INFORMATION PROCESSES OF HEALTH COMMUNICATION AND FRUIT AND VEGETABLE CONSUMPTION: A MULTI-SAMPLE STRUCTURAL EQUATION MODELING APPROACH BY INTERVENTION AND COLON CANCER STATUS GROUPS

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Health Behavior and Health Education of the School of Public Health

Chapel Hill
2008

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ABSTRACT

LINDA K. KO: Information Processes of Health Communication and Fruit and Vegetable Consumption: A Multi-Sample Structural Equation Modeling Approach by Intervention and Colon Cancer Status Groups

(Under the direction of Brenda DeVellis (Chair), Jo Anne Earp, Megan Lewis, Marci Campbell, & Abigail Panter)

A diet low in fruits and vegetables has been associated with increased risk for colorectal cancer. Health communications with Tailored Print Communication (TPC) and Telephone Motivational Interviewing (TMI) have been shown to be effective in promoting fruits and vegetable consumption (FVC). This study explored the mechanisms underlying TPC and TMI effectiveness among colon cancer survivors and colon cancer-free individuals, guided by the Information Processing Theory.

The data come from the North Carolina Strategies to Improve Diet, Exercise, and Screening study (NC STRIDES). NC STRIDES tested the efficacy of TPC and TMI to promote FVC among a population-based sample of 735 participants (36% colon cancer survivors and 64% colon cancer-free individuals) who were randomized to control, TPC, TMI, or combined (TPC+TMI) groups. Information processes were perception of message relevance, trust, and recall. Multi-sample structural equation models were constructed.

Among colon cancer survivors, the relationship between health communication and FVC was mediated by information processes but only in those who received the TPC+TMI. The model fit resulted in $\chi^2(27, N=266) = 31.52$, $CFI = .99$, $TLI = .99$, $RMSEA = .025$, and $SRMR = .027$. Receiving a combination of TPC+TMI was associated with perception of message relevance ($p = .05$). Greater relevance was associated with trust ($p < .001$), and

higher trust was related to FVC (p <.05). In the colon cancer-free group, the relationship between health communication and FVC was mediated by information processes among those who received the TMI intervention only and TPC+TMI. The model had a good fit with $\chi^2(28, N=469) = 68.11$, $CFI = .98$, $TLI = .97$, $RMSEA = .055$, and $SRMR = .036$. TMI had an indirect effect on FVC through message relevance. TPC+TMI influenced FVC through two paths. In the first path, message relevance was associated with trust (p <.001) and greater trust was related to recall (p <.05). More recall influenced FVC (p <.05). In the second path, message relevance was associated with recall (p <.001), and more recall with FVC (p <.05).

Given the significant finding that information processes mediate the relationship between health communication and FVC, a promising direction for developing interventions would be to enhance information processes in future interventions.

To Jongil, Karen, & my parents, Ko Chang Sun & Kwon Jae Bun for their love and support

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the love and support of the following individuals, who have surrounded me with love and supported me in my journey to accomplishing one of the most difficult, yet amazing undertakings of my life.

To my dissertation chair and advisor, Dr. Brenda DeVellis, thank you for your support, expertise, patience, encouragement, and career guidance throughout this process. Your wisdom and candor during the last five years have been invaluable. You truly made this training process a wonderful experience.

I give my heartfelt thanks to my dissertation committee members, for their comments and crucial input throughout this dissertation process. Dr. Marci Campbell, thank you for sharing your expertise, patience, encouragement, and time with me. You are truly a great researcher and have taught me what it means to have passion for my research. Dr. Jo Anne Earp, thank you for your expertise, enthusiasm, insight, and most of all helping me expand my own horizons. You are one of the greatest mentors I have ever had. Dr. Megan Lewis, thank you for your expertise, patience and your openness to guide me as I navigate the difficult path of becoming an independent researcher. Dr. Abigail Panter, thank you for introducing me to the world of structural equation models and demystifying this powerful technique to be used in my dissertation.

I would like to thank Dr. Michael O'Malley for the enthusiasm and positive encouragement he brought to the UNC Cancer Control Education Program and to the UNC Lineberger Comprehensive Cancer Center for awarding me a pre-doctoral fellowship and

financial support for my research. To my academic advisor, Dr. Allan Steckler, I will always be grateful for your support, candor and warmth. I would have been completely lost without your guidance in the first few years in the program.

I would also like to thank my dearest friends who have enriched my life, Sarah, Poo, Lesha, Zoe, Anh, Kim, Judy, William, and Hester. Thank you for sharing, lamenting, and celebrating life with me. I could not have done all that I have without your encouragement, friendship, laughter, get-togethers, and memorable coffee breaks.

To my dear friend, Kathryn, thank you for your friendship. Thank you for all you have done-every note, card, email, and phone call, helped me in reaching the next step. I am blessed to have been surrounded by the encouragement, laughter, and wisdom of you and your family.

To my parents, thank you for being my first and best teachers. You have always reminded me that anything is possible with the courage to dream, a clear vision, hard work, and faith in God. Thank you for instilling me a sense of optimism and the audacity to embrace every challenge and opportunity. Your spirit and dedication to your children has allowed me to come so far. To my mother-in-law, Hwaja Lee, thank you for your encouragement and support. I feel blessed to have another person who cared about me just as much as my mother.

To my favorite people in the world, my brothers and sisters, Kyong-Hwan, Kyong-Mi, Kyong-Yol, and Michelle, thank you for your encouragement and humor - as always your timing was impeccable. I could always count on you to remind me how much I am loved, because first and foremost, I am your sister. To my sister-in-law and brother-in-law Hyang-ran, Lena, and Richard, thank you for your continued encouragement and thoughtful

words. To my nieces and nephews, Minji, Hanjoon, Hanbee, Michelle, Minjung, David, Andrew, Daniel, Dylan, Moses, Rachael, and Faith, thank you for your unconditional love.

And finally I would like to thank the people who helped me maintain my perspective on the important things in life - my family. To my husband, Jongil Choi, thank you for believing in me and reminding me that I could accomplish anything with love, faith, and courage. Your love was a place where I could retreat to when I needed rest along this journey. To my precious little girl, Karen Choi, thank you for growing up so beautifully and bringing joy into my life. Your smile and your love kept me going in reaching the next step. I feel blessed to have you both in my life.

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LIST OF ABREVIATIONS

CRC Colorectal Cancer

FVC Fruit and Vegetable Consumption

SEM Structural Equation Model

TMI Tailored Motivational Interviewing

TPC Tailored Print Communication

CHAPTER 1

INTRODUCTION

1.1 Overview

Unhealthy lifestyle behaviors, such as a poor diet, can lead to increased morbidity and mortality among American adults (Berlin & Colditz, 1990; Ness & Powless, 1997; Srinath & Katan, 2004). For example, a diet low in fruits and vegetables is associated with increased risk for chronic diseases such as cancer (American Cancer Society (ACS), 2008; Slattery, 2000). In 1991, the National Cancer Institute and the Produce for Better Health Foundation jointly launched the 5-A-Day Program to increase public awareness of the importance of eating at least 5 servings of fruits and vegetables each day. Despite these efforts, more than half of all American adults do not meet national guidelines for daily fruit and vegetable consumption (FVC) (Casagrande, Wang, Anderson, & Gary, 2007).

Health communication interventions can promote healthy eating behaviors when messages are strategically designed and delivered to audiences through selected health communication channels (Campbell et al., 2004; Emmons et al., 2005; Janer, Sala, & Kogevinas, 2002; Noar, Benac, & Harris, 2007). Communication strategies such as tailored print communications (TPC) have shown to be particularly effective in promoting FVC (Brug, Steenhuis, va Assema, deVries, 1996; Campbell et al., 1996; Campbell et al., 2004; Pierce et al., 1997). TPC are personalized communications in which the content and/or style of the printed materials are created based on an assessment of an individual's characteristics

(Kreuter & Skinner, 2000; Kreuter, Stretcher, & Glassman, 1999; Skinner, Strecher, & Hosper, 1994). The characteristics used in tailoring are typically grounded in social-psychological theories that are known to predict behavior change (Kreuter et al., 1999; Kreuter & Skinner, 2000; Skinner et al., 1994). Tailoring seems to work by inducing more attention and enhancing personal relevance of the materials (Campbell & Quintiliani, 2006).

Telephone Motivational Interviewing (TMI), an alternative medium for tailored health communication, has also been used to promote healthy eating (Resnicow et al., 2004; Resnicow & Shaikh, 2007). Such strategies apply a counseling technique known as motivational interviewing to increase an individual's motivation for behavior change (Miller & Rollnick, 1991; Rollnick, 1996). Motivational interviewing sessions are successful in influencing behavior change when the counselor begins by establishing rapport and trust (Bundy, 2004; Emmons & Rollnick, 2001). Rapport and trust are built when individuals perceive that the counseling sessions are relevant to their personal values and goals (Berg-Smith et al., 1999; Resnicow & Shaikh, 2007).

Health communication experts have focused extensively on testing and developing new and effective communication strategies for behavior change. Less attention, however, has been given to understand how health communications work to exert their effects (Rimer & Glassman, 1999; Skinner et al., 1999). Experts have discussed the need to examine theory-based mediators of health communication to understand how and why interventions work and whether each type of intervention works differently for various populations (Rimer & Glassman, 1999; Skinner et al., 1999).

Theories of information processing paradigms may hold the key to understanding how health communications work. One such theory is the information processing theory

developed by William McGuire (1968, 1969, 1985, 1999, 2001), which describes steps in persuasion starting with message attention, message processing, attitude change, and finally behavior modification. The information processing theory states that factors such as channel of delivery and the information receiver's characteristics can influence how individuals process health communications (McGuire, 1968, 1969, 1985, 1999, 2001).

Health communication researchers suggest that information processes can be considered mediators of the relationship between health communication and behavior (Bull, Holt, Kreuter, Clark, Scharff, 2001; Kreuter et al., 2004). Unfortunately, no study has investigated this hypothesized relationship, leaving a gap about whether information processes mediate the relationship between health communication interventions and behavior change. This knowledge can help us identify which information processes are important to individuals and expand our understanding of developing more effective health communications intervention to increase FVC.

1.2 Dissertation Study Purpose and Aims

The purpose of the study was to explore whether information processes are mediators of the relationship between a theory-based intervention and FVC. Specifically, the aims of the study are to:

1. Identify the information processes that mediate the relationship between health communication and FVC.
2. Assess whether similar or different information processes mediate the relationship between perception of message relevance and FVC across different intervention groups.

3. Assess whether similar or different information processes mediate the relationship between health communication and FVC across different colon cancer groups.

The data used came from the North Carolina Strategies to Improve Diet, Exercise, and Screening study (NC STRIDES; Principal Investigator: Marci Campbell). NC STRIDES was a population-based randomized intervention trial that aimed to influence behavior in colon cancer survivors (N = 266) and colon cancer-free individuals (N= 469) living in North Carolina. NC STRIDES tested the efficacy of two health communication strategies (tailored print communications and telephone motivational interviewing) to promote FVC among North Carolinians. The diverse sample included 35% African Americans, 51% male, and 35% colon cancer survivors.

CHAPTER 2

LITERATURE REVIEW

2.1 Colorectal Cancer

Colorectal cancer is the third most common cancer in the United States and the second leading cause of cancer death (ACS, 2008). An estimated 108,070 new colon cancer and 40,740 rectal cancer cases will occur in 2008. Furthermore, 49,960 colorectal cancer deaths are estimated for 2008 (ACS, 2008). The lifetime risk for colorectal cancer (CRC) is approximately 5.4% for the average adult, and this risk is similar for men and women (ACS, 2008; Ries et al., 2007). CRC risk, however, differs among race/ethnicities. African American adults have higher rates of CRC and lower survival rates from the disease (ACS, 2008; Ries et al., 2007).

The risk of colorectal cancer also increases with age and more than 90% of cases are diagnosed in individuals aged 50 and older (ACS, 2008; Ries et al., 2007). Studies also have shown that certain inherited genetic mutations, a personal or family history of colorectal cancer and/or polyps, or a personal history of chronic inflammatory bowel disease can increase risk of CRC (ACS, 2008; Burt & Neklason, 2005). Although one of the most effective means of controlling CRC is screening and early detection, dietary factors have been linked to decrease CRC rates as well (ACS, 2008; Adams & Standridge, 2006; Bingham et al., 2003; Key, Schatzkin, Willet, Allen, Spencer, & Travis, 2004; Slattery, 2000; Steinmetz & Potter, 1996).

A diet high in fruits and vegetables has been shown to decrease risk for colorectal cancer (Adams & Standridge, 2006; Bingham et al., 2003; Slattery, 2000; Steinmetz & Potter, 1996). Specifically, diets high in fruits, vegetables, and fiber while low in fat are associated with as much as a 50% decreased risk of CRC (Bingham et al., 2003). Findings from a prospective cohort study of over 7000 individuals reported that high intakes of fruits and vegetables can lower the risk of developing colorectal adenomas, which are precursors of most colorectal cancer occurrences (Giovannucci, Colditz, Stampfer, & Willet, 1996; Giovanucci, Stampfer, Colditz, Rimm, & Willett, 1992; Hill, Morson, & Bussey, 1978; Kim & Lance, 1997; Millen et al., 2007).

Vegetable consumption, in particular, has shown a protective effect against colorectal cancer in virtually all studies (Millen et al., 2007; Steinmetz & Potter, 1996). A systematic review of 206 epidemiologic studies investigating the relationship between vegetable consumption and risk of cancer revealed an inverse relationship between vegetable consumption and risk for CRC (Steinmetz & Potter, 1996). In a more recent study of over 10,000 men and women, researchers found that consuming 5 or more servings of deep-yellow, dark-green vegetables, and onions per day lowered the risk of colorectal adenomas with OR < 1.0 (Millen et al., 2007).

The findings on fruit consumption are less consistent than those for vegetable consumption; although, there is some evidence that fruit consumption does decrease the risk for CRC as well (Millen et al., 2007; Steinmetz & Potter, 1996). Researchers revealed that risk of distal adenoma was significantly lower among subjects eating more than five servings of fruit per day versus one serving (Millen et al., 2007).

Currently, national guidelines recommend that adults eat at least five servings of fruits and vegetables a day (United States Department of Agriculture, 2005). The significant relationship between FVC and the risk for CRC across a vast literature underscores the importance of working with individuals in making changes in FVC.

2.2 Fruit and Vegetable Consumption in the U.S.

Recognizing the benefits of eating FVC on health, health agencies worked collaboratively to increase FVC in the U.S. population. In 1991, the National Cancer Institute and the Produce for Better Health Foundation jointly launched the 5-A-Day Program for Better Health to increase public awareness about the importance of eating at least five fruits and vegetables each day. These efforts took the form of mass advertising campaigns as well as school and workplace-based interventions (Casagrande et al., 2007; Heimendinger, Van Duyn, Chapelsky, Foerster, Stables, 1996).

Unfortunately, implementation of the national FVC campaign did not influence Americans to consume more fruits and vegetables, and only a small proportion met the general dietary recommendations of health agencies (Casagrande et al., 2007). Findings from the National Health and Nutrition Examination Survey (NHANES) reported that the proportion of participants meeting fruit and vegetable guidelines was 10.9% in 1988–1994 and remained consistent at 10.8% in 1999–2002 (Casagrande et al., 2007). Given the effort devoted to the national campaign, the recent plateau in FVC is troublesome. Therefore, more innovative public health approaches are needed to promote healthy eating in the U.S.

Certain race/ethnic groups are less likely to consume the recommended servings of fruits and vegetables (Casagrande et al., 2007; Gary et al., 2004; Patterson, Block,

Rosenberger, Pee, & Kahle, 1990; Patterson, Harlan, Block, & Kahle, 1995; Subar, Heimendinger, Patterson, Krebs-Smith, Pivonka, & Kessler, 1995; Swanson et al., 1993; USDA 2005; Watters, Satia, & Galanko, 2007). For example, findings from the NHANES data showed African Americans were less likely to meet the FVC guidelines of five servings a day compared to their white counterparts (7% vs 11%) (Casagrande et al., 2007). Other studies reported that African Americans lagged behind whites in vegetable consumption, but not in fruit consumption (Subar et al., 1995; Watters et al., 2007). It is, however, important to note that African Americans consumed fruits mostly through fruit juice, which contains less fiber than whole fruit (Subar et al., 1995; USDA, 2005). On average, both African-American men and women consume 3.3 and 3.5 servings of fruits and vegetables per day, respectively, far less than the recommended guidelines of 5 servings per day (Subar et al., 1995; Watters et al., 2007).

FVC has also been shown to be positively associated with income, education, and age (Casagrande et al., 2007; Dibsdall, Lambert, Bobbin, & Frewer, 2003; Li, Serdula, Bland, Mokdad, Bowman, & Nelson, 2000; Miller, Sales, Kopjar, Fihn, & Bryson, 2005; Serdula, Gillespie, Kettel-Khan, Farris, Seymour, & Denny, 2004). Individuals with higher income were more likely to meet the 5-a day guideline compared to those with lower incomes. Those with a high school education or greater were also more likely to meet the FVC guidelines compared to their less educated counterparts (Dibsdall et al., 2003; Miller et al., 2005; Serdula et al., 2004). Lastly, individuals over age 40 were more likely to meet the guidelines than younger individuals (Li et al., 2000; Miller et al., 2005; Serdula, 2004).

Researchers also report that women, overall, consume more vegetables compared to men, but fewer fruits compared to men (Center for Disease Control and Prevention (CDC),

2007). Findings from the 2005 Behavioral Risk Factor Surveillance System (BRFSS) revealed that the prevalence of eating vegetables three or more times per day was 32.2% among women and 22.1% among men. Meanwhile, the prevalence of eating fruits two or more times per day was 28.7% among women and 36.4% among men (CDC, 2007). Although these numbers show that some groups consume more fruits and vegetables than others, the majority of the population is not meeting the 5-a day guidelines for FVC.

Without proper education or access to pertinent nutrition information, many Americans are missing important messages regarding the health benefits of eating more fruits and vegetables. These findings highlight the importance of behavioral interventions for the general populations as well as targeting demographic groups that are less likely to meet the national dietary guidelines such as African Americans, younger individuals, and those from low socioeconomic groups.

2.3 Colorectal Cancer Survivors and Fruit and Vegetable Consumption

On the whole, cancer survivors report having a strong interest in making positive lifestyle changes such as eating more fruits and vegetables (Blanchard et al., 2003; Demark-Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000). There are over one million CRC survivors in the United States, and the most recent report reveals that they make up one of the largest subgroups (11%) of cancer survivors (Ries et al., 2004; Surveillance Epidemiology and End Results (SEER), 2003). The increased number of colon cancer survivors is primarily due to improvements in early cancer detection and treatment (ACS, 2008; Ries et al., 2007). The 1-and 5-year relative survival rates for persons with CRC are 82% and 64%,

respectively. The 5-year survival is particularly high (i.e., 90%) when colorectal cancers are detected early at the localized stage (ACS, 2008).

Cancer survivors tend to make positive dietary changes after a cancer diagnosis. In a recent survey, Patterson and colleagues (2002) found that two thirds of breast, colorectal, and prostate cancer patients reported making changes in their diet, dietary supplement use, and physical activity. Having survived cancer once, CRC survivors remain at increased risk for recurrence, metastases, second cancers, as well as other chronic diseases (Tichansky et al., 2002; Evans, Moller, Robinson, Lewis, Bell, & Hogdson, 2002; Meyerhardt et al., 2007). Lifestyle changes such as eating more fruits and vegetables may help prevent recurrences, reducing the risk of secondary cancers and other future diseases (Tichansky et al., 2002; Evans et al., 2002; Meyerhardt et al., 2007). A study that examined the relationship between dietary patterns and colon cancer recurrence found that colon cancer survivors with a diet high in red meat, fat, and processed grains were about 3 times more at risk of colon cancer recurrence compared to those whose diets included fruits and vegetables (Meyerhardt et al., 2007).

