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Information Processes Mediate the Effect of a Health Communication Intervention on Fruit and Vegetable Consumption

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Abstract

Health communication interventions have been effective in promoting fruit and vegetable consumption (FVC). To explore mechanisms underlying health communication effectiveness, we investigated whether information processes mediated the relationship between health communication and FVC, using data from NC STRIDES. NC STRIDES tested the efficacy of two health communication strategies to promote FVC among a diverse population-based sample of older adults. Participants were randomized to one of four groups: control, tailored print communication (TPC), telephone motivational interviewing (TMI), or combined (TPC+TMI). Multi-sample structural equation models were constructed to analyze data from 469 participants. Information processes mediated the effect of TMI and TPC+TMI on FVC. TMI had an indirect effect on FVC through relevance of the communications. TPC+TMI influenced FVC through perceived relevance of the communications, trust in the communications, and dose recall via two paths. In the first path, relevance was associated with trust. Trust was associated with recall, and greater recall predicted FVC. In the second path, relevance was associated with dose recall, and more recall predicted FVC. Thus, we found that key information processes mediated the relationship between a health communication intervention and FVC. Further research should investigate ways to enhance relevance, trust, and recall during the delivery of interventions.

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Keywords

health communication; information processing; fruit and vegetable consumption; intervention

Introduction

Unhealthy lifestyle behaviors, such as poor diet, lead to greater morbidity and mortality among American adults (Ness & Powless, 1997; Srinath et al., 2004). A diet low in fruits and vegetables is associated with increased risk for chronic diseases such as cardiovascular disease, hypertension, diabetes, and cancer (Adams & Standridge, 2006; 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 the health benefits of eating more fruits and vegetables, more than half of all American adults do not meet nationally-recognized guidelines for daily fruit and vegetable consumption (FVC) (Casagrande, et al. 2007).

Health communication interventions can promote healthy eating behaviors when messages are strategically designed and delivered through specific communication channels (Campbell et al., 2004; Emmons et al., 2005; Resnicow et al., 2004). Communication strategies such as tailored print communications (TPC) have been shown to be particularly effective in promoting FVC (Campbell et al., 2004; Emmons et al., 2005). In TPC, the content and style of printed materials are based on individual characteristics, and social-psychological theories provide a basis for determining the characteristics most likely to influence behavior change (Skinner et al., 1999). Telephone motivational interviewing (TMI) is an alternative medium to deliver tailored health communications (Resnicow et al., 2000; Resnicow et al., 2004) through use of specific counseling techniques that increase motivation for behavior change (Miller & Rollnick, 1991).

Health communication experts have developed new and effective communication strategies, such as TPC and TMI, to promote healthy eating behaviors. Less attention, however, has been paid to understanding how these health communication strategies work to exert their effects. Experts recognize the need to examine theory-based information processes of health communication to understand how and why interventions work, and whether different types of communication strategies work differently (Rimer & Glassman, 1999; Skinner et al., 1999).

The information processing model describes ways that persuasive communications can influence information processing and lead to change in attitudes and behaviors (McGuire, 1985; McGuire, 2001). The information processing model is an input/output model. Input factors, such as characteristics of the messages (tailored vs. non-tailored) and channel of information delivery (print vs. interpersonal communication), can influence output factors ranging from perceptive (e.g., attention) and cognitive (e.g., retrieval) to behavior change. McGuire (1985) proposes that for a communication to achieve a higher-order effect (e.g., behavior change), outcomes appearing earlier in the sequence must be achieved first. For example, health communication strategies will be more effective if the recipients are

exposed to the communication, attend to it, find it interesting, understand it, learn from it, and can recall the information received (Bull et al., 2001; McGuire, 1985).

Studies on tailored health communications report that these types of communication are effective because they enhance information processing. Findings from process evaluations report that people who receive tailored printed 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., 1996; Campbell & Quintiliani, 2006).

Moreover, different processes may be involved when interventions are delivered through print vs. interpersonal communication (Kreuter et al., 2004; McGuire, 1985). Tailored print interventions induced more attention resulting in greater attitude change when compared to non-tailored messages. Interpersonal communications, on the other hand, enhanced credibility of and trust in the information (McGuire, 2001). Motivational interviewing, in particular, begins by establishing rapport and trust with clients (Bundy, 2004; Emmons & Rollnick, 2001). This technique facilitates clients' perceptions that the counseling sessions are personally relevant to their values and goals (Resnicow & Shaikh, 2007). Although intervention studies with tailored print materials and motivational interviewing provide insight into the different ways in which individuals process health communication interventions, we do not know whether these processes are mediators between health communication and behavior change. To advance the current state of our knowledge about health communication interventions, we must identify processes that mediate the effects of various interventions. We can then enhance specific processes during the delivery of interventions (Rimer & Glassman, 1999; Skinner et al., 1999).

