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MATCHING HEALTH MESSAGES TO HEALTH LOCUS OF CONTROL BELIEFS FOR PROMOTING MAMMOGRAPHY UTILIZATION

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This field experiment examined the persuasiveness of matching health messages to individuals' health locus of control beliefs in an effort to promote screening mammography. Women ($N = 499$) who called the New England regional office of the Cancer Information Service were stratified by their health locus of control and randomly assigned to receive a telephone message and follow-up print materials matched to either an internal or external health locus of control orientation. As expected, women who received information consistent with their health locus of control beliefs generally were more likely to obtain a mammogram 6 and 12 months after the intervention than women who received information that was not consistent with their health locus of control orientation.

Keywords: Breast cancer; Mammography; Locus of control; Tailored; Persuasion

INTRODUCTION

About 1 in 8 women in the United States will develop breast cancer during their lifetimes. Breast cancer is the second leading cause of cancer death among American women, following lung cancer (American Cancer Society [ACS], 2002). At the time this study was conducted, the ACS, the National Cancer Institute (NCI), and other national health organizations recommended that women over the age of 40 obtain a mammogram every one to two years, and that women ages 50 and over obtain one annually (Murphy *et al.*, 1995). Mammography is likely the most effective screening behavior for breast cancer, and the recent increase in mammography utilization and early detection is thought to be a major reason that the death rate from breast cancer has fallen (ACS, 2002). Although the number of women who follow the recommendation has increased, only 67% of women in the United States ages 40

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and older had a mammogram within the past two years (NCI, 2001). Therefore, it is crucial to investigate effective ways to motivate women to adhere to this recommendation.

In an effort to inform and persuade individuals to perform early detection behaviors such as mammography, health educators traditionally have developed uniform health education materials for the general population. Although these standard materials provide important information to recipients, they do not take into account individual differences in psychological characteristics that could influence individuals' decisions to engage in health behaviors. The objective of the experiment described here was to determine whether educational messages matched to an important psychological characteristic of recipients could be especially effective at motivating mammography among callers to a cancer information line.

Health Locus of Control

In the experiment described here, we matched messages to recipients' health locus of control beliefs. Health locus of control refers to individuals' characteristic attributions of responsibility for their health. Individuals differ in the extent to which they believe that their health outcomes are determined primarily by their own behavior or by external forces. Individuals are described as "internals" if they believe that they are primarily in control of their health or as "externals" if they believe that powerful others, such as doctors and other health professionals, or chance is primarily responsible for their health outcomes (Wallston *et al.*, 1978). Individual differences in health locus of control have been linked to the performance of important health behaviors. Internals are more likely to engage in screening behaviors that allow for a greater degree of personal control, such as performing breast self-examinations. In contrast, externals are more likely to engage in screening behaviors that are dependent on health professionals, such as obtaining Pap smears (Bundek *et al.*, 1993).

Few investigators have examined the utility of health locus of control for developing health messages. In one study, participants in a weight loss program with an orientation that matched their health locus of control beliefs were more satisfied with the program and lost slightly more weight than participants in a mismatched program (Wallston *et al.*, 1976). Quadrel and Lau (1989) found that messages consistent with women's health locus of control beliefs were more likely to motivate breast self-exams, although this benefit was found primarily among internals. However, when a reminder message was delivered later, the results shifted dramatically.

Rothman *et al.* (1993) demonstrated that messages emphasizing an internal health locus of control were generally more effective in motivating middle-class, working women to obtain a screening mammogram than messages emphasizing an external health locus of control. However, they did not attempt to match individuals' health locus of control beliefs to messages that reflected these beliefs. In the current experiment, we examined this question by investigating whether matching health messages to individual differences in health locus of control enhances their effectiveness.

Communications Aimed at Increasing Mammography

Targeted communications attempt to match the content and presentation of messages to the characteristics of specified populations (Kreuter *et al.*, 1999), such as ethnicity

(e.g., Schneider *et al.*, 2001), in order to appeal especially to these groups. Messages matched to recipients' psychological characteristics have been somewhat effective in promoting mammography utilization. Rakowski *et al.* (1998) found that messages matched to recipients' stage in the behavioral change process according to the Transtheoretical Model (TTM; Prochaska and DiClemente, 1983) were significantly more effective than no educational messages and somewhat, but not significantly, more effective than standard messages for encouraging mammography. Similarly, stage-matched educational messages were more effective than no educational messages, but not appreciably more effective than standard educational messages, for improving repeat mammography screening (Clark *et al.*, 2002).