Studies also show that the benefits of eating fruits and vegetables begin even before a cancer diagnosis. One study showed that women with lung cancer who had eaten more fruits and vegetables before diagnosis had longer survival times than women who had eaten less (Goodman, Kolonel, Wilkens, Yoshizawa, LeMarchand, & Hankin, 1992; Steinmetz & Potter, 1996). Another study of women who underwent surgery for an early breast cancer showed that those who had previously eaten more fruits and vegetables had tumors smaller in diameter and more normal cell differentiation, leading to better prognosis (Ingram, Roberts, & Nottage, 1992; Steinmetz & Potter, 1996).

The numbers of CRC survivors are predicted to increase as CRC diagnosis gains better survival rates, and the U.S. aging population continues to rise. By and large, adopting a lifestyle with high FVC can help individuals reduce their risk for CRC, lower the risk for future disease in CRC survivors, and increase the chance of better CRC prognoses in individuals newly diagnosed with CRC.

2.4 Health Communication Intervention and Fruit and Vegetable Consumption

Health communication interventions have been shown to influence healthy eating behaviors when health messages are strategically designed and delivered to target audiences through selected channels (Campbell et al., 2004; Emmons et al., 2005; Janer et al., 2002; Noar et al., 2007). Health communication encompasses communication strategies that influence individual and community decisions to enhance health (Cassell et al., 1998; NCI, 1989; Piotrow, Kincaid, Rimon, & Rinehard, 1997).

To develop an effective health communications, a series of operational tasks must be completed. These tasks include selecting credible sources, choosing a message strategy, and determining optimal settings or channels through which the communication is delivered (Kreuter & Wray, 2003). Research shows that these decisions present an opportunity to enhance the relevance of the communication to its intended audience (Kreuter & Wray, 2003). Traditionally, health communication has been channeled through educational messages in print materials and public service announcements on billboards, radio, and television (Atkin, 2001; Baker et al., 1992; Maibach & Holtgrave, 1995; NCI, 1989). More recently, health communication strategies are being built upon past experiences to create and implement new innovative strategies such as tailored print communications and telephone

motivational interviewing. These strategies have enhanced the relevance of the message to its audiences, influencing individuals to care about the issue or the content and accept the message as personally important (Brug et al., 1996; Campbell et al., 1996; Campbell et al., 2004; Maibach & Holtgrave, 1995; Pierce et al., 1997; Resnicow et al., 2004).

2.5 Tailored Print Communication and Fruit and Vegetable Consumption

Health communication strategies such as tailored print communications (TPC) seem to be particularly effective in promoting FVC (Brug et al., 1996; Campbell et al., 1996; Campbell et al., 2004; Pierce et al., 1997). For example, a church-based intervention study examining effects of computer-tailored newsletters combined with targeted videos was effective in increasing FVC (Campbell et al., 2004).

TPC are personalized communications in which the content and/or style of the printed materials are created based on an assessment of an individual's characteristics (Kreuter & Skinner, 2000; Kreuter et al., 1999; Skinner et al., 1994). Tailoring is similar to tailor-made clothing; custom fit in size and style to a particular person (Kreuter & Skinner, 2000; Skinner et al., 1994). Specifically, TPC are distinguished from other communications in that (1) the collection of messages or strategies is intended for a particular person rather than a group of people, and (2) the messages or strategies are based on individual-level factors that are related to the health and behavioral outcome of interest (Kreuter & Skinner, 2000; Kreuter & Wray, 2003).

The characteristics used in tailored messages are typically grounded in social-psychological theories that are known to predict behavior change (Campbell & Quintiliani, 2006; Kreuter, Stretcher, & Glassman, 1999). An example would be to present an individual

his or her own perceived barriers and benefits of changing versus maintaining usual behavior, while also providing feedback on the behavior of interest. Another characteristic of tailored messages would be matching the message to the recipient's demographics such as gender and race/ethnicity (Campbell & Quintilliani, 2006; Kreuter, Stretcher, & Glassman, 1999). It is important to note that tailoring is different from targeting. Targeting usually involves developing a single intervention approach for a defined population subgroup that takes into account characteristics shared by the subgroup's members (Kreuter & Skinner, 2000; Kreuter & Wray, 2003). Although most research shows that tailored print communications are more effective than targeted messages, little has been done to understand the specific mechanisms that drive tailored health communication effectiveness (Noar et al., 2007; Rimer & Glassman, 1999; Skinner, Campbell, Rimer, Curry, & Prochaska, 1999).

A handful of studies show that tailored communications seem to induce more attention and influence attitude change about health behaviors. Specifically, researchers who conducted process evaluations reported that people who receive tailored information were more likely to read the material, perceive greater personal relevance and recall more information compared to those who received non-tailored information (Brug et al., 2003; Campbell & Quintiliani, 2006; Petty, Priester, & Wegener, 1994).

Research suggests that greater personal relevance leads to cognitive elaboration of the message content (Campbell & Quintilliani, 2006). Cognitive elaboration is a process where an individual who receives a message attempts to relate the new information to his or her existing knowledge, attitudes, and feelings (Greenwald, 1968). An individual is then able to retrieve elaborated information more easily from his or her own memory than information that is not elaborated (Brug et al., 2003; Campbell & Quintiliani, 2006; Petty et al., 1994). In

addition, tailored messages were also found to be more attractive to individuals because they were often created using colors, graphics, and pictures of celebrities (Campbell & Quintilliani, 2006).

2.6 Telephone Motivational Interviewing and Fruit and Vegetable Consumption

Telephone counseling offers an alternative medium for tailored health communication and has been used widely to promote behavior change (Pierce et al., 1997; Resnicow et al., 2004; Stevens et al., 1995). One such counseling technique called motivational interviewing was successfully applied to increase motivation and readiness to change behavior by using interactive negotiation techniques to overcome an individual's ambivalence about behavior change (Miller & Rollnick, 1991; Rollnick, 1996).

Motivational interviewing is a directive, client-centered counseling style for eliciting behavior change by helping clients explore and resolve ambivalence (Miller & Rollnick, 1991; Rollnick 1996). The examination and resolution of ambivalence is its central purpose, and the counselor's role is to be directive in pursuing this goal. Ambivalence takes the form of a conflict between two courses of action (e.g., indulgence versus restraint), each of which has perceived benefits and costs (Miller & Rollnick ,1991). An intervention study aimed at FVC with peer counselors using the motivational interviewing approach showed that participants significantly increased their daily intake of fruits and vegetables by about 1 serving a day after 6 months compared to those who did not receive the intervention (Resnicow et al., 2004).

Motivational interviewing is successful when a counselor identifies and mobilizes an individual's intrinsic values and goals to stimulate behavior change (Miller & Rollnick,

1991; Rollnick, 1996). Intrinsic value is the enjoyment the individual gets from performing the activity or the subjective interest the individual has in the subject (Eccles & Wigfield, 2002). Rollnick (1995) describes several components of successful counselor-client interaction that are effective in mobilizing an individual's values and goals. First, the individual is motivated to change, and motivation is not imposed by the counselor. Second, the individual articulates and resolves his or her ambivalence. Third, a counselor facilitates expression of both sides of the ambivalence, and guides an individual toward an acceptable resolution that triggers change. Fourth, a counselor's role is to be directive in helping the client examine and resolve ambivalence by eliciting, clarifying, and resolving ambivalence in a client-centered and respectful counseling atmosphere (Miller, Benefield & Tonigan, 1993, Miller and Rollnick, 1991). Lastly, the counselor-client relationship is a partnership, and the counselor's role is to respect the client's autonomy and freedom of choice over his or her own behavior. Thus, for an intervention that is channeled through motivational interviewing, the role of a counselor becomes an important element of an intervention's success (Emmons & Rollnick, 2001; Miller & Rollnick, 1991; Rollnick, 1995).

Literature reports that motivational interviewing counseling sessions are most successful in influencing behavior change when the counselor begins by establishing rapport and trust with a client (Bundy, 2004; Emmons & Rollnick, 2001). Rapport and trust are built when individuals perceive that the counseling sessions are relevant to their values and goals (Berg-Smith et al., 1999; Resnicow & Shaikh, 2007). Interventions that are perceived as more personally relevant have been shown to be more successful in influencing behavior change (Elliot, Goldberg, Kuehl, Moe, Breger, & Pickering, 2007; Murphy et al., 2001). An intervention study aimed at reducing drinking among college students using motivational

interviewing reported that those who perceived the intervention materials to be more interesting and more personally relevant were more successful at reducing drinking compared to their counterparts (Murphy et al., 2001).

2.7 Characteristics of Colon Cancer Survivors and Health Communication

Receiving a diagnosis of cancer can be a major shock (Kreps, 2003). Research shows that rates of anxiety, fear, and depression are as much as 7% higher for colon cancer survivors compared to the same age group in the general population (Bottomley, 1998; Stark & House, 2000). From the time of diagnosis, cancer survivors face a number of critical decisions for which they have little training or preparation, such as deciding on a treatment type (Mills & Sullivan, 1999; O'Hair et al., 2003). Even when treatment has been successful, they face the uncertainty of cancer recurrence and developing secondary cancers (Mills & Sullivan, 1999; O'Hair et al., 2003). In addition, colon cancer survivors' affective and cognitive conditions are further compromised when they face the reality of navigating the complex and often frustrating health care system (O'Hair et al., 2003).

Colon cancer survivors may experience challenges processing health information (O'Hair et al., 2003). The physical and emotional demands of a colon cancer diagnosis can impair one's cognitive abilities to process health communications (O'Hair et al., 2003). Information processing, however, can be improved when cancer communications are designed and delivered to match the characteristics of cancer survivors' skills, needs, and predispositions (Kreps, 2003; O'Hair et al., 2003). Studies report that health communications that enhances message relevance and social support are successful in helping cancer survivors overcome physical and psychological challenges (Kilpatrick, Kritjanson, Tataryn, & Fraser, 1998; Krep, 2003; Rowland, Aziz, Tesauro, & Feuer, 2001).

A more recent study reports similar findings. Colon cancer survivors reported that they preferred messages that were personally relevant and tailored to their needs from trusted and credible sources (Mayer et al., 2007). The unique challenges that colon cancer survivors experience call for future studies to investigate the types of communications that are most effective for them.

2.8 Summary

Colorectal cancer is one of the leading causes of mortality and morbidity in the U.S. (ACS, 2008). A diet high in FVC has been shown to decrease the risk for CRC (Adams & Standridge, 2006; Bingham et al., 2003; Slattery, 2000; Steinmetz & Potter, 1996). Despite national efforts to increase five servings of fruits and vegetable daily, only about 10% of the U.S. population currently meets the recommended guidelines for daily FVC (Casagrande et al., 2007). Research shows that some groups, such as younger individuals, those of lower education and income, and African Americans are less likely to meet the recommended guideline of eating 5 servings of fruits and vegetables a day (Casagrande et al., 2007; Disdall et al., 2003; Gary et al., 2004; Li et al., 2000; Miller et al., 2005; Patterson et al., 1990; Patterson et al., 1995; Serdula et al., 2004; Subar et al., 1995; Swanson et al., 1993; USDA 2005; Watters et al., 2007).

With improvements in the early detection and treatment of colon cancer, the number of CRC survivors is on the rise (Ries et al., 2004; SEER 2003). Lifestyle changes, such as eating more fruits and vegetables, can reduce the risk of cancer recurrence and secondary cancers as well as other future chronic diseases (Evans et al., 2002; Goodman et al., 1992; Ingram et al., 1992; Meyerhardt et al., 2007; Patterson et al., 2002; Steinmetz & Potter, 1996; Tichansky et al., 2002).

Health communication interventions with TPC and motivational interviewing calls can successfully increase daily FVC (Campbell et al., 2004; Emmons et al., 2005; Janer et al., 2002; Noar et al., 2007; Resnicow et al., 2004). TPC seems to enhance message attention and recall compared to non-tailored messages (Brug et al., 1996; Brug, Oenema, & Campbell, 2003; Campbell, et al., 1996; Campbell & Quintialini, 2006; Kreuter & Skinner, 2000; Petty et al., 1994; Skinner, et al., 1994). In interventions using the motivational interviewing, rapport and trust are important components of behavior change (Bundy, 2004; Emmons & Rollnick, 2001).

Certain characteristics of colon cancer survivors' may influence how they process health information (Bottomley, 1998; Simon et al., 2008; Stark & House, 2000). Colon cancer survivors experience physical and psychological outcomes as a result of their cancer diagnosis that could impair their processing of health information (O'Hair et al., 2003). Even so, health communications that enhance message relevance has been found to be effective in influencing behavior change (Kilpatrick et al., 1998; Krep, 2003; Rowland et al., 2001).

Currently, little is known about how health communication works for colon cancer survivors and the general population. Less is known about whether health communications delivered via tailored print versus counseling calls work through similar or different mechanisms. If health communication interventions are to become a mainstream intervention approach, it is essential to better understand how and why they work, and whether interventions work differently depending on the types of intervention and population.

CHAPTER 3

INFORMATION PROCESSING THEORY

3.1 Overview

Theories of information processing may provide valuable insights on intervention effectiveness, particularly on how interventions work. One such theory, the information processing paradigm developed by William McGuire (1985), describes steps in persuasion starting with message attention and moving to message processing (e.g., comprehending the message), then "yielding" to the arguments (e.g., convinced by the arguments), and finally, behavior modification (e.g., adopting a new behavior). McGuire (1968) first developed the information processing theory to understand the psychology of an individual's decision, specifically, to explain how people process mass media campaigns and make choices about products. More recently, this theory has been applied to understand behavior change ranging from mammogram screening (Kreuter et al., 2004) to eating more fruits and vegetables (Bull, et al., 2001).

3.2 Information Processes as an Input/Output Model

McGuire's (1999, 2001) information processing theory is an input/output model. That is, input factors related to the communication can influence output persuasion outcomes (output factors) ranging from attention to attitude change and, finally, to behavior change. The input factors include: 1) source, 2) message, 3) channel, 4) audience, and 5) destination,

that is who says it, what is said, via which media, to whom, and aimed at changing what, as presented in Table 1 (page 76).

Each of the input factors consists of subcategories that examine more specific communication characteristics. For example, the input factor, "source," examines whether the source of the message has credibility (perceived expertise and trustworthiness), attractiveness (perceived pleasantness and familiarity), and power (ability to reward and punish the listener) (McGuire 1999, 2001). Next, McGuire (1999, 2001) explains how the "message" can influence an individual's decision when it is structured to increase the salience of information already within the audience's own belief system. In addition, he states that messages are more effective when they appeal to the individual's obvious needs (e.g., feelings of well-being) and motives (e.g., beauty) at multiple times (e.g. repetition).

McGuire (1999, 2001) describes the third factor as "channels" of information delivery. According to the information processing theory (McGuire, 1999, 2001), face-to-face communication is more effective than a mass media campaigns. For instance, face-to-face communication involves two-way channels, with the receiver able to communicate back to the source, whereas mass media generally only allows one-way communication. He (1999, 2001) also describes how multiple channels of delivery may be used to increase impact of persuasive communication. For example, a print communication on cancer prevention may be complimented by a word-of-mouth campaign to community groups such as churches and workplaces. To explain the "audience" factor, McGuire (1999, 2001) presents a multi-postulate theory that explains how individuals' differences in personality, attitudes, and motivations affect their susceptibility to communication persuasion. For example, McGuire (1999, 2001) describes how an individual's level of anxiety can affect

message attention and comprehension in multiple ways. First, an individual's level of anxiety may directly influence his/her attention to and comprehension of the message. Second, an individual's level of anxiety may increase or decrease depending on the situation of the individual. Third, some individuals who have better coping mechanisms for anxiety may not be as affected compared to those with poor coping mechanisms. The last input factor, "destination" explains how a successful communication can have more persuasive impact when target variables are based on theories and causal paths (direct and indirect) that have been conceptualized by researchers *a priori*.

McGuire (1985) states that these five input factors can influence 12 successive "outputs" or outcomes of communication that range from perceptive (e.g. attention) and cognitive (e.g. retrieval) effects to behavioral outcomes, as shown in Table 2 (page 77). In the first step, "exposure to the message," McGuire (1985) explains that for communication to have an impact, an individual needs to be exposed to the message. Exposure alone does not guarantee the second step, "attending to the message," which is described as a process of connecting with the message. An individual who attends to the message should be able to recognize subsequent information. In the third step, an individual may "like the message and become interested" in it (McGuire, 1985). When individuals become interested, they may move to the fourth step, "comprehending the message." This step is described as absorbing and grasping the full meaning and implications of the message. In the fifth step, "cognitive elaboration," McGuire (1985) explains that an individual generates and retrieves related cognitive content already possessed and develops supportive arguments or counterarguments against the new message. The sixth step "acquiring relevant skills" describes that a persuasive message impacts not only learning about a behavior, but also the actual process of

changing a behavior (McGuire, 1985; Wright, 1980). For example, a public health campaign against smoking can teach about smoking cessation as well as provide skills to quit smoking (Meyer, Nash, McAlister, Maccoby, & Farquhar, 1980; Sackett & Haynes, 1976). In the seventh step "agreeing with the supportive information," an individual's agreement with the message can result in attitude change. For a communication to have a long-term impact, the eighth step, "retention step," is needed. This is a step where individuals store their attitude change in memory. From there individuals move to the ninth step, "retrieving relevant materials from the message." In this step individuals search and retrieve convincing arguments that are stored in their memory (Anderson, 1981). In the tenth step, "decision making," individuals use the retrieved message to make a decision. The eleventh step is when individuals adopt certain behaviors or "act" in accordance with the decision made. According to McGuire (1985) long-term adherence is enhanced by the twelfth step, "postbehavioral consolidation." This step, which involves individuals complying with an action, can occur in two levels, intrapersonal and interpersonal. Intrapersonal consolidation occurs when the new behavior becomes part of an individual's belief system (McGuire, 1960, 1985; Wright, 1980), and interpersonal consolidation occurs when individuals share the new behavior with others, and are supportive of those who also adopt the new behavior (McGuire 1985).

The information processing paradigm also proposes that for a communication to achieve higher-order effect (e.g. behavior change), outcomes appearing earlier in the sequence have to be achieved first (McGuire, 1985). For example, health communication materials would be more effective in conveying the information to recipients about eating

more fruits and vegetables, if the recipients were *exposed* to the communication, *attended* to it, *understood* it, and *learned* from it, before they were able to *retrieve* it.

3.3. Health Communication can Enhance Information Processes

Colon Cancer interventions such as North Carolina Strategies to Improve Diet, Exercise, and Screening study (NC STRIDES) can help us investigate how input factors, channel and receivers' characteristics, can influence similar or different output factors. NC STRIDES was a population-based randomized intervention trial that aimed to improve health behaviors associated with lowering risk of CRC such as increasing FVC among colon cancer survivors and colon cancer-free individuals. There were two intervention arms to the study: the TPC (tailored print communication) arm and the TMI (telephone motivational interviewing) arm. Individual were assigned to one of the four groups: control group (non-tailored messages), TPC group, TMI group, and TPC+TMI group (received both interventions). Individuals who were assigned to TPC received tailored print newsletters, while those in TMI received counseling calls. In addition, the intervention was delivered to two different populations: colon cancer survivors and colon cancer-free individuals.

Studies suggest that different cognitive processes may be involved when health communications are channeled in written forms vs. spoken words (McGuire, 1969; 1985, 1999). For example, studies have reported that message comprehension and recall are greater with reading the information rather than hearing it (Chaiken & Eagly, 1976; Wold, 1977). Other studies, however, reported that delivering messages through spoken words are perceived as more credible as compared to written messages (McGuire, 1969, 1999). In NC STRIDES, TPC were channeled as newsprints and TMI as counseling calls. In line with

findings from previous studies, these two interventions may have influenced different information processes. Newsprints may have enhanced comprehension and recall, while the telephone calls may have enhanced credibility and trust.

In addition, print media may enhance liking as opposed to a person-to-person interaction, particularly for individuals who value privacy and personal space. McGuire (1985) describes how close proximity from the source of the message can evoke feelings of personal-space invasion minimizing message attractiveness (Fisher & Byrne, 1975).