Conceptual Model

Guided by the information processing paradigm, we developed a conceptual model to understand the information processes that mediate the relationship between a health communication intervention and FVC. In this model (Figure 1), we posit that the effect of a health communication intervention strategy on FVC can occur directly, and can also occur indirectly through the relevance of communication, trust in the communication, and dose recall. Relationships between intervention and information processes, and between information processes and behavior change, have already been documented in the literature (Bull et al., 2001; Kreuter et al., 2004). These studies, however, have not tested for the mediation effect of information processes to explain the effect of health communication interventions on FVC (Kreuter et al., 2004).

The Present Study

This study examines two research questions: a) Which information processes mediate the relationship between health communication strategies and FVC and b) Do similar or different processes mediate the different types of health communication strategies?

Method

Sample

Data used in this study come from the North Carolina Strategies to Improve Diet, Exercise, and Screening study (NC STRIDES). NC STRIDES used a classic 2 x 2 randomized factorial design that tested the efficacy of tailored print communication and telephone motivational interviewing to promote FVC. Participants were randomized into one of four intervention groups: tailored print communication (TPC), telephone motivational interviewing (TMI), combined (TPC+TMI), or control. The NC STRIDES intervention was conducted in 33 counties in eastern and central North Carolina. The individuals in the TPC group received a series of four tailored print newsletters, the TMI group received a series of four counseling calls, the combined group received four tailored print newsletters and four counseling calls, and the control group received two “generic” or non-tailored health education mailings on breast or prostate cancer. The intervention has been described in detail elsewhere (James et al., 2006).

Study participants from NC STRIDES were recruited from the North Carolina Colon Cancer Study (NCCCS), a population-based, case-control study of colon cancer patients in North Carolina conducted from 1996–2000. 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 diverse socioeconomic backgrounds and a racial composition, at the time of the study, consisting primarily of African Americans and whites. 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 were identified using a rapid ascertainment component of the North Carolina Central Cancer Registry. Population-based controls in the NCCCS had been 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 Health Care Financing Administration registry. NCCCS participants were invited to participate in the NC STRIDES study between January 2001 and June 2002.

Detailed recruitment procedures have been described previously (James et al., 2006; Satia et al., 2004). NC STRIDES recruited 922 participants (49.8%), of whom 825 individuals (89.5%) completed the baseline survey (304 cancer cases and 521 controls). Of those 825 participants, 735 (89.1%) completed the follow-up survey (266 cancer cases and 469 controls). Non-responses on the follow-up survey resulted from 18 deaths, 21 people who withdrew from the study for health reasons, 19 refusals, and 32 lost contacts.

Because a colon cancer diagnosis may affect how individuals process information (McGuire, 1985; Petty & Cacioppo, 1981), separate analyses were conducted for colon cancer survivors and for the population-based control group. The analyses for this study used only data from population-based controls (N=469).

Data Collection

After NC STRIDES participants were randomized into intervention groups, researchers collected baseline data using a telephone-administered self-report survey. Data included

socio-demographic 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 questionnaire. That survey asked the same health, behavioral, and psychosocial questions as the baseline survey, and also included information processing questions.

Participants' baseline age was 67 (±9.5) years (Table 1). More than half of the participants were white (66%). Half of the participants were male, and a little more than one-third (38%) were employed either full-time or part-time. More than half of the participants (57%) had an annual income greater than $30,000, and most had some high school education or had completed high school. Participants reported, on average, eating 5 servings of fruits and vegetables a day. There were no significant demographic differences between the intervention groups.

Measures

Independent Variable

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

Dependent Variable

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 in their work with a diverse Southern population (Resnicow et al., 2000). Resnicow's measure was slightly modified to ask how often food was consumed in the last month as opposed to the last week, and food items that were not fruits and vegetables were omitted. 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 FVC. The distribution of FVC was skewed to the right; therefore we employed a log transformation (ln+1) in order to improve normality.

Mediator Variables

Relevance of communication: This variable was constructed as a latent variable and 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 the communication in the phone calls instead of newsletters. For those receiving the combined intervention (TPC+TMI), questions were asked about both newsletters and phone calls. The mean of the responses for newsletters and phone calls was calculated for those receiving both TPC+TMI. 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).

Trust in the communication: Trust was measured 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 communication in the phone calls instead of newsletters. For those receiving the combined intervention, the question asked about trust in both newsletters and phone calls.

