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Why are Tailored Messages More Effective? A Multiple Mediation Analysis of a Breast Cancer Screening Intervention

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Past research has found that tailoring increases the persuasive effectiveness of a message. However, the observed effect has been small and the explanatory mechanism remains unknown. To address these shortcomings, a tailoring software program was created that personalized breast cancer screening pamphlets according to risk, health belief model constructs, and visual preference. Women aged 40 and older (N = 119) participated in a 2 (Tailored vs. Stock Message) × 2 (Charts/Graphs vs. Illustrated Visuals) × 3 (Nested Replications of the Visuals) experiment. Participants provided with tailored illustrated pamphlets expressed greater breast cancer screening intentions than those provided with other pamphlets. In a test of 10 different mediators, perceived message relevance was found to fully mediate the Tailoring × Visual interaction.

In communication, tailoring is the personalization of messages for an individual based on his/her beliefs, traits, or abilities (Kreuter, Strecher, & Glassman, 1999). Past studies have found that tailored messages can improve behavioral outcomes, including public adherence to cancer prevention and detection recommendations (Kreuter, Farrell, Olevitch, & Brennan, 2000).

This study evaluates the efficacy of a tailoring software program designed to increase mammography screening in women 40+ years of age. In addition to providing a practical tool for advancing public health, the software program provides an opportunity to engage two pressing questions within the tailoring literature. First, though tailoring has proved to be an effective communication strategy, a recent meta-analysis (Noar, Benac, & Harris, 2007) revealed that the mean effect size for tailoring interventions was relatively small ($r = .07$). In other words, personalized

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messages appear to be more effective than nonpersonalized messages, but testing promising tailoring variables that might yield a larger impact is a priority.

Similarly, a second priority of tailoring research is the identification, and empirical validation, of mediators that might explain the relationship between personalization and outcomes (Rimer & Kreuter, 2006). That is, despite a growing body of tailoring research, the "exact mechanism responsible for this tailoring effect is not known" (Haugh et al., 2010, p. 367). Researchers have suggested, for example, that perceived message relevance could be an explanatory mechanism (Kreuter et al., 2000; Updegraff, Sherman, Luyster, & Mann, 2007). Consistent with this idea, researchers have routinely observed that tailored messages are perceived as more relevant than nontailored messages (Manne et al., 2010; Resnicow et al., 2009; Strecher, Shiffman, & West, 2006), but narrative reviews of the tailoring literature note that few attempts have been made to statistically test the mediating role of perceived message relevance (Noar, Harrington, & Aldrich, 2009).

To date, most tailoring studies have utilized perceptual data as a manipulation check and thus never subjected it to empirical mediation analysis. O'Keefe (2003) argued that this situation was common in message effects research and that a more informative utilization of message perception data, like perceived message relevance, would be empirical tests of mediation. Several studies have taken up this question in the past (e.g., Ko, Campbell, Lewis, Earp, & DeVellis, 2011; Strecher et al., 2006). These studies offer preliminary evidence that relevance, in some capacity, is a mediator of tailoring effects; however, none of the aforementioned studies compared perceived message relevance to multiple plausible mediators in a single empirical test. This study engages this issue by examining whether several message perceptions (relevance, attractiveness, effectiveness, message quality, informativeness, and visual informativeness) and health belief model (HBM) constructs (self-efficacy, benefits, barriers, and susceptibility) mediate the relationship between tailoring and behavioral intention.

Tailored communication

Researchers have examined the impact of tailoring on a number of health behaviors (see Noar et al., 2007), including intentions to engage in mammography screening. Skinner, Strecher, and Hospers (1994) found that women who received a letter tailored to screening benefits and barriers were more likely to have read the letter and, for low-income and Black participants, intend to engage in mammography in the next 6 months. Champion et al. (2007) personalized messages according to the HBM and found that tailored messages delivered via different channels (e.g., tailored phone counseling, tailored print) were more effective at increasing mammography screening intentions than stock messages. A meta-analysis of tailored breast cancer screening interventions found a significant overall effect (odds ratio = 1.42, 95% CI: 1.27–1.60) favoring tailored messages (Sohl & Moyer, 2007). Tailored interventions were most effective at increasing mammography screening intentions when they included a physician recommendation and message features were personalized according to HBM variables (i.e., barriers, benefits, self-efficacy, and risk).

In a meta-analytic synthesis of tailoring research, Noar and colleagues (2007) also found that tailoring was an effective communication strategy ($r = .07$, 95% CI: $0.06-0.08$), especially at increasing intentions to screen for cancer ($r = .08$, 95% CI: $0.06-0.09$). The average effect size for tailored mammography interventions was slightly smaller, but still statistically significant ($r = .05$, 95% CI: $0.03-0.06$). Messages were most effective when they were personalized on four or five factors ($r = .09$, 95% CI: $0.07-0.10$) and communicated via a pamphlet or leaflet (as opposed to a letter, manual, or newsletter; $r = .16$, 95% CI: $0.14-0.19$). Another recent meta-analytic review (Krebs, Prochaska, & Rossi, 2010), which extended the previous analysis by adding studies and weighting effect sizes for study quality, once again found that tailored messages were more effective (Hedges $g = .17$, 95% CI: $0.14-0.20$). Thus, we hypothesize that pamphlets tailored to individual demographics, breast cancer risk, and HBM variables will be more effective than nontailored pamphlets at increasing intentions to utilize mammography (H1).