Interpersonal communication through counseling calls, however, may facilitate message retention compared to print materials. McGuire (1969, 1999) describes that interpersonal communication usually involves two-way channels, with the receiver able to communicate back to the source, whereas mass media generally only allows one-way communication. In addition, during an interpersonal interaction, an individual becomes an active participant providing supporting arguments and counterarguments to the messages. This modality allows a counselor to provide feedback to the individual's specific arguments, reinforcing messages that were not fully understood (Jecker, Maccoby, & Breitrose, 1965; McGuire 1969, 1999; Rosenthal, 1967). On the other hand, with print media communication such interaction is not available, and thus limits researchers' response to counterarguments from the individuals (McGuire 1985, 1999; Rosenthal, 1967).

Attention to the message may be enhanced by interpersonal communication compared to information delivered through print media (McGuire, 1969, 1985). For example, traditional norms tend to prevent individuals from leaving the interaction when another person begins to express his or her opinions. There is, however, much less constraint against turning the page with a print communication. Thus, even when an individual may be

experiencing boredom or fatigue during an interaction, interpersonal communication demands courtesy and these efforts by the individual can enhance attention (McGuire, 1985, 2001).

3.4. Multi-component Intervention and Information Processes

Studies show that receiving messages through multiple channels can enhance information processes. Researchers report that individuals' attention and interest in a message can decline when several messages are delivered through the same channel, but this effect can be reversed when researchers present the same message through different media (Cacciopo & Petty, 1979; Grass & Wallace, 1969). Receiving messages through multiple channels can increase message salience and recall as well as promote positive thoughts (Cacciopo & Petty, 1979; Strong 1974). Among NC STRIDES' participants receiving both the TPC and TMI messages may have influenced the individual to find the message more important and enhance recall.

One major disadvantage of receiving a message through multiple channels is information overload. Information overload occurs when the information provided exceeds an individual's ability to process it both cognitively and emotionally (McGuire 1985). Researchers suggest that individuals in this situation tend to absorb from one type of information only at the cost of less absorption of another (McConnell, 1970; McGuire, 1985; Pool, 1983). Information overload, however, can be minimized when messages are kept simple and short (McGuire, 1985).

3.5 Information Processes and Characteristics of Colon Cancer Survivors

Receiver's characteristics is another important input factor relevant to how colon cancer survivors and the general population process a health communication intervention (McGuire, 1968, 1969, 1985, 1999, 2001). McGuire (1985, 2001) explains that people's individual differences in personality, abilities, and motivations affect their acceptance of the health communication. One individual characteristic particularly relevant to NC STRIDES' participants is colon cancer status, as the study included both colon cancer survivors and those without a history of colon cancer. The two groups may differ as research shows that colon cancer survivors experience more psychological outcomes such as anxiety, fear, and depression compared to colon cancer-free individuals (Bottomley, 1998; Simon et al., 2008; Stark & House, 2000).

McGuire (1999, 2001) states that an individual's characteristics, such as having anxiety, can influence information processing. The person's state can affect his or her level of participation in the communication process, and active participation enhances information processing. For example, individuals with high anxiety are less likely to be active participants compared to those with low anxiety (McGuire, 1969). Due to their passive participation, message processing may be restricted and influence message comprehension (McGuire, 1999). For example, if colon cancer survivors experience greater anxiety than colon cancer-free individuals, the current state of colon cancer survivors' may limit their comprehension of the intervention message.

Individuals' information processing can be enhanced when they develop coping mechanisms for anxiety. McGuire (2001) asserts that when an individual experiences certain situation for a prolonged time period, s/he can develop compensatory coping mechanisms

(McGuire, 2001). For example, individuals who experience chronic anxiety may develop coping mechanisms that protect them from experiencing these feelings (McGuire, 2001). If colon cancer survivors developed coping mechanisms for anxiety, these may have reversed the effect of anxiety in message comprehension.

An individual may acquire multiple characteristics that can interact with each other, thereby, influencing message processing. McGuire describes (2001) that a chronic characteristic such as anxiety can interact with a new acute characteristic such as fear and this can affect information processing. Researchers find that colon cancer survivors experience multiple psychological outcomes such as anxiety, fear, and depression (Bottomley, 1998; Simon et al., 2008; Stark & House, 2000). If NC STRIDES participants who were colon cancer survivors were experiencing anxiety and fear at the same time, then these two states may have interacted influencing message processing.

3.6 Information Processes as Mediators of Health Communication and FVC

In information processing theory, McGuire (2001) describes how 12 output factors can be conceptualized as a series of sequential mediating steps for behavioral change. Its application for empirical studies, however, can be simplified in four ways (McGuire, 1968, 1985, 2001). First, some output steps can be omitted. For example, some mass media ads may affect attitudes or behavior without enhancing comprehension (McGuire 1985; Petty & Cacioppo, 1981). In addition, decisions to make a behavior change can be made without message retrieval step (Nisbett & Wilson, 1977). Second, output steps can occur in reverse sequence. If one is forced to comply with a behavior change, behavioral change may precede attitude change (Wicklund & Brehm, 1976). Third, some steps can be combined. For

example, a researcher may combine the attention and liking steps together. Fourth, a researcher can decide to stop anywhere in the sequence depending on the purpose of their research (McGuire 1985, 2001).

Health communication researchers suggest that information processes can be considered mediators of health communication and FVC. An intervention study with tailored health education materials focused on healthy eating reported that health communication has a greater persuasive impact for eating more fruits and vegetables when the materials are perceived as attractive and seen as trustworthy (Bull et al., 2001). Results from a process evaluations also show that people who receive tailored information are more likely to read the material, perceive greater personal relevance, and recall more information compared to those who receive non-tailored information (Brug et al., 2003; Campbell & Quintiliani, 2006; Petty et al., 1994).

Furthermore, similar and different information processes can mediate types of health communication and FVC. Kreuter and colleagues (2004) tested the relationship between two types of tailored health communications on information processes. One health communication strategy was a behaviorally-tailored message, that is, a message tailored on a specific behavior (e.g. FVC, mammogram). Another one was a culturally-tailored message or a message tailored based on a group's culture (e.g. African American culture). The findings from this study were that different types of messages enhanced similar and different processes. For example, regardless of the type of message, both interventions were related to eliciting attention, liking, and message relevance (Kreuter et al., 2004). The individuals who received the behaviorally-tailored messages, however, were able to recall more messages than those who received the culturally tailored messages. Unfortunately, these investigators

only assessed the relationship between variables and did not test for a mediation effect. They, however, encouraged other researchers to test for mediation effects between health communication and behavior. Additionally, they urged others to explore whether different types of health communication can influence similar or different information processes (Kreuter et al., 2004). Despite the literature's suggestion about the role of information processes as mediators of health communication and behavior change, currently, no study has examined the relationship between these variables.

3.7 Matching Variables of NC STRIDES and Information Processes

Guided by the information processing theory developed by McGuire (1968, 1969, 1985, 2001), this dissertation study aims to fill gaps in the literature related to how health communication operates to elicit a behavior change. The variables collected by NC STRIDES matched several information processes described by McGuire (1985). These processes are cognitive elaboration, agreement with the message, and retrieval of the message as shown in Table 2 (page 77). The information processing variable, cognitive elaboration, matched the latent variable, message relevance, which was measured with three variables: message especially designed for self, importance of the message to self, and message application to life. Message agreement matched the NC STRIDES' variable "message trust." Finally, retrieval of the message matched the NC STRIDES' variable "message recall." The matched variables were conceptualized in the sequence as presented in the information processing theory (McGuire, 1985).

3.8 Conceptual Framework of the Study

In this conceptual model, the relationship between the intervention and behavior change can occur through two pathways as presented in Figure 1 (page 78). First, the intervention may directly influence behavior change, increasing FVC. Second, the intervention may indirectly influence FVC mediated through message relevance, message trust, and message recall. The latent variable, perception of message relevance, is hypothesized to have three indicator variables which include an individual's belief that the message was designed for the self, perception of the importance of the message to self, and perception of how the message applies to self.

3.9 Research Questions, Aims, and Hypotheses

3.9.1 Research Question 1

How do individuals who receive a health communication process the information resulting in increased FVC (Figure 2, page 79)?

AIM 1: To identify the information processes that mediate the relationship between health communication and FVC.

H. 1.1: The information processes of message relevance, message trust, and message recall will significantly mediate the effects of health communication on FVC, compared to the controls.

3.9.2 Research Question 2

Do individuals, who receive different types of health communication, process information through similar or different information processes resulting in FVC (Figure 3, page 80)?

AIM 2: To assess whether similar or different information processes mediate the relationship between perception of message relevance and FVC across different intervention groups.

H. 2.1: Individuals who receive the TPC, TMI, or TPC+TMI interventions are significantly more likely to process through similar processes compared to those in the control group.

3.9.3 Research Question 3

Do individuals' history of colon cancer influence similar or different information processes resulting in FVC (Figure 4, page 81)?

AIM 3: To assess whether similar or different information processes mediate the relationship between health communication and FVC across different colon cancer groups

H. 3.1: Individuals in the colon cancer-free group will be more likely to process the intervention messages through different processes compared to the colon cancer survivors group.

3.10 Summary

Information processing theory may help us understand how health communication interventions work to result in behavior change. Information processing theory describes how input factors, such as channel of message delivery and receiver's characteristics, can influence twelve output factors, which range from more affective (e.g. liking), to more cognitive (e.g. comprehension) to behavior change (e.g. FVC) (McGuire, 1968, 1999, 2001). Intervention studies applying these measures suggest that information processes can be considered mediators of health communication and behavior change.

The data from NC STRIDES was used to investigate whether information processes mediate the relationship between health communication intervention and FVC. NC STRIDES tested two health communication strategies, one channeled as print newsletters and the other as counseling calls. These features further allowed me to investigate whether health communication interventions that are channeled through different modalities can influence similar or different information processes. In addition, because the health communication strategies were delivered to colon cancer survivors and colon cancer-free individuals, I was able to investigate whether a characteristics such as having a colon cancer diagnosis related to how individuals process information through similar to different information processes

CHAPTER 4

METHODOLOGY

4.1 Overview

This chapter describes the study methodology used to investigate the relationship between health communication, information processes, and FVC among NC STRIDES' participants. It includes information about NC STRIDES such as study design, sample, recruitment, intervention, and measures. Analytic approaches including a review of multi-sample structural equation models follow.

4.2 Study Design

The NC STRIDES used a classic 2 x 2 randomized factorial design with two levels of intervention (tailored print communication and telephone motivational interviewing) delivered to two different groups (colon cancer survivors and colon cancer-free individuals). Both cancer survivors and cancer-free individuals were randomized to either a control group, TPC group, TMI group, or TPC+TMI group, as shown in Figure 5 (page 82). NC STRIDES was a randomized intervention trial funded by the National Cancer Institute (P.I.: Dr. Marci Campbell) to implement an intervention that provided colon cancer survivors and cancer-free individuals with tailored print communication (TPC) and telephone motivational counseling (TMI) to promote FVC.

4.3 Sample

Study participants from NC STRIDES were recruited from the North Carolina Colon Cancer Study (NCCCS), a population-based, case-control study of colon cancer in North Carolina conducted from 1996-2000. The NCCCS study participants were from 33 counties in the central and eastern part of North Carolina, an area including rural, suburban, and urban counties whose residents represent a diverse socioeconomic backgrounds and a racial composition consisting primarily of African Americans and whites. Detailed recruitment procedures have been described previously (Satia, Campbell, Galanko, James, Carr, & Sandler, 2004). Eligible cases were individuals with adenocarcinomas of the colon, ages 40-80, of African American or white, non-Hispanic ethnicity, who were being treated in one of 38 non-federal hospitals. Cases with a first diagnosis of histologically confirmed invasive adenocarcinoma of the colon between July 1, 1996, and June 30, 2000 were identified using the rapid ascertainment system of the North Carolina Central Cancer Registry.

Population-based controls in the NCCCS were recruited from two sources: those under age 65 came from the NC Department of Motor Vehicles roster and those over age 65 came from the registry of the Center for Medicare and Medicaid Services (formerly known as the Health Care Financing Administration). Cases were sampled to provide approximately equal numbers of African Americans and whites, and the controls were sampled to provide a group with similar age, race, and gender as the cases. In this dissertation study, cases are referred to as colon cancer survivors while controls are referred to as colon cancer-free individuals.

4.4 Recruitment

NCCCS participants were invited to participate in the NC STRIDES study between January 2001 and June 2002. All NCCCS cases and controls were mailed a letter and brochure explaining the NC STRIDES study. NCCCS research staff then contacted potential participants via telephone to solicit their consent to participate in NC STRIDES. NC STRIDES excluded NCCCS participants who were not able to make changes in FVC due to a health condition (e.g., advanced stage of colon cancer). Of the 1,850 NCCCS participants, NC STRIDES was able to recruit 922 participants (49.8%). Of those, 825 individuals (89.5%) completed the baseline survey (304 colon cancer survivors and 521 colon cancer-free individuals) and 735 (89.1%) completed the follow-up survey (266 colon cancer survivors and 469 cancer-free individuals). Non-responses on the follow-up survey were due to 18 deaths, 21 people who withdrew from the study for health reasons, 19 refusals, and 32 lost contacts. Survey response rates were equivalent among cases and controls, with an overall response rate of 90%.

The participants recruited to NC STRIDES were randomized into one of four intervention groups (control, tailored print, motivational interviewing, tailored print plus motivational interviewing). Originally, NC STRIDES' researchers had planned to include colon cancer survivors in early stage only (Stage 1 and 2); however, they found that many people were not aware of their stage at diagnosis. Individuals with more advanced stage cancer, therefore, were considered for recruitment attempts if they reported being healthy enough to make lifestyle changes and participate over the course of the year-long study.

4.5 Intervention

Participants were randomized into one of four intervention types. One group (TPC only) received a series of four individually tailored, printed newsletters. Another group (TMI only) received a series of four telephone motivational interviews. The third group (Combined group) received four individually tailored, printed newsletters and four motivational interviews. The fourth group served as the control group and received four "generic" mailings during the intervention and four individually tailored print newsletters after the final survey. Information provided to the control group focused on other cancer related topics, breast cancer for female participants and prostate for males.

The TPC intervention included four personalized computer-tailored newsletters, mailed to participants' homes bi-monthly for the first six months after baseline data collection (months 2, 4, and 6); the fourth mailing occurred 9 months post-baseline. Newsletters 1-3 were tailored using the baseline survey data and the fourth newsletter incorporated additional data from a 6-month update telephone call to give feedback on participant's progress.

The TMI intervention consisted of four brief (20-minute) motivational interviewing calls delivered over a nine-month period. Each call followed a counseling protocol based on MI principles of communication, brief counseling, and negotiation (Miller & Rollnick, 1991), as shown in Appendix A (page 96 & 97). Motivational interviewing principles include a client-centered, collaborative decision-making approach, giving non-judgmental feedback, rolling with resistance, and encouraging the participant to make the argument for change. Interviewers relied on open-ended questions and reflections to draw out participants' motives and desires about behavior change (Miller & Rollnick, 1991). Calls were conducted by trained research team members. Careful training on MI principles and

techniques and the protocol were conducted prior to starting the interviews. The calls were additionally "tailored" by incorporating information derived from participant baseline and update surveys regarding priorities baseline behavior change, and cancer status.

Participants in the CONTROL group received four mailings of generic (non-tailored) health information that was not related to the primary study outcomes. The purpose of these mailings was to provide an "attention control" for the TPC materials. The information consisted of brochures obtained from sources such as the Cancer Information Service and other agencies, on topics that participants in other studies have found useful, such as prostate cancer for males and breast cancer for females.

4.6 Data Collection

Trained research staff collected baseline data for NC STRIDES using a telephone-administered self-report survey. Surveys took, on average, 30 to 40 minutes to complete. Data were collected regarding sociodemographic information, self-rated health, health information, FVC, and psychosocial factors related to FVC. One year after baseline, participants were asked to complete a second telephone survey. This survey, which lasted about 45 minutes, asked the same health, behavioral, and psychosocial questions as the baseline survey, information processing measures as well as intervention process measures. Although NC STRIDES interviewers were masked to the intervention assignments, they were aware of case status, as there were slightly different versions of the survey for colon cancer survivors and the colon cancer-free group.

4.7 Measures

All measures were assessed through self-report. Demographic variables were assessed during NCCCS or at baseline in NC STRIDES.

4.7.1 Dependent Variables

Fruit and vegetable consumption. Average daily FVC was measured using a 36-item modified version of the Block food frequency questionnaire (FFQ) validated by Resnicow and colleagues (2000) in their work with a diverse Southern population. Resnicow's tool was slightly modified to ask how often food was consumed in the last *month* as opposed to the last *week*; and omitted food items that were not fruits and vegetables. For analysis purposes, the item "French fries, fried potatoes, or home fries" was eliminated from calculations, thus the FVC total was based on 35 items. Fruit and vegetable item frequencies were converted to servings/day and then summed to provide total daily consumption values for fruit, vegetables, and total fruits and vegetables. The distribution of FVC was skewed to the right; therefore we employed a log transformation (ln + 1) in order to improve normality. In addition to the FFQ, participants were asked to estimate their intake of fruit and vegetables per day using a brief 2-item screener ("How many servings of [(vegetables and/or vegetable juices) (fruit or fruit juices)] do you usually have during a single day?"). The screener served as a second estimate of FVC that might be less subject to over-reporting, which can occur with long FFQ instruments (Krebs-Smith, Cook, Subar, Cleveland, & Friday, 1995).

4.7.2 Mediator Variables

Message Relevance was defined as the relevance of the intervention's message to the participant's life. Three indicators measured this concept: (1) "How important to you

personally was the information in the newsletter," (2) "How much did you feel that the newsletters were designed especially for you," and (3) "How much did the information in the newsletters apply to your life." The response categories ranged from 1 (*not at all*) to 5 (*completely*). For participants receiving TMI, the three questions were asked about phone calls instead of newsletters. For those receiving the combined intervention (TPC+TMI), the same questions were asked about both newsletters and phone calls. The mean of the questions on newsletters and phone calls was calculated for those receiving the combined intervention. Cronbach's alpha showed good reliability for the three questions on newsletters (α = .73) and phone calls (α = .76) and high reliability for the mean of the two (α = .94).

Message Trust was collected with one question: "How much did you trust that the information in the newsletter was accurate?" Response categories ranged from 1 (*not at all*) to 5 (*completely*). For participants receiving TMI, the question asked about phone calls instead of newsletters. For those receiving the combined intervention (TPC+TMI), the question asked about both newsletters and phone calls. The mean of the questions on newsletters and phone calls was calculated for those receiving the combined intervention.

Message Recall was collected as the participant's ability to recall the number of the intervention messages that he or she received and was measured by the question: "How many newsletters do you remember receiving?" The answers ranged from 1 to 5, where 1 = 1, 2 = 2 newsletters, 3 = 3 newsletters, 4 = 4 newsletters, and 5 = more than 4 newsletters. For participants receiving TMI, the three questions were asked about phone calls instead of newsletters. To those receiving the combined intervention (TPC+TMI), questions were asked about both the newsletters and phone calls. The mean of the questions on newsletters and phone calls were calculated for those receiving the combined intervention.

Self-efficacy for eating five or more daily servings of fruits and vegetables a day for most days of the week was measured using one item: "If you decided to, how sure are you that you have the ability to succeed in eating five or more servings of fruits and vegetables every day for the next six months?" This was measured with a five-point Likert-type response from 1 (*very unsure*) to 5 (*very sure*).

4.7.3 Independent Variables

Intervention. As discussed above, participants were randomized to four intervention types: control, tailored print communication (TPC), telephone motivational interviewing (TMI), and combined (TPC+TMI).

4.7.4 Other Variables

Demographic variables. Age was collected as a continuous variable and calculated using the date of birth and the date of the interview. Race was collected as white and Black. Gender was collected as male or female. Education was assessed as the highest grade of school completed and used as a categorical variable with the options of "8 years or less," "9-12 years," and "13+ years." Employment status was collected as yes/no. Annual income was collected by asking the total yearly household income and included 6 categories; "less than $10,000," "$10,000 - $19,999," "$20,000 - $29,999," "$30,000 - $49,999," "$50,000 - $74,999," "$75,000 or more." These categories were collapsed for analytic purposes and dichotomized as less than $30.000 or greater than equal to $30,000.