Dose recall: This variable was defined as participants' ability to recall the number of intervention messages that they received, and was measured for TPC participants by the question: "How many newsletters do you remember receiving?" The answers ranged from 1 to 5, where 1 = 1 newsletter, 2 = 2 newsletters, 3 = 3 newsletters, 4 = 4 newsletters, and 5 = more than 4 newsletters. For participants receiving TMI, the question asked about phone calls. To those receiving the combined intervention, questions were about both newsletters and phone calls.

Other Variables

Demographic variables: *Age* was a continuous variable, calculated using the respondent's date of birth and the date of the interview. *Race* was collected as white or Black. *Gender* was collected as male or female. *Education* was the highest grade of school completed, collected as a categorical variable with the options of "8 years or less," "9–12 years," and "13+ years." *Employment* was measured 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," and "$75,000 or more." These categories were dichotomized as less than $30,000 or greater than/equal to $30,000.

Data Analysis—Data formatting, management, and descriptive statistics were conducted using SAS version 9.2. Descriptive analyses generated frequencies for categorical variables and means for continuous variables. Bivariate analyses were conducted with Fisher's exact test of significance for categorical variables, and t-tests and ANOVA were used for continuous variables. Alpha levels of .05 were used for all analyses. The structural equation model was estimated using MPLUS version 5. A multi-sample structural equation model was specified to test the hypothesized relationships between the variables among the four intervention groups.

Criteria for Establishing Mediation—The structural equation model (SEM) provides a multivariate method for evaluating mediation by first allowing the user to evaluate the effect of the intervention on the outcome (Model 1). A second model (Model 2) is tested to simultaneously evaluate the effects of the intervention on the proposed mediators and their effects on the outcome (MacKinnon & Dwyer, 1993).

Model Fit—Multiple fit indices were used to assess model fit. These included the Chi-square test statistic, the Root-Mean-Square-Error of Approximation (*RMSEA*), the

Standardized Root Square Mean Residual (*SRMR*), the Comparative Fit Index (*CFI*), and the Tucker–Lewis Index (*TLI*). We also relied on standard cutoff recommendations for the *RMSEA*, *SRMR*, *CFI*, and *TLI* because with a large sample size, the Chi-square test is not a reliable method for assessing model fit (Hu & Bentler, 1999). For the *RMSEA* and the *SRMR*, values approximating 0.05 indicate close fit. For the *CFI* and the *TLI*, values greater than or equal to 0.95 suggest a model with proportionate improvement in fit from the baseline model (Hu & Bentler, 1999). When models were just identified, that is, when the number of observable variances and covariances equaled the number of parameters of the model to be estimated, the fit indices could not be used to evaluate the model fit (Byrne, 2001).

Model Specification—A SEM was built to test the relationship between the intervention variables (TPC, TMI, TPC+TMI), mediating variables (relevance, trust, and dose recall), and FVC. The SEM analyses proceeded in three steps. First, a confirmatory factor analysis measurement model was specified to evaluate the viability of the proposed latent factor (relevance). Next, two models were specified to establish mediation as described above. The variance and covariance upon which the analyses were based are presented in Appendix A. Finally, a multi-sample SEM was specified to examine whether the mediation pathways varied across the four intervention groups (group 1 = control, group 2 = TPC, group 3 = TMI, and group 4 = TPC+TMI).

In a multi-sample SEM model, 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 similarities and differences in the parameters between these groups (Byrne, 2001; Duncan et al., 1999). Multi-sample SEM was conducted through three major steps (Byrne, 2001). 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 to differ across the groups. Second, model equivalence were evaluated using a $\chi 2$ difference test. The $\chi 2$ difference test is an asymptotically equivalent $\chi 2$ test which represents an approximate decrease in model goodness-of-fit resulting from eliminating equality restrictions (Duncan et al., 1999). When the $\chi 2$ test favored the model with unequal paths across the intervention groups, nested models were specified. Third, nested models were built by constraining and releasing each individual structural path. Where significant differences in model parameters existed between nested models, constraints were relaxed and the model re-estimated.

Results

Confirmatory Factor Analysis of Relevance of Communication

The measurement model confirmed that the three questions used for this latent variable (communication especially designed for self, importance of communication, and communication's application to life) were sufficiently empirically related to reliably form one factor. All variable loadings on the hypothesized latent factor were found to be strong and significant. The fit indices could not be calculated because the model was just identified.

Mediational Analysis of Health Communication Strategies, Information Processes, and FVC

The model testing the direct relationship between health communication strategies and FVC, adjusting for baseline FVC, is shown in Figure 2. The combined health communication strategy (TPC+TMI) had a direct significant effect on FVC (β= 0.68, p = .011). There was no significant association between either single strategy, TPC (β= 0.16, p = .56) or TMI (β= 0.32, p = .23), and FVC. This model was just identified.

