of food consumption: A sociological critique. In C. Counihan & S. L. Kaplan (Eds.), *Food and gender: Identity and power* (pp. 133-177). Amsterdam: Harwood Academic Publishers.

McKinlay, J., & Marceau, L. (2000a). US public health and the 21st century: Diabetes Mellitus. *Lancet, 356,* 287-294.

McKinlay, J. B., & Marceau, L. D. (2000b). To boldly go…. *American Journal of Public Health, 90,* 25-33.

Monteiro, C. A. (2009). Nutrition and health: The issue is not food, nor nutrients, so much as processing. *Public Health Nutrition, 12,* 729-731.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2,* 192-222.

Morse, J. M., & Field, P. A. (1995). *Qualitative research methods for health professionals* (2nd ed.). Thousand Oaks, CA: Sage.

National Institutes of Health. (1998). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults – the evidence report. *Obesity Research, 6,* 1S-209S.

Ndirangu, M., Perkins, H., Yadrick, K., West, J. R. Bogle, M. L., Avis-Williams, A., … Connell, C. (2007). Conducting needs assessment using the comprehensive participatory planning and evaluation model to develop nutrition and physical activity interventions in a rural community in the Mississippi Delta. *Progress in Community Health Partnerships: Research, Education, and Action, 1.1,* 29-36.

Newton, R. L., Thomson, J. L., Rau, K. K., Duhe, S. A., Sample, A. D., Singleton, N. N., … Williamson, D. A. (n.d.). *Psychometric characteristics of process evaluation measures for a rural school-based childhood obesity prevention study: Louisiana health.* Unpublished Manuscript.

Nunnally, J. C. (1967). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Orleans, C. T., Gruman, J., Ulmer, C., Emont, S. L., & Hollendonner, J. K. (1999). Rating our progress in population health promotion: Report card on six behaviors. *American Journal of Health Promotion, 14,* 75-82.

Orcher, L. T. (2005). Instrumentation in quantitative research In *Conducting research: social and behavioral science methods* (pp. 111-119). Glendale, CA: Pyrczak Publishing.

Ostlund, L. E. (1969). Product perceptions and predispositional factors as determinants of innovative behavior. Unpublished Doctoral Dissertation, Harvard University.

Pankratz, M., Hallfors, D., & Cho, H. (2002). Measuring perceptions of innovation adoption: The diffusion of a federal drug prevention policy. *Health Education Research, 17,* 315-326.

Parham, G. P., & Scarinci, I. C. (2007). Strategies for achieving healthy energy balance among African Americans in the Mississippi Delta. *Preventing Chronic Disease, 4*(4), 1-10. Retrieved from http://.www.cdc.gov/pcd/issues/2007/oct/07_0076.htm

Patten, M. (2002). Quantitative vs. qualitative research I. In *Understanding research methods,* (3rd ed.) (p. 19). Los Angeles, CA: Pyrczak Publishing.

Paul, C. L. (2008). A modified Delphi approach to a new card sorting methodology. *Journal of Usability Studies, 4*(1), 7-30.

Pedhazur, E. J., & Schmelkin, L. P. (1991). *Measurement, design, and analysis: An integrated approach.* Hillsdale, NJ: Lawrence Erlbaum

Riboli, E., & Norat, T. (2003). Epidemiologic evidence of the protective effect of fruit and vegetables on cancer risk. *American Journal of Clinical Nutrition, 78,* 559S-569S.

Rockett, H. R. H. (2007). Family dinner: More than just a meal. *Journal of the American Dietetic Association, 107,* 1498-1501.

Rogers, E. M. (1961). Characteristics of agricultural innovators and other adopter categories. *Agriculture Experiment Station*, Research Bulletin 882.

Rogers, E. M. (1973). *Communication Strategies for Family Planning.* New York: Free Press.

Rogers, E. M. (1995). *Diffusion of Innovations*. 4th ed., New York: Free Press.

Rogers, E. M. (2003). *Diffusion of Innovations*. 5th ed., New York: Free Press.

Rogers, E. M., & Storey, J. D. (1988) Communication campaigns. In Charles R. Berger and Steven H. Chaffe (Eds.), *Handbook of Communication Science* (pp. 817-846). Newbury Park, CA: Sage.

Rosenstock, R. (1990). The past, present, and future of health education. In K. Glanz, F. M. Lewis, & B. K. Rimer (Eds.), *Health behavior and health education: Theory research and practice*. San Francisco, CA: Jossey-Bass.

Royce, J. R. (1963). Factors as theoretical constructs. In D. N. Jackson and S. Messick (Eds.), *Problems in Human Assessment.* New York: McGraw-Hill.

Ryan, B., & Gross, N. (1943). Diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology, 8,* 15-24.