4.8 Statistical Analysis

Data formatting, management, and descriptive statistics were conducted using SAS version 9.2. Descriptive statistics were generated using chi-square analyses for categorical variables and t-test and Analysis of Variance (ANOVA) for continuous variables. Alpha level of .05 was used for all analyses. The structural equation modeling was estimated using MPLUS version 5. Sobel test was conducted to assess whether the indirect effect was statistically significant (Sobel, 1982). A multi-sample structural model was specified to test hypothesized relations among the variables between intervention groups and colon cancer groups.

4.8.1 Structural Equation Model as an Analytic Method

Structural Equation Modeling (SEM) is a technique used for specifying and estimating models of linear relationships among variables (MacCallum & Austin, 2000). A model may include both measured and latent variables (McCallum & Austin, 2000). Latent variables are hypothetical constructs that cannot be measured directly, and is usually represented by multiple measured variables that serve as indicators of the latent variable. A structural equation model is used to hypothesize patterns of directional and non-directional linear relationships among a set of measured and latent variables. Directional relationships imply some sort of directional influence of one variable on another. Non-directional relationships are correlated, but imply no directed influence. The purpose of the model is to account for variation and co-variation of the measured variables (Kline, 2005).

SEM consists of two parts: the measurement model and the structural model (Byrne, 1998; Kline, 2005). The measurement model depicts the links between the latent variable and the measured variables hypothesized to represent the latent variable. The structural

model describes the relationship among latent variables and between latent variables and measured variables. It could also be viewed as a regression model (Bollen 1989).

All the models in this dissertation study are recursive, meaning that model disturbances are uncorrelated and that the relationship between variables is unidirectional (Kline 2005). The directions of arrows in the structural equation model represent the study's hypothesized relationship between the variables.

4.8.2 Multi-sample Structural Equation Model

Multi-sample structural equation model (SEM), which began from the work of Jöreskog and Sorbom (1979), describes analyses that explain whether or not a structural model is invariant (e.g., equivalent) across particular groups (Byrne, 1998). In multi-sample SEM models, several groups are analyzed at the same time, providing the ability to simultaneously test a theoretical model for its applicability to different groups and to identify the differences in the parameters between the groups (Duncan, Duncan, Strycker, Li, & Alpert, 1999; Byrne, 2001).

According to Jöreskog and Sorbom (1979), intervention groups may be viewed as data from two different populations in an intervention setting. The control group population represents the normative set of individuals that would have been observed also in the treatment group had they not been chosen for treatment (Muthen and Curran, 1997). The effect of treatment is assessed by comparing the set of pathways in the treatment population with those in the control population (Muthen & Curran, 1997).

4.8.3 Model Fit Indexes

Fit indexes assess how close the data fit the measurement and structural models. Currently, several fit indexes are available. Since each fit index captures different information about model fit, researchers are encouraged to report multiple fit indexes (Hu & Bentler, 1999). This study used five fit indexes including Chi-squared statistic test, *Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), the Root Mean Square Error Approximation (RMSEA) and the Standard Root Mean Residual (SRMR).*

Chi-squared statistic test: The chi-squared statistic test assesses the probability associated with the postulates that the sample covariance matrix for the model under study is valid. A non-significant chi-squared test indicates that there is no difference between the model implied covariance matrix and the data covariance matrix, that is, the hypothesized model fits closely to the data (Bollen, 1989; Byrne, 1998). This test statistic, however, is sensitive to sample size. If the sample size is large, the chi-squared could be significant (model does not closely fit the data) although there may be only a slight difference between the data covariance matrix and model-implied covariance matrix (Kline, 2005).

Comparative Fit Index (CFI): The *CFI* assesses the improvement in fit of the hypothesized model compared with the baseline model. A baseline model typically assumes that population covariance among the observed variables is zero, that is, the observed variables are assumed to be uncorrelated (Kline, 2005). The *CFI* ranges between 0 and 1, 1 being the best fit. A *CFI* value of greater than .95 is considered a very good fit of data to the model (Hu & Bentler, 1999).

Tucker-Lewis Index (TLI): The *TLI* is the value that reflects the proportion of improvement of the implied model relative to the baseline model (Kline, 2005). Similar to *CFI*, the baseline model assumes that population covariance among the observed variables is

zero. *TLI* is different from *CFI* in that *TLI* includes a correction for model complexity. A *TLI* value greater than .95 represents a very good fit (Hu & Bentler, 1999). This value may exceed 1 but generally not by much.

Root Mean Square Residual Approximation Index (RMSEA): The *RMSEA* measures the error of approximation or the difference between the fit of the model to the sample covariance matrix and to the population covariance (Kline, 2005). The *RMSEA* assess the "badness-of-fit" in that a value of zero indicates the best fit and higher values indicate worse fit. A rule of thumb is that $RMSEA \leq .05$ indicates a close approximate fit, while values between .05 - .08 suggest reasonable error of approximation, and $RMSEA \geq .10$ suggests poor fit (Brown and Cudeck, 1993).

Standard Root Mean Residual (SRMR): The *SRMR* is the measure of mean absolute correlation residual. Correlation residuals are the difference between the observed and model-implied correlations. When the fit of the model is perfect, the *SRMR* equals zero. Increasingly higher values indicate worse fit (Kline, 2005). *SRMR* values of less than .10 are considered favorable (Kline, 2005).

4.8.4 Modification Index

Modification indexes reflect the extent to which the hypothesized model is appropriately described (Byrne, 1998). A modification index reports evidence of misfit and is conceptualized as a χ^2 statistic with one degree of freedom (Bollen, 1989). For each parameter specified, a modification index is estimated. This value represents the expected drop in overall χ^2 value if that same parameter is not estimated in a subsequent model (Byrne, 1998). This step is analogous to a stepwise regression where the variable that adds most to

the explained variation of the dependent variable is added first and then the variable that explains variation to the subsequent equation is added next, until no other variables lead to a significant increment in R^2 (Bentler, 1986; Bollen, 1989). Re-specification of models based on modification indexes must be based on study rationale and make theoretical sense.

4.8.5 Model Identification

A model is identified if the model can derive a unique estimate for each parameter. If parameters cannot be estimated, then the model is not identified, and needs to be re-specified. For a structural model to be identified, it must 1) have at least as many observations as free parameters in the model, and 2) every latent variable must be assigned a scale, that is, one indicator variable that loads on a factor is independent of the measurement errors (Kline, 2005). All models presented in this dissertation study met the identification criteria.

4.8.6 Analysis for Aim 1

AIM 1: To identify the information processes that mediate the relationship between health communication and FVC, as presented in Figure 2 (page 79).

This aim was tested first among colon cancer survivors and then in colon cancer free-individuals. First, the viability of the proposed latent factor (perceived message relevance) was established through the use of the confirmatory factor analysis measurement model. This procedure served to examine whether the variables hypothesized to form the latent factor indeed were sufficiently empirically related to reliably form one factor (Kline, 2005). If the conceptualized measurement model is correct, indicators specified to measure a

common factor have relatively high standardized loadings on that factor. Thus, assessment was done by observing variable loadings on the latent factor.

To test the hypothesized relationship among health communication, information processes, and FVC, a structural equation model (SEM) was specified. Intervention variables were dummy coded for each intervention type (e.g., TPC =1 vs. control = 0; TMI = 1 vs. control = 0; TPC+TMI = 1 vs. control = 0), and a structural equation model was built with intervention types as covariates. The model fit was evaluated using the *CFI, TLI*, *RMSEA* and *SRMR*. Hu and Bentler (1999) recommend cutoff values of .95 for *CFI* and *TLI* and .06 for *RMSEA*. The covariance matrices for colon cancer survivors and the colon cancer-free group are presented at Appendix B & C (pages 98-99) respectively.

4.8.7 Analysis for Aim 2

AIM 2: To assess whether similar or different information processes mediate the relationship between perception of message relevance and FVC across different intervention groups, as presented in Figure 3 (page 80).

This aim was tested only among colon cancer free-individuals because in colon cancer survivors, only the combined intervention showed mediation effect through information processes. Prior to testing the model, the intervention types were conceptualized as groups (group 1= control, group 2 = TPC, group 3 = TMI, and group 4 = TPC+TMI). Multi-sample SEM was conducted through three major steps, as shown in the literature (Duncan et al., 1999).

First, two models were built, one where all structural paths were specified as equal across the four intervention groups, and another where all paths were specified as not equal

across the groups. Second, model equivalence between the two models (paths equal across the groups vs. paths not equal across the groups) were evaluated using a χ^2 difference test. The χ^2 difference test is an asymptotically equivalent χ^2 test, and the χ^2 difference represents an approximate decrease in model goodness-of-fit resulting from eliminating equality restrictions (Duncan et al., 1999). A χ^2 difference value that is significant at alpha = .05 indicates that paths are not equal across the groups. While a value that is non-significant indicates that paths are equal across the groups (Duncan et al., 1999). When the structural paths were found to be different across the four intervention groups, nested models were specified to identify which paths were different.

Third, nested models were built and constrained following the order on which the information processes were conceptualized based on the hierarchy described in information processing theory (McGuire, 1985). The order was as follows: 1) measurement model constrained, the relationship between 2) message relevance and message trust constrained, 3) message relevance and message recall constrained, 4) message trust and message recall constrained, 5) message relevance and FVC constrained, 6) message trust and FVC constrained, 7) message recall and FVC constrained, and finally, 8) FVC at baseline and FVC at follow-up constrained. It is important to note that before adding additional constraints, previous constraints were kept across the groups.

The model was tested among colon cancer-free individuals (N = 469) to observe the pathways of the relationship between message relevance and FVC. The sample sizes for each intervention group was as follows: control = 122, TPC = 111, TMI = 113, and TPC+TMI = 123. The covariance matrices for the four intervention groups, control, TPC, TMI, and TPC+TMI are presented at Appendix D (pages 100-101).

4.8.8 Analysis for Aim 3

AIM 3: *To assess whether similar or different information processes mediate the relationship between health communication and FVC across different colon cancer groups, as presented in Figure 4 (page 81).*

This aim was tested only among individuals who received the combined interventions because this intervention group had an indirect effect on FVC through information processes both among colon cancer survivors and colon cancer-free individuals. Prior to testing the model, colon cancer survivorships were conceptualized as groups (group 1= colon cancer survivors and group 2 = colon cancer-free individuals). Multi-sample SEM was also employed to investigate this aim.

Similar to aim 2, the analyses began by building two models. The structural paths of the first model were specified as equal across the two colon cancer groups. The structural paths of the second model were specified as not equal across the groups.

Second, model equivalence between the two models (paths equal across the groups vs. paths not equal across the groups) were evaluated using a χ^2 difference test. The χ^2 difference test is an asymptotically equivalent χ^2 test, and the χ^2 difference represents an approximate decrease in model goodness-of-fit resulting from eliminating equality restrictions (Duncan et al., 1999). A χ^2 difference value that is significant at alpha = .05 indicates that paths are not equal across the groups. While a value that is non-significant indicates that paths are equal across the groups (Duncan et al., 1999). When the structural paths were found to be different across the two colon cancer groups, nested models were specified to identify the source of difference.

Third, nested models were built and constrained following the order on which the information processes were conceptualized based on the hierarchy described in information processing theory (McGuire, 1985). The order was as follows: 1) measurement model constrained, the relationship between 2) intervention and message relevance constrained, 3) message relevance and message trust constrained, 4) message relevance and message recall constrained, 5) intervention and message recall constrained, 6) message trust and message recall constrained, 7) FVC at baseline and FVC at follow-up constrained, 8) message trust and FVC constrained, and finally 9) message recall and FVC constrained. It is important to note that before adding additional constraints, previous constraints were kept across the groups.

The model was tested among individuals who received the combined interventions (N = 181). It involved the same technique described for Aim 2 with two groups: colon cancer survivors (N = 58) vs. colon cancer-free individuals (N = 123). The covariance matrices for the two colon cancer groups; colon cancer survivors and colon cancer-free group are presented in Appendices E & F (pages 102-103) respectively.

CHAPTER 5

RESULTS

5.1 Overview

This chapter describes the results of the analyses of this study. It begins with a description of the study sample. Next, main analyses are presented, including the results for measurement models, structural equation models, and multi-sample structural equation models. The results for each model include model fit, path coefficients (regression weights), and sample covariance (included in the appendices).

5.2 Description of the Study Sample

The baseline age of the NC STRIDES participants was 66 years old ($\pm$ 9.9) with colon cancer survivors being slightly younger than the colon cancer-free individuals (65 vs. 67, p = .003), as shown in Table 3 (page 83). More than half of the participants were white (65%) and male (51%). About one-third (38%) were employed either full-time or part-time. A little over half of the participants (55%) had an annual income greater than $30,000. Most participants had some high school education or had completed high school with colon cancer survivors being less educated than colon cancer-free group (89% for colon cancer survivors vs. 94% colon cancer-free group, p = .014). Participants reported that, on average, they ate 5 servings of fruits and vegetables a day.

The demographic characteristics were also examined separately among colon cancer survivors and colon cancer-free group by interventions types, as shown in Tables 4 & 5 (pages 84 & 85). Colon cancer survivors did not significantly differ across intervention types except on annual income as shown in Table 4 (page 85). Participants who received TPC+TMI intervention were more likely to have an annual income greater than $30,000 compared to all other intervention types (control = 52%, TPC = 42%, TMI = 48%, and TPC+TMI= 68%, $p = .036$). The demographic characteristics of the colon cancer-free group did not significantly differ across intervention types, as shown in Table 5 (page 85).

5.3 Relationship between Intervention and Information Processes

Next, bivariate relationships between intervention and information processes were examined among NC STRIDES' participants. Among colon cancer survivors, there was a significant difference in means of information processes between intervention types, as shown in Table 6 (page 86). Colon cancer survivors who received the combined interventions (TPC+TMI) were more likely to perceive that the message was especially designed for them ($p = .011$), found the message to be important to them ($p = .020$), and that the message was applicable to their life ($p = .015$) as compared to those who received TPC only. Individuals who received the combined intervention also reported higher trust in the message ($p = .050$) compared to the TPC only, and recalled receiving more messages ($p = .023$) compared to all other intervention types. There was no significant relationship between intervention and self-efficacy.

Similar results were found among the colon cancer-free group where individuals who received the combined intervention had greater means of information processes compared to other intervention types, as shown in Table 7 (page 87). Compared to the controls and those

who received TPC only, individuals who received the combined intervention were more likely to perceive the message as especially designed for self ($p = .0002$) and that the message was applicable to their life ($p < .0001$). The combined intervention also reported higher means for the message being important to self ($p = .0002$) and higher trust ($p = .0023$) compared to the controls. Those who received the combined intervention also reported greater recall compared to all other intervention types ($p < .0001$). There was no significant relationship between intervention and self-efficacy.

5.4 Main Findings

5.4.1 Findings for AIM 1

To identify the information processes that mediate the relationship between the health communication and FVC

A structural equation model was specified as shown in Figure 2 (page 79) among the hypothesized variables, intervention, information processes, and FVC. Separate models were run for colon cancer survivors and colon cancer-free individuals. The reports first describe findings from colon cancer survivors, which are then followed by findings for the colon cancer-free group.

Colon Cancer Survivors Group

Measurement Model

Before testing the structural model, the viability of the proposed latent factor, perception of message relevance, was first established among colon cancer survivors using confirmatory factor analysis measurement models. Measurement models confirmed that the

measured variables (especially designed for self, importance of the message, and message application to life) hypothesized to form perception of message relevance were sufficiently empirically related to form one factor. All variable loadings on the hypothesized latent factor were found to be strong and significant as indicated in Table 8 (page 88). The fit indexes were not available because the model was just identified.

Structural Equation Model

The structural model testing the hypothesized relationship between intervention, information processes, and FVC had a good fit with χ^2 (29, N = 266) =49.55, *CFI* = .98, *TLI* = .97, *RMSEA* = .052, and *SRMR* = .045. Two additional paths were specified as indicated by modification indexes and were deemed conceptually and theoretically sensible. These paths included hypothesizing a relationship between message trust and FVC and perception of message relevance and message recall. The modified model with these additional two paths improved the fit of the model with χ^2 (27, N = 266) =31.52, *CFI* = .99, *TLI* = .99, *RMSEA* = .025, and *SRMR* = .027. The path estimates are shown in Figure 6 (page 89).

The relationship between intervention and FVC was mediated through information processes among colon cancer survivors who received the combined intervention only. Receiving a combination of TPC and TMI was significantly related to the perception that the message was relevant to them (β = 0.41, p = .05). Having a greater perception of message relevance was significantly related to message trust (β = 0.99, p < .001), and greater trust was significantly related to eating more fruits and vegetables (β = 0.50, p = .002). The indirect effect was 0.19, and it was significant (p = .05). Receiving a single intervention of either TPC or TMI, did not significantly increase perception of message relevance. Significant

relationships were not found between message trust and message recall as well as between message recall and FVC.

Colon Cancer-Free Group

Measurement Model

The viability of the proposed latent factor, perception of message relevance, was also established through the use of confirmatory factor analysis measurement model among colon cancer-free group. All loadings of the measured variables on the latent factor were also strong and significant as shown in Table 9 (page 90).

Structural Equation Model

The structural equation model had a good fit with χ^2 (29, N = 469) =93.93, *CFI* = .96, *TLI* = .95, *RMSEA* = .069, and *SRMR* = .048. One additional path was specified as indicated by modification indexes and was deemed conceptually and theoretically sensible as shown. This additional path hypothesized a relationship between perception of message relevance and message recall. The modified model with the additional path improved the model fit with χ^2 (28, N = 469) =68.11, *CFI* = .98, *TLI* = .97, *RMSEA* = .055, and *SRMR* = .036. The path estimates are shown in Figure 7 (page 91).

The relationship between the intervention and FVC was mediated through information processes in all intervention types. Both single and combined interventions were significantly associated with higher perception of message relevance (TPC: β = 0.35, p = .02, TMI: β = 0.52, p < .001, TPC+TMI: β = 0.76, p < .001). Having a greater perception that the message was relevant to the participants significantly increased participants' trust in the

message ($\beta = 1.11$, $p < .001$) and message recall ($\beta = 0.52$, $p < .001$). Message recall, was significantly related to FVC ($\beta = 0.38$, $p = 0.001$). Trust, however, was not significantly associated with message recall. The indirect effect was significant for the TMI ($\beta = 0.13$, $p = .02$) and the combined groups ($\beta = 0.19$, $p = .007$). For the TPC group, the indirect effect was borderline significant ($\beta = 0.09$, $p = .06$).

5.4.2 Findings for AIM 2

To assess whether similar or different information processes mediate the relationship between perception of message relevance and FVC across different intervention types

A multi-sample structural equation model was specified as shown in Figure 3 (page 80) treating intervention types as groups. Model was run among the colon cancer-free group to assess whether similar or different processes mediate for different intervention groups. This model was not tested among colon cancer survivors because only the combined intervention showed a mediation effect.

Colon Cancer-Free Group

Multi-Sample Structural Equation Model by Intervention Groups

First, intervention types were conceptualized as groups. Then, two models were built (constrained and unconstrained) as specified in Figure 3 (page 80), and the χ^2 difference test was used to evaluate whether the overall model was indeed non-equivalent across the intervention groups. Lastly, when there was evidence of model non-equivalence, nested models were built to evaluate source of non-equivalence, that is, to identify paths that were different across the intervention groups.

Model comparison between all paths constrained vs. non-constrained showed model non-equivalence, that is, all paths were not equal across intervention groups. The model fit of a constrained model was χ^2 (73, N = 469) = 94.87, p = .04, *CFI* = .98, *TLI* = .98, *RMSEA* = .051, and *SRMR* = .09. The model fit of an unconstrained model was χ^2 (46, N = 469) = 46.69, p = .44, *CFI* = 1.00, *TLI* = .99, *RMSEA* = .01, and *SRMR* = .03. The fit of the constrained model was significantly worse than that of the unconstrained model χ^2 (24, N = 469) = 50.31, p = .007, supporting model nonequivalence. That is, paths differed across groups; thus, nested models were built to identify the source of non-equivalence across intervention groups.

