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Effectiveness of the extended parallel process model in promoting colorectal cancer screening

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Abstract

Objective: Relatives of colorectal cancer (CRC) patients are at increased risk for the disease, yet screening rates still remain low. Guided by the Extended Parallel Process Model (EPPM) we examined the impact of a personalized, remote risk communication intervention on behavioral intention and colonoscopy-uptake in relatives of CRC patients, assessing the original additive model and an alternative model in which each theoretical construct contributes uniquely.

Methods: We collected intention-to-screen and medical-record-verified colonoscopy information on 218 individuals who received the personalized intervention.

Results: Structural equation modeling showed poor main model fit (RMSEA=0.109; SRMR=0.134; CFI=0.797; AIC=11601; BIC=11884). However, the alternative model (RMSEA=0.070; SRMR=0.105; CFI=0.918; AIC=11186; BIC=11498) showed good fit. Cancer susceptibility (B =0.319, p <.001) and colonoscopy self-efficacy (B=0.364, p<0.001) perceptions

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ETHICS

This study was approval by the University of Utah Institutional Review Board and complies with all local, state and federal ethics laws.

Conflict of Interest Statement: RWB has acted in an advisory or consultant role for Myriad Genetics. All other authors report no conflict of interest.

predicted intention-to-screen which was significantly associated with colonoscopy uptake (B=0.539, p<0.001).

Conclusions: Our findings provide support of the utility of EPPM for designing effective interventions to motivate CRC screening in persons at increased risk when individual elements of the model are considered.

Keywords

cancer; oncology; colorectal cancer; EPPM; efficacy; threat

Average lifetime risk for developing colorectal cancer (CRC) is approximately 5%; having a first-degree relative (FDR) with CRC increases risk two to eight-fold [1, 2]. Colonoscopy has the potential to reduce both CRC incidence and mortality through early detection and removal of precancerous polyps. The American Cancer Society and the National Comprehensive Cancer Network recommend individuals with an intermediate risk of familial CRC (i.e., CRC diagnosis in a FDR < age 60 or two or more FDR or second-degree relatives (SDR) with CRC) begin CRC screening at age 40, or 10 years earlier than the youngest age at diagnosis in the family, whichever comes first [3, 4] and to repeat screening every 3-5 years. Because colonoscopy is effective at cancer prevention through early detection and removal of polyps, it is the standard of care for most individuals considered to be at increased familial risk[5].

CRC incidence and mortality rates have been declining in the United States since the mid-1980s, largely attributed to the increase in detection and removal of precancerous polyps through colonoscopy [6], yet screening rates among relatives of CRC patients remain low [7]. Less than half of individuals at increased familial risk are up-to-date with colonoscopy [8]. Low adherence to screening recommendations may be related to lack of a clear understanding of familial risk and current screening recommendations [9]. The low participation rates of intermediate-risk individuals underscore the importance of developing effective strategies for increasing adherence to CRC screening.

Effective risk communication depends not only on presenting general risk factors and preventive information but also on factors unique to the individual. Acceptance of a risk message depends on an individual’s knowledge, values and beliefs.[10]. Personalized interventions in which the message is based on an individual’s beliefs about CRC, personal risk factors, and knowledge of the effectiveness of CRC screening [11] may be viewed as more salient and lead to the desired behavior.

Theory-based interventions addressing multiple determinants of behavior have the highest likelihood of promoting healthy behaviors [12]. One such theory is the Extended Parallel Process Model (EPPM) which incorporates affective processes (i.e., fear) in risk communication [13]. The EPPM focuses on channeling fear in a protective direction rather than a maladaptive direction. The model is based on the idea that when individuals fear a threat, they will be motivated to take action to reduce the unpleasant state. Fear can then be reduced by adaptive actions to control the danger or by maladaptive actions to control the fear. The model posits that when an individual is presented with a fear-arousing message two

cognitive appraisal processes will be initiated: (1) threat appraisal and (2) efficacy appraisal. In the first stage, the individual considers two aspects of the perceived threat: severity and susceptibility. Severity appraisals involve determining the degree of harm expected from the threat (e.g., “CRC can kill me.”) while susceptibility appraisals involve determining how likely the threat could affect the individual (e.g. “I have a family history of CRC so I can get this disease.”). If the perceived threat is determined to be low, the individual is unlikely to process the message further. However, if the perceived threat is high the individual will enter the efficacy appraisal stage to evaluate response efficacy and self-efficacy. In response efficacy the individual assesses how effective the recommended behavior will be in averting the threat. (“Colonoscopies can identify cancer early and save my life.”). In self-efficacy the individual assesses their ability to perform the recommended behavior to avert the threat (“I am capable of getting a colonoscopy.”). . When both threat and efficacy appraisals are high, the individual will enter a cognitive process to control the *danger* and will engage in adaptive behavior (e.g., getting a colonoscopy). If threat appraisals are high but efficacy is low, the individual will enter a cognitive process to control the *fear* rather than the danger. This process is likely to lead to maladaptive responses such as defensive avoidance (e.g., “I’m not going to think about that!”)