The model testing the indirect relationship between intervention and FVC through information processes had a good fit with (χ^2 (29, N = 469) = 93.93, *CFI* = .96, *TLI* = .95, *RMSEA* = .07, and *SRMR* = .05). The relationship between the health communication strategies and FVC was mediated by information processes as shown in Figure 3. All three health communication strategies were significantly related to communication relevance (TPC: β = 0.32, p < .05; TMI: β = 0.51, p < .001; TPC+TMI: β = 0.73, p < .001). The participants' reports of relevance of communication were significantly related to their trust in the communication (β = 1.11, p < .001). Trust was significantly related to dose recall (β = 0.47, p < .001) and recall was significantly associated with FVC (β = 0.37, p < .05). The Sobel (1992) test showed a significant indirect effect for the TMI group (β = 0.01 p = .03) and the TPC+TMI group (β = 0.14, p = .009).

Similar and Different Information Processes in the Four Intervention Groups

Results of the multi-sample SEM showed that when comparing intervention groups, some of the structural paths were similar and some were different. Model comparisons of all paths, constrained vs. non-constrained, showed model non-equivalence; i.e., all paths were not equal across intervention groups. The model fit where all paths were constrained as equal was χ^2 (55, N = 469) = 94.63, p < .001, *CFI* = .97, *TLI* = .97, *RMSEA* = .08, and *SRMR* = .11. The model fit for the unconstrained model was χ^2 (34, N = 469) = 43.31, p = .13, *CFI* = .99, *TLI* = .99, *RMSEA* = .05, and *SRMR* = .03. The χ^2 difference test showed that the fit of the constrained model was significantly worse than that of the unconstrained model χ^2 (21, N = 469) = 51.32, p < .001, supporting the model where paths were set to differ across the four intervention groups. Nested models, then, were built to identify which paths were equal or different across the four intervention groups.

Model 1 was the reference model with the measurement model constrained. Model 2, constrained on the path *relevance and trust*, was not significantly different from the reference model when using the χ^2 difference test. This finding indicates that the intervention groups were equal in that structural path, χ^2 (3, N = 469) = 1.74, p > .05. In model 3, the structural path *relevance and dose recall* was significantly different between the four intervention groups χ^2 (3, N = 469) = 8.29, p < .05, which indicates that the intervention groups were different on that path. In model 4, there was no significant difference in the path *trust and dose recall*, χ^2 (3, N = 469) = 4.34, p > .05, indicating that the intervention groups were similar in that path. In model 5, the structural path *relevance and FVC* was significantly different between intervention groups, χ^2 (3, N = 469) = 10.19, p < .05. Lastly, in model 6, intervention groups also differed in the path *dose recall and FVC*, χ^2 (3, N = 469) = 9.19, p < .05.

Model 4 was selected as the final model. It included constraints on the measurement model and the structural paths *relevance and trust* and *trust and dose recall*. Selection was based on model parsimony; that is, we selected a model with relatively few free parameters and more constraints (Preacher, 2006). The final model fit resulted in χ^2 (46, N = 469) = 60.83, p = .07, *CFI* = .99, *TLI* =.99, *RMSEA* = .05, and *SRMR* = .05.

Across all four intervention groups, paths were equal in the relationships between a) *relevance and trust*, and b) *trust and dose recall*, as shown in Figure 4. That is, individuals who perceived the intervention as relevant had greater trust in the communication, and greater trust was related to greater dose recall in every type of intervention received.

Paths were different across the four intervention groups in the relationships between a) *relevance and dose recall*, b) *relevance and FVC*, and c) *dose recall and FVC*. Among those who received either the non-tailored information (control group) or the TPC intervention only, information processes did not mediate FVC. Individuals who received the TMI intervention only and perceived that the communication in the phone calls was relevant to them consumed significantly more fruits and vegetables (β = 0.93, p < .05). Receiving a combination of TPC and TMI was significantly related through two paths to eating more fruits and vegetables. First, those who reported that the intervention was relevant to them trusted the communication more (p < .001). More trust was associated with greater dose recall (p < .05) and greater recall increased FVC (β= 0.78, p < .05). In addition, the more the communication was perceived as relevant, the better it was recalled (p< .001) and recall increased FVC (β= 0.78, p < .05).

Discussion

This study examined whether information processes mediated the association between a health communication intervention and FVC among a population-based sample. The relationship between the intervention and FVC was only mediated through relevance of communication for those receiving TMI. Relevance of communication mediated the relationship for participants receiving TPC+TMI as well, but for them the relationship was also mediated by trust and dose call. For those receiving the control message or TPC only, these processes did not mediate the effect of the intervention on FVC. Furthermore, when comparing health communication intervention groups, some of the structural paths were similar and some were different.

