Tailoring Messages and Design in a Web-Based Skin Cancer Prevention Intervention

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Abstract

Skin cancer is the most common and preventable form of cancer in the US. This study used a randomized experiment and four-week follow-up to evaluate a web-based computer-tailored intervention. Participants who received the tailored web page were more likely to have read the page and less likely to hold positive beliefs about tanning than participants who received a generic web page. Results suggest that web-based tailoring may hold promise for skin cancer prevention.

Introduction

More than one million new cases of skin cancer are diagnosed each year, making it the most common form of cancer in the United States (Skin Cancer Foundation, 1999). Yet, compared to other forms of cancer, skin cancer is the most preventable (American Cancer Society, 1999). This study used a randomized experiment to evaluate an innovative skin cancer prevention intervention that involved developing and delivering personally tailored skin cancer prevention messages to individuals over the World Wide Web. There have been few studies that have applied the technique of tailoring to skin cancer prevention, and no known experimental studies to date that have utilized web-based tailoring.

People can reduce their risk of skin cancer by limiting their sun exposure, using sunscreens, wearing protective clothing when exposed to sunlight, and avoiding artificial sources of UV light (US Department of Health and Human Services, 1991). College students are at high risk for future skin cancer due to their risky beliefs and behaviors related to the skin cancer prevention. Many college students believe that being tan is important and many report high rates of sun exposure (Hillhouse, Stair, & Adler, 1996), high use of tanning salons (Hillhouse, Adler, Drinnon, Turrisi, 1997), and low use of sunscreens (Buller & Borland, 1998).

One of the few things in the US growing much faster than new cases of skin cancer is the number of people using the Internet. In 2000, the Internet was used by an estimated 56% of Americans (Rainie & Packel, 2001), representing what may be the fastest adoption rate of any innovation in history (Rogers, 2000). As a communication medium, the Internet has the potential to revolutionize health education efforts because it can be used as a tool within existing health education models, frameworks, principals, and values (Bernhardt, 2000). One of the greatest strengths of Internet-based health education is the ability to take existing health messages and instantaneously deliver them over the web in a manner that is tailored to each user's specific needs, characteristics, and preferences.

This strategy of "tailoring" theoretically-informed health messages to peoples' unique characteristics has become possible with recent advances in computer technology, and has become popular with repeated demonstrations of its successful application. This process uses computers to match a person's measured attributes on selected psychosocial behavioral determinants with messages designed specifically for his or her attributes. In other words, a different health message is produced for each program participant that includes only those health messages that are appropriate for that participant. This approach has been applied to many public health issues including diet (Campbell, Bernhardt, Waldmiller, et al., 1999), physical activity (Bull, Kreuter & Scharff, 1999), cancer screening (Skinner, Strecher & Hospers, 1994), and smoking cessation (Strecher, Kreuter, Den Boer, et al., 1994).

Although tailored messages frequently have been found to be more effective than non-tailored messages for promoting individual-level behavior change, the improvements have been rather modest overall. One possible explanation for these moderate effects is that, despite being tailored, many individuals still do not pay close attention to the health messages they receive. For example, several studies of tailored messages have found that some participants did not remember receiving or reading their tailored health message (Campbell, Bernhardt, Waldmiller, et al., 1999; Kreuter & Strecher, 1996) and many did not realize that the

message was personalized for them (Brug, Glanz, Van Assema, et al., 1998). This study addressed these concerns by introducing a new level of tailoring designed to increase the attention people pay to the message.

One limitation of traditional tailoring is that the message *content* is tailored for individual recipients but the message *design* or presentation style is not. Failing to address design ignores a factor that may influence how people process their messages. Kreuter and colleagues (2000) have observed that this "…is roughly the equivalent of a clothing tailor taking a customer's waist, inseam, and outseam measurements to make a pair of trousers, but not asking about the preferred style, color, or fabric." Although these tailored pants may fit in size, they will probably not be worn unless they also fit with the owner's clothing preferences.

In order to create messages that fit people's measurements and preferences, this project created and evaluated websites that were tailored to individual's skin cancer prevention behaviors and beliefs and also to their message design preferences. It was hypothesized that people who receive a skin cancer prevention web page with tailored messages and design will pay greater attention to the information, which will lead to more healthy skin cancer prevention beliefs, than people who receive a non-tailored (i.e., generic) skin cancer prevention web page. This hypothesis was tested using a randomized experimental design with baseline and four-week follow-up self-assessment surveys.

Methods
Participants
Participants were recruited from eight undergraduate classes at a large southeastern university during the summer of 2000. Eligibility requirements included being at least 18 years old, being able to read English, and having access to the Internet at home or school. Participants who completed the study received a $10 honorarium. Of the 110 students who provided written informed consent to participate in the study, 102 completed the baseline survey (93%), and 84 completed the posttest survey (82%). One participant was removed from the dataset because he was an age outlier at 35 years old, resulting in a final sample size of 83 participants.

Theoretical Frameworks
Social Cognitive Theory (Bandura, 1986) informed the theoretical framework for the tailored messages. This theory has been used extensively for skin cancer prevention interventions (c.f., Parrott et al., 1998; Glanz et al., 1998; Mayer et al., 1997; Buller et al., 1994) and

features outcome expectations and self-efficacy as its two primary theoretical constructs. The theoretical framework for the tailored design elements was derived from health communication theories, including the Elaboration Likelihood Model (Petty & Caccioppo, 1986), that explain how people attend to and process health messages. Research in communications, skin cancer prevention, and adult learning styles suggests three important design factors that can affect message processing: the use of text vs. graphics (Carbone, 1999), the message source (Gerbert, Wolff, et al., 1997; DeBono & Talesca, 1990), and the message design style (Philpsen & Albrecht, 1997). The intervention in this study had participants at baseline indicate: (1) whether they should receive skin cancer prevention messages that are primarily text or a combination of text and graphics, (2) their preferred source for skin cancer prevention messages, and (3) the preferred design of their skin cancer prevention message.