The first model, constrained on the path perception of message relevance and message trust, was not significantly different from the reference model (measurement model constrained) in the chi-square difference test as presented in Table 10 (page 92). This finding indicated that the intervention groups were equivalent in that structural path, χ^2 (3, N = 469) = 1.63, p = .65. The structural path, "message relevance to message recall," was significantly different across the intervention groups χ^2 (3, N = 469) = 8.29, p = .040 and indicates that intervention groups were different on that path. There was also a significant difference across the intervention groups in the structural path, "message trust to message recall," χ^2 (3, N = 469) = 10.38, p = .0016, indicating that intervention groups were different in that structural path. The structural path "message relevance to FVC" was not significantly different between the intervention groups, χ^2 (3, N = 469) = 4.97, p = .17. Intervention groups also did not significantly differ in the path, "message trust to FVC," χ^2 (3, N = 469) = 7.50, p = .06. The following path, "message recall to FVC," also did not significantly differed between intervention groups, χ^2 (3, N = 469) = 2.95, p = .4. The last model was

constrained in the structural path, FVC at baseline and FVC at follow up, and that path was not significantly different across the intervention groups, χ^2 (3, N = 469) = 0.99, p = .80.

Model 2 was selected as the final model. It included constraints on the measurement model, and the structural paths "message relevance to message trust" as shown in Table 10 & Figure 8 (page 93). Model selection was based on model parsimoniousness, that is, a model with relatively few free parameters and most constraints was chosen (Preacher, 2006). The final model fit resulted in a χ^2 (58, N = 469) = 68.08, p = .17, *CFI* = .99, *TLI* =.99, *RMSEA* = 0.03, and *SRMR* = .05.

Across all four intervention groups, paths were equal in the relationships between a) message relevance and message trust as shown in Figure 8 (page 93). That is, individuals who perceived the intervention message to be relevant to them had greater trust in the message. These effects persisted regardless of the type of intervention that they had received.

Paths were different across the four intervention groups in the relationship between message relevance and message recall, message trust and message recall, message relevance and FVC, and message recall and FVC, as presented in Figure 8 (page 93). Those who received the TPC intervention only, message relevant was not significantly associated with FVC, but this relationship trended toward statistical significance (β= 0.97; p = .07). Individuals who received the TMI intervention only and perceived that the message was relevance to them consumed significantly more fruits and vegetables (β= 1.55*; p* <.001). Receiving a combination of TPC and TMI was significantly related to eating more fruits and vegetables through two paths. First, message relevance was related to greater trust (p < .001). Having greater trust in the message was associated with more recall (β= 0.23*; p* =

.002) and recall increased FVC (β= 0.67*; p* = .035). In addition, perception of message relevance was directly associated with message recall ($p < .001$) and recalling more messages was related to FVC (β= 0.67*; p* = .035).

5.4.3 Findings for AIM 3

To assess whether similar or different information processes mediate the relationship between health communication and FVC across different colon cancer groups

Multi-Sample Structural Equation Model by History of Colon Cancer Status

To assess model non-equivalence between colon cancer survivors and the colon cancer-free group, a multi-sample structural equation model was specified as shown in Figure 4 (page 81). The hypothesized model was tested on those receiving the combined intervention since only this group showed a mediation effect of information processes on both colon cancer survivors and the colon cancer-free group.

Model comparison between all paths constrained vs. non-constrained showed model non-equivalence, that is, all paths were not equal across history of colon cancer groups. The model fit of a constrained model was χ^2 (44, N = 181) = 62.26, p = .04, *CFI* = .99, *TLI* = .99, *RMSEA* = .03, and *SRMR* = .05. The fit of the unconstrained model was χ^2 (34, N = 181) = 35.95, p = .38, *CFI* = .99, *TLI* = .99, *RMSEA* = .01, and *SRMR* = .03. The fit of the constrained model was significantly worse than that of the unconstrained model χ^2 (10, N = 181) = 26.31, p = .003, indicating model non-equivalence, that is, paths differed across history of colon cancer groups. Thus, nested models were built to identify the source of nonequivalence across the two colon cancer groups.

The first model, constrained on the path "intervention to message relevance" was not significantly different from the reference model (measurement model constrained) in the chi-square difference test, indicating that groups were equal in the structural path χ^2 (1, N = 181) = 0.58, p = .45 as presented in Table 11 (page 94). Colon cancer groups were also equivalent in the structural path "message relevance to message trust," χ^2 (1, N = 181) = 1.15, p = .28. The structural path, "message relevance to message recall," was also equal across the groups, as shown by chi-square difference tests: χ^2 (1, N = 181) = 0.03, p = .86. There was a significant difference in the structural path "intervention to message recall," χ^2 (1, N = 181) = 6.96, p = .008, indicating that colon cancer groups were different on that path. The structural path, "message trust to message recall" was not significantly different between colon cancer groups, χ^2 (1, N = 181) = 1.68, p = .19. The structural path, "baseline fruit and vegetable consumption and follow up consumption," did not significantly differ between colon cancer groups, χ^2 (1, N = 181) = 3.75, p = .06. There was also no significant difference in the structural path, "message trust to FVC" between the groups, χ^2 (1, N = 181) = 3.40, p = .07. Lastly, the structural path message recall to FVC was not significantly different between the groups, χ^2 (1, N = 181) = 0.05, p = .82.

Model 4 was selected as the final model. It included constraints on the measurement model and the structural paths, "intervention and message relevance," " message relevance and message trust," and " message relevance and message recall" as shown in Table 11 (page 94) & Figure 9 (page 95). The final model fit resulted in χ^2 (40, N = 181) = 53.38, p = .077, *CFI* = .98, *TLI* = .98, *RMSEA* = .020, and *SRMR* = .04. Model selection was based on model parsimoniousness, that is, a model with relatively few free parameters and most constraints was chosen (Preacher, 2006).

Across the colon cancer groups (colon cancer survivors and colon cancer-free group), paths were equal in the relationship between a) intervention and message relevance, b) message relevance and message trust, and c) message relevance and message recall as shown in Figure 9 (page 95). That is, individuals who received the combined intervention reported that the message was relevant to them regardless of their colon cancer status. Those who perceived the intervention message to be relevant had greater trust in the message and also recalled receiving more messages.

Paths were different across the two colon cancer groups in the relationship between a) intervention and recall, b) message trust and message recall, c) message trust and FVC, and d) message recall and FVC as presented in Figure 9 (page 95). Among colon cancer survivors, the relationship between intervention and FVC occurred through perception of message relevance and message trust. That is, those who received the combined intervention perceived that the message was relevant to them ($p < .001$). Individuals who perceived the message to be more relevant had greater trust in the message ($p < .001$), and greater trust increased FVC ($\beta = 0.44$; $p = .003$).

The relationship between intervention and FVC occurred through three paths among the colon cancer-free group. First, those who received the combined intervention recalled receiving more messages ($p < .001$), and higher recall was related to FVC ($\beta = 0.29$; $p = .05$). Second, those who received the combined intervention perceived greater message relevance ($p < .001$). Greater perception of message relevance was related to message recall ($p < .001$), and higher recall influenced FVC ($\beta = 0.29$; $p = .05$). Finally, the intervention was significantly related to message relevance ($p < .001$), and those who perceived greater message relevance had greater trust ($p < .001$). Having greater trust was significantly related

to recalling receipt of more messages (β= 0.18; p = .004), and message recall was significantly associated with FVC (β= 0.29; p = .05).

5.5 Summary

The results of the analyses show that information processes, message relevance, trust, and recall mediate the relationship between health communication and FVC among colon cancer survivors and colon cancer-free individuals. When the relationship was examined across intervention types, similar and different processes mediated the relationship between health communication and FVC among colon cancer-free individuals. In addition, similar and different information processes mediated the relationship between the combined intervention and FVC across the two colon cancer groups.

In the final chapter, study findings are discussed including previous literature that supports or challenges the findings from this dissertation study. Strengths and limitations of this study as well as implications for future behavioral interventions and its contribution to public health will be discussed.

CHAPTER 6

DISCUSSION

6.1 Overview

This chapter discusses the results presented in Chapter V. The chapter highlights and explains the main study findings and addresses their strengths and limitations. Implications for intervention studies, future research, and public health are also discussed. Finally, the last section summarizes the research conclusions.

6.2 Discussion of Main Findings

This study examined the relationship between a health communication intervention and FVC in a population-based sample of colon cancer survivors and colon cancer-free individuals. Among colon cancer survivors, the relationship between the intervention and FVC was mediated by information processes but only for those that received the combined intervention (TPC+TMI). Thus, the relationship between intervention and FVC was not mediated by information processing variables for those who received a single intervention.

In the colon cancer-free group, the relationship between the intervention and FVC was mediated by information processes among those who received only the TMI intervention and the combined TPC+TMI. For those receiving only the TPC intervention, the information processes did not significantly increase FVC, although the relationship trended toward statistical significance.

6.2.1 Information Processes of Health Communication and FVC among Colon Cancer Survivors

The relationship between intervention and FVC was mediated by information processes but only in those who received the combined intervention (TPC+TMI). This relationship was not found among those who received either the TPC or TMI alone. Thus, it was the effect of receiving both interventions that influenced FVC and not whether the information was delivered through newsletters or counseling calls. Previous intervention studies corroborate the finding that a multimodal intervention approach is important in promoting dietary change among cancer survivors (Newman et al., 2005; Pierce et al., 2002). In a multi-center intervention study aimed at dietary change among breast cancer survivors, an intervention based on telephone counseling combined with print materials and cooking classes influenced dietary change among breast cancer survivors (Newman et al., 2005; Pierce et al., 2002).

It is important to note that baseline FVC was high among NC STRIDES' participants who were colon cancer survivors and in colon cancer-free group, with individuals reporting about five servings of FVC a day. This is not surprising for two reasons. First, NC STRIDES' participants were older with an average age of 66 years, and other studies have found that older individuals tend to meet the FVC guideline established by health agencies (Casagrande et al., 2007). In addition, and specific to colon cancer survivors, the high FVC is also consistent with findings from other studies which reveal that after a cancer diagnosis, many cancer survivors make lifestyle changes such as eating more fruits and vegetables (Patterson, 2000). Even so, studies report that interventions using multiple strategies can

further increase FVC in cancer survivors who may have already made behavioral changes after a cancer diagnosis (Newman et al., 2005; Pierce et al., 2002).

Among colon cancer survivors, the combined intervention had an indirect effect on FVC via two information processes, message relevance and trust. Research has shown that tailored messages are more likely to be perceived as personally relevant and messages that are perceived as more personal are more likely to stimulate cognitive activity (Kreuter & Wray, 2003, Kreuter et al., 2004; McGuire, 1985). Message trust was the second important information process for colon cancer survivors and trust has emerged as important in other studies of cancer survivors as well (Finney et al., 2005; Mayer et al., 2007; Mills & Davidson, 2002; Rees & Bath, 2000; Warner & Procaccino, 2004). In these studies, cancer survivors preferred to receive information about cancer from a personal and trusted source such as a healthcare provider (Arora, Bakos, Aziz, & Roland, 2005; Finney Rutten, Rees & Bath, 2000; Mayer et al., 2007; Mills & Davidson, 2002; Warner & Procaccino, 2004). Researchers also report that the internet and books were second and third most used sources of information by cancer survivors (Mayer et al., 2007). NC STRIDES's participants who received the combined intervention had access to a trained motivational interviewing counselor who was personal, trustworthy, and delivered the counseling session tailored to the participant's needs. They also received tailored newsletters which were available for them to read at their convenience. The interaction with the counselors may have served to develop trust in the message about FVC, and the newsletters may have served to reinforce the message about FVC.

Repeating the intervention message using two different strategies was important in influencing FVC among colon cancer survivors. Previous studies examining the effect of

message repetition on information processes suggest that repetitions beyond the first three messages add little for the positive effect and may even diminish message impact (Becker & Doolittle, 1975; Cacioppo & Petty, 1979; Calder and Sternthal, 1980). Other researchers reported that although attention and interest to a message declined with repetition, the decline was reversed when messages were presented with new and relevant arguments (Grass & Wallace, 1969; McGuire 1989). Colon cancer survivors in the combined intervention group received four tailored newsletters and four counseling calls. It is likely that receiving combined messages delivered through multiple channels keept the participants interested and engaged in the intervention message.

6.2.2 Information Processes of Health Communication and FVC among the Colon Cancer-Free Group

In the colon cancer-free group, the relationship between the intervention and FVC was mediated by information processes in those who received the TMI alone as well as the TPC+TMI condition. For those receiving TPC intervention alone, the information processes did not significantly increase FVC, although the relationship trended toward statistical significance.

Findings suggest that similar and different processes were involved in the relationship between types of interventions and FVC among colon cancer-free group. For instance in all intervention conditions, individuals in the colon cancer-free group reported that their trust in the intervention message and their number of the recollection of the messages they received was influenced by perceived message relevance. As discussed above, tailored messages are perceived as more personally relevant, and when messages are

perceived as personally relevant, they are more likely to stimulate information processing (Kreuter & Wray, 2003; Kreuter et al., 2004; McGuire, 1985). Therefore, it was not surprising to find that message relevance, message trust, and message recall were mediators for TPC, TMI, and the combined (TPC+TMI) intervention's effect on FVC as these interventions were developed with tailored elements.

Nonetheless, it was refreshing to observe how message relevance, message trust, and message recall were important processes to individuals who were in the control group as well. The control group received four non-tailored, generic brochures. Kreuter & Wray (2004) reported that when non-tailored messages are a good fit for an individual, they are just as effective as tailored messages in reinforcing message relevance. NC STRIDES' participants in the control group received non-tailored messages that are based on their gender. For example, women received information about breast cancer and men received information about prostate cancer. Since NC STRIDES' participants were mainly older individuals (average age was 66 years old), the topic of breast or prostate cancer may have been a particularly salient topic for these individuals. Other studies corroborate this idea. Kreuter and colleagues (2004) reported that women aged 40 and older considered the topic of breast cancer prevention to be important. Similarly, prostate cancer screening has been garnering much attention as prostate cancer has become the most frequently diagnosed cancer in men (ACS, 2008). Thus, the non-tailored messages may have been a good fit for individuals in the control group.

Findings also suggest that different processes were involved in the relationship between types of intervention and FVC among the colon cancer-free group. For example, individuals in the TMI-only intervention who believed that the message was relevant to them

consumed more fruits and vegetables. This relationship, however, was not significant among those receiving the TPC-only intervention, although the relationship trended toward statistical significance (p = .07). Individuals in the combined intervention group showed different cognitive processes compared to TMI and TPC, including two distinct paths for eating more fruits and vegetables. In the first path, individuals who received the combined intervention perceived greater relevance to the message. Those individuals who perceived greater relevance trusted the message more. Having greater trust in the message was related to recalling receiving greater number of messages and message recall was ultimately related to FVC. In the second path, individuals who received the combined intervention perceived greater relevance to the message. Those who perceived greater relevance recalled receiving more number of messages. Ultimately, recalling more messages influenced FVC.

One is left to wonder why both single interventions did not have the same effect instead of TMI having a greater effect than TPC. The success of TMI over TPC may be that the counseling calls were more personal and interactive than print materials. Since the same counselor was assigned to the same participant each time, the counseling sessions provided a platform for building rapport during the intervention.

Another explanation is that motivational interviewing counseling sessions were client-centered, and the counselor's role was to facilitate individuals in setting his or her own goals as well as finding ways to overcome barriers to increase FVC. Studies suggest that client-centered counseling sessions are more effective than those that instruct the client on what to do because participants are motivated when they set their own goals and formulate solutions for their problem behaviors (Miller & Rollnick, 1991; Lewis, DeVellis, & Sleath, 2002). In motivational interviewing counseling sessions, the client is seen as the expert and

is responsible for generating self-motivating strategies. The counselor's role involves offering clients facts and pointing out discrepancies between the clients' goals and behavior (Lewis, DeVellis, & Sleath, 2002).

In addition, counselors for the TMI-only group used an emphatic, supportive, and complementary style when counseling individuals. McGuire (1985) explains that verbal communication using words like "I see," "yes," "fine," enhance an individual's interest and liking for the message. Among the NC STRIDES participants who received the TMI intervention, having the affirmation of the counselors during their interactions could have made the message more attractive.

The counseling sessions may have served to reinforce information that was unclear to the study participants. The interaction with the counselor involved two-way communication channels, with the participants communicating back to the counselor, whereas print communication did not have this element. This opportunity may have motivated individuals to be more active participants. In addition, the counselor may have provided more feedback to individuals, reinforcing messages that were not fully understood (Jecker et al., 1965; McGuire 1969, 1999; Rosenthal, 1967).

Finally, the counseling sessions may have provided NC STRIDES' participants an opportunity to receive social support. NC STRIDES' participants were generally older. Receiving support from friends and family can become more important for older individuals because the number of social networks from which they receive support may be reduced following retirement, children leaving home, death, and disability (Lockenhoff & Carstensen, 2004). It is possible that NC STRIDES' participants responded better to an interaction with a

person, rather than reading a print message, because personal interaction provided an opportunity for them to get social support.

6.2.3 Information Processes of Colon Cancer Survivors and the Colon Cancer Free-Group

The findings of this study suggest that similar and different information processes were used by colon cancer survivors and the colon cancer free group receiving the combined intervention. For example, regardless of their colon cancer status, the combined intervention influenced message relevance, message trust, and recalled receiving more number of messages.

In addition, different processes were involved among colon cancer survivors and the colon cancer-free group. For example, individuals with a history of colon cancer who had more trust in the message consumed more fruits and vegetables. Among colon cancer free individuals, message recall emerged as the important mediator for FVC. Previous studies have found similar results that individuals who received tailored messages and found the information to be relevant were more likely to remember the message (Campbell & Quintiliani, 2006).

The importance of message trust to colon cancer survivors is not unusual (Blanchard et al., 2003; Patterson et al., 2000). One possible explanation is that colon cancer survivors' perception of trust and the credibility of the message are related to their previous knowledge about colon cancer. Colon cancer survivors are more knowledgeable about colon cancer compared to their counterparts because a cancer diagnosis often leads information seeking about their illness (Blanchard et al., 2003; Patterson et al., 2000). This prior knowledge may become a point of reference to which new information is compared and judged as trustworthy

or not. For example, upon hearing an intervention message, colon cancer survivors may be cognitively stimulated to reflect on their previous knowledge, and develop arguments to support or dispute the message that they received. Depending on whether they support or disagree with the message, individuals may draw conclusions about the messages credibility and trustworthiness. This trustworthiness may be more relevant and more important to colon cancer survivors.

The findings indicate that the mediated relationship between combined intervention and FVC among colon cancer survivors occurred through one pathway, while several pathways were operating among the colon cancer-free group. These differences may have occurred for two reasons. First, colon cancer survivors may be already processing colon cancer information. At the time of the delivery of the intervention, colon cancer survivors may have already been seeking information about their illnesses and processing this information. McGuire (1985) explains when the new information is presented at a simple and easy form, it may lead individuals to attend to the new message. It is possible that the tailored print communications and the counseling calls may have been perceived as being effortless and easy to comprehend as they were created based on the individual's needs, prompting them to process this information through one path. Colon cancer-free individuals, however, may have processed the information through multiple paths if the information was perceived as relatively new, attractive, and interesting.

In addition, colon cancer survivors' may be experiencing more anxiety, stress, and/or depression that could distract individuals from processing information. Colon cancer survivors experience more negative psychological outcomes compared to their colon cancer-free counterparts because they face uncertainty about their health such as fear of colon cancer

recurrence and developing secondary cancers and other chronic illnesses (Bottomley, 1998; Simon et al., 2008; Stark & House, 2000). Such uncertainties may interact with daily stresses that individual's experience, ultimately affecting their information processing.

6.3 Strengths and Limitations

A major strength of this study was my ability to build on findings from previous research when conceptualizing information processes as mediators of health communication and FVC. Past studies reported a bivariate relationships between intervention and information processes as well as a relationship between information processes and behavior change. I expanded on this prior knowledge by conceptualizing and empirically testing information processes as mediators of health communication and FVC, guided by a theoretical framework (Bull et al., 2001; Kreuter et al., 2004).

A methodological strength was the use of multi-sample structural equation models to test the theoretical model across intervention types and colon cancer status. Not only did this technique allow me to observe whether information processes mediated the relationship between the interventions and FVC, but specifically it helped me identify the information processes that mediated each intervention type for each colon cancer group.