Study Aims

Prior cancer-related studies have examined the EPPM in relation to smoking cessation [14], and early detection behaviors such as testicular self-exam [15] , mammography [16], skin cancer screening and sun protective behaviors [17] but little is known about how the EPPM influences CRC screening intentions and behavior. To address this gap, we explored the validity of the EPPM on predicting message acceptance in the context of a personalized risk communication intervention effects on intention to screen and on colonoscopy utilization. We examined whether perceptions of CRC threat and efficacy were associated with greater message acceptance, and whether perceived CRC threat and efficacy were associated with fear and maladaptive responses at controlling the fear, namely defensive avoidance.

In the event the data did not fit the main additive model, we planned to examine an alternative model. In Witte’s original EPPM model, perceptions of threat are determined by combining susceptibility scores with severity scores and perceptions of efficacy are determined by combining response efficacy scores with self-efficacy scores [18]. However, with regard to CRC threat we postulated there would be little variance in the perceived severity scores as prior research on cancer screening behavior has found perceptions of cancer severity to be universally high [19]. Likewise, we posited that self-efficacy and response efficacy contribute uniquely to the model. While an individual may have high levels of perceived response efficacy (“Colonoscopy can save my life.”), low self-efficacy perceptions (“I am unable to get a colonoscopy.”) may substantially influence overall perceived efficacy scores. Prior studies examining utilization of CRC screening have indicated that individuals without insurance and in lower socioeconomic strata were less likely to have ever screened [20]. These barriers are likely to have influence on efficacy perceptions and screening behavior. Therefore, if the additive model indicated poor fit we planned to examine the individual EPPM constructs of perceived severity, susceptibility, response efficacy and self-efficacy as distinct factors contributing to the model (alternative

model). In the case of poor additive model fit we hypothesized that our alternative model would show perceived susceptibility and perceived self-efficacy to be associated with greater message acceptance.

Method

Participants and Intervention

This study used data from the Family Colorectal Cancer Awareness and Risk Education Project (Family CARE). The Family CARE Project tested the efficacy of a theoretically-based personalized CRC risk assessment and behavior change intervention (TeleCARE) based on the EPPM. All participants had at least one close relative with CRC and met the criteria for enhanced screening with colonoscopy [3, 4]. The intervention is described in detail elsewhere [21-24]. Briefly, the intervention consisted of mailed tailored print materials and a cancer risk assessment and counseling telephone call by a genetic counselor. Participants were recruited through state cancer registries in California, Colorado, Idaho, New Mexico, and Utah; from Cancer Genetics Network's population-based registries in Colorado, New Mexico and Utah; and from two hospital based registries covering approximately 85% of cancer care in Utah. Eligibility requirements included participants be age 30-74 years; be **at intermediate risk for** CRC; were not members of families with hereditary CRC and had not had a colonoscopy in the prior 5 years. Participants were initially contacted by mail or telephone and after providing informed consent, completed a mail or telephone baseline survey [23, 24]. Eligible participants (n=481) completed the baseline survey and were randomized to one of two arms. Investigators and telephone interviewers were blinded to participant condition. The intervention arm consisted of a tailored telephone-based CRC risk counseling session with a cancer risk specialist (i.e., genetic counselor) as well as follow up letters and reminder postcards. Telephone sessions were tailored to the participants' perceptions of CRC risk and severity, self-efficacy regarding obtaining colonoscopy and beliefs about colonoscopy effectiveness. Sessions incorporated risk communication and behavior change approaches based on raising perceptions of threat of familial CRC, arousing fear, enhancing beliefs about colonoscopy benefits and increasing self-efficacy and motivation to undergo colonoscopy. The comparison group received a mailed generic educational brochure only. Two-hundred eighteen eligible participants were randomly assigned to the TeleCARE arm and completed the intervention and were included in this study's intent-to-treat analysis. Of these, 188 (86%) returned the one-month follow-up survey and were included in the per protocol analysis. Because the TeleCARE intervention was explicitly guided by the EPPM while the control arm was not, this analysis included only those in the TeleCARE arm.