Messages matched to recipients' stage of change for promoting other health behaviors have produced similar findings. For example, stage-matched intervention materials were more effective in increasing the level of physical activity of college personnel than mismatched and control interventions (Blissmer and McAuley, 2002). The stage-matched intervention did not produce better results than a standard of care intervention, which was largely action-oriented and may have been inherently appropriate for this physically active sample (i.e., in the action and maintenance stages). Similarly, messages matched to recipients' stage of change according to the precaution adoption process model (Weinstein, 1988) were more effective than mismatched messages in increasing recipients' desire to test their homes for radon among recipients who were undecided about testing and in increasing test orders among individuals who had already decided to act (Weinstein *et al.*, 1998). Stage-matched messages have motivated stage transitions and smoking cessation for one week among smokers with high readiness to quit more often than mismatched messages, although these findings were only of borderline statistical significance (Dijkstra *et al.*, 1998). However, stage-matched messages were not especially effective in motivating quit attempts in smokers with low readiness to quit (Dijkstra *et al.*, 1998; Quinlan and McCaul, 2000). Although further investigation is needed to understand why stage-matched messages are not consistently more effective than standard of care messages, overall these studies demonstrate some utility for stage-matched messages for motivating health behavior. The effectiveness of matching message content with respect to other psychological characteristics, such as health locus of control, has not been investigated systematically.

The Present Field Experiment

We tested the hypothesis that messages designed to match recipients' health locus of control are more effective in promoting mammography utilization than mismatched messages. We conducted this field experiment through the NCI's Cancer Information Service, an ecologically relevant site in which information specialists routinely provide health information to callers. We targeted callers with a history of nonadherence to mammography guidelines because this is an especially important group of women to influence. Roughly half of the callers received mismatched messages, serving as a comparison group. The content of both the matched and mismatched messages was consistent with the standard NCI-developed messages, yet altered to emphasize differing health locus of control orientations. This atypical experimental design allowed us to account for the variance in mammography utilization due to an individual characteristic, a message characteristic, and the interaction between an individual

characteristic and a message characteristic. It was expected that an internally-oriented message is more motivating for internals, and an externally-oriented message is more motivating for externals. Therefore, the experiment was a two-way factorial design – individual health locus of control by message type. The "matching hypothesis" was that women receiving messages appropriate for their health locus of control beliefs are more likely to obtain mammograms 6 or 12 months later than women receiving messages not matched to their health locus of control beliefs.

METHOD

Participants

Female callers to the New England office of the Cancer Information Service (CIS) were asked questions to determine their eligibility for this experiment at the end of the regular CIS-provided service. A caller was considered eligible if she: (a) did not call the CIS for breast cancer information for herself, so the intervention could be delivered *proactively* to CIS callers, thereby capturing a sample who may not have been especially motivated to improve their mammography utilization status; (b) had not already participated in the study; (c) was not a current cancer patient, waiting for test results to determine cancer status, or taking tamoxifen, in order to avoid adding the potential burden of study participation during this stressful time in one's life; (d) was at least 41 years of age, so that mammography would be appropriate according to the general guideline; and (e) had received fewer than 50% of the lifetime mammograms she should have had given her age, if following the prevailing guideline. This final eligibility criterion enabled us to recruit a sample of women who were not adhering to the recommended guideline, and were in particular need of the intervention since they were less likely to be screened. In the past, focusing on women who have received fewer than 50% of the lifetime mammograms has enabled us to recruit, at an acceptable accrual rate, an appropriately sized sample whose behavior could (and should) be influenced (Banks *et al.*, 1995; Schneider *et al.*, 2001).

If, during the course of the regular-service telephone conversation, callers were deemed ineligible based on the aforementioned criteria, they were not asked the eligibility questions. A total of 3305 callers were asked if they were willing to answer the eligibility questions, and 158 (5%) refused. Of the remaining 3147 callers, those women who had already participated in the study were excluded (3%), as were those who were current cancer patients, waiting for test results to determine cancer status, or taking tamoxifen (3%). In keeping with eligibility criteria, those women who refused to report their age and those women younger than 41 years of age were excluded (26%). Callers were also asked about the number of mammograms they had had in their lifetime, and those women who refused to answer (1%) and those women who had received at least 50% of the lifetime mammograms they should have had given their age (67%) were excluded from the study.

Of the 708 women who met all of the eligibility criteria, 499 (71%) agreed to participate and were randomized to one of the intervention arms. Three hundred and ten participants (310/499 = 62%) completed and returned at least part of the follow-up questionnaire. Two hundred and forty participants (240/499 = 48%) were reached six months later for the behavioral follow-up. By the 12-month follow-up, 233 participants (233/499 = 47%) were reached.

Procedure

Trained information specialists at the CIS collected the baseline data. They invited CIS callers to participate in the study after their regular service was completed. Eligible and consenting callers answered a baseline telephone survey and listened to a brief, randomly-assigned health message (targeted toward either an internal or external health locus of control). A few days later, participants received a packet by mail containing a targeted brochure (consistent with the type of message delivered over the phone), a similarly targeted refrigerator magnet, and a questionnaire. Participants who completed and returned at least part of the questionnaire were provided $10 compensation.

Six months after the baseline assessment, participants were contacted. During brief follow-up telephone interviews, mammography utilization since baseline was assessed. Participants who could not be reached by phone were mailed a stamped, pre-addressed postcard requesting their mammography utilization status. At 12 months, the participants who had not yet obtained a mammogram after 6 months were re-contacted. Participants reached at either follow-up wave or both were included in the analyses cumulatively.