This study also provides some ability to generalize the results. NC STRIDES' participants were a diverse group of people including 50% females, 35% African Americans, and 36% colon cancer survivors.

Finally, because a secondary data analysis was conducted, the data were easily available at no cost to the researcher. In addition, researchers from the original study were available to answer questions about NC STRIDES during this study.

A potential limitation of the study is that the data were collected as part of a larger study that tested for effectiveness of two types of intervention and not specifically designed to test the information processes of interest. This limitation led us to use measures that seemed related to the concepts of information processing described by McGuire (1985). In addition, there were no baseline measures of communication needs/preferences of the individuals.

Another limitation is that not all the information processes were included in the conceptual model, and variable selection was dependent on the variables available from the NC STRIDES dataset. McGuire, however, states that "simplifications" can be made when applying the information processing theory to empirical studies including combining processing steps (McGuire, 1985).

In addition, print communications and counseling calls have different levels of interactivity and can influence various sensory appeals (e.g. visual for print newsletters vs. audio for counseling calls) (Kreuter & McClure, 2004). It is difficult to disentangle whether receiving messages through newsletters vs. a telephone call was due to interactivity, sensory appeal, or both in this dissertation study. The findings, however, show that types of communication modalities can influence different information processes.

Furthermore, NC STRIDES' participants were a highly motivated group who had previously participated in another study. Therefore, interventions effectiveness may be different for individuals who are not as highly motivated as NC STRIDES' participants.

Finally, the data are based on self-report, and therefore, open to bias. It is likely, however, that the bias was equal across the intervention groups, due to randomization. In

addition, participants in the control group were masked to their intervention status and were provided a non-tailored print newsletter at the same quantity as other interventions.

6.4 Implications for Future Intervention Studies and Public Health

This study provides evidence that information processes can be considered mediators of the relationship between a health communication intervention and FVC. Future intervention studies aimed at increasing fruit and vegetable consumption among colon cancer survivors might consider developing their messages around perception of message relevance, message trust and then test for the mediating effects of those variables on behavior change. Interventions aimed at the colon cancer-free population may consider intensifying perceptions of message relevance, trust, and recall for behavior change.

Another direction for future intervention studies is to measure each step in the information processes model at different intervals to account for the temporality and hierarchy of information processes as proposed by McGuire (1985). Since measuring all 12 steps may be time consuming, researchers may consider selecting several steps that have been shown to be important in previous studies such as message attention, message relevance, message liking, and message comprehension (McGuire, 1985). Other studies can investigate applicability of the information processing theory for other behaviors that are similar to FVC.

One last direction is for intervention studies to investigate what impacts the information processes, message relevance, message trust, and recall for different groups. Specifically investigate which input factors are important to influence these processes.

This study has many important implications for public health. Research has shown that health information tailored to meet the unique needs and interests of specific individuals is more effective than generic information on risk-reducing behavior changes. Since tailored messages, particularly printed materials, can be computer generated on a mass scale, this approach may become increasingly important as a public health education tool in the information age. When health educators understand how people process and respond to tailored messages, they have a basis for fine-tuning methods of tailoring to maximize effectiveness.

Currently, there has been a rising interest in using a computer-mediated communication as an alternative to face-to-face interactions (Cassell, Jackson, & Cheuvront, 1998). In the past few years, the Internet has emerged as a unique and prominent medium for this type of communication with more than 30 million users in the United States alone and an annual growth rate of about 100% (Nielsen Media Research, 1997; Graphic, Visualization, & Usability Center (GVU), 1997). It is important to note that in this dissertation study, receiving just four calls of 20 minutes each during six months was effective in promoting FVC. This communication medium could be particularly valuable for intervention on cancer prevention. The content of the message could be tailored and structured to an individual's needs and the person-to-person interaction will provide a platform to increase social support.

6.4 Conclusion and Recommendations

The interest in understanding how interventions work and whether different types of interventions work differently will continue to grow, as will the need to better measure information processing variables that mediate the relationship between intervention and behavior change. The literature on this topic is currently limited. This dissertation study was a first step in testing information processes as mediators between theory-based health communication and FVC. As intervention studies evolve, special attention paid to information processes may yield a more refined understanding of the kinds of processes that "matter" for which types of interventions and for whom, as well as the potential influence of information processes on other health behaviors.

Table 1. Five Input Factors of Communication of Information Processing Theory

Input Factors Communications
1. Source: expertise, credibility, pleasantness, familiarity, power, etc. 2. Message: appeal, style, repetition, etc. 3. Channel: modality, directness, etc. 4. Receiver: demographics, ability, personality, motivation, etc. 5. Destination: immediacy/delay, prevention/cessation, etc

Table 2. Twelve successive outputs or outcomes of communication of information processing theory and matching variables from NC STRIDES

Information Processing Model's Outcomes of Communications	**NC STRIDES** Variables Collected
1. Exposure to the message	
2. Attention to the message	
3. Liking or Becoming Interested in the message	
4. Comprehending the message (learning what)	
5. Cognitive Elaboration of the message	Message Relevance -Especially Designed for Self -Importance of the Message -Message Application to Life
6. Acquiring Relevant Skills	
7. Message Agreement	Message Trust
8. Memory Retention/Storage	
9. Message Retrieval	Message Recall
10. Decision Making	
11. Action	Fruit and Vegetable Consumption
12. Post-Behavioral Consolidating	

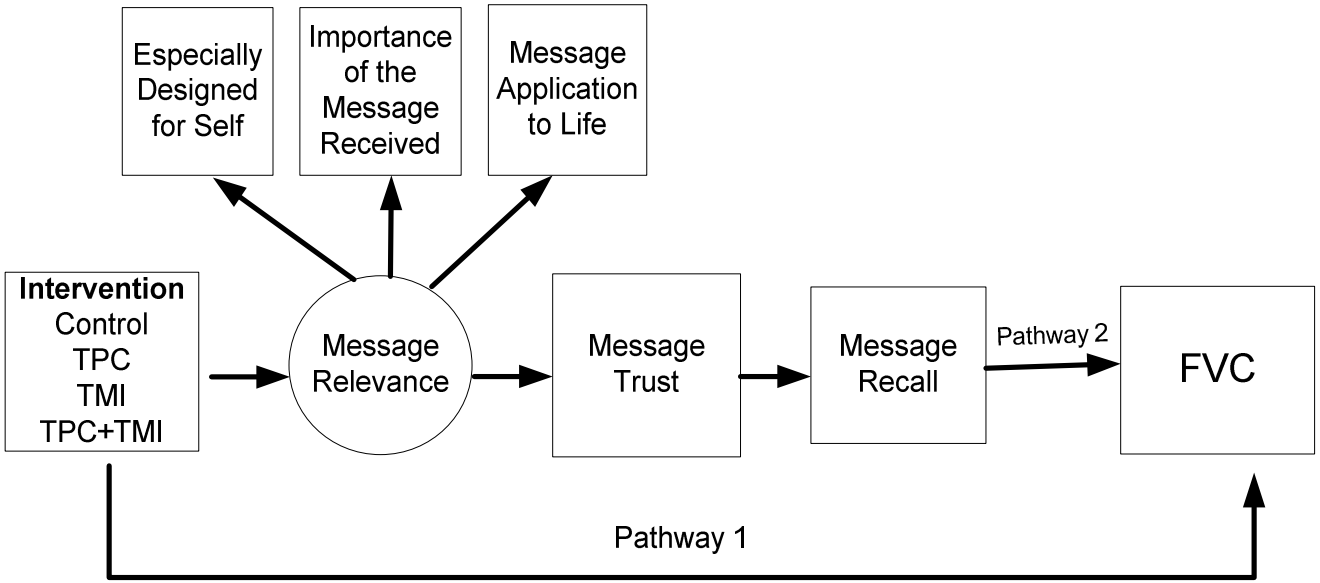


Figure 1. Conceptual model of the relationship between health communication, information processes, and fruit and vegetable consumption in NC STRIDES' participants. TPC=Tailored Print Communication; TMI = Telephone Motivational Interviewing; FVC = Fruit and Vegetable Consumption

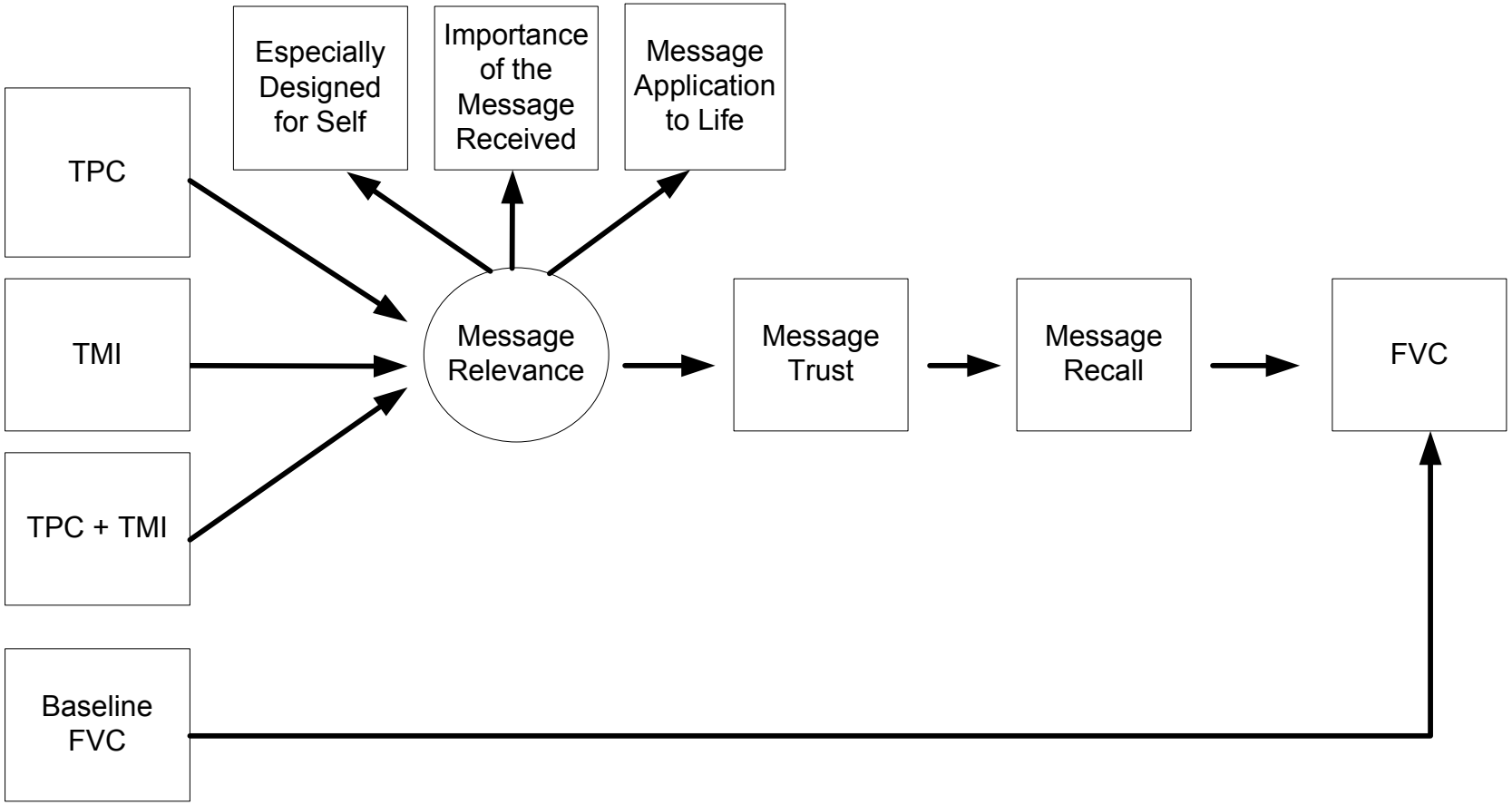


Figure 2. Hypothesized model for AIM 1 of the relationship between health communication, information processes, and fruit and vegetable consumption in NC STRIDES' participants. TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; FVC = Fruit and Vegetable Consumption.

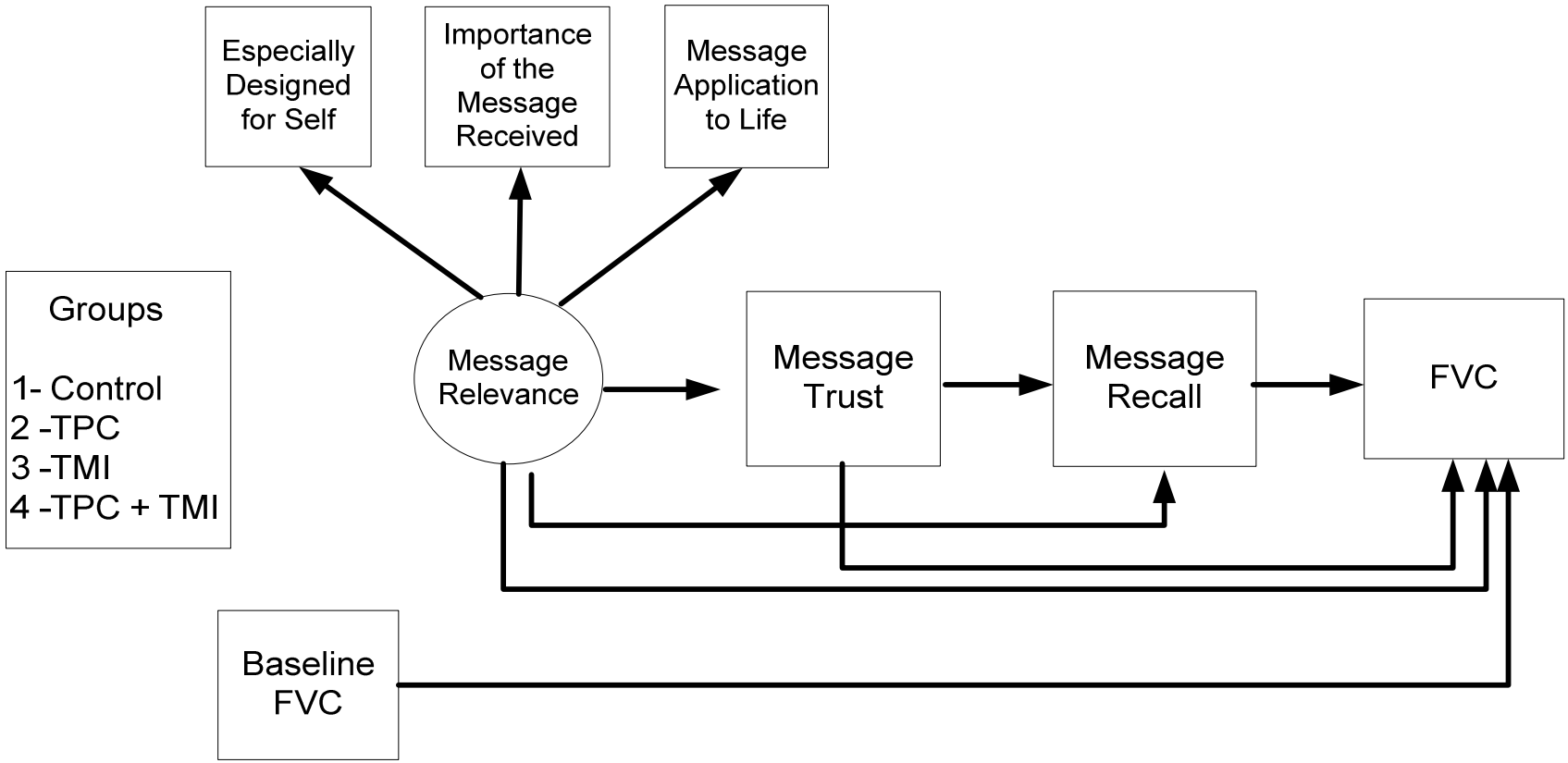


Figure 3. Hypothesized model for AIM 2 of the relationship between information processes and fruit and vegetable consumption by intervention groups. TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; FVC = Fruit and Vegetable Consumption.

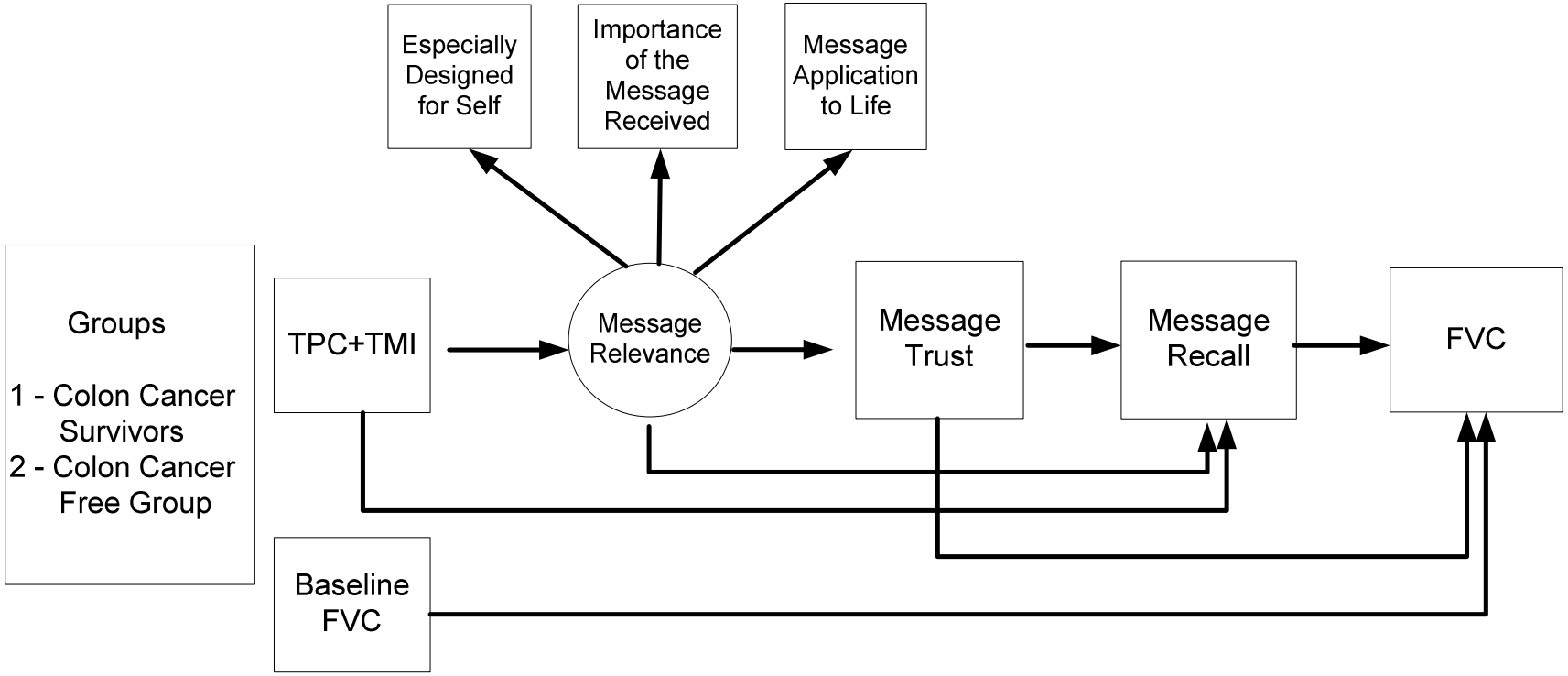


Figure 4. Hypothesized model for AIM 3 of the relationship between health communication and fruit and vegetable consumption among NC STRIDES' participants by colon cancer groups. TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; FVC = Fruit and Vegetable Consumption