In light of the small overall effect size for tailoring, Noar et al. (2007) argued that future research should investigate new factors for tailoring efforts. Specifically, Noar and colleagues (2007) noted that there was a shortage of tailoring studies examining the impact of visual tailoring; that is, the manipulation of visual design and layout in accord with the preferences of individual message recipients (Resnicow et al., 2009). Visual tailoring could take many forms, including the personalization of depicted models (e.g., by race, gender, age; Resnicow et al., 2009) or the type of visual information provided (e.g., charts, growth curves; Armstrong et al., 2005). Tailoring according to type of visual information allows communicators to assess and provide the sort of material that might facilitate learning or increase message impact. Researchers have sometimes referred to numerical and graphical information as distinctive categories (Lipkus, 2007), but an alternative approach is distinguishing between numerically focused visuals such as charts, graphs, and figures (henceforth, charts/graphs) and example- or experiential-focused visuals such as models, samples, or illustrations (henceforth, illustrative). If visual preference falls along these lines, then it has the potential to be an effective tailoring target. Accordingly, we hypothesize that pamphlets tailored to an individual's preference for charts/graphs or illustrative visual material will be more effective than nontailored pamphlets at increasing intentions to utilize mammography (H2).

Mediators

A growing body of research supports the idea that tailored messages are more effective at changing attitudes and behaviors, but little research has examined why this might be the case (Rimer & Kreuter, 2006). In recognition of this shortcoming, several researchers have proposed that the next generation of tailoring studies focus on moderators and mediators (Noar et al., 2007; Rimer & Kreuter, 2006).

To date, several tailoring studies have explored possible moderators and mediators. A recent meta-analysis revealed that tailored messages in computer-mediated safer-sex interventions significantly impacted two mediator variables: sexual/condom

attitudes and condom self-efficacy (Noar, Pierce, & Black, 2010). For messages promoting skin cancer detection behaviors, Manne et al. (2010) observed that tailoring effects were mediated by intentions but not perceived benefits, barriers, or sunscreen self-efficacy. Most relevant to the present study, Updegraff et al. (2007) found that increased message scrutiny and a host of message perceptions (persuasiveness, clarity, accuracy, memorability, importance, helpfulness, and usefulness) mediated the relationship between tailored information and flossing behavior. Perceived message relevance was not assessed, though the authors suggested that increased message scrutiny was likely a byproduct of greater perceived message relevance.

Perceived message relevance—the extent to which people view some communicative stimuli being related or applicable to a person and/or situation—has often been proposed as a key mediator of tailoring effects (Kreuter & Wray, 2003; Kreuter et al., 2000; Updegraff et al., 2007), but few studies have tested this proposition outright (Noar et al., 2009). This is unfortunate, as perceived message relevance has the potential to mediate both personalization (system-level tailoring based on individual characteristics) and customization (user-derived tailoring; see Sundar & Marathe, 2010).

There have been tests of two types of relevance, relevance of communication and program relevance, in past studies. Ko and colleagues (2011) found that perceptions of communication relevance mediated the effects of a program intended to increase fruit and vegetable consumption. For the evaluation of a smoking cessation program, Strecher and colleagues (2006) found that perceptions of program relevance mediated the effect of an intervention. Within advertising and marketing literature, personalized messages have proven to be more effective (Campbell & Wright, 2008; Kim & Sundar, 2010) and Tam and Ho (2006) found that two forms of relevance seemed to mediate this effect: content relevance and self-reference. These studies provide initial evidence that relevance, in some form, provides a partial explanation of the success of tailored versus nontailored programs. However, none of these studies tested multiple mediators at once and perceived message relevance is still untested as an explanatory mechanism.

Perceived message relevance is proposed as a mediator because research on tailored communication has been frequently situated (implicitly or explicitly) within the elaboration likelihood model (ELM; Booth-Butterfield & Welbourne, 2002; Petty & Wegener, 1999). The ELM posits that personal involvement with a topic or message dictates processing style. High-involvement receivers pay close attention to the arguments within a message, whereas low-involvement receivers are more influenced by surface-level details (e.g., what the speaker is wearing or how other people react to the message). Both processing styles can result in short-term change, but research has found that close attention to the arguments within a message is more likely to produce stable attitudes, beliefs, and behaviors (Petty & Wegener, 1999) likely by stimulating increased message scrutiny (Updegraff et al., 2007). The ELM is applicable to tailoring because tailored messages may be viewed as more personally relevant and therefore more likely to trigger high personal involvement

(Kreuter et al., 2000). If true, this proposition suggests that a priority of tailoring research is the identification of factors that increase perceived message relevance both generally and within a particular context of interest, as well as to determine perceived message relevance's role as a mediating feature of tailored communication. Thus, we hypothesize that perceived relevance will mediate the relationship between tailoring/visual tailoring and intentions to utilize mammography (H1a/H2a).

Tailored messages may be more effective because they are perceived as relevant; however, a complete test of mediation should also consider plausible alternatives (Hayes, 2012). In line with past research (e.g., Champion et al., 2007), the messages in the present study were tailored according to four HBM constructs (barriers, benefits, self-efficacy, and risk). Thus, it is plausible to explore whether perceptions of these variables mediate the effects (RQ1).

Tailored messages could also be perceived as more attractive (Bull, Holt, Kreuter, Clark, & Scharff, 2001), informative (Cho & Boster, 2008; King, Jensen, Davis, & Carcioppolo, in press), effective (Fishbein, Hall-Jamieson, Zimmer, von Haeften, & Nabi, 2002), or higher in message quality (Cho & Boster, 2008); all characteristics that may explain the effectiveness of tailoring (RQ2).

Method

Design

A 2 (Tailored vs. Stock Message) × 2 (Charts/Graphs vs. Illustrated Visuals) × 3 (Nested Replications of the Visuals) experiment was carried out to test the validity of a tailoring software program.

Participants

Women ($N = 119$) aged 40 and older ($M_{age} = 52.26$, $SD = 8.34$, range: 40–69) were recruited to the study. Women were targeted as breast cancer is overwhelmingly a disease that affects women. Of the 209,060 estimated new cases of breast cancer in 2010, roughly 207,090 were in women (Jemal, Siegel, Xu, & Ward, 2010). In terms of racial/ethnic demographics, the majority of participants self-identified as White (84%) followed by Asian/Pacific Islander (5.9%), Black (3.4%), Hispanic/Latino (2.5%), and mixed racial identity (4.2%). Participants could check more than one racial/ethnic category. The mean family income for participants was $51,000–60,000. Education was distributed as follows: some high school (1.1%), high school graduate (31.1%), some college/technical training (14.4%), graduate 2- or 4-year college (32.2%), and graduate school or beyond (21.1%).