Similar Information Processes of Health Communication and FVC

Our findings suggest that participants process messages similarly regardless of the type of interventions received. In all intervention groups, relevance of communication was the first important information process. The elaboration likelihood model (ELM) developed by Petty and Cacioppo (1981) helps explain this finding. The ELM posits that people are more likely to process information thoughtfully if they perceive it as personally relevant. Tailored communication is often reported as being more personally relevant, and when information is seen as more personally relevant, it is more likely to stimulate information processing (Campbell & Quintiliani, 2006; Kreuter et al., 2004; Hawkins et al., 2008). Trust in the communication was also important for our study participants. Petty and colleagues posit that

an active information processor considers the information that he or she receives, carefully relating it to prior knowledge, past experiences, and other information to assess its credibility (Hawkins et al. 2008). Lastly, recall was another mediator in our study. Communication that is processed or "elaborated" tends to be retained longer (Petty et al., 1994). Campbell and Quintiliani (2006) found that tailored messages were more likely than non-tailored ones to be remembered by individuals. Both TPC and TMI interventions were personalized for the individual participants; therefore, we were not surprised to find that individuals in the TPC, TMI and combined groups were processing information through relevance, trust, and recall.

Nonetheless, it was surprising to observe that individuals in the control group, who received non-tailored newsletters, also processed through relevance, trust, and recall. Others have found similar phenomena. Kreuter and Wray (2003) reported that when non-tailored communications are a good fit for an individual, it is just as effective as tailored communications in stimulating information processing. The participants in the control group received messages on gender-relevant health topics. Women received information about breast cancer and men about prostate cancer. These topics may have been salient for the participants, who were mainly older individuals. Kreuter and colleagues (2004) reported that women aged 40 and older considered the topic of breast cancer prevention to be important. Similarly, prostate cancer has generated much attention among men, as the most frequently diagnosed cancer in men (American Cancer Society, 2008). Thus, the non-tailored messages may have been a good fit for individuals in the control group. It is, however, important to note that information processes did not influence FVC for this group. One possible explanation is that the non-tailored newsletters did not address FVC. Alternately, when individuals process information, they may also elaborate counterarguments. This process may have lessened the effects of the non-tailored communication (Hawkins et al., 2008; Petty & Cacioppo, 1994).

Differentiated Information Processing by Intervention Groups

Our findings also point to differentiated processes explaining intervention effectiveness. Among individuals in the TMI-only intervention, those who believed that the communication in the phone calls was relevant to them ate more fruits and vegetables. This relationship, however, did not emerge as significant among those receiving the TPC-only intervention. This could have been possible for several reasons. First, the communication via phone may have been perceived as more personal than print newsletters, as it involved interpersonal interaction with a counselor. Additionally, the same counselor was assigned to the same participant each time, enabling the counselor to build rapport during the intervention. Finally, the counseling sessions were client-centered, with counselors trained in the "Spirit of Motivational Interviewing" to use empathy and a non-judgmental counseling style (Miller & Rollnick, 1991). Client-centered counseling sessions are more effective than those that instruct the client on what to do, because participants become motivated as they reflect on their values and explore ways to resolve ambivalence about adopting new behaviors (Miller & Rollnick, 1991). In contrast, individuals in the TPC-only intervention group received a printed menu of advice for goal setting and ways to overcome barriers to

eating more fruits and vegetables, and may have lacked the support needed to motivate them to overcome such barriers.

Individuals in the combined intervention group processed information about eating more fruits and vegetables through multiple mediating paths. Studies show that receiving messages through multiple ways can enhance information processes (Cacioppo & Petty, 1979; Grass & Wallace, 1969). In our study, it is likely that the communication from the newsletters and the phone calls may have served to reinforce one another. The telephone counseling calls using MI may have served to resolve ambivalence and clarify questions for our study participants, while the tailored print newsletters may have reinforced the communication from the calls.

Additionally, the combined effect may be a reflection of the dose of the intervention. The individuals in the combined group received four TPCs plus four TMI calls, which was double the number of intervention contacts for each separate intervention. Another study that standardized the intervention dose by giving the combined intervention group two TPCs and two TMI calls, while a TPC-only group received four mailings and a TMI group received four calls, reported that all three intervention groups showed similar effects at follow-up (van Keulen et al., 2008; van Keulen, personal communication, 2009).