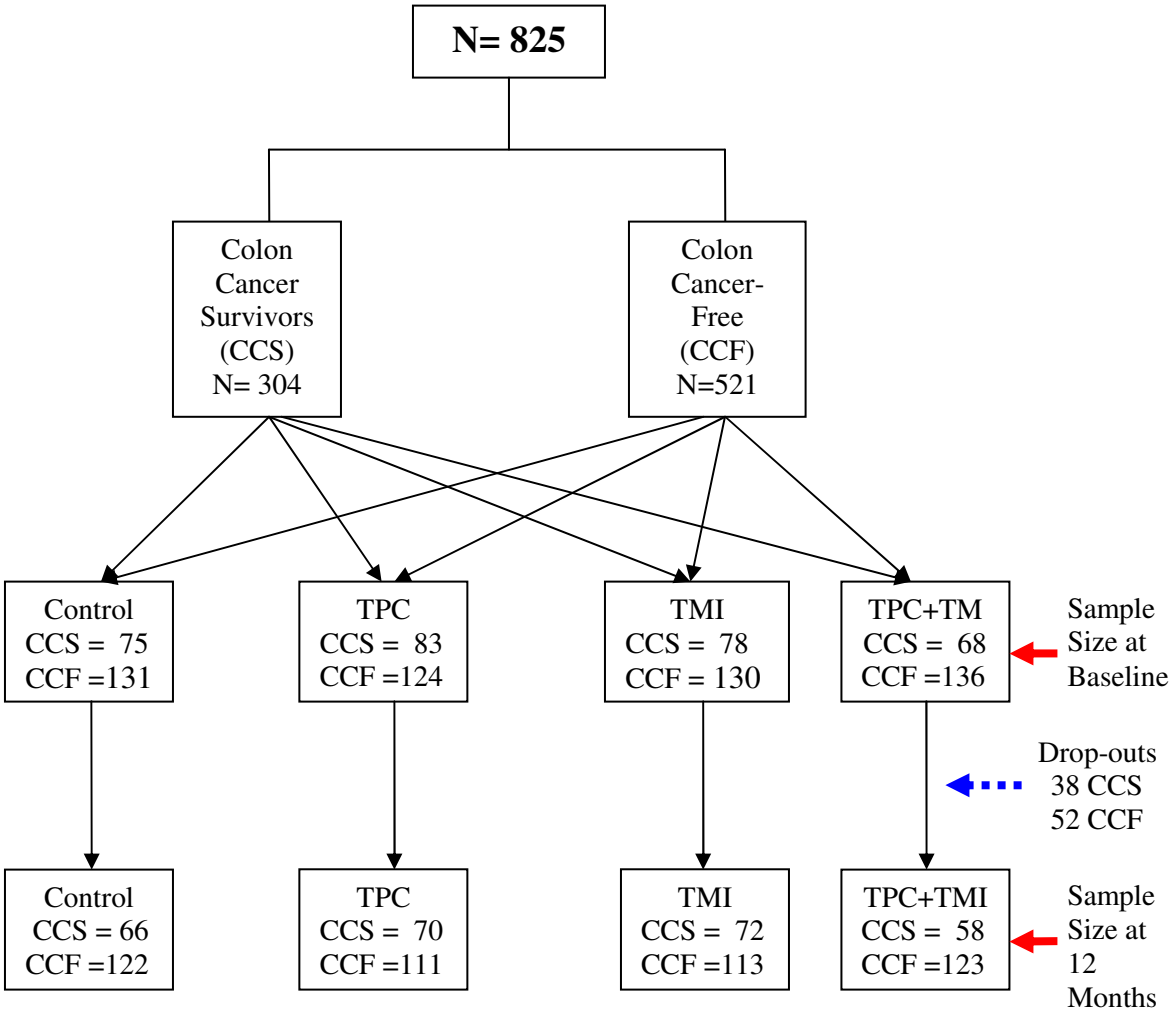


Figure 5. Randomization of NC STRIDES study population. CCS= Colon Cancer Survivors, CCF=Colon Cancer-Free, TPC= Tailored Print Communication, TMI= Telephone Motivational Interviewing

Table 3. Demographic Characteristics of All Participants by Colon Cancer Survivorship

Variable	Total N = 735	CC Survivors N = 266	Colon Cancer-Free N = 469	P-value
Age in Years, Mean (SD)	66.4 (9.9)	65.0 (10.5)	67.3 (9.5)	.003
Daily FVC, Mean (Median)	5.5 (5.1)	5.4 (4.8)	5.5 (5.2)	.749
Race, % (N)				
White	65% (475)	62% (166)	66% (309)	.343
Sex, % (N)				
Male	51% (372)	52% (138)	50% (234)	.605
Employed, % (N)				
Yes	38% (275)	38% (99)	38% (176)	.947
Annual Income, % (N)				
$\geq$ $30,000	55% (370)	52% (126)	57% (244)	.189
Education, % (N)				
8 years or less	8% (55)	11% (28)	6% (27)	.014
9-12 years	42% (305)	44% (118)	40% (187)	
13+	51% (369)	45% (119)	54% (250)	

Note: FVC = Fruit and Vegetable Consumption, CC = Colon Cancer

Table 4. Demographic Characteristics of Colon Cancer Survivors by Intervention Type

	Study Group among Colon Cancer Survivors N = 266				
Variable	Control N = 66	TPC N = 70	TMI N = 72	TPC+TMI N = 58	P value
Age in Years, Mean (SD)	65.1 (10.6)	64.8 (11.3)	66.6 (9.7)	63.2 (10.4)	.325
Daily FVC, Mean (Median)	5.1 (4.7)	5.3 (4.9)	5.7 (4.6)	5.7 (4.9)	.320
Race, % (N)					
White	70% (46)	69% (48)	54% (39)	57% (33)	.141
Sex, % (N)					
Male	58% (38)	46% (32)	57% (41)	47% (27)	.345
Employed, % (N)					
Yes	35% (23)	37% (26)	31% (22)	49% (28)	.225
Annual Income, % (N)					
≥ $30,000	52% (31)	42% (27)	48% (32)	68% (36)	.036
Education, % (N)					
8 years or less	6% (4)	16% (11)	13% (9)	7% (4)	.455
9-12 years	44% (29)	47% (33)	42% (30)	45% (26)	
13+	50% (33)	37% (26)	45% (32)	48% (28)	

Note: FVC = Fruit and Vegetable Consumption, CC = Colon Cancer, TPC = Tailored Print Communication, TMI = Telephone Motivational Interviewing

Table 5. Demographic Characteristics of the Colon Cancer-Free Group by Intervention Type

Variable	Study Group among Colon Cancer-Free Group N=469				
	Control N = 122	TPC N = 111	TMI N = 113	TPC+TMI N = 123	P-value
Age in Years, Mean (SD)	67.3 (9.8)	67.1 (9.9)	67.4 (9.3)	67.2 (9.2)	.996
Daily FVC, Mean (Median)	5.7 (5.4)	5.4 (5.4)	5.4 (5.1)	5.5 (5.1)	.231
Race, % (N)					
White	64% (78)	72% (80)	60% (68)	68% (83)	.275
Sex, % (N)					
Male	47% (57)	46% (51)	57% (64)	50% (62)	.355
Employed, % (N)					
Yes	33% (40)	40% (44)	38% (43)	40% (49)	.625
Annual Income, % (N)					
≥ $30,000	63% (71)	56% (56)	48% (51)	59% (66)	.133
Education, % (N)					
8 years or less	5% (5)	6% (7)	6% (7)	6% (7)	.764
9-12 years	34% (41)	42% (47)	41% (46)	44% (53)	
13+	61% (73)	51% (57)	53% (59)	50% (61)	

Note: FVC = Fruit and Vegetable Consumption, CC = Colon Cancer, TPC = Tailored Print Communication, TMI = Telephone Motivational Interviewing

Table 6. Bivariate Analysis of the Relationship between Intervention and Information Processes among Colon Cancer Survivors by Intervention Type

	Study Group among Colon Cancer Survivors N = 266				
Variable	Control N = 66	TPC N = 70	TMI N = 72	TPC + TMI N = 58	P value
Especially Designed for Self, Mean (SD)	$2.23_{a,b}$ (1.07)	2.10_{a} (0.90)	$2.63_{a,b}$ (1.20)	2.69_{b} (1.16)	.011
Importance of the Message, Mean (SD)	$2.20_{a,b}$ (0.85)	2.10_{a} (0.95)	$2.57_{a,b}$ (1.13)	2.62_{b} (1.12)	.020
Message Application to Life, Mean (SD)	$2.19_{a,b}$ (0.97)	1.97_{a} (0.88)	$2.46_{a,b}$ (1.04)	2.53_{b} (1.07)	.015
Message Trust, Mean (SD)	$2.85_{a,b}$ (1.01)	2.53_{a} (0.90)	$2.97_{a,b}$ (1.24)	3.09_{b} (1.27)	.050
Message Recall, Mean (SD)	1.41_{a} (0.71)	1.53_{a} (0.77)	1.90_{a} (1.00)	1.94_{a} (1.06)	.023
Self-efficacy, Mean (SD)	3.45_{a} (1.36)	3.44_{a} (1.30)	3.69_{a} (1.37)	3.34_{a} (1.40)	.501

Note. Means that do not share the same subscript differ at $p < .05$ in the Tukey honestly significant difference comparison.
TPC = Tailored Print Communication, TMI = Telephone Motivational Interviewing

Table 7. Bivariate Analysis of the Relationship between Intervention and Information Processes among the Colon Cancer-Free Group by Intervention Type

	Study Group among Colon Cancer-Free Group N = 469				
Variables	Control N = 122	TPC N = 111	TMI N = 113	TPC + TMI N = 123	P value
Especially Designed for Self, Mean (SD)	1.95_{a} (0.88)	2.17_{a} (0.89)	$2.33_{a,b}$ (1.09)	2.61_{b} (1.12)	.0002
Importance of the Message, Mean (SD)	1.95_{a} (0.86)	$2.28_{a,b}$ (0.93)	2.50_{b} (1.09)	2.63_{b} (1.13)	.0002
Message Application to Life, Mean (SD)	1.83_{a} (0.87)	$2.19_{a,b}$ (0.92)	$2.38_{b,c}$ (1.03)	2.65_{c} (1.19)	<.0001
Message Trust, Mean (SD)	2.58_{a} (1.01)	$2.85_{a,b}$ (1.07)	$2.99_{a,b}$ (1.32)	3.26_{b} (1.32)	.0023
Message Recall, Mean (SD)	1.13_{a} (0.55)	1.89_{c} (1.02)	1.71_{b} (0.92)	2.27_{d} (0.99)	<.0001
Self-efficacy, Mean (SD)	3.43 (1.29)	3.45 (1.40)	3.43 (1.36)	3.64 (1.34)	.5571

Note. Means that do not share the same subscript differ at $p < .05$ in the Tukey honestly significant difference comparison. TPC = Tailored Print Communication, TMI = Telephone Motivational Interviewing

Table 8. Summary of Confirmatory Factor Analysis Measurement Models for Colon Cancer Survivors

	Unstandardized Coefficient (SE)	Standardized Coefficient	R-Square
Variable Loading on latent factor: Message Relevance			
Especially Designed for Self	1.00[†]	0.92	0.85
Importance of the Message	0.97 (0.04)**	0.94	0.89
Message Application to Life	0.92 (0.04)**	0.93	0.86

Note: [†]Variable loading was set to equal to 1.00 to set the metric for the factor.
**denotes $p < .001$.
Missing N=66.

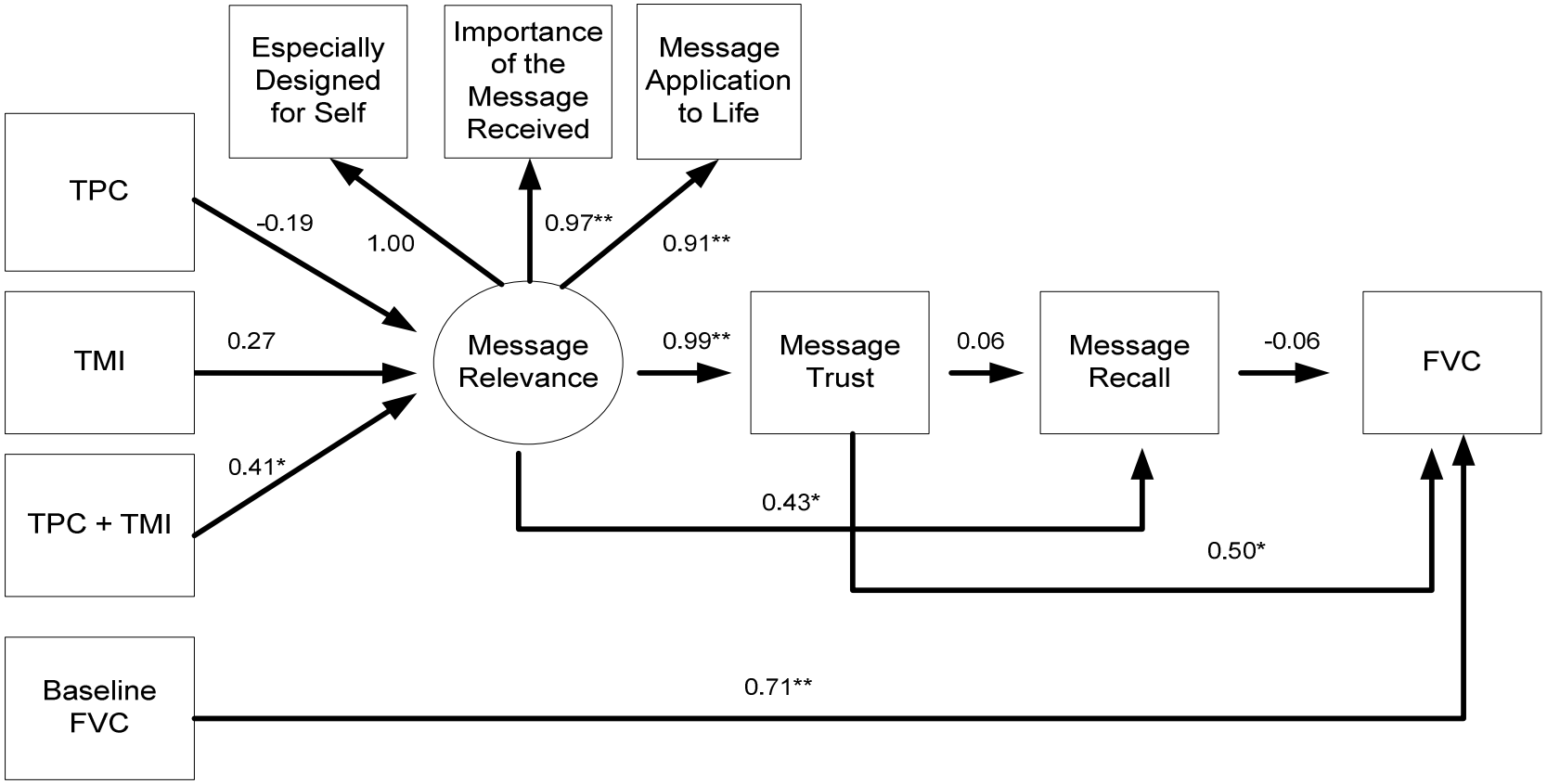


Figure 6. Path diagram of model testing information processes as mediators of the relationship between health communication and fruit and vegetable consumption among colon cancer survivors. Unstandardized β weights for variables entered into the model are shown. Baseline fruit and vegetable consumption adjusted. Significant relationships are indicated by asterisks (*$p < .05$, **$p < .001$). TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; FVC = Fruit and Vegetable Consumption.

Table 9. Summary of Confirmatory Factor Analysis Measurement Models for the Colon Cancer-Free Group

	Unstandardized Coefficient (SE)	Standardized coefficient	R-Square
Variable Loading on latent factor: Message Relevance			
Especially Designed for Self	1.00[†]	0.92	0.84
Importance of the Message	1.00 (0.04)**	0.91	0.83
Message Application to Life	1.01 (0.04)**	0.91	0.83

Note: [†]Variable loading was set to equal to 1.00 to set the metric for the factor.
**denotes $p < .001$.
Missing N=123.

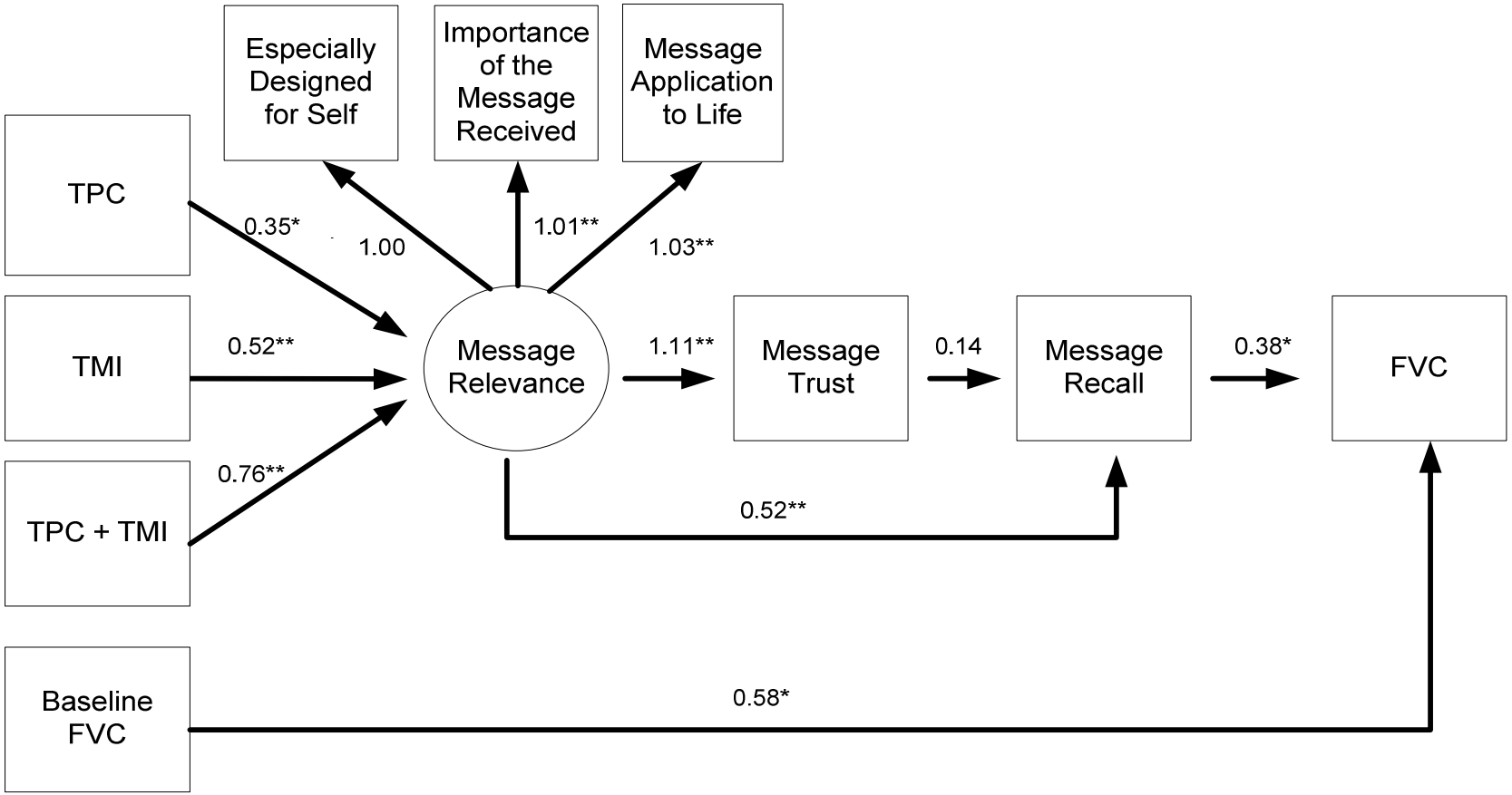


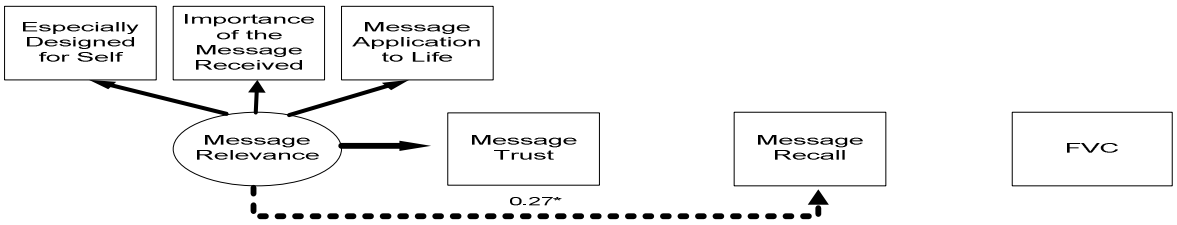
Figure 7. Path diagram of model testing information processes as mediators of the relationship between health communication and fruit and vegetable consumption among the colon cancer-free group. Unstandardized β weights for variables entered into the model are shown. Baseline fruit and vegetable consumption adjusted. Significant relationships are indicated by asterisks (*$p < .05$, **$p < .001$). TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; FVC = Fruit and Vegetable Consumption.