Breast cancer survivors were included in this study as they are at a higher risk for breast cancer and because many survivors bypass annual screening (Doubeni et al., 2006). Eleven of the participants (9.2%) had a history of breast cancer. In the pretest, participants completed the breast cancer risk assessment tool which uses the Gail Model to calculate a women's lifetime risk of developing invasive breast cancer (National Cancer Institute, 2011). Participants in the current study had a mean

lifetime risk of 19.09% ($SD = 26.74$). Average lifetime risk is 14% or below, moderate lifetime risk is 15–20%, and high risk is anything greater than 20% (Gail et al., 2007).

In terms of individual risk factors, approximately 16.8% of the sample reported menarche at 11 years of age or younger, 16% had never given birth to a child, 10.9% gave birth to their first child after the age of 29, 22.6% had one or more first degree relatives with a history of breast cancer, 23.5% had one or more breast biopsies, 4.2% reported atypical hyperplasia in their past, and 0.8% had been identified as a carrier of BRCA1 or BRCA2 (though 71.4% had never been tested).

Procedure

A portable lab consisting of 11 laptops and a full-color laser printer connected by a 20-port switch was set-up in the main intersection of a mall. The mall was located in Lafayette, IN, a midsized town (population 100,000) in the Midwestern region of the United States. Participants were recruited to the study using 7-foot retractable signs that advertised the study and compensation ($15). The study was described as a ''University Research Study.'' Only one person dropped out of the study after learning the topic during the pretest.

In the study, participants initially completed a brief survey on one of the laptops. The survey assessed their breast cancer risk using the Gail Model (see Gail et al., 1989; Gail et al., 2007; Rockhill, Spiegelman, Byrne, Hunter, & Colditz, 2001), past screening behavior (Champion, 1999), time since last screening (Rakowski et al., 1992), and visual preference for charts/graphs or illustrative information as well as HBM variables identified as key predictors of mammography utilization in past research (Champion et al., 2007).

After completing the initial survey, participants were randomly assigned to receive either a tailored pamphlet (personalized based on their initial survey responses) or a stock pamphlet. The stock pamphlet was created using materials from several breast cancer screening pamphlets (created by the American Cancer Society and other cancer-focused organizations). The tailored pamphlet had identical structure, except that various components were personalized. Pamphlets were tailored according to age, race, family history of breast cancer, access to insurance, breast cancer risk, and HBM constructs (i.e., benefits, barriers, self-efficacy).

The pamphlets also contained visual information that was charts/graphs (e.g., tables, charts, graphs) or illustrative (e.g., photographs of women having mammograms, examples of mammography output). To assess visual preference, participants were asked, ''Which statement best reflects your personality?'' Response options were ''I am the sort of person that likes to see numbers and charts when making a decision'' or ''I am the sort of person that likes to see examples and illustrations when making a decision.'' In the tailored condition, participants received the type of visual information they preferred. Three different sets of charts/graphs and illustrative images were used in the study to allow for comparisons across replications (i.e., visual replication was nested). Put another way, we had nine chart/graph images and nine illustration images. Each pamphlet contained either three chart/graph images or

three illustration images. Thus, there were three chart/graph pamphlets (each with three unique chart/graph images) and three illustration pamphlets (each with three unique illustration image). This was done to increase generalizability of the data; the chart/graph condition had three different sets of images representing that category. However, it is not possible to manipulate a single image as either a chart/graph or an illustration, so image sets were nested within condition.

Full-color pamphlets were printed on the laser printer and given to the participants (an example of one of the pamphlets, the algorithm, and message materials can be found on the lead author's webpage). The participants were then asked to spend 5–10 minutes reading through the pamphlet. Once they finished reading the pamphlet, they completed a second survey assessing their perceptions of the pamphlet and their attitudes/beliefs about breast cancer screening. Following completion of the second survey, participants were debriefed and compensated. All of these procedures were approved by a University Institutional Review Board.

Dependent variable

Behavioral intent is often used as a proxy for actual behavior in social and behavioral science research. Evidence suggests there is a definite link between intentions and behavior (Armitage & Conner, 2001; Webb & Sheeran, 2006), although the link is often moderated or mediated by a variety of other factors (Sheeran & Abraham, 2003). In line with other past research (Champion, 1999), participants were asked, "Do you intend to have a mammogram?" and provided with the following response options: *no* (coded as 0) and *yes* (coded as 1) ($M = 0.51$, $SD = 0.50$). For this measure, roughly half of the participants expressed no desire to screen (47.9%) and half wanted to screen (49.6%) (three missing data).

Mediator variables—perceived message constructs

Perceived message relevance

A 2-item scale was used to assess perceived relevance, a construct that has been identified as central to the ELM and possibly tailoring (Kreuter et al., 2000). The two items were "The pamphlet seemed to be written personally for me" and "The pamphlet was very relevant to my situation." Both items were anchored by 5-point response options ranging from *strongly disagree* to *strongly agree* ($M = 3.77$, $SD = 0.87$, $\alpha = .79$).

Perceived message effectiveness

A 3-item perceived effectiveness scale, adapted from Fishbein et al. (2002) was used to assess the perceived persuasiveness of the message. The three items were "Was the pamphlet convincing," "Would people your age who have never been screened be more likely to get screened after reading the pamphlet," and "Would the pamphlet be helpful in convincing your friends to be screened for breast cancer regularly" with 4-point response options: *definitely no*, *no*, *yes*, and *definitely yes* ($M = 3.31$, $SD = 0.49$, $\alpha = .83$).

Perceived message informativeness
A 2-item perceived informativeness scale taken from Cho and Boster (2008) was used to assess participant's feelings about the amount of information culled from the message materials. The two items were "The pamphlet was informative" and "I learned something from this pamphlet" with 5-point response options ranging from *strongly disagree* to *strongly agree* ($M = 4.40, SD = 0.76, \alpha = .77$).