Within one month of the baseline survey, one of five certified cancer genetic counselors conducted a 30-45 minute telephone session with each participant, individualizing the counseling session according to participant's perceptions of CRC threat, screening efficacy, and perceived barriers. The session included a "fear-appeal" that informed the individual about their increased risk for CRC, and population risks of dying of CRC and mortality. Counselors discussed colonoscopy as a strategy for reducing the risk of developing CRC and detecting it early. Counselors also recommended or reinforced the benefits of getting a

colonoscopy because of their familial risk. Thirty days following the intervention, participants completed a mailed or telephone follow-up survey that assessed threat and efficacy perceptions, intention to get a colonoscopy and actual colonoscopy utilization. Reported colonoscopy was medically verified. The trial's primary outcome was medically verified colonoscopy by the 9 month follow-up.

Measures

Perceived threat and perceived efficacy.—EPPM threat and efficacy constructs were assessed using an adapted version (**i.e**., adapted to refer to colorectal cancer and/or colonoscopy specifically) of the16-item Risk Behavior Diagnosis Scale (RBDS) [25]. Each construct included four items and individuals indicated agreement with statements using a 5-point Likert-type scale ranging from 1 (strongly agree) to 5 (strongly disagree) (see Table 1 for Cronbach's alpha on these and all subsequent constructs).

Fear.—CRC fear was assessed with an adapted (i.e., adapted to refer to colorectal and/or colonoscopy cancer specifically) six-item scale from the Negative Affect in Risk subscale of the Cancer Risk Beliefs Scale [26]. Participants indicated agreement using a 4-point Likert-type scale ranging from 1 (strongly agree) to 4 (strongly disagree).

Defensive avoidance.—To assess if participants avoided thinking about the intervention information as an effort to control fear we utilized an adapted (i.e., adapted to refer to colorectal cancer and/or colonoscopy specifically) [13] 3-item scale utilizing a 7-point Likert-type scale where 1 = "I didn't want to think about it" and 7 = "I wanted to think about it."

Message acceptance.—Intention to be screened for CRC was assessed with a single item, "Do you intend to have a colonoscopy in the next 6 months?" on a 7-point Likert-type scale ranging from 1 (definitely will not have) to 7 (definitely will have). CRC screening behavior was assessed at each follow up. Colonoscopy utilization was verified by medical records within 9 months post-intervention.

Analysis

Structural equation modeling (SEM) was used to assess the data fit to the proposed theoretical model that was developed *a priori* according to the EPPM theory. Before examining the additive and the alternative models, we tested the adequacy of each measurement model to operationalize the latent variables and examine goodness of fit. To assess the measurement model fit, we considered Root Mean Square Error of Approximation (RMSEA)<.08, Comparative Fit Index (CFI)>.90 and Standardized Root Mean Residual (SRMR)<.08 as good fit to the models [27-29].

A full SEM analysis was then conducted to specify *a priori* hypothesized relationships among the latent and/or observed variables in the model.. We conducted **intent-to-treat** analyses of the hypothesized models, as well as per protocol analyses to examine whether there is any major discrepancy between the per protocol and intent-to-treat results. Full information maximum likelihood (FIML) estimation was used to impute missing values. In

addition, a sensitivity analysis with and without imputation for missing data was conducted. Three sets of missing data imputation (FIML, multiple imputations (MI) with 5 replications, MI with 10 replications) were performed. Model fit was assessed by RMSEA, SRMR, and CFI. We compared the models based on the model fit indices, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), with lower AIC and BIC indicating preferred model.

Results

Participant sociodemographics are presented in Table 2. Logistic regression analysis of responders versus non-responders to the 1-month intention and behavior items revealed no difference between the groups on baseline demographics or EPPM variables.

Confirmatory factor analyses showed that our four self-efficacy items had poor fit (RMSEA = 0.452, CFI= 0.786, SRMR= 0.102). In order to achieve good-fitting measurement models, the latent construct was re-specified. After excluding one self-efficacy item, ("I can get a colonoscopy to prevent the onset of colorectal cancer") the self-efficacy construct showed excellent fit (RMSEA = 0.00, CFI= 1.00, SRMR= 0.00) [30, 31]. Results of the main additive and alternative measurement models and confirmatory factor fit indices are reported in Tables 1, 2 and 3 of the Appendix.

Main additive model results.

The overall fit statistics indicated that the measurement model for the four latent constructs (threat, efficacy, fear, defensive avoidance) did not fit the data (RMSEA=0.113; SRMR=0.109; CFI=0.811) (see Table 1 of the Appendix). The full SEM analysis of the hypothesized main additive model did not support the model's fit (RMSEA=0.109; SRMR=0.134; CFI=0.797; AIC=11601; BIC=11884). (see Figure 1). Even though the fit indices did not support the main additive model, we still reported the results as this model is the original theoretical model and a comparison of the fit with the alternative model was the overarching goal of this study.

Alternative model results.