Table 10. Fit Results of the Structural Invariance among Intervention Groups in Colon Cancer-Free Group

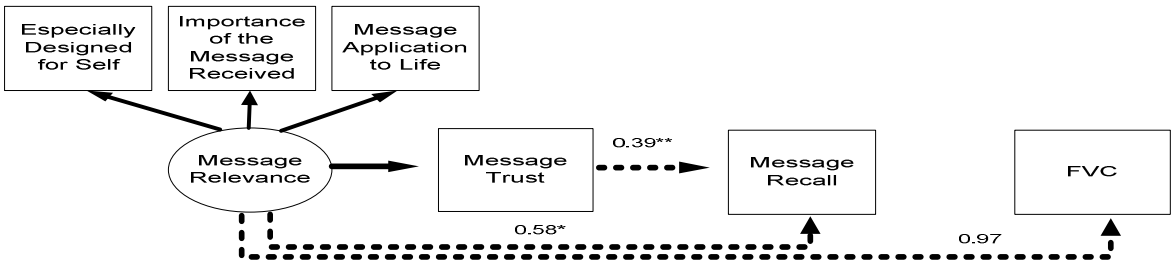
Model	Parameter(s) constrained to be equal across groups	χ^2Value	χ^2Difference	*P-value*	Compare	FP	*CFI*	*TLI*	*RMSEA (90% CI)*
1	Measurement Model	$\chi2(52) = 58.16$				80	.99	.99	.03 (.00 - .07)
2	Relevance to Trust	$\chi2(55) = 59.79$	$\chi2(3) = 1.63$	>.05	2 v 1	77	.99	.99	.03 (.00 - .07)
3	Relevance to Recall	$\chi2(58) = 68.08$	$\chi2(3) = 8.29$	<.05	3 v 2	74	.99	.99	.04 (.00 - .07)
4	Trust to Recall	$\chi2(61) = 78.46$	$\chi2(3) = 10.38$	<.05	4 v 3	71	.99	.99	.05 (.00 - .08)
5	Relevance to FVC	$\chi2(64) = 83.43$	$\chi2(3) = 4.97$	>.05	5 v 4	68	.99	.98	.05 (.00 - .08)
6	Trust to FVC	$\chi2(67) = 90.93$	$\chi2(3) = 7.50$	>.05	6 v 5	65	.99	.98	.06 (.02 - .08)
7	Recall to FVC	$\chi2(70) = 93.88$	$\chi2(3) = 2.95$	>.05	7 v 6	62	.99	.98	.05 (.02 - .08)
8	B_FVC to FVC	$\chi2(73) = 94.87$	$\chi2(3) = 0.99$	>.05	8 v 7	59	.99	.98	.05 (.00 - .08)

Note. Missing *N*=11 for controls; *N*=12 for TPC; *N*=8 for TMI; *N* = 10 for TPC+TMI.
FP = Free Parameters; *CFI* = Comparative Fit Index; *TLI* = Tucker Lewis Index; *RMSEA* = Root Mean Square Error Approximation; B_FVC = Baseline Fruit and Vegetable Consumption; FVC = Fruit and Vegetable Consumption. The highlighted cell denotes model 2 being selected as the final model.

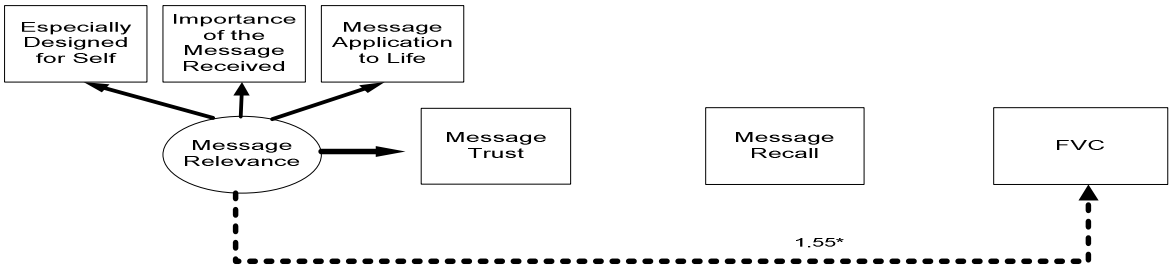
Group 1: CONTROL



Group 2: TPC



Group 3: TMI



Group 4: TPC+TMI

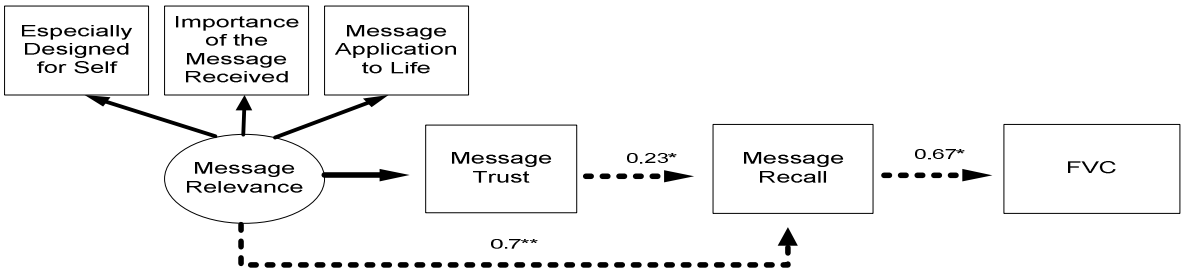


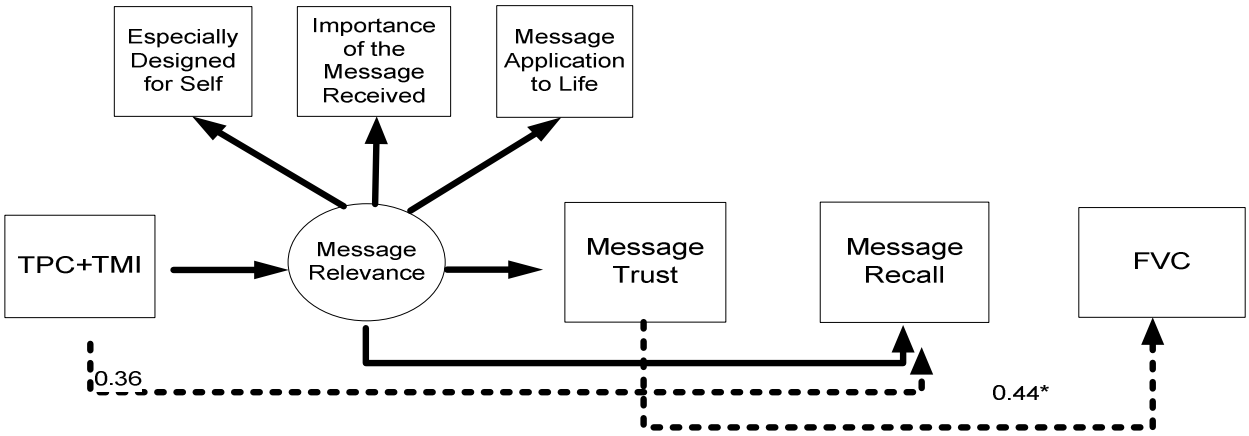
Figure 8. Path diagram of multi-sample structural equation model by intervention groups among colon cancer-free group. Unstandardized β weights for variables entered into the model are shown. Solid arrows indicate equal paths, dashed arrows different paths. Significant relationship is indicated with asterisks (*$p < .05$, **$p < .001$).

Table 11. Fit Results of the Structural Invariance among Colon Cancer Groups

Model	Parameter(s) constrained to be equal across groups	χ^2Value	χ^2Difference	*P-value*	Compare	FP	*CFI*	*TLI*	*RMSEA (90% CI)*
1	Measurement Model	$\chi2(36) = 44.66$				42	.99	.99	.03 (.00 - .05)
2	TPC+TMI to relevance	$\chi2(37) = 45.24$	$\chi2(1) = 0.58$	>.05	2 v 1	41	.99	.99	.03 (.00 - .05)
3	Relevance to trust	$\chi2(38) = 46.39$	$\chi2(1) = 1.15$	>.05	3 v 2	40	.99	.99	.03 (.00 - .05)
4	Relevance to recall	$\chi2(39) = 46.42$	$\chi2(1) = 0.03$	>.05	4 v 3	39	.98	.98	.02 (.00 - .05)
5	TPC+TMI to recall	$\chi2(40) = 53.38$	$\chi2(1) = 6.96$	<.05	5 v 4	38	.99	.99	.03 (.00 - .05)
6	Trust to Recall	$\chi2(41) = 55.06$	$\chi2(1) = 1.68$	>.05	6 v 5	37	.99	.99	.03 (.00 - .05)
7	B_ FVC to FVC	$\chi2(42) = 58.81$	$\chi2(1) = 3.75$	>.05	7 v 6	36	.99	.99	.03 (.01 - .05)
8	Trust to FVC	$\chi2(43) = 62.21$	$\chi2(1) = 3.40$	>.05	8 v 7	35	.99	.98	.04 (.01 - .05)
9	Recall to FVC	$\chi2(44) = 62.26$	$\chi2(1) = 0.05$	>.05	9 v 8	34	.99	.99	.03 (.01 - .05)

Note. Missing *N*= 16 for colon cancer survivors; *N*=30 for colon cancer-free group.
FP = Free Parameters; *CFI* = Comparative Fit Index; *TLI* = Tucker Lewis Index; *RMSEA* = Root Mean Square Error Approximation; B_FVC = Baseline Fruit and Vegetable Consumption; FVC = Fruit and Vegetable Consumption.
The highlighted cell denotes model 4 being selected as the final model.

Group 1: Colon Cancer Survivors



Group 2: Colon Cancer-Free Group

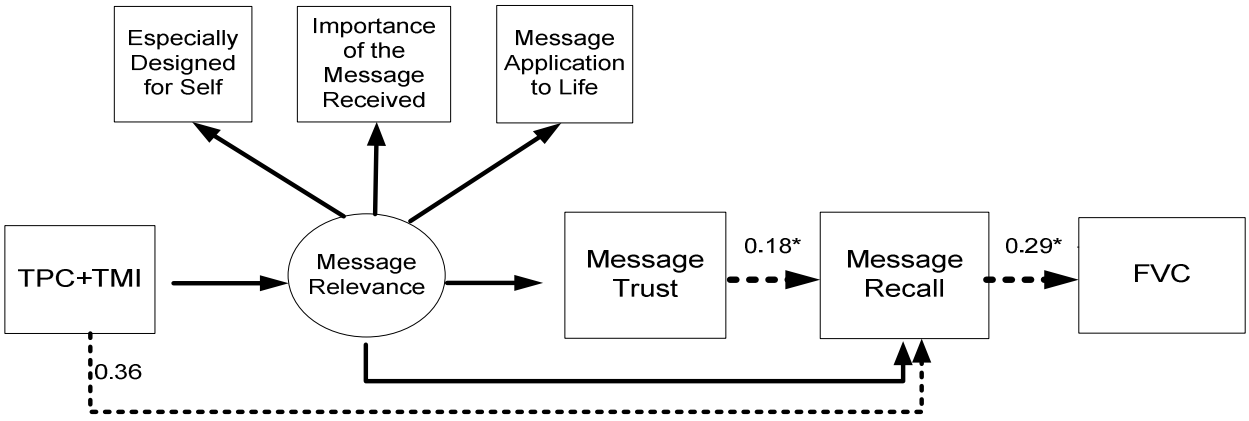


Figure 9. Path diagram of multi-sample structural equation model by colon cancer groups among participants in the combined intervention group. Unstandardized β weights for variables entered into the model are shown. Solid arrows indicate equal paths, dashed arrows different paths. Significant relationship is indicated with asterisks (*$p < .05$).

APPENDIX A: MOTIVATIONAL INTERVIEWING CALLS ROADMAP

Introduction
- **Identify project**
- **Indicate when they did survey**
- **Check they received phone card**
- **Remind of letter/4 calls**
- **ASK PERMISSION TO TAPE RECORD**

Set the Stage
- **Disclaimer: we are invested in the value of these behaviors but decision to change is yours alone**
- **Check if topic is still OK**
- **Give feedback for this behavior**
- **Get participant at ease/talking**
- **Try to focus this talk on behavior topic**
- **Listen, reflect**

Feedback
- **Give behavior recommendation here or elsewhere**
- **"What do you think of these?"**
- **Listen, reflect**

Values
- **Research basis for interest**
- **Permission to talk about these**
- **Expand from value words to "Tell me more about what these mean to you"**
- **Listen well, reflect**
- **Connect to behavior change? "Thinking about these is there any connection between them and _____?"**
- **Reflect connection or lack of connection**

Rate Importance and Confidence
- **Scale of 1 to 10 *or* pros and cons of change**
- **Listen well, reflect, paying close attention to ambivalence expressed**

Elicit thoughts and feelings
- **"We have discussed a lot of things today. What stands out to you?"**

Closing

- **Summarize briefly including:**
  - **Ambivalent feelings**
  - **Importance**
  - **Plan**
  - **Confidence in plan**
- **Affirm where appropriate**
- **Discuss follow up in call 2**
- **Close**

APPENDIX B: SAMPLE COVARIANCE FOR AIM 1 FOR COLON CANCER SURVIVORS

	Especially	Importance	Application	FVC	Trust	Recall	TPC+TMI	TPC	TMI	B_FVC
Especially	1.208									
Importance	.995	1.088								
Application	.937	.913	1.006							
FVC	.529	.599	.550	8.761						
Trust	1.035	.979	.928	.692	1.263					
Recall	.470	.503	.471	.249	.517	.836				
TPC+TMI	.067	.063	.063	- .011	.056	.058	.171			
TPC	-.079	-.076	-.079	.082	- .085	- .036	- .057	.194		
TMI	.062	.051	.035	- .026	.023	.046	- .059	- .071	.197	
B_FVC	.132	.156	.215	4.772	.087	.015	.064	- .049	.081	6.682

Matrix Key: Especially = Especially Designed for Self; Importance = Importance of the Message Received to Self; Application = Message Application to Life; FVC = Fruit and Vegetable Consumption at Follow-up; Recall = Message Recall; Trust = Message Trust; TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; B_FVC = Fruit and Vegetable Consumption at Baseline

APPENDIX C: SAMPLE COVARIANCES FOR AIM 1 FOR COLON CANCER-FREE GROUP

	Especially	Importance	Application	FVC	Recall	Trust	TPC+TMI	TPC	TMI	B_FVC
Especially	1.085									
Importance	.918	1.104								
Application	.926	.932	1.137							
FVC	.507	.412	.395	6.443						
Recall	.587	.599	.625	.335	.988					
Trust	.986	1.003	1.031	.309	.719	1.498				
TPC+TMI	.088	.077	.102	.102	.137	.096	.193			
TPC	- .015	- .018	- .015	- .050	.035	- .023	- .062	.181		
TMI	.015	.044	.033	- .007	- .011	.016	- .063	- .057	.183	
B_FVC	.108	- .002	- .041	3.616	- .006	- .101	.002	- .031	- .025	6.278

Matrix Key: Especially = Especially Designed for Self; Importance = Importance of the Message Received to Self; Application = Message Application to Life; FVC = Fruit and Vegetable Consumption at Follow-up; Recall = Message Recall; Trust = Message Trust; TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; B_FVC = Fruit and Vegetable Consumption at Baseline

APPENDIX D: SAMPLE COVARIANCE FOR AIM 2 FOR COLON CANCER-FREE GROUP

CONTROL GROUP

	Especially	Importance	Application	FVC	Recall	Trust	B_FVC
Especially	1.101						
Importance	.769	.705					
Application	.842	.690	.909				
FVC	.205	.386	.305	8.141			
Recall	.436	.383	.491	.261	.407		
Trust	.749	.551	.660	.792	.462	.973	
B_FVC	.001	.208	-.049	4.016	- .051	.277	4.961

TPC GROUP

	Especially	Importance	Application	FVC	Recall	Trust	B_FVC
Especially	.784						
Importance	.643	.851					
Application	.611	.711	.748				
FVC	.543	.750	.770	9.076			
Recall	.241	.331	.212	.520	.562		
Trust	.657	.647	.602	.723	.260	.797	
B_FVC	.432	.302	.657	3.498	.142	.254	4.846

Matrix Key: Especially = Especially Designed for Self; Importance = Importance of the Message Received to Self; Application = Message Application to Life; FVC = Fruit and Vegetable Consumption at Follow-up; Recall = Message Recall; Trust = Message Trust; B_FVC = Fruit and Vegetable Consumption at Baseline

TMI GROUP

	Especially	Importance	Application	FVC	Recall	Trust	B_FVC
Especially	1.429						
Importance	1.289	1.354					
Application	1.008	.964	1.065				
FVC	1.039	1.001	.598	7.859			
Recall	.500	.474	.523	- .075	.970		
Trust	1.318	1.305	1.074	.967	.579	1.530	
B_FVC	.549	.524	.288	5.632	- .022	.318	7.448

COMBINED GROUP

	Especially	Importance	Application	FVC	Recall	Trust	B_FVC
Especially	1.300						
Importance	1.092	1.228					
Application	1.095	1.053	1.123				
FVC	.497	.478	.600	10.040			
Recall	.531	.618	.544	.131	1.083		
Trust	1.230	1.227	1.178	.510	.675	1.585	
B_FVC	- .657	- .488	- .266	6.144	- .349	- .568	9.500

Matrix Key: Especially = Especially Designed for Self; Importance = Importance of the Message Received to Self; Application = Message Application to Life; FVC = Fruit and Vegetable Consumption at Follow-up; Recall = Message Recall; Trust = Message Trust; B_FVC = Fruit and Vegetable Consumption at Baseline

APPENDIX E: SAMPLE COVARIANCES FOR AIM 3 FOR COLON CANCER SURVIVORS

	Especially	Importance	Application	FVC	Recall	Trust	B_FVC	TPC+TMI
Especially	1.207							
Importance	.995	1.089						
Application	.938	.914	1.008					
FVC	.498	.574	.526	8.761				
Recall	.471	.505	.474	.230	.833			
Trust	1.036	.980	.929	.671	.519	1.263		
B_FVC	.124	.153	.217	4.772	.003	.097	6.682	
TPC+TMI	.137	.119	.099	.047	.125	.084	.197	.250

Matrix Key: Especially = Especially Designed for Self; Importance = Importance of the Message Received to Self; Application = Message Application to Life; FVC = Fruit and Vegetable Consumption at Follow-up; Recall = Message Recall; Trust = Message Trust; TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; B_FVC = Fruit and Vegetable Consumption at Baseline

APPENDIX F: SAMPLE COVARIANCES FOR AIM 3 FOR COLON CANCER-FREE GROUP

	Especially	Importance	Application	FVC	Recall	Trust	B_FVC	TPC+TMI
Especially	1.085							
Importance	.917	1.100						
Application	.925	.928	1.133					
FVC	.514	.417	.402	6.443				
Recall	.587	.596	.623	.341	.987			
Trust	.987	1.001	1.030	.317	.720	1.499		
B_FVC	.109	- .004	- .042	3.616	- .005	- .099	6.278	
TPC+TMI	.127	.135	.170	.096	.273	.152	- .058	.248

Matrix Key: Especially = Especially Designed for Self; Importance = Importance of the Message Received to Self; Application = Message Application to Life; FVC = Fruit and Vegetable Consumption at Follow-up; Recall = Message Recall; Trust = Message Trust; TPC = Tailored Print Communication; TMI = Telephone Motivational Interviewing; B_FVC = Fruit and Vegetable Consumption at Baseline

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