Perceived message quality
Participant's perception of the overall quality of the message was assessed using the 5-item perceived message quality scale (Cho & Boster, 2008). The scale includes items such as "Both the content and style of the pamphlet were good" and 5-point response options ranging from *strongly disagree* to *strongly agree* ($M = 4.28, SD = 0.74, \alpha = .95$).

Perceived message attractiveness
Consistent with past research (Bull et al., 2001), a single-item was used to assess perceived attractiveness: "How attractive did you find the materials?" The item was responded to using a 7-point scale ranging from *very much* to *not at all* ($M = 5.16, SD = 0.93$).

Perceived visual informativeness
A 7-item perceived visual informativeness scale assessed "individual's evaluation of the quality of visual evidence provided in an image" (King et al., in press, p. 8). The scale includes items such as "I found the images in the pamphlet informative" and 5-point response options ranging from *strongly agree* to *strongly disagree* ($M = 3.59, SD = 0.81, \alpha = .88$).

Mediator variables — HBM constructs
Finally, participants completed HBM questions both before and after reading the pamphlet. However, the initial battery of HBM questions offered only dichotomized response options (*yes* or *no*), whereas the second round of questions used the traditional 5-point scale responses (i.e., *strongly disagree* to *strongly agree*). The reason for this difference is that the initial questions were used to tailor the pamphlet (in the tailored condition), therefore they had to provide a clear-cut decision criteria for the software program (i.e., if *yes*, then provide the participant with *message X*). All measures come from Champion (1999) or Champion, Skinner, and Menon (2005).

Perceived benefits
Participant beliefs about the benefits of screening were assessed using Champion's 6-item perceived benefits scale. The scale includes items such as "Having a mammogram will help me find breast lumps early" ($M = 4.37, SD = 0.76, \alpha = .88$).

Perceived barriers
Participant beliefs about barriers to screening were assessed using Champion's 11-item perceived barriers scale. The scale includes items such as "Having a mammogram is too painful" ($M = 1.38, SD = 0.59, \alpha = .82$).

Perceived susceptibility

Participant beliefs about their susceptibility to breast cancer were assessed using Champion's 3-item perceived susceptibility scale. The scale includes items such as "I feel I will get breast cancer sometime during my life" ($M = 2.58$, $SD = 0.88$, $\alpha = .88$).

Mammogram self-efficacy

Participant self-efficacy was assessed using Champion's 10-item mammography self-efficacy scale. The scale includes items such as "you can arrange transportation to get a mammogram," ($M = 4.57$, $SD = 0.75$, $\alpha = .97$).

Results

In the past, researchers tested for mediation using a four-step approach (Baron & Kenny, 1986). First, they tested for a direct relationship between the predictor and outcome variable (c path). If that relationship was significant, then they tested to see if the predictor variable was related to proposed mediator variables (a path) and whether the mediator was directly related to the outcome (b path). Assuming that significant relationships materialized, the final step in the analysis was to test whether the direct relationship between the predictor and the outcome decreased or moved to nonsignificance when the significant mediator variable was entered as a covariate (c′ path). Loss or decrease of the c′ path was assumed to demonstrate partial or full mediation. Hayes (2009) recently noted that this approach was suboptimal as it required a significant c path (even though indirect effects can occur without a direct relationship) and does not provide researchers with an actual test of the mediation.

To overcome these limitations, all hypotheses were tested using PROCESS, a conditional process modeling program that utilizes an ordinary least squares- or logistic-based path analytical framework to test for both direct and indirect effects (Hayes, 2012). PROCESS is ideal for analyzing the current data because it allows researchers to examine multiple moderators and mediators simultaneously. Specifically, the current analysis employed PROCESS Model 8 which allows for moderators and multiple mediators. All indirect effects were subjected to follow-up bootstrap analyses with 1,000 bootstrap samples and a 95% CI. Intention to screen was entered as the outcome variable, tailored condition as the independent variable, visual condition as a moderator variable, lifetime breast cancer risk, past screening behavior, time since last screening, and nested visual replications as covariates, and all 10 mediator variables as mediators. Nested visual replications were treated as a covariate in this analysis as Hayes (2012) recommends that clusters or replications be treated as such if there are fewer than 10.

Similar to the Baron and Kenny approach, PROCESS tests a, b, and c paths; however, the c path need not be significant for mediation to occur. That said, the first question is whether there are significant relationships between the predictors and the outcome variable (c paths). H1 and H2 postulated that here would be a positive relationship between tailoring and intentions to screen (H1) that would be moderated by

**Table 1** Direct Relationships Between Intentions to Screen and Predictors, Covariates, and Mediators

	b (SE)	Z
Constant	4.26 (3.82)	1.11
Predictor variables		
Tailored condition	3.92 (0.93)	4.22**
Visual condition	1.55 (1.24)	1.25
Tailored × Visual	−4.12 (1.13)	−3.63**
Covariates		
Lifetime BC risk	−0.03 (0.01)	−2.57*
Past screening behavior	0.02 (1.43)	0.01
Time since last screening	−0.43 (0.36)	−1.20
Nested visual replications	0.09 (0.33)	0.26
Mediator variables		
Perceived message relevance	1.12 (0.44)	2.57*
Perceived message effectiveness	0.03 (0.65)	0.05
Perceived message informativeness	−0.41 (0.52)	−0.78
Perceived message quality	−1.20 (0.69)	−1.74+
Perceived message attractiveness	−0.02 (0.35)	−0.07
Perceived visual informativeness	−0.20 (0.39)	−0.52
Perceived benefits	0.08 (0.45)	0.17
Perceived barriers	−1.23 (0.66)	−1.87+
Perceived susceptibility	0.67 (0.35)	1.91+
Mammography self-efficacy	−0.20 (0.41)	−0.47