Message Development

In order to develop the messages used in the baseline telephone interview, mailed brochure, and refrigerator magnets, standard educational materials developed by the NCI as the most current and scientifically sound advice were acquired. Then, websites, brochures, and public statements from the Centers for Disease Control and Prevention (CDC) and the ACS were reviewed as well to glean any additional information, and to ensure that the messages were up-to-date. The next step was to target these messages toward either an internal or an external health locus of control, holding actual information about cancer and mammography constant. The brochure targeted to internals, entitled "The Best Thing *You* Can Do For Your Health – Mammography," underscored the woman's responsibility for her health, parallel to the internal health locus of control belief that individuals are responsible for their own health outcomes. The brochure targeted to externals, entitled "The Best Thing Medical Science Has to Offer for Your Health – Mammography," emphasized that the responsibility for maintaining health is in a woman's partnership with her health care provider, which corresponds to the external health locus of control belief that doctors and other health professionals determine health outcomes. Example sentences from the two types of messages are provided in Table I.

Measures

Telephone Assessments

After determining that callers met eligibility criteria, participants answered baseline survey items over the telephone. Because the length of the baseline telephone intervention and survey was limited by CIS restrictions to a total of 7 minutes, it was not possible to assess the following constructs utilizing multiple-item scales. These constructs, some of the more likely determinants of breast cancer screening as suggested from prior research, were assessed prior to the intervention so their influence could be accounted for. Because nonpathological (moderate) worry about breast cancer gener-

TABLE I   Samples of the content of the targeted messages

Internal health locus of control	*External health locus of control*
The responsibility for maintaining your good health belongs to you.	The responsibility for maintaining your good health resides in your partnership with your health care provider.
If your doctor doesn't suggest a mammogram, it's up to you to raise the issue.	If your doctor doesn't suggest a mammogram and you don't feel comfortable raising the issue, have someone you trust, like a friend or family member, help you raise the issue.
You hold the key to your health. Schedule a mammogram today!	Health care providers hold the key to your health. Schedule a mammogram today!

ally facilitates mammography utilization (Lerman and Rimer, 1995; McCaul *et al.*, 1996; Deifenbach *et al.*, 1999), we included a single item that measured the extent of participants' agreement that they *worry* about developing breast cancer with a 5-point scale ranging from *strongly disagree* (1) to *strongly agree* (5). Similarly, perceived risk (Rosenstock, 1974) or perceived vulnerability (Leventhal, 1965) for developing breast cancer is positively associated with mammography utilization among some groups of women (McCarthy *et al.*, 1996; Royak-Schaler *et al.*, 1996; but see Duke *et al.*, 1994; Deifenbach *et al.*, 1999). In order to assess *perceived risk of breast cancer*, participants indicated their agreement that they are likely to get breast cancer in the future on a 5-point scale ranging from *strongly disagree* (1) to *strongly agree* (5). Finally, behavioral intentions are hypothesized by the Theory of Reasoned Action (Ajzen and Fishbein, 1980) to predict behavior, and they have been shown to predict repeat mammography (Drossaert *et al.*, 2003). Participants were asked if they expected to schedule a mammogram when next due for one and responded on a scale of *strongly disagree* (1) to *strongly agree* (5), serving as a measure of *intentions*. Immediately following the information specialists' presentation of the targeted messages, participants were asked to rate their agreement with a statement that the message was *interesting* using a scale of *strongly disagree* (1) to *strongly agree* (5).

Mailed Questionnaire

Three items with the highest factor loadings on the internal subscale of Form C of the Multidimensional Health Locus of Control Scales (Wallston *et al.*, 1994) served as the *health locus of control* measure on which participants were stratified (Cronbach's alpha = 0.67). A median split of the scores on this subscale was used to distinguish between those callers who were oriented toward an internal *versus* an external health locus of control.

   As part of the questionnaire included in the follow-up packet, participants evaluated the brochure. They described the brochure's *focus* by answering the question, "How much did the brochure focus on you, versus your health care provider, as being responsible for your health?" (1 = *mostly on health care provider*; 5 = *mostly on you*). It was expected that the group who received the internally-oriented message would rate the focus as being mostly on them, and that the group who received the externally-oriented message would rate the focus as being mostly on the health care provider. Single items also were used to measure the brochure's *believability* and *interestingness*. Three items were used to assess emotional reactions to the brochure

including how *reassured*, *anxious*, and *hopeful* the brochure made them feel ($1 = not$ *reassured/anxious/hopeful*, $5 = extremely$ *reassured/anxious/hopeful*). We hoped to find no differences between messages groups in their ratings of *believability*, *interestingness*, or *emotional reactions*, in order to rule out these potential confounds.