The overall fit statistics indicated the alternative measurement model for the six latent constructs provided adequate fit to the data (RMSEA=0.068; SRMR=0.063; CFI=0.933) (see Table 2 of the Appendix). Intercorrelations among the six constructs for the alternative models are presented in Table 4 of the Appendix. We compared the main additive model versus the alternative model based on RMSEA, SRMR, CFI, AIC and BIC indices, with lower RMSEA, lower SRMR, lower AIC, lower BIC and higher CFI indicating a better model. Results from the FIML intent-to-treat analyses indicated the alternative model is a better fit than the main model in all areas (RMSEA=0.070; SRMR=0.105; CFI=0.918; AIC=11186; BIC=11498). As shown in Figure 2, we found perceived susceptibility to be associated with intention to screen (B =0.319, p <.001) but no association between perceived severity (B=0.061, p=0.444) and intention. Perceived self-efficacy (B=0.364, p<0.001) was associated with intention but perceived response efficacy was not (B=−0.181, p=0.113). Neither perceived susceptibility (B=.132, p=0.158) nor perceived self-efficacy (B=−0.181,

p=0.113) were associated with fear; however perceived severity (B=0.177, p=0.034) and perceived response efficacy (B=0.242 p=0.043) were both associated with fear. When we examined fear processes, we found fear to be associated with lower levels of defensive motivation (B=−0.343, p<0.001). Importantly, intention to screen was associated with colonoscopy behavior (B=0.539, p<0.001). The results obtained from the per-protocol analyses (See Figures 1 and 2 in Appendix) were essentially identical to the intent-to-treat analyses reported above. Additionally, the results with and without imputation for missing data were concordant. (See Figures 3, 4, 5, 6, 7 and 8 in Appendix)

Discussion

Risk communication involves raising awareness of increased cancer risk and creating a sense of efficacy. The EPPM contains both components and has been effectively used across a variety of topics[32], but has not previously been examined in the context of CRC screening intentions and behavior. Our study examined the full EPPM in which an additive relationship exists between perceived severity and susceptibility (i.e., threat) and between perceived response and self-efficacy (i.e., efficacy) to determine the model's predictive validity regarding model effectiveness on CRC screening intentions and behavior. Our findings did not support the main additive EPPM model. Another aim, upon main model poor fit, was to examine an alternative model in which perceived susceptibility, severity, self-efficacy and response efficacy each contribute individually to the model. Consistent with our hypothesis perceived susceptibility was significantly associated with intention to screen while perceptions of CRC severity were not. Additionally, perceived self-efficacy but not perceived response efficacy was significantly associated with intention to screen. According to the tenets of the EPPM, when one is exposed to a fear appeal message, an appraisal of the message's threat is first preformed and then an appraisal of the individual's ability to prevent the threat. However, perceptions of cancer severity may fundamentally differ from other types of fear appeal severity messages. Cancer has been considered the "dread disease"[19], impacting lifestyle, incurring high costs and causing significant and permanent morbidity. Furthermore, cancer is often viewed as so frightening that individuals may refrain from obtaining cancer screening tests due to their fear of being diagnosed with cancer [33] and the belief that death is inevitable when cancer is present [34]. Consistent with this view our data indicate that most participants viewed CRC as serious and severe with little variability in perceived severity scores. Such high severity scores create a ceiling effect that may affect the threat component in the main additive model. Thus, fear-arousing cancer-related messages, specifically those focused on CRC, should focus on increasing levels of personal susceptibility, prevention and on early detection strategies.

In the main additive model, perceived self- and response efficacy are combined to create an efficacy value. According to the EPPM, self-efficacy may be viewed as the degree to which the individual perceives he/she can perform the recommended response to avert the threat. In the case of CRC and for the purposes of our study self-efficacy is the degree to which the individual perceives he/she is capable of obtaining a colonoscopy and response efficacy is the degree to which the individual believes that colonoscopy can early-detect and prevent CRC. In fear-arousing communications aimed to increase health-promoting lifestyle choices, self-efficacy is often associated with the self-control, self-regulation and self-motivation

needed to perform the behavior. However, many of these health-promoting lifestyle behaviors need to be performed on a regular basis, while colonoscopy screening need only be performed every few years for most people with a family history of cancer and in this case would be considered as a single-event decision. Additionally, while colonoscopy self-efficacy would include the self-motivation to actively pursue a colonoscopy recommendation from a provider and to follow up with that recommendation, screening for CRC also involves securing transportation from a social network member, having insurance coverage or the ability to pay for a rather costly procedure. Prior research has consistently shown an association between lack of health insurance and non-adherence to cancer screening guidelines [35]. Accordingly while one may strongly agree that colonoscopy can save lives, without the ability to pay either the cost of the colonoscopy or the copay, belief in the effectiveness of colonoscopy would not likely predict intention to obtain colonoscopy nor predict colonoscopy uptake. Messages to increase efficacy may need to include information on transportation options and ways to obtain colonoscopy if one's insurance does not cover the cost.