Notes: Direct relationship between intentions to screen and predictors, covariates, and mediator variables. For predictor variables, this table represents the c paths. For mediator variables, this table represents the b paths. Significant a paths are reported in text and tests of mediation are reported in Table 2. Covariates are reported to aid with interpretation and to allow readers to reconstruct the full regression model.
+$p < .10$. *$p < .05$. **$p < .001$.

visual tailoring (H2). Consistent with H1, tailoring was significantly related to intention to screen (see Table 1). Individuals in the tailored condition had greater intentions to screen ($M = .68$, $SD = 0.45$) than those in the stock condition ($M = .32$, $SD = 0.46$, $d = .79$, $r = .37$). Visual condition was not related to intention to screen; however, consistent with H2, there was a significant Tailored × Visual interaction. PROCESS revealed that tailoring was effective for those viewing illustrations ($b = 3.92$, $SE = 0.93$, $t = 4.23$, $p = .0001$) but not charts/graphs ($b = −.21$, $SE = 0.65$, $t = −.32$, $p = .75$). In fact, planned contrasts revealed that individuals in the tailored illustrations group had significantly greater intentions to screen than those in all other groups (see Figure 1).

The second question is whether other variables are related to the outcome (b paths). One covariate (lifetime breast cancer risk) and one mediator variable (perceived message relevance) were related to intentions to screen (see Table 1).
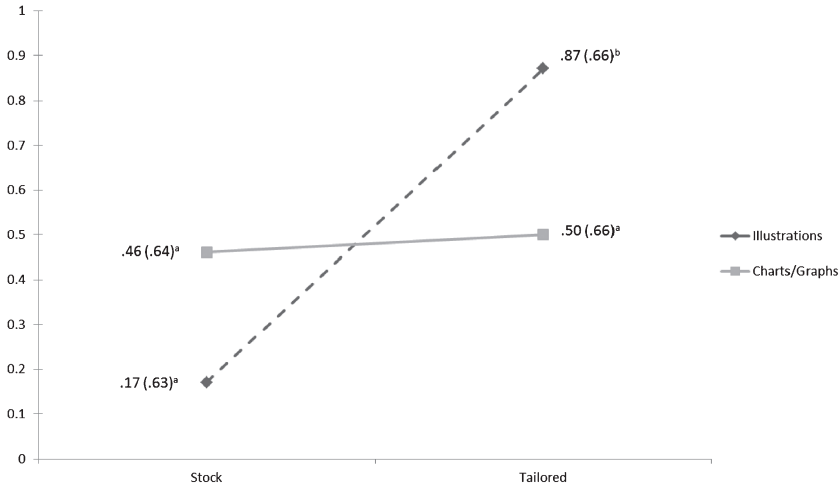
Figure 1 Intention to screen by visual and tailoring conditions. Higher scores reflect greater intentions to screen. Means that do not share a superscript are significantly different, $p < .05$. Means for cells: Stock Illustrated ($n = 25$), Stock Charts/Graphs ($n = 29$), Tailored Illustrated ($n = 30$), Tailored Charts/Graphs ($n = 27$).

Those with greater lifetime risk were more likely to intend to screen as were those who perceived the message as more relevant. Three other mediator variables, perceived message quality, perceived barriers, and perceived susceptibility, were marginally related to screening.

It has been suggested that tailored information is more persuasive than nontailored information because the former is perceived as increasingly relevant by audiences. For this to be true, tailoring would need to be related to perceived message relevance (a path). Tailoring was positively related to four mediator variables: perceived message relevance ($b = .55$, $SE = 0.25$, $t = 2.21$, $p = .03$), perceived message attractiveness ($b = .65$, $SE = 0.25$, $t = 2.60$, $p = .01$), perceived message effectiveness ($b = .30$, $SE = 0.13$, $t = 2.24$, $p = .03$), and perceived visual informativeness ($b = .45$, $SE = 0.21$, $t = 2.11$, $p = .04$).

In summary, tailoring was significantly related to intentions (c path) and perceived message relevance (a path), and perceived message relevance was significantly related to intentions (b path). One of the advantages of PROCESS is that it provides an actual test of the mediation including bootstrapping to quantify the stability of the indirect effect. Even though a, b, and c paths were significant, PROCESS revealed that perceived message relevance (nor any other variable) did not mediate the relationship between tailoring and intentions to screen (see Table 2). Nonsignificance can be seen in that the 95% CI for the bootstrapping sample overlapped the zero point (-1.77, 0.96). Thus, H1a was not supported.

Though no variable significantly mediated the main effect for tailoring, perceived message relevance did mediate the Tailoring × Visual condition interaction. Perceived

Table 2 Bootstrap Coefficients, Standard Errors, and Confidence Intervals for Mediation Tests

	b (*SE*)	95% CI for Bootstrap
Perceived message relevance	−0.27 (0.75)	(−1.77, 0.96)
Perceived message effectiveness	−0.01 (0.36)	(−0.57, 0.83)
Perceived message informativeness	0.06 (0.40)	(−0.62, 0.87)
Perceived message quality	0.29 (0.76)	(−0.71, 2.25)
Perceived message attractiveness	0.01 (0.34)	(−0.59, 0.82)
Perceived visual informativeness	0.08 (0.44)	(−0.44, 1.30)
Perceived benefits	0.00 (0.25)	(−0.49, 0.45)
Perceived barriers	0.31 (0.60)	(−0.39, 1.80)
Perceived risk susceptibility	0.00 (0.37)	(−0.73, 0.79)
Mammography self-efficacy	0.01 (0.28)	(−0.36, 0.75)

Notes: 1,000 bootstrap samples with 95% CI. Bootstrapping reveals, for example, that perceived message relevance does not reliably mediate the relationship between tailoring and intention to screen as the 95% CI for the coefficient overlaps zero.

message relevance was a significant mediator for those viewing illustrations ($b = .62$, $SE = 0.71$, 95% CI: $0.05–2.64$), but not charts/graphs ($b = .35$, $SE = 0.68$, 95% CI: $−0.22$ to 2.04). In other words, consistent with H2a, participants expressed greater intentions to screen in the tailored illustrations group because they perceived the information to be more personally relevant.