Subjective norms were assessed with a single question that asked, "Do the women who you know best get mammograms every year?" ($1 = none$; $5 = all$). This item differs from the way the construct is typically operationalized in health behavior models; it measures more of a descriptive norm, the individual's belief regarding whether or not significant others are engaging in the proscribed behavior, than an injunctive norm, the individual's belief regarding what significant others think they should or should not do (Ajzen and Fishbein, 1980). In addition, two open-ended items requested the number of mammograms women had received since age 40 and within the last two years (the best fit with the recommended guideline). These measures of *prior mammography use* seemed to tap into two aspects of prior behavior that are somewhat separable (r (263) $= 0.55$), but relevant to the design of this study.

Behavioral Follow-up

Six months following the baseline assessment, participants were contacted via telephone to determine whether they had obtained a mammogram. Participants who had not obtained a mammogram and participants who could not be reached by 6 months were contacted after 12 months.

Statistical Analysis

First, we examined the demographic characteristics of the sample. Next, we checked for differences between the message groups prior to the message manipulation, and tested for significant associations between baseline variables and mammography utilization at 6 and 12 months. Then, we verified the efficacy of the message manipulation. Finally, differences in mammography utilization at 6 and 12 months due to matching the message type to participants' health locus of control were assessed using chi-square and logistic regression analyses. Separate logistic regression models were calculated for the 6- and 12-month behavioral follow-ups. Only those individuals for whom we had complete data were included in the analyses examining mammography utilization status at the 6- and 12-month follow-ups.

RESULTS

Description of the Sample

The mean age of the 499 participants was 57 ($SD = 11.32$; range $= 41–80$). Additional demographic information was gathered for 39% of the callers (sampled randomly) as part of the CIS's usual data collection procedure. The 197 callers who provided full demographic information were similar in age to the full sample ($M = 58.77$, $SD = 11.77$). Ninety percent of sampled participants were White, 4% African-American, 2% Hispanic, 2% American-Indian or Alaskan Native, and 2% from other ethnic groups. The sample was fairly well educated. Although few had

attended graduate school (11%), 23% of those sampled were college graduates, 28% had attended some college, and 29% were high school graduates. Only 5% reported that they only had attended some high school, and 4% only had attended grade school.

Participants who were lost to follow-up at 6 months reported lower baseline intentions to schedule a mammogram, $M = 3.85$, $SD = 1.20$ *versus* $M = 4.20$, $SD = 0.93$, $F(1, 475) = 12.64$, $p < 0.001$, than those who were reached at the 6-month follow-up. They were also more likely to be Caucasians than members of other ethnic groups ($\chi^2(1) = 4.99$, $p < 0.05$). Participants lost to follow-up at 12 months reported lower intentions at baseline ($M = 3.92$, $SD = 1.01$ *versus* $M = 4.16$, $SD = 1.09$; $F(1, 475) = 5.74$, $p < 0.05$). They also tended to report fewer mammograms in the past 2 years ($M = 0.87$, $SD = 0.74$ *versus* $M = 1.33$, $SD = 0.81$; $F(1, 289) = 15.88$, $p < 0.001$) and fewer lifetime mammograms ($M = 3.97$, $SD = 6.16$ *versus* $M = 5.70$, $SD = 5.71$; $F(1, 271) = 4.17$, $p < 0.05$). Loss to follow-up was not associated with participant health locus of control, message type, or their interaction at either follow-up time, so we can assume that differential drop-out did not compromise the internal validity of this experiment. Nonetheless, we included an intent-to-treat data analytic strategy that considered callers who dropped out of the experiment as not obtaining a mammogram.

Participants' health locus of control scores were calculated by summing the responses for the three health locus of control questions. Scores ranged from 3 to 15 ($M = 12.00$, $SD = 2.52$) with a median of 12. A median split of scores was used to classify participants as having an internal or external health locus of control, with participants scoring below 12 classified as having an external health locus of control and those scoring 12 or above classified as having an internal health locus of control. The external health locus of control group had a mean score of 10.11 ($SD = 1.95$), and the internal health locus of control group had a mean score of 14.11 ($SD = 0.85$).

Associations between Baseline Variables and Mammography

At baseline, the women assigned to the externally-oriented message ($M = 3.36$, $SD = 1.19$) reported significantly more worry about developing breast cancer than the women assigned to the internally-oriented message ($M = 3.12$, $SD = 1.25$; $F(1, 493) = 4.57$, $p < 0.05$). Similarly, at baseline, the women assigned to the externally-oriented message ($M = 2.50$, $SD = 1.01$) reported significantly greater perceived risk for breast cancer than the women assigned to the internally-oriented message ($M = 2.29$, $SD = 0.95$; $F(1, 496) = 5.53$, $p < 0.05$). There were no significant differences in baseline intentions between the message groups ($F(1, 475) = 0.22$, ns); overall, participants expected that they would schedule a mammogram at their next due date ($M = 4.17$, $SD = 1.11$). The baseline differences in worry and perceived risk were controlled for in all subsequent analyses.

Correlational analyses revealed significant associations between baseline variables and obtaining a mammography by the 6- and 12-month follow-ups. The zero-order correlations and point-biserial correlations showing these relationships with mammogram status at 6 and 12 months are reported in Table II. When significant, these variables were entered into the logistic regression analyses at the 6-month or 12-month time point, as appropriate.