It is important to note that, although we did not find a significant direct relationship between TMI and FVC, we found an indirect effect through relevance of the communication. This finding is not uncommon, as several researchers have questioned the necessity of testing a direct association, particularly in an experimental study (MacKinnon et al., 2000; Shrout & Bolger, 2002). For example, Shrout and Bolger explain that when mediation involves proximal causal processes and when the intervention is a strong agent of change in the outcome, then a significant direct effect may occur shortly thereafter. When it involves distal causal processes, however, this relationship may be absent and the mediation effect may be larger, because it assesses the relationship between more proximal variables (intervention to mediator and mediator to outcome). They recommend that researchers not be rigid about the presence of an overall direct effect.

Study Strengths and Limitations

This study has several strengths. First was our ability to extend previous findings by conceptualizing information processes as mediators of health communication and FVC. Past studies have reported a significant bivariate relationship between intervention and information processes, as well as noting a relationship between information processes and behavior change (Bull et al., 2001; Kreuter et al., 2004). We extended this research by conceptualizing and empirically testing theory-based information processes as mediators of health communication and FVC. A methodological strength was the use of multi-sample SEM to test the theoretical model across intervention groups. This technique allowed us to identify the information processes that mediated each intervention group. This study also provides some ability to generalize the results, as the participants from this study were a diverse group of people, including 50% females and 35% African Americans.

The limitations of the study are that the data were collected as part of a larger study that was not designed for testing information processes. Therefore, not all the information processes were included in the conceptual model (McGuire, 1985), and variable selection was dependent on the variables available from the original study dataset. McGuire (1985), however, states that it is not necessary to include all information processes in empirical studies. Finally, the data are retrospective self-reported data, and may have been open to recall bias. However, it is likely that randomization minimized bias across the intervention groups.

Conclusions

This study provides evidence that information processes can be considered as mediators of the relationship between a health communication intervention and FVC. Interventions that focus on FVC may be evaluated with regard to their potential for increasing perception of relevance of communication, trust in the communication, and dose recall. As intervention studies continue to evolve, special attention paid to information processes may yield a more refined understanding of what kinds of processes “matter” for which types of interventions and for whom, as well as the potential influence of information processes on health behaviors.

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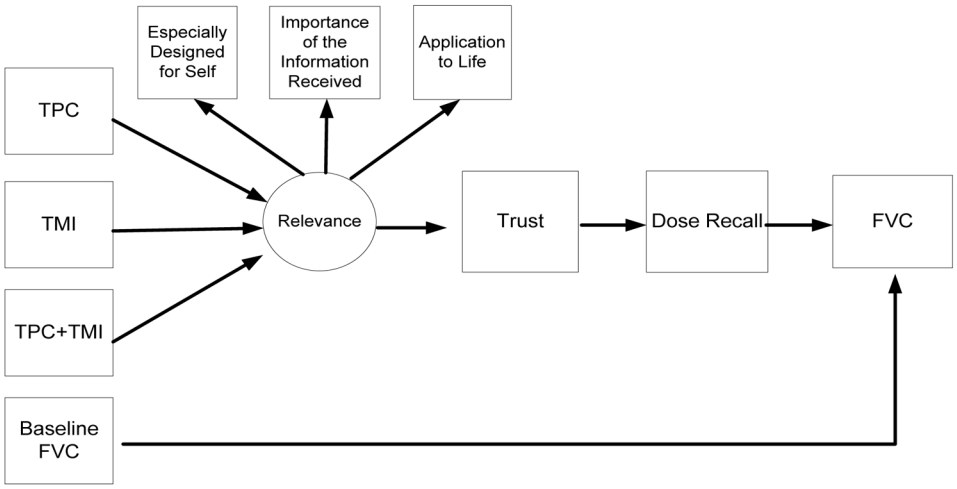

Figure 1.

Conceptual model depicting the relationship between intervention, information processes, and fruit and vegetable consumption. TPC = tailored print communication, TMI = telephone motivational interviewing, TPC+TMI = tailored print communication + telephone motivational interviewing. FVC = fruit and vegetable consumption.