Importantly, we also examined colonoscopy behavior within nine months following the intervention and, as hypothesized, our results indicated motivation to screen was significantly associated with colonoscopy uptake. This is an important aspect to examine, as people with positive intentions often fail to actually perform the behavior [36].

Of particular interest is our finding that fear was negatively associated with maladaptive responses, suggesting participants did not avoid the message despite high fear. It may be that a cancer message cannot be dismissed easily. One often need not look beyond one's own neighborhood to see examples of the significant and harmful impact cancer can have on families, finances and lives. It would likely be difficult to dismiss cancer fear messages as "unimportant" or "not worth thinking about". Our participants all had a family member with CRC diagnosis and may well have seen these impacts first hand. While some fear messages might be viewed as less threatening than cancer and thus may be easier to derogate or avoid, cancer fear cannot be easily dismissed. Additionally, effective communication depends on whether the individual views the communication source as credible [10]. Our participants may have viewed the risk counselors as credible and thus did not discredit their message. Importantly, individuals seemed to believe the relevance of the message regarding CRC despite increased levels of fear.

The EPPM-based intervention [22] was effective in promoting CRC screening behavior and an examination of pre-to-post intervention changes [23] indicated the intervention increased CRC knowledge, perceptions of susceptibility, response efficacy, self-efficacy and reduced decisional uncertainty from baseline to follow-up. In this study, we aimed to assess the underlying theoretical model to determine whether the original EPPM additive model versus an alternative model was a better fit. Thus, our findings provide a unique contribution to the literature regarding the use of the EPPM in promoting adherence to CRC screening guidelines in those at increased familial risk. Specifically, our findings suggest that the EPPM alternative model in which each component of the EPPM contributes individually is a better fit for motivating CRC screening intentions and CRC screening behavior. This is an important contribution to the literature as few studies have tested theoretical models with

regard to an intervention's effect on psychosocial pathways and actual cancer screening behavior [37] and there remains no clear agreement on which model best predicts cancer screening behaviors. Empirical examination of theories to better understand causal pathways that link constructs to cancer screening behavior is an important first step. Noteworthy, in our study we measured not only participants' intention to screen as an indicator of message acceptance, but their actual behavior as well.

While our study has provided an important examination of how the EPPM framework may aid in interventions to motivate CRC screening intentions and behavior, our study has limitations. Specifically, the majority of our population was non-Hispanic white. Most of our population reported having health insurance, however, the TeleCARE intervention was effective in motivating colonoscopy within 15 months of intervention in both those who did and did not report cost barriers, although it was more effective in those who did not cite cost as a barrier [38]. While no ethnic/racial or insurance differences were observed, differences may emerge with a more racially diverse or uninsured population. Thus, our results cannot be generalized to other socioeconomic groups. Additional work are needed to assess the feasibility of the EPPM framework to motivate more socioeconomically disadvantaged and uninsured/underinsured populations. Finally, our surveys were remotely administered. This led to a higher rate of missing responses than would have been achieved with in-person surveys.

An important extension to this study would include determining if factors beyond the control of the participant function to inhibit colonoscopy behavior. Qualitative studies to identify such factors would be useful. Additionally, we did not explore the pathways between fear and intention-to-screen and actual screening behavior for two reasons: this particular pathway was not specified in Witte's original model and our sample size limited the number of pathways we could include in the model. However, it might be informative to examine this pathway in future. Nonetheless, our finding support key theoretical tenets of the EPPM and can be used to guide the development and implementation of effective interventions to promote guideline-concordant cancer screening.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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References