TABLE II Correlations among baseline variables associated with obtaining a mammogram 6 and 12 months after participating in the intervention

	Mammography use since age 40	Age	Baseline intentions	Baseline worry	Baseline perceived risk	Subjective norms	Mammography use past 2 years	Obtained mammogram in last 6 months
Age	0.57***							
Baseline intentions	0.28***	0.03						
Baseline worry	−0.07	−0.13**	0.22***					
Baseline perceived risk	−0.02	−0.06	0.22***	0.43***				
Subjective norms	0.31***	0.22***	0.27***	0.00	0.08			
Mammography use in past 2 years	0.55***	0.28***	0.39***	0.04	0.05	0.40***		
Obtained mammogram in last 6 months	0.21**	0.20***	0.18**	0.06	0.05	0.22***	0.23***	
Obtained mammogram in last 12 months	0.28***	0.19**	0.34***	0.09	0.13*	0.31***	0.30***	0.65***

Correlations are Pearson correlations, except for those with *obtained mammogram in last 6 and 12 months*, which are point-biserial correlations. All tests are two-tailed.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. N's range from 213 to 495, but generally $N = 330$.

Message Evaluations

Participants assigned to the externally-oriented telephone message reported that the message was as interesting ($M = 4.28$, $SD = 0.76$) as those assigned to the internally-oriented message ($M = 4.28$, $SD = 0.69$; F (1, 489) $= 0.70$, ns). The follow-up brochures were also evaluated. As expected, there were significant differences in ratings of the brochures' perceived focus. Participants who read the brochure targeted to internals thought the brochure was focused mostly on the individual as responsible for getting a mammogram ($M = 4.27$, $SD = 0.93$), and those who read the brochure targeted to externals thought it was focused more on the health care provider as responsible for health ($M = 3.29$, $SD = 1.02$; F (1, 297) $= 75.48$, $p < 0.001$). There was neither a significant main effect of participant health locus of control nor a significant interaction effect on perceived message focus. There were no differences between the groups in terms of their evaluations of the believability or the interestingness of the brochures, or the emotional reactions elicited by the messages (i.e., how reassured, anxious, or hopeful participants felt after reading the brochure).

Post-Intervention Findings

Six Months

Of those participants reached at the 6-month follow-up, 40.4% reported that they had obtained a mammogram. The pattern of mammography use by condition, displayed in Figure 1, supported the general "matching hypothesis" motivating this experiment. At 6 months, the internally- and externally-oriented messages were similarly effective at encouraging mammography utilization (42.5 and 38.1%, respectively). And, internals and externals reported obtaining a mammogram to a similar extent (43.0 and 38.1%, respectively). However, internals who were exposed to the internally-oriented messages were most likely to report obtaining a mammogram (50.8%), second were externals who heard the externally-oriented messages (41.7%). Externals and internals who received mismatched messages, however, were less likely to report obtaining mammograms (34.9 and 34.0%, respectively).

To test the hypothesis that a matched message would be more persuasive than a mismatched message (i.e., that internally-oriented messages would be most effective for internals and externally-oriented messages would be most effective for externals), we conducted a logistic regression analysis, depicted in Table III. The independent variables included message type (targeted to internal *versus* external health locus of control), participant health locus of control (internal *versus* external), and their interaction. In addition, baseline variables significantly correlated with mammogram utilization at 6 months were included. The addition of the interaction of message type and participant health locus of control to the logistic regression model provided a significant improvement in fit over the model that only included the baseline variables and the main effects (ΔWald χ^2 (1) $= 3.91$, $p < 0.05$). This regression analysis also was conducted including the upper and lower tertiles on health locus of control, instead of a median split. A similar pattern of results was observed: message type ($b = 0.82$, $SE = 0.48$, $OR = 2.26$, $p = 0.09$), participant health locus of control ($b = 0.97$, $SE = 0.55$, $OR = 2.65$, $p = 0.09$), and their interaction ($b = 1.36$, $SE = 0.78$, $OR = 3.90$, $p = 0.08$) were borderline significant predictors in the final step of the model. Further, in an analysis with only the upper and lower quartiles of health locus of
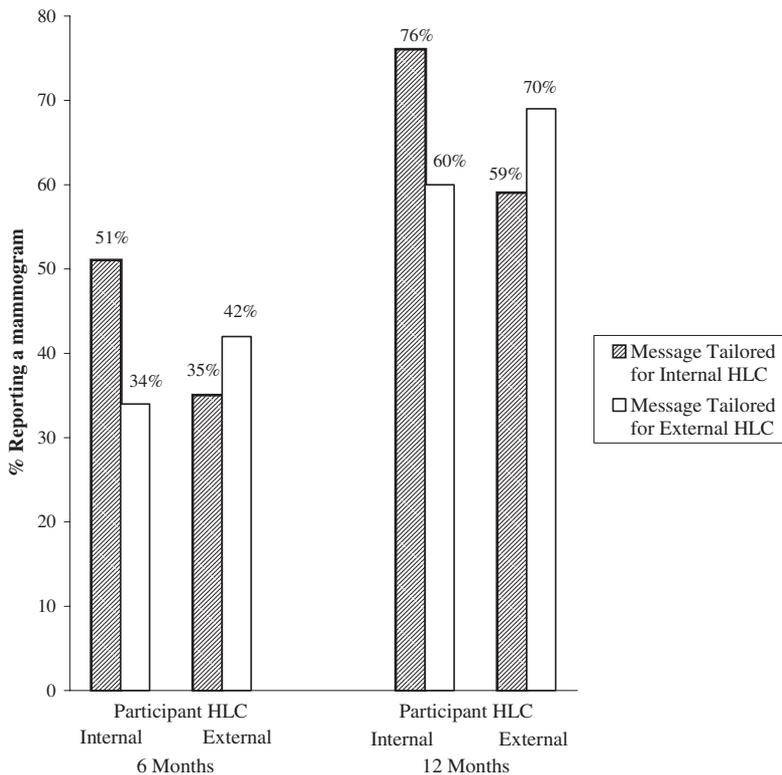
FIGURE 1   Percentage of women who reported obtaining a mammogram 6 and 12 months following the intervention, by participant health locus of control (HLC) and message type.