Discussion

Participants exposed to tailored illustrative pamphlets expressed greater screening intentions, a relationship that was mediated by perceived message relevance. This finding provides empirical support for the theoretical notion that perceived message relevance mediates tailoring effects, and confirms that the ELM is a potentially useful framework for this line of research. For example, a logical next step may be to examine the impact of tailoring on central message processing. Central message processing has been related to more enduring behavior change, which would be of significant value in tailoring research.

Importantly, the significance of perceived relevance suggests a guiding principle for identifying or selecting tailoring constructs. Constructs are more likely to explain variance if they increase perceived relevance. Some constructs will likely prove efficacious in this regard across a variety of behaviors, whereas others will be context-specific. Survey research could be used to identify factors that are strongly related to perceived relevance across a variety of contexts; a research approach that highlights the utility of a validated measure of perceived relevance.

In this study, a 2-item measure of perceived relevance demonstrated moderate internal reliability ($\alpha = .79$) and predictive validity (i.e., it performed and predicted

in line with theory; see DeVellis, 2003). Future psychometric research should seek to increase the internal reliability of the scale (perhaps by adding more items), examine the underlying factor structure, and establish convergent and divergent validity with related constructs. For example, the current measure may be enhanced by including items that quantify perceptions of message tailoring components such as adaptation, personalization, and feedback (Dijkstra, 2008; Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008). Additionally, distinctions should be made—for tailoring research, practice, and theorizing—among perceived relevance, perceived message relevance, issue involvement, message salience, and issue salience (Noar et al., 2009). These constructs are thought to differ, but for tailoring research understanding which construct is more important is essential for continued theoretical and practical success.

One concern with a mediator like perceived message relevance is that it may be a black-box construct. That is, in and of itself, perceived message relevance can only hint at more concrete message features. If researchers find that messages perceived to be more relevant are more effective, then that still leaves unanswered questions about what message features influence perceived message relevance (for a discussion of this problem, see O'Keefe, 2003). The present study is not immune from this criticism, yet it does engage the issue on several levels. First, the results of the multiple mediation analysis revealed that only perceived message relevance functioned as a mediator. This finding serves to explicate perceived message relevance by demonstrating that it is distinguishable from other related message perceptions such as attractiveness, effectiveness, informativeness, quality, and visual informativeness (DeVellis, 2003). Second, perceived message relevance did not mediate the relationship between tailoring and intention, rather, it explained the effectiveness of one cell: tailored illustrations. This finding suggests that what participants find relevant to mammography screening decisions (e.g., illustrative information) may differ from what is commonly targeted by health communication researchers. HBM constructs have been related to mammography screening intentions and behaviors (e.g., Champion, 1999); however, effective or not, women may view other information as more relevant to the decision.

The effect size for tailoring in this study was significantly larger ($r = .37$) than the mean effect for past tailoring studies (approximately $r = .08$), and the effect is even larger if one compares stock illustrated to tailored illustrated ($r = .48$). One explanation for the larger effect is that the current study utilized meta-analytic findings to optimize message tailoring (e.g., tailoring pamphlets on 4–5 variables). Yet, the observed effect still falls outside the bounds of what researchers might have expected given optimal conditions (e.g., for tailored pamphlets, the mean $r = .16$, 95% CI: 0.14–0.19). One explanation for this difference is that the present study measured behavioral intention rather than behavior (the outcome in meta-analytic work to date). Outcome measure aside, the present study offers a second plausible explanation for the difference, namely the apparent effectiveness of the visual tailoring manipulation. Tailored illustrative images proved to be highly effective at increasing mammography screening intentions among women aged 40–69, a finding that raises several key questions for future research. First, perceived message relevance

mediated the Tailoring × Visual Condition interaction, but researchers will want to consider why tailored illustrative messages resonated strongly with this audience. One possibility is that the illustrative images were perceived to be more informative, yet perceived visual informativeness, which was influenced by tailoring, did not mediate the aforementioned relationship. What is it about illustrative images then, paired with tailored components, that made the message relevant? This is a question for researchers interested in identifying and testing visual message features.

Though not directly addressed in the present study, tailoring research would benefit significantly from research that addresses how to get avoidant populations to attend to tailoring pretests (necessary to tailor the messages) and the subsequent tailored materials. It is promising that tailored messages are more effective, and communication technology provides tools to develop and deliver tailored interventions, yet implementation of this communication approach still seems to be hindered by selective exposure and avoidance. Researchers in other areas have started to consider how to address selective exposure issues (e.g., see Knobloch-Westerwick & Alter, 2007). Is it possible for communication practitioners to leverage the interactivity to increase exposure among avoidant groups? Does this suggest that customization (which is user-generated) may be more effective at reaching avoidant groups? These are questions that need to be answered for tailoring to be a truly viable tool.

Limitations

This study relied on a single-item measure of behavioral intention which is not ideal, but it is consistent with other studies of mammography intentions (see, e.g., Stewart, Rakowski, & Pasick, 2009). Relatedly, behavioral intention is related to behavior; however, demonstrating mediation between tailoring and behavior would be a more complete test of the message strategy. For instance, tailoring interventions delivered through electronic health record interfaces, perhaps paired with incentives to screen (Hesse, Ahern, & Woods, 2011), would allow researchers to deliver tailored messages, track behavior, and rigorously test for mediation. Researchers should also explore whether perceived message relevance mediates tailoring for behaviors other than mammography screening. The present study tested 10 mediators, but only in the context of mammography screening. Replicating the observed mediation findings in other contexts is necessary before generalizations can be made. Context aside, the current tailoring effort addressed visual preference, demographics, beliefs, personal risk, and efficacy, but it did not consider culture. Given the value of cultural tailoring approaches (Davis & Resnicow, 2011), future research should examine how cultural tailoring might enhance or alter the results obtained here.