1. Butterworth AS, Higgins JP, and Pharoah P, Relative and absolute risk of colorectal cancer for individuals with a family history: a meta-analysis. Eur J Cancer, 2006 42(2): p. 216–27. [PubMed: 16338133]
2. Johns LE and Houlston RS, A systematic review and meta-analysis of familial colorectal cancer risk. Am J Gastroenterol, 2001 96(10): p. 2992–3003. [PubMed: 11693338]
3. National Comprehensive Cancer Network, I., NCCN Practice Guidelines in Oncology, Colorectal Cancer Screening. 2007, National Comprehensive Cancer Network, Inc.: Jenkintown, PA p. CSCR-7–CSCR-10.
4. ACS, American Cancer Society. Cancer Facts & Figures 2012. 2012, Atlanta: American Cancer Society.
5. Society, A.C., Colorectal Cancer Facts & Figures 2011–2013. 2011, Atlanta: American Cancer Society.
6. Edwards BK, et al., Annual report to the nation on the status of cancer, 1975–2006, featuring colorectal cancer trends and impact of interventions (risk factors, screening, and treatment) to reduce future rates. Cancer, 2010 116(3): p. 544–73. [PubMed: 19998273]
7. Ruthotto F, et al., Participation in screening colonoscopy in first-degree relatives from patients with colorectal cancer. Ann Oncol, 2007 18(9): p. 1518–22. [PubMed: 17761708]
8. Taylor DP, et al., Comparison of compliance for colorectal cancer screening and surveillance by colonoscopy based on risk. Genet Med, 2011 13(8): p. 737–43. [PubMed: 21555945]
9. Longacre AV, Cramer LD, and Gross CP, Screening colonoscopy use among individuals at higher colorectal cancer risk. J.Clin Gastroenterol, 2006 40(6): p. 490–496. [PubMed: 16825930]
10. Berry DC, Risk, Health Communication and Psychology. 2006: Open University Press/McGraw Hill Education
11. Noar SM, Benac CN, and Harris MS, Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychol.Bull, 2007 133(4): p. 673–693. [PubMed: 17592961]
12. Briss P, et al., Promoting informed decisions about cancer screening in communities and healthcare systems. Am.J.Prev.Med, 2004 26(1): p. 67–80. [PubMed: 14700715]
13. Witte K, Fear control and danger control: A test of the extended parallel process model (EPPM). Communication Monographs, 1994 61(2): p. 113–134.
14. Wong NC and Cappella JN, Antismoking Threat and Efficacy Appeals: Effects on Smoking Cessation Intentions for Smokers with Low and High Readiness to Quit. J Appl Commun Res, 2009 37(1): p. 1–20. [PubMed: 20046966]
15. Morman MT, The influence of fear appeals, message design, and masculinity on men's motivation to perform the testicular self-exam. Journal of Applied Communication Research, 2000 28(2): p. 91–116.
16. Hubbell AP, Mexican American women in a rural area and barriers to their ability to enact protective behaviors against breast cancer. Health Commun, 2006 20(1): p. 35–44. [PubMed: 16813487]
17. Cho H and Salmon CT, Fear Appeals for Individuals in Different Stages of Change: Intended and Unintended Effects and Implications on Public Health Campaigns. Health Communication, 2006 20(1): p. 91–99. [PubMed: 16813492]
18. Witte K, et al., Predicting risk behaviors: Development and validation of a diagnostic scale. J Health Commun, 1996 1(4): p. 317–41. [PubMed: 10947367]
19. Patterson JT, The Dread Disease: Cancer and Modern American Culture. 1987, President and Fellows of Harvard College p. 380.