control included, the strength of the interaction of message type and participant health locus of control was consistent with the other analyses ($b = 1.68$, $SE = 0.94$, $OR = 5.34$, $p = 0.08$). These analyses suggest that although the predicted interaction did not always quite reach conventional levels of statistical significance, it appears to be a stable finding and not one due to some irregularity in the distribution of health locus of control scores.

Finally, we analyzed the data using an intent-to-treat analysis, in which those callers who were unable to be reached for the 6-month follow-up were coded as *not* obtaining a mammogram. In this analysis, the addition of the interaction of message type and participant health locus of control to the logistic regression model resulted in a significant improvement in fit over the model that only included the control variables and the main effects (ΔWald χ^2 (1) $= 4.08$, $p < 0.05$). The only significant predictors in the final step of this model were message type ($b = 0.85$, $SE = 0.45$, $OR = 2.34$, $p = 0.06$), participant health locus of control ($b = 0.98$, $SE = 0.44$, $OR = 2.67$, $p < 0.05$), and their interaction ($b = 1.27$, $SE = 0.63$, $OR = 3.55$, $p < 0.05$).

Twelve Months

By the 12-month follow-up, 66.1% of the participants reached informed us that they had obtained a mammogram. At 12 months, the internally- and externally-oriented

TABLE III Hierarchical logistic regression analyses predicting mammogram utilization by 6-month follow-up

Predictor	b	SE	Odds Ratio	95% CI	Model $\Delta\chi^2$	Model p
Step 1						
Mammography use since age 40	0.03	0.04	1.03	0.96–1.10		
Mammography use in past 2 years	0.01	0.24	1.01	0.63–1.63		
Age	0.01	0.02	1.01	0.98–1.05		
Baseline intentions	0.33	0.22	1.39	0.90–2.14		
Baseline worry	0.00	0.15	1.00	0.75–1.34		
Baseline perceived risk	0.01	0.20	1.02	0.69–1.49		
Subjective norms	0.40	0.22	1.50[†]	0.98–2.29	15.43	0.03
Step 2						
Mammography use since age 40	0.03	0.04	1.03	0.95–1.10		
Mammography use in past 2 years	0.06	0.25	1.06	0.65–1.72		
Age	0.01	0.02	1.01	0.98–1.05		
Baseline intentions	0.34	0.22	1.40	0.91–2.18		
Baseline worry	0.03	0.15	1.03	0.77–1.38		
Baseline perceived risk	0.04	0.20	1.04	0.71–1.53		
Subjective norms	0.40	0.22	1.50[†]	0.97–2.30		
Message HLC	0.24	0.34	1.20	0.63–2.29		
Participant HLC	0.37	0.34	1.52	0.79–2.95	1.91	0.39
Step 3						
Mammography use since age 40	0.04	0.04	1.04	0.96–1.12		
Mammography use in past 2 years	0.03	0.25	1.03	0.63–1.68		
Age	0.00	0.02	1.00	0.97–1.04		
Baseline intentions	0.33	0.23	1.39	0.88–2.17		
Baseline worry	0.20	0.15	1.02	0.76–1.37		
Baseline perceived risk	0.02	0.20	1.02	0.69–1.50		
Subjective norms	0.38	0.22	1.46[†]	0.95–2.24		
Message HLC (MHLC)	0.95	0.48	2.28[†]	0.91–5.75		
Participant HLC (PHLC)	1.02	0.47	2.79*	1.12–6.94		
Interaction of MHLC × PHLC	1.33	0.68	3.80*	1.00–14.38	3.91	0.05

[†]$p < 0.09$; *$p < 0.05$. HLC = Health locus of control. $N = 179$ due to missing values on some variables.

messages in the same way were effective at encouraging mammography utilization (66.9 and 65.2%, respectively). Comparable to the findings for the 6-month follow-up, internals were somewhat but not significantly more likely to report obtaining a mammogram than externals (68.5 and 63.9%, respectively). As shown in Figure 1, internals who were presented with the internally-oriented message were most likely to report obtaining a mammogram (75.9%), second were externals who received externally-oriented messages (69.5%). Internals and externals who were presented with mismatched messages were less likely to get mammograms (60.4 and 58.7%, respectively). This pattern of findings is consistent with the "matching hypothesis."