Conclusion

Tailored messages have been shown to increase mammography screening intentions in past research. The present study replicated this finding in an experimental setting while also extending research on tailoring by empirically demonstrating that perceived

relevance serves as the explanatory mediator variable. Tailoring is a strategy that is well-suited to the increasingly interactive communication environment and will likely continue to evolve in the years ahead.

Acknowledgments

References

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, **40**, 471–500. doi: 10.1348/014466601164939

Armstrong, K., Weber, B., Ubel, P. A., Peters, N., Holmes, J., & Schwartz, J. S. (2005). Individualized survival curves improve satisfaction with cancer risk management decisions in women with BRCA1/2 mutations. *Journal of Clinical Oncology*, **23**, 9319–9328. doi: 10.1200/JCO.2005.06.119

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*, **51**, 1173–1182. doi: 10.1037/0022-3514.51.6.1173

Booth-Butterfield, S., & Welbourne, J. (2002). The elaboration likelihood model: It's impact on persuasion theory and research. In J. P. Dilliard & M. Pfau (Eds.), *The persuasion handbook: Developments in theory and practice* (pp. 155–173). Thousand Oaks, CA: Sage.

Bull, F. C., Holt, C. L., Kreuter, M. W., Clark, E. M., & Scharff, D. (2001). Understanding the effects of printed health education materials: Which features lead to which outcomes? *Journal of Health Communication*, **6**, 265–279. doi: 10.1037/0278-6133.26.5.598

Campbell, D. E., & Wright, R. T. (2008). Shut-up I don't care: Understanding the role of relevance and interactivity on customer attitudes toward repetitive online advertising. *Journal of Electronic Consumer Research*, **9**, 62–76.

Champion, V. (1999). Revised susceptibility, benefits, and barriers scale for mammography screening. *Research in Nursing & Health*, **22**, 341–348. doi: 10.1002/(SICI)1098-240X

Champion, V., Skinner, C. S., Hui, S., Monahan, P., Juliar, B., Daggy, J., & Menon, U. (2007). The effect of telephone versus print tailoring for mammography adherence. *Patient Education & Counseling*, **65**(3), 416–423. doi: 10.1016/j.pec.2006.09.014

Champion, V., Skinner, C. S., & Menon, U. (2005). Development of a self-efficacy scale for mammography. *Research in Nursing & Health*, **28**, 329–336. doi: 10.1002/nur.20088

Cho, H., & Boster, F. J. (2008). First and third person perceptions on anti-drug ads among adolescents. *Communication Research*, **35**, 169–189. doi: 10.1177/0093650207313158

Davis, R. E., & Resnicow, K. (2011). The cultural variance framework for tailoring health messages. In H. Cho (Ed.), *Health communication message design: Theory and practice* (pp. 115–136). Los Angeles, CA: Sage.

DeVellis, R. F. (2003). *Scale development: Theory and applications*. Thousand Oaks, CA: Sage.

Dijkstra, A. (2008). The psychology of tailoring-ingredients in computer-tailored persuasion. *Social and Personality Psychology Compass*, **2**, 765–784. doi: 10.1111/j.1751-9004.2008.00081.x

Doubeni, C. A., Field, T. S., Ulcickas, Y. M., Yood, M., Quessenberry, C. P., Fouayzi, H., et al. (2006). Patterns and predictors of mammography utilization among breast cancer survivors. *Cancer*, **106**, 2482–2488. doi: 10.1002/cncr.21893

Fishbein, M., Hall-Jamieson, K., Zimmer, E., von Haeften, I., & Nabi, R. (2002). Avoiding the boomerang: The need for experimental tests of the relative effectiveness of anti-drug public service announcements prior to their use in a national campaign. *American Journal of Public Health*, **92**, 238–245. doi: 10.2105/AJPH.92.2.238

Gail, M. H., Brinton, L. A., Byar, D. P., Corle, D. K., Green, S. B., Shairer, C., et al. (1989). Projecting individualized probabilities of developing breast cancer for white females who are being examined annually. *Journal of the National Cancer Institute*, **81**, 1879–1886. doi: 10.1093/jnci/81.24.1879

Gail, M. H., Constantino, J. P., Pee, D., Bondy, M., Newman, L., Selvan, M., et al. (2007). Projecting individualized absolute invasive breast cancer risk in African American women. *Journal of the National Cancer Institute*, **99**, 1782–1792. doi: 10.1093/jnci/djm223

Haugh, S., Meyer, C., Ulbricht, S., Gross, B., Rumpf, H., & John, U. (2010). Need for cognition as a predictor and a moderator of outcome in a tailored letters smoking intervention. *Health Psychology*, **29**, 367–373. doi: 10.1037/0278-6133.26.5.598

Hawkins, R. P., Kreuter, M., Resnicow, K., Fishbein, M., & Dijkstra, A. (2008). Understanding tailoring in communicating about health. *Health Education Research*, **23**, 454–466.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, **76**, 408–420. doi: 10.1080/03637750903310360

Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling. Retrieved from http://www.afhayes.com/.

Hesse, B. W., Ahern, D. K., & Woods, S. S. (2011). Nudging best practice: the HITECH act and behavioral medicine. *Translational Behavioral Medicine*, **1**, 175–181. doi: 10.1007/s13142-010-0001-3

Jemal, A., Siegel, R., Xu, J., & Ward, E. (2010). *Cancer statistics, 2010.* CA: *A Journal for Clinicians*. doi: 10.3322/caac.20073

Kim, N. Y., & Sundar, S. S. (2010). Relevance to the rescue: Can "smart ads" reduce negative response to online ad clutter? *Journalism and Mass Communication Quarterly*, **87**, 346–362. doi: 10.1177/107769901008700208

King, A. J., Jensen, J. D., Davis, L. A., & Carcioppolo, N. (in press). Perceived visual informativeness (PVI): Construct and scale development to assess visual health information in printed materials. *Journal of Health Communication*.