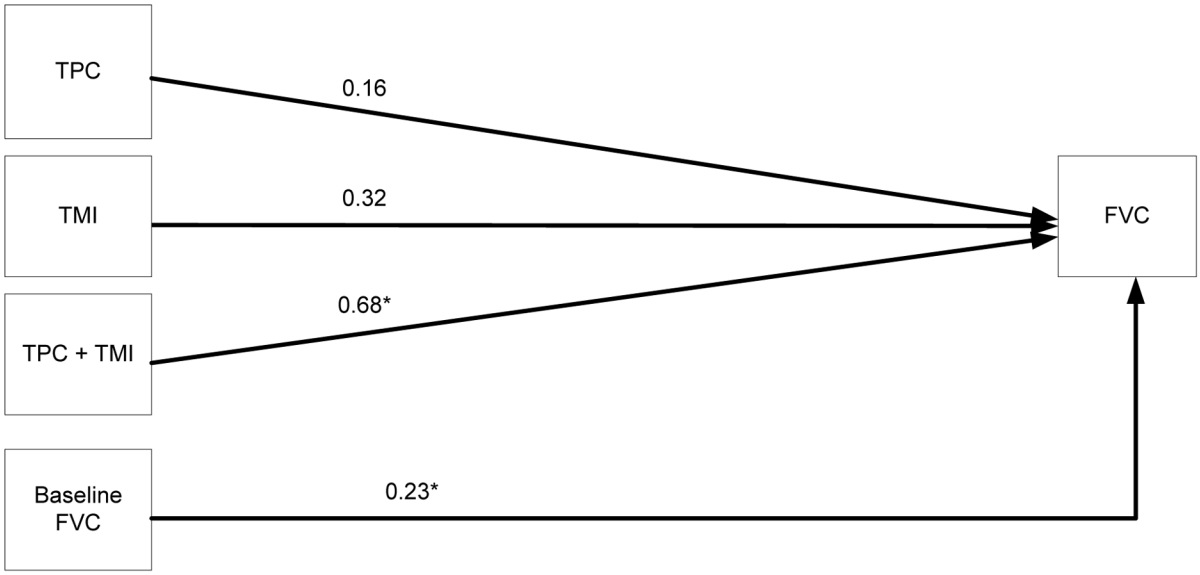

Figure 2.

Path diagram of model testing direct relationship between intervention and fruit and vegetable consumption, adjusting for baseline fruit and vegetable consumption. Unstandardized β weights for variables entered into the model are shown. Significant relationships are indicated by asterisks (*$p < .05$, **$p < .001$).

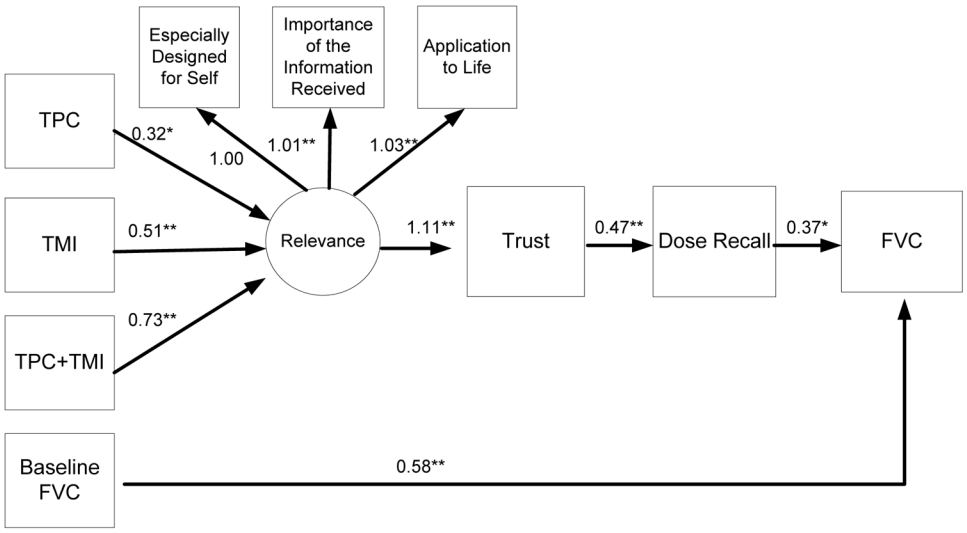

Figure 3.

Path diagram of model testing information processes as mediators of the association between intervention and fruit and vegetable consumption, adjusting for baseline fruit and vegetable consumption. Unstandardized β weights for variables entered into the model are shown. Significant relationships are indicated by asterisks (*$p < .05$, **$p < .001$).