A logistic regression analysis, reported in Table IV, was conducted to see if the predictions held at the 12-month follow-up. The addition of the interaction of message type and participant health locus of control to the logistic regression model showed some improvement in fit over the model that only included the control variables and the main effects, although it was not statistically significant (ΔWald χ^2 (1) = 2.55, $p = 0.11$). Similar analyses were conducted including the upper and lower tertiles of health locus of control and including the upper and lower quartiles of health locus of control, instead of a median split. As with the results from the median-split analysis, message type remained a borderline significant predictor in the final steps of the models ($b = 0.90$, $SE = 0.54$, $OR = 2.47$, $p = 0.10$ and $b = 1.18$, $SE = 0.63$, $OR = 3.25$,

TABLE IV Hierarchical logistic regression analyses predicting mammogram utilization by 12-month follow-up

Predictor	b	SE	Odds Ratio	95% CI	Model $\Delta\chi^2$	Model p
Step 1						
Mammography use since age 40	0.07	0.06	1.07	0.96–1.19		
Mammography use in past 2 years	−0.05	0.28	0.95	0.55–1.65		
Age	−0.01	0.02	0.99	0.95–1.04		
Baseline intentions	0.77	0.24	2.16**	1.35–3.46		
Baseline worry	−0.10	0.18	0.90	0.64–1.27		
Baseline perceived risk	0.32	0.23	1.38	0.87–2.17		
Subjective norms	0.72	0.24	2.06**	1.29–3.29	47.60	< 0.001
Step 2						
Mammography use since age 40	0.07	0.06	1.07	0.96–1.19		
Mammography use in past 2 years	0.00	0.29	1.00	0.57–1.76		
Age	−0.01	0.02	0.99	0.95–1.04		
Baseline intentions	0.77	0.24	2.17**	1.35–3.47		
Baseline worry	−0.09	0.18	0.92	0.65–1.30		
Baseline perceived risk	0.37	0.24	1.44	0.90–2.30		
Subjective norms	0.71	0.24	2.03**	1.27–3.26		
Message HLC	0.33	0.38	1.39	0.66–2.96		
Participant HLC	0.29	0.39	1.33	0.62–2.85	1.19	0.55
Step 3						
Mammography use since age 40	0.07	0.06	1.08	0.96–1.20		
Mammography use in past 2 years	−0.05	0.29	0.96	0.54–1.69		
Age	−0.01	0.02	0.99	0.95–1.03		
Baseline intentions	0.78	0.25	2.18**	1.34–3.53		
Baseline worry	−0.11	0.18	0.90	0.63–1.28		
Baseline perceived risk	0.34	0.24	1.41	0.88–2.26		
Subjective norms	0.68	0.24	1.97**	1.23–3.16		
Message HLC (MHLC)	0.93	0.54	2.53†	0.87–7.30		
Participant HLC (PHLC)	0.90	0.55	2.45	0.83–7.25		
Interaction of MHLC × PHLC	1.22	0.77	3.40	0.75–15.32	2.55	0.11

†$p < 0.09$; *$p < 0.05$; **$p < 0.01$. HLC = Health locus of control. $N = 175$ due to missing values on some variables.

$p = 0.06$, respectively), but the interaction of participant health locus of control and message type was not significant.

The results of an intent-to-treat analysis of the 12-month data showed that when the interaction of message type and participant health locus of control was added to the logistic regression model, there was not a significant improvement in fit over the model that only included the control variables and the main effects (ΔWald χ^2 (1) = 1.65, ns). Participant health locus of control was a borderline significant predictor in the final step of the model ($b = 0.80$, $SE = 0.43$, $OR = 2.23$, $p = 0.06$) with internals being more likely to report obtaining a mammogram, but message type and the interaction of participant health locus of control and message type were not significant predictors. Overall, then, the matching hypothesis was supported 6 months after the messages were delivered but not after 12 months by which time, perhaps, the impact of this intervention had attenuated.