20. Stimpson JP, et al., The effect of marriage on utilization of colorectal endoscopy exam in the United States. Cancer Epidemiol, 2012 36(5): p. e325–32. [PubMed: 22633538]
21. Pengchit W, et al., Motivation-based intervention to promote colonoscopy screening: An integration of a fear management model and motivational interviewing. J Health Psychol, 2011 16(8): p. 1187–97. [PubMed: 21464114]
22. Kinney AY, Boonyasiriwa t W.P., Walters ST, Stroup AM, Schwartz MD, Pappas LM, Edwards SL, Rogers A, Kohlmann WK, Boucher KM, Burt RW, Vernon SW, Simmons RG, Lowery JT, Wiggins CL, Williams MS, Hill DA, Higginbotham JC, Telehealth personalized cancer risk communication to motivate colonoscopy in relatives of colorectal cancer patients: A randomized controlled trial. Journal of Clinical Oncology, 2013.
23. Simmons RG, et al., Examining the challenges of family recruitment to behavioral intervention trials: factors associated with participation and enrollment in a multi-state colonoscopy intervention trial. Trials, 2013 14: p. 116. [PubMed: 23782890]
24. Boonyasiriwat W, et al., Intention to Undergo Colonoscopy Screening Among Relatives of Colorectal Cancer Cases: a Theory-Based Model. Ann Behav Med, 2013.
25. Cheah WH and Zimmerman RS, Self-construal and fear appeals: An empirical examination of college students' gonorrhea risk perceptions, in International Communication Association 2005: New York, NY.
26. Hay J, et al., Development and validation of a scale assessing novel cancer-related risk perceptions, in Society for Behavioral Medicine 2006 p. S190.
27. Hu L, & Bentler PM, Cutoff criteria for fit indexes in covariance structure analysis. Structural Equation Modeling, 1999 6: p. 1–55.
28. Hu LT, & Bentler P, Evaluating model fit Structural Equation Modeling. concepts, Issues, and Applications. 1995, London: Sage.
29. Steiger JH, Understanding the limitations of global fit assessment in structural equation modeling. Personality and Individual Differences, 2007 42(5): p. 893–98.
30. McDonald RP and Ho MH, Principles and practice in reporting structural equation analyses. Psychol Methods, 2002 7(1): p. 64–82. [PubMed: 11928891]
31. Tabachnick BG and Fidell LS, Using multivariate statistics. Vol. Fourth 2001, Boston, MA: Allyn & Bacon.
32. Gore TD and Bracken CC, Testing the theoretical design of a health risk message: reexamining the major tenets of the extended parallel process model. Health Educ.Behav, 2005 32(1): p. 27–41. [PubMed: 15642752]
33. Subramanian S, et al., Adherence with colorectal cancer screening guidelines: a review. Prev Med, 2004 38(5): p. 536–50. [PubMed: 15066356]
34. Powe BD, Fatalism among elderly African Americans: Effects on colorectal cancer screening. Cancer Nurs, 1995 18(5): p. 385–392. [PubMed: 7585493]
35. Hendren S, et al., Patients' barriers to receipt of cancer care, and factors associated with needing more assistance from a patient navigator. J Natl Med Assoc, 2011 103(8): p. 701–10. [PubMed: 22046847]
36. Webb TL and Sheeran P, Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. Psychol Bull, 2006 132(2): p. 249–68. [PubMed: 16536643]
37. Manne S, et al., Understanding intention to undergo colonoscopy among intermediate-risk siblings of colorectal cancer patients: A test of a mediational model. Prev.Med, 2003 36(1): p. 71–84. [PubMed: 12473427]
38. Steffen LE, Boucher KM, Damron BH, Pappas LM, Walters ST, Flores KG, Boonyasiriwat W, Vernon SW, Stroup AM, Schwartz MD, Edwards SL, Kohlmann W, Lowery JT, Wiggins CL, Hill DA, Higginbotham JC, Burt R, Simmons RG, Kinney AY, Efficacy of a Telehealth Intervention on Colonoscopy Uptake when Cost is a Barrier: The Family CARE Cluster Randomized Controlled Trial. Cancer Epidemiology Biomarkers & Prevention, 2015 **(conditionally accepted)**. **(conditionally accepted)**

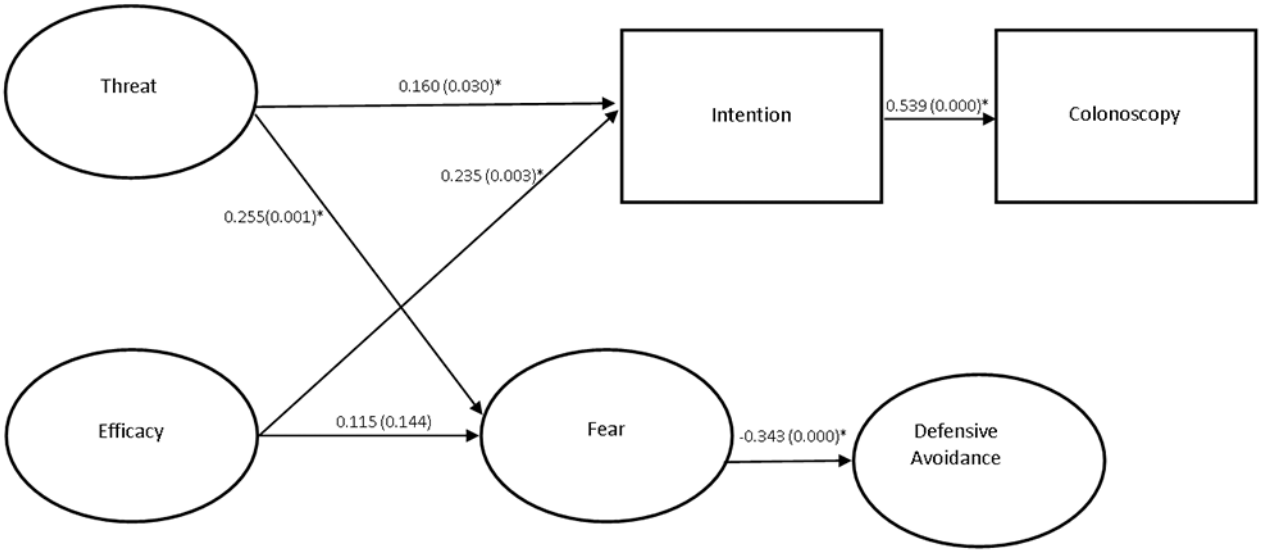

Figure 1.