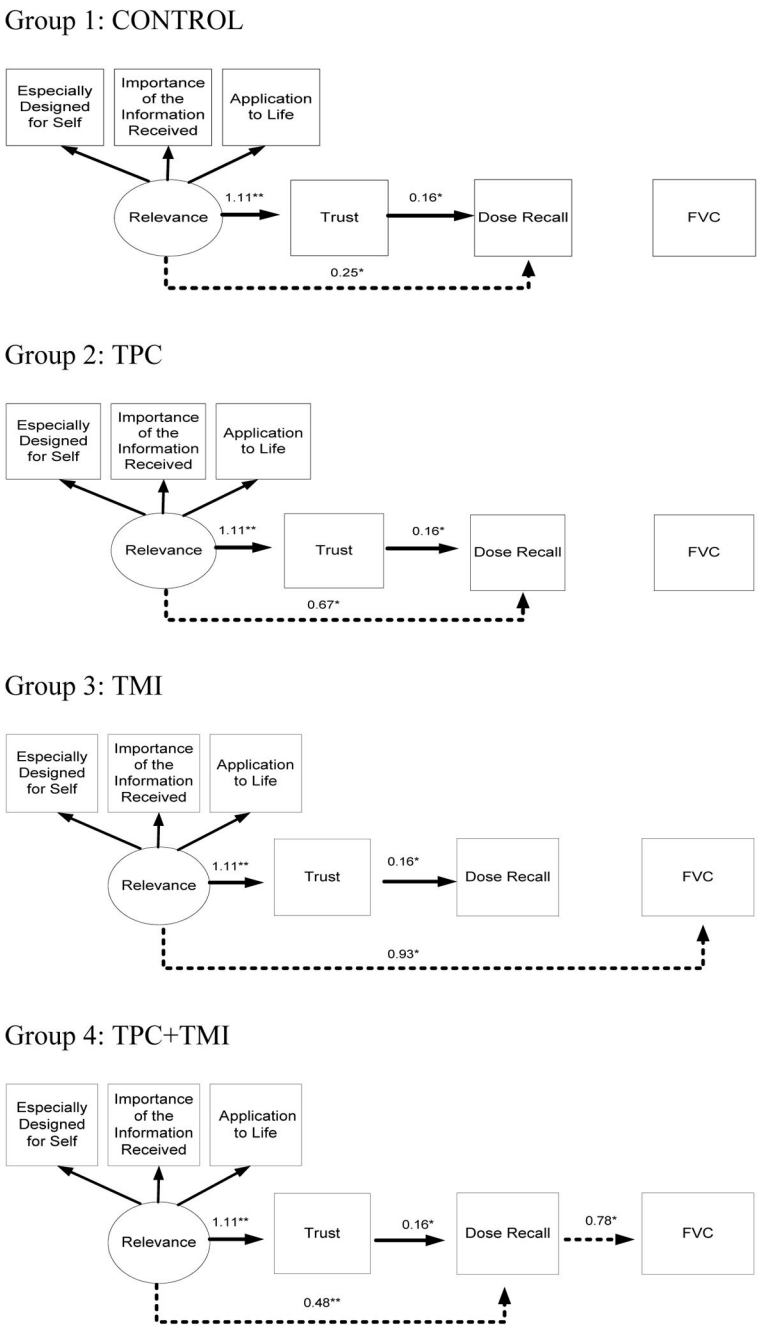

Figure 4.

Path diagram of multi-sample structural equation model by intervention groups. Unstandardized β weights for variables entered into the model are shown. The solid arrow indicates significant equal paths, the dashed arrow significant different paths. Significant relationships are indicated by asterisks (*$p < .05$). FVC = fruit and vegetable consumption.

Table 1

Demographic Characteristics of the Study Population by Intervention Group

Variable	Total N = 469	Control N = 122	TPC N = 111	TMI N = 113	TPC+TMI N = 123	P-value
Age in Years						
Mean (SD)	67.3 (9.5)	67.3 (9.8)	67.1 (9.9)	67.4 (9.3)	67.2 (9.2)	.99
Race, % (N)						
White	66% (309)	64% (78)	72% (80)	60% (68)	68% (83)	.28
Sex, % (N)						
Male	50% (234)	47% (57)	46% (51)	57% (64)	50% (62)	.35
Employed, % (N)						
Yes	38% (176)	33% (40)	40% (44)	38% (43)	40% (49)	.63
Income, % (N)						
≥ $30,000	57% (244)	63% (71)	56% (56)	48% (51)	59% (66)	.13
Education, % (N)						
8 years or less	6% (27)	5% (5)	6% (7)	6% (7)	6% (7)	.76
9–12 years	40% (187)	34% (41)	42% (47)	41% (46)	44% (53)	
13+	54% (250)	61% (73)	51% (57)	53% (59)	50% (61)	
Daily FVC						
Mean (Median)	5.5 (5.2)	5.7 (5.4)	5.4 (5.4)	5.4 (5.1)	5.5 (5.1)	.23

Note: FVC = fruit and vegetable consumption

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Appendix A

Sample Covariance among Intervention, Information Process Measures and Fruit and Vegetable Consumption

	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 = communication especially designed for self; Importance = importance of the communication to self; Application = communication application to life; FVC = follow-up fruit and vegetable consumption; Recall = dose recall; Trust = trust in the communication; TPC = tailored print communication; TMI = telephone motivational interviewing; B_FVC = baseline fruit and vegetable consumption