Finally, because differences exist in mammography recommendations for women ages 40–50 and women ages 50 and above and because in prior research on tailored interventions women in the different age groups have been shown to react differently to educational messages (e.g., Rimer *et al.*, 2002), we analyzed the data separately based on these age-specific recommendations. Similar to the 6-month findings for the entire sample, women ages 50 and above ($N = 129$) were more likely to report

mammography utilization when the message was consonant with their health locus of control orientation (ΔWald χ^2 (1) $= 3.08$, $p = 0.08$, $OR = 4.14$). Among the women less than 50 years old ($N = 50$), the interaction of message type by health locus of control did not significantly improve model fit (ΔWald χ^2 (1) $= 1.82$, $p = 0.18$), although the sample size was insufficient for a reliable test. By 12 months, analyses stratifying women by age revealed that the matching effect was stronger among women aged 50 and above than evidenced in other analyses (ΔWald χ^2 (1) $= 3.98$, $p < 0.05$, $OR = 6.06$). Among the women under 50 years old, the message-matching hypothesis did not hold (ΔWald χ^2 (1) $= 0.27$, $p = 0.60$, $OR = 0.33$). Taken together, these findings suggest that messages matched to women's health locus of control orientation generally were more effective in motivating mammography than mismatched messages, especially among women over age 50, and in this age group the effects held for the full 12 months.

DISCUSSION

This field experiment examined the effects of messages matched to an individual's health locus of control, an individual's attributions of responsibility for her health, on mammography utilization. Messages appropriately matched to women's health locus of control beliefs were, for the most part, more influential in promoting mammography than mismatched messages 6 and 12 months later. After 12 months, the effect was significant only among women aged 50 and over.

We found that matched messages, then, were more likely to motivate behavior, particularly among internals, as also reported by Quadrel and Lau (1989). According to Holt *et al.* (2000), externals respond with more negative thoughts than internals to messages directly addressing their lifestyle, but not in reaction to standard messages. This may explain why mammography utilization was not as high for the externals who received the matched messages.

The findings compare favorably to those of other studies that explored matching messages to psychological variables in an effort to increase mammography utilization (Rakowski *et al.*, 1998; Clark *et al.*, 2002). However, the findings from this field experiment are tempered by several considerations. First, they are limited in their generalizability. The sample was comprised primarily of white, relatively educated women. Because there was limited heterogeneity in the demographic background of CIS callers, the findings may not be generalizable to other ethnic and demographic groups. In addition, these women were seeking health information when they called the CIS for cancer-related information. This matching technique may not be as effective with other groups of individuals who are less interested or less motivated to obtain health information.

Second, the inclusion of a "standard of care" control group may have provided a stronger study design. In our study, the "mismatched" message group who received the discordant information served as a comparison group for the "matched" message group. It does not appear that the mismatched group provided an overly generous comparison. Recall that every woman in this sample was recruited because her prior probability of obtaining a mammogram was less than 50%. The overall adherence rate of 66.1% at the 12-month follow-up in this study (with all 4 groups of callers > 50%) represents a significant increase over baseline (χ^2 (1) $= 9.26$, $p < 0.01$),

suggesting that participants increased their mammography utilization over their base rates even when messages were mismatched.

Despite a financial incentive and multiple attempts to contact participants, the retention rate in this study was not optimal. There was no face-to-face contact with study participants; all contact was made over the telephone or through written materials, which might have resulted in less commitment by participants to remain in the study. Further, the primary outcome measure was self-reported mammography use, which always raises concern about the validity of the measure. There is some evidence, however, that self-reports of mammography utilization are valid and reliable (King *et al.*, 1990; Barratt *et al.*, 2000).

It is unfortunate that the utilized measure of health locus of control was included in the follow-up packet rather than at baseline. However, health locus of control is thought to be a relatively stable disposition (Wallston *et al.*, 1994). Within this experiment, the type of intervention message was not related to participant health locus of control (F (1, 152) = 0.40, ns) among the women who obtained mammograms by 12 months, ruling out the concern that participants who were motivated to get mammograms became more internal or more external in orientation as a result of the message they received. It is perplexing that the effect sizes were not higher for the tests of the more extreme health locus of control groups. The analyses conducted using the upper and lower tertiles of health locus of control and using the upper and lower quartiles of health locus of control did not improve the findings, suggesting that, psychometrically, the scale may not be sensitive enough to discriminate subgroups optimally. The use of an abbreviated scale may have contributed to these findings. Although, the health locus of control scale was valid – we used the three items with the highest factor loadings on the internal subscale of Form C of the Multidimensional Health Locus of Control Scales (Wallston *et al.*, 1994) – the alpha was less than ideal. Therefore, future research should use the full scale. We suspect that if a more reliable, complete measure had been used, it would have more effectively distinguished these subgroups.

Even with these considerations, the findings suggest ways for health communications practitioners to provide health information more effectively. They imply that health educators, such as the information specialists at the CIS, could readily incorporate this information into their usual service. The CIS information specialists could assess briefly health locus of control during a telephone interview. Then, they could mail follow-up brochures (as is common at the CIS) that match the recipients' health locus of control to yield an increase in health behaviors. Also, physicians, nurses, or other health care professionals could take this psychological characteristic into account when presenting patients with information. Finally, interactive websites that communicate personal health risk information could easily generate targeted responses, based on individuals' answers to a few items measuring their health locus of control. Future research should examine the long-term effects of messages matched to psychological characteristics. If minimal interventions, such as the one used in this experiment, have lasting effects, they would represent incredible cost-effectiveness in changing health behaviors.

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