Sahyoun N.R., Pratt, C. A., & Anderson, A. (2004). Evaluation of nutrition education interventions for older adults: A proposed framework. *Journal of the American Dietetic Association, 104,* 58-69.

Sallis, J., Hovell, M., & Hofstetter, C. (1992). Predictors of adoption and maintenance of vigorous physical activity in men and women. *Preventative Medicine, 21,* 237-251.

Segaar, D., Willemsen,M., Bolman, C., & de Vries, H. (2007). Nurse adherence to a minimal-contact smoking cessation intervention on cardiac wards. *Research in Nursing Health, 30,* 426-444.

Simpson, J., Oldenburg, B., Owen, N., Harris, D., Dobbin, T., Salmon, A., Vita, P., Wilson, J., & Saunders, J. B. (2000). The Australian national workplace health project: Design and baseline findings. *Preventive Medicine, 31,* 249-260.

Smedley, B. D., & Syme, S. L. (Eds.) (2000). *Promoting health: Intervention strategies from social and behavioral research.* Washington, D.C.: National Academy Press.

Spencer, D. (2009). Use exploratory analysis. In *Card sorting: Designing usable categories* (pp. 109-126). Rosenfeld Media: Brooklyn, New York.

Steckler, A., Goodman, R. M., McLeroy, K. R., Davis, S. & Koch, G. (1992). Measuring the diffusion of innovative health promotion programs. *American Journal of Health Promotion, 6,* 214-224.

Stewart, B., & Tinsley A. (1995). Importance of food choice influences for working young adults. *Journal of the American Dietetic Association, 95,* 227-230.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage Publications, Inc.

Tabachnick, B. G., & Fidell, L. S. (2001). Using multivariate statistics (4th ed.). Boston: Allyn & Bacon.

Thoits, P. A. (1995). Stress, coping, and social support processes: Where are we? What next? *Journal of Health and Social Behavior, 35,* 53-59.

Thomson, J. L., Onufrak, S. J., Connell, C. L., Zoellner, J. M., Tussing-Humphreys, L. M., Bogle, M. L., & Yadrick, K. (2011). Food and beverage contributing to dietary guidelines adherence in the Lower Mississippi Delta. *Public Health Nutrition.* doi:10.1017/S136898001443

Tinsley, H. E. A., & Tinsley, D. J. (1987). Uses of factor analysis in counseling psychology research. *Journal of Counseling Psychology, 34*(4), 414-424.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management, EM-29*(1), 28-43.

Tucker, K. L., Maras, J., Champagne, C., Connell C., Goolsby, S., Weber, J., Zaghloul, S., … Bogle, M.L. (2005). A regional food-frequency questionnaire for the US Mississippi. *Delta Public Health Nutrition. 8,* 87-96.

Ulin, P. R., Robinson, E. T., & Tolley, E. E. (2005). Invitation to explore. In *Qualitative methods in public health: A field guide for applied research* (pp 1-10). San Francisco, CA: Jossey-Bass.

US Department of Agriculture, Agricultural Research Service. (2010). *Research Project: Lower Mississippi Delta Nutrition Intervention Research Initiative - Louisiana Cooperative Extension Service.* Retrieved from http://www.ars.usda.gov/research/ projects/projects.htm ?accn_no=407644

US Department of Agriculture, Agricultural Research Services. (2011). USDA, ARS, Delta obesity prevention research unit (Delta OPRU). Retrieved from http://www.ars.usda.gov/main/ sitemain.htm?modecode=62-51-05-00

Wang, Y. Beydoun, M. A., Liang, L., Cabellro, B., & Kumanyika, S. K. (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity, 16*, 2223-2330. doi:10.1038/oby.2008.351

Welsh S. Davis, C., & Shaw, A. (1992). Development of the Food Guide Pyramid. *Nutrition Today, 27,* 12-23.

Wiecha, J. L., EL Ayadi, A. M., Fuemmeler, B. F., Carter, J. E., Handler, S. H., Johnson, S., et al. (2004). Diffusion of an integrated health education program in an urban school system: Planet Health. *Journal of Pediatric Psychology, 29,* 467-474.

Yadrick, K., Horton, J., Stuff, J., McGee, B., Bogle, M., Davis, L, … Zaghloul, S. (2001). Perceptions of Community nutrition and health needs in the lower Mississippi Delta: A key informant approach. *Journal of Nutrition Education, 33,* 266-277.

Zoellner, J. Connell, C., Santell, R., Fungwe, T., Strickland, E., Avis-Williams, A., Yadrick, K., Bogle, M. (2007). Fit for Life Steps: Results of a community walking intervention in rural Mississippi Delta. *Progress in Community Health Partnerships: Research, Education, and Action, 1*, 49-60.