Knobloch-Westerwick, S., & Alter, S. (2007). Sex-segregated news consumption: Origins of gender-typed patterns of Americans' selective exposure to news topics. *Journal of Communication*, **57**, 739–758. doi: 10.1111/j.1460-2466.2007.00366.x

Ko, L. K., Campbell, M. K., Lewis, M. A., Earp, J. A., & DeVellis, B. (2011). Information processes mediate the effect of a health communication intervention on fruit and vegetable consumption. *Journal of Health Communication*, **16**, 282–299. doi: 10.1080/10810730.2010.532294

Krebs, P., Prochaska, J. O., & Rossi, J. S. (2010). A meta-analysis of computer-tailored interventions for health behavior change. *Preventive Medicine*, **51**, 214–221. doi: 10.1016/j.ypmed.2010.06.004

Kreuter, M. W., Farrell, D., Olevitch, L., & Brennan, L. (2000). *Tailoring health messages: Customizing communication with computer technology*. Mahwah, NJ: Erlbaum.

Kreuter, M. W., Strecher, V. J., & Glassman, B. (1999). One size does not fit all: The case for tailoring print materials. *Annals of Behavioral Medicine*, **21**, 276–283.

Kreuter, M. W., & Wray, R. J. (2003). Tailored and targeted health communication: Strategies for enhancing information relevance. *American Journal of Health Behavior*, **27**, S227–S232. doi: 10.1177/1090198102251021

Lipkus, I. M. (2007). Numeric, verbal, and visual formats of conveying health risks: Suggested best practices and future recommendations. *Medical Decision Making*, **27**, 696–713. doi: 10.1177/0272989X07307271

Manne, S., Jacobsen, P. B., Ming, M. E., Winkel, G., Dessureault, S., & Lessin, S. R. (2010). Tailored versus generic interventions for skin cancer risk reduction for family members of melanoma patients. *Health Psychology*, **29**, 583–593. doi: 10.1037/a0021387

National Cancer Institute. (2011). Breast cancer risk assessment tool. National Cancer Institute. Retrieved from http://www.cancer.gov/bcrisktool/.

Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin*, **133**(4), 673–693. doi: 10.1037/0033-2909.133.4.673

Noar, S. M., Harrington, N. G., & Aldrich, R. A. (2009). The role of message tailoring in the development of persuasive health communication messages. *Communication Yearbook*, **33**, 72–133.

Noar, S. M., Pierce, L. B., & Black, H. G. (2010). Can computer-mediated interventions change theoretical mediators of safer sex? A meta-analysis. *Human Communication Research*, **36**, 261–297. doi: 10.1111/j.1468-2958.2010.01376.x

O'Keefe, D. J. (2003). Message properties, mediating states, and manipulation checks: Claims, evidence, and data analysis in experimental persuasive message effects research. *Communication Theory*, **13**, 251–274. doi: 10.1093/ct/13.3.251

Petty, R. E., & Wegener, D. T. (1999). The elaboration likelihood model: Current status and controversies. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 41–72). New York: Guilford.

Rakowski, W., Dube, C. E., Marcus, B. H., Prochaska, J. O., Velicer, W. F., & Abrams, D. A. (1992). Assessing elements of women's decisions about mammography. *Health Psychology*, **11**, 111–118.

Resnicow, K., Davis, R., Zhang, N., Strecher, V., Tolsma, D., Calvi, J., et al. (2009). Tailoring a fruit and vegetable intervention on ethnic identity: Results of a randomized study. *Health Psychology*, **28**, 394–403. doi: 10.1037/a0015217

Rimer, B. K., & Kreuter, M. W. (2006). Advancing tailored health communication: A persuasion and message effects perspective. *Journal of Communication*, **56**, S184–S201. doi: 10.1111/j.1460-2466.2006.00289.x

Rockhill, B., Spiegelman, D., Byrne, C., Hunter, D. J., & Colditz, G. (2001). Validation of the Gail et al. model of breast cancer risk prediction and implications for chemoprevention. *Journal of the National Cancer Institute*, **93**, 358–366. doi: 10.1093/jnci/93.5.358

Sheeran, P., & Abraham, C. (2003). Mediator of moderators: Temporal stability of intention and intention-behavior relation. *Personality & Social Psychology Bulletin*, **29**, 205−215. doi: 10.1177/0146167202239046

Skinner, C. S., Strecher, V. J., & Hospers, H. (1994). Physicians' recommendations for mammography: Do tailored messages make a difference? *American Journal of Public Health*, **84**, 43−49. doi: 10.2105/AJPH.84.1.43

Sohl, S. J., & Moyer, A. (2007). Tailored interventions to promote mammography screening: A meta-analytic review. *Preventive Medicine*, **45**, 252−261. doi: 10.1016/j.ypmed.2007.06.009

Stewart, S. L., Rakowski, W., & Pasick, R. J. (2009). Behavioral constructs and mammography in five ethnic groups. *Health Education & Behavior*, **36**(Suppl. 5), 36S−54S. doi: 10.1177/1090198109338918

Strecher, V. J., Shiffman, S., & West, R. (2006). Moderators and mediators of a Web-based computer-tailored smoking cessation program among nicotine patch users. *Nicotine & Tobacco Research*, **8**, S95−S101. doi: 10.1080/14622200601039444

Sundar, S. S., & Marathe, S. S. (2010). Personalization versus customization: The importance of agency, privacy, and power usage. *Human Communication Research*, **36**, 298−322. doi: 10.1111/j.1468-2958.2010.01377.x

Tam, K. Y., & Ho, S. Y. (2006). Understanding the impact of web personalization on user information processing and decision outcomes. *Management Information Systems Quarterly*, **30**, 865−890.

Updegraff, J. A., Sherman, D. K., Luyster, F. S., & Mann, T. L. (2007). The effects of message quality and congruency on perceptions of tailored health communications. *Journal of Experimental Social Psychology*, **43**, 249−257. doi: 10.1016/j.jesp.2006.01.007

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, **132**, 249−268. doi: 10.1037/0033-2909.132.2.249