Main model - Standardized effects with p values in parentheses. RMSEA=0.109; CFI=0.797; SRMR=0.134.

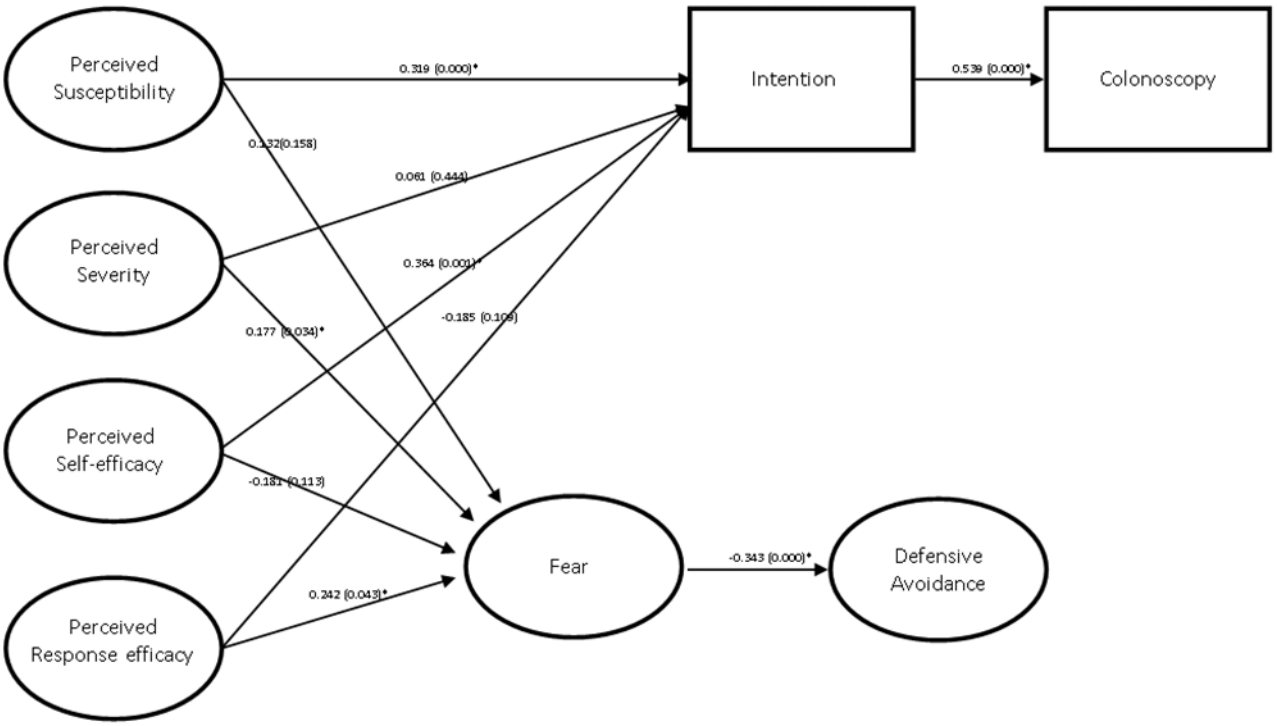

Figure 2.

Alternative model - Standardized effects with p values in parentheses. RMSEA=0.070; CFI=0.918; TLI=0.906; SRMR=0.105.

Table 1

Cronbach's alpha for latent variables

Latent Variables Main model	**Cronbach's Alpha**
THREAT	0.878
EFFICACY	0.880
FEAR	0.941
Defensive avoidance	0.790
Latent Variables Alternative model	**Cronbach's Alpha**
Self-efficacy	0.817
Response efficacy	0.881
Perceived susceptibility	0.849
Perceived severity	0.952
Fear	0.941
Defensive avoidance	0.790

Table 2

Demographic characteristics (N=188)

Variable	n (%)
Age	
<40 years	12 (6.4)
40-49	83 (44.1)
50-59	60 (31.9)
60-69	28 (14.9)
70+	5 (2.7)
Sex	
Male	65 (34.6)
Female	123 (65.4)
Race/Ethnicity	
Race Unknown, not Hispanic	1 (0.5)
Any Race, Hispanic	7 (3.7)
White, not Hispanic	175 (93.1)
Black, not Hispanic	2 (1.1)
Other	3 (0.5)
Education	
<High school	5 (2.7)
High School/GED	35 (18.6)
Some college/college grad	123 (65.5)
Postgrad	25 (13.3)
Income	
Refused	20 (10.6)
Less than 15,000	21 (11.2)
15,000 – 29,999	20 (10.6)
30,000 – 49,999	35 (18.6)
50,000 – 69,999	30 (16.0)
70,000 or more	62 (33.0)