Developing the Intervention
The process of developing a web-based tailored intervention involves exploring important characteristics and preferences of the target audience through systematic formative research, constructing a theoretical framework to inform the content and design of the measures and the messages, determining the message algorithms and constructing all of the possible messages, and developing the computer application that will collect the data, derive the tailored message, and deliver it over the World Wide Web. Two focus groups were conducted with undergraduate students to determine their characteristics and preferences about sun protection and to pilot test the study measures. Focus group questions explored the participants' beliefs about skin cancer, risk behaviors and settings, barriers to protective behaviors, popular language and phrases regarding tanning and skin cancer, trusted health information sources, the appropriateness of graphical images, and preferences regarding the design of prevention messages. The lessons learned from the focus groups informed the development and design of the tailored skin cancer prevention messages.

Each treatment group web page was composed of more than 20 tailored messages that were derived from more than 30 pieces of data from each participant, resulting in millions of possible message combinations. More than 125 unique text messages were written along with more than 90 unique images and headlines. The tailored messages were based on the constructs and principles of Social Cognitive Theory (Bandura, 1986) and focused on participants' expected outcomes of

regularly using or not using sunscreen and their perceived self-efficacy to regularly use sunscreen during their high-risk sun exposure behaviors.

Additional tailored messages addressed participants' skin cancer risk based on their self-identified skin tone, their specific high risk sun exposure behaviors, barriers to wearing sunscreen, perceived risk of skin cancer, and perceived personal involvement with the issue of skin cancer. In addition, all messages were written from the point of view of a source that participants selected from a number of choices at baseline, and a gender-matched photo of the source was included on the web page adjacent to the messages. Furthermore, participants selected the headline fonts and colors that appeared on their tailored web page. The source, font, and color choices were derived from findings from the formative research.

Program and Procedure

This study was implemented during the summer when participants would be more likely to experience outdoor activities. Participants who provided informed consent were given the web address of the project website and told to visit the site within one week. Participants who did not access the study web page were reminded first by e-mail and then by phone.

All data collection and message generation were administered over the World Wide Web. A computer programmer from the Office of Information Technology at the participating university created a program in Perl programming language that allowed participants to log into the site with their student number, randomly assigned them to the treatment or comparison group, administered the baseline survey, and immediately linked them to the appropriate web page: a web page with generic sun protection information for comparison group members or a newly generated tailored web page for each treatment group member.

Four weeks after completing the baseline, participants were contact by e-mail and asked to return to the project website to complete the follow-up survey. Four weeks were selected for the follow-up window because that time would enable the participants to process the messages and have some opportunity for sun exposure. Participants who did not complete the survey within one week were reminded first by e-mail and then by phone.

Measures

All measures were administered using automated forms over the World Wide Web. Most answers used "radio buttons" or "pull down lists" which required

participants to select on one answer from a series of choices. Each survey used a self-checking routine that required each user to answer every question. There were six categories of variables, some of which were measured at baseline, some at follow-up, and some at both.

Demographic information were collected only at baseline and included sex, age, race/ethnicity, and skin type. Choices for skin type included "only burn, never tan," "burn easily, tan minimally," "burn moderately, tan gradually," "burn minimally, always tan," "rarely burn, tan profusely," and "never burn, deeply pigmented." These choices were based on those using in the "sun care profile" (2000) available at drugstore.com.

Variables used for tailored message design were collected at baseline and were administered only to treatment group participants. Message source was determined by asking participants, "If you could get advice from one person about protecting your skin, who would it be?" Source choices were derived from those preferred by formative research participants and included a "dermatologist," "older person," "parent," "professional athlete," or "skin cancer patient." Font choices and colors also were derived from focus group data. To collect participant preferences, they were asked, "What font style would you prefer for messages about protecting your skin," and "What color would you prefer for messages about protecting your skin?" An example of each font choice (i.e., impact, matisse, and curlz) and color (i.e., blue, orange, and pink) was shown next to a radio button.

Perceived involvement was assessed at baseline and follow-up by asking participants, "How often do you think about protecting your skin," and answers ranged from "never" to "every day." Treatment group participants who were low involvement at baseline received photos on their web page of several different types of skin cancer lesions and treatment group participants who were high involvement at baseline received a paragraph with an in-depth description of the different types of skin cancer (basal cell carcinoma, melanoma, etc.).

Sun exposure risk behaviors were assessed at baseline by asking participants, "In the next 30 days, how often do you think you will perform each of the following behaviors?" The list of possible behaviors were derived from focus group findings and included "outdoor sunbathing," "outdoor swimming activities," "outdoor sports and recreation," "outdoor exercising," "yard work or gardening," and "other outdoor

activities." Answer choices included "never," "1-2 times," "3-5 times," "6-9 times," and "10 or more times."

Self-efficacy to wear sunscreen during risk behaviors was assessed by asking, "In the next 30 days, how easy will it be for you to use sunscreen when you are doing each of the following?" The same sun exposure risk behaviors categories from above were used and answer choices ranged from "very hard" to "very easy" or they could answer "not applicable." Previous behavior wearing sunscreen also was assessed for each of these risk behaviors by asking, "Last summer, how often did you wear sunscreen while you were doing each of the following?" Answers ranged from "never" to "always" with an option of indicating "not applicable."

The sun exposure risk behaviors and self-efficacy variables were used to create a "target risk behavior variable" for each participant that reflected the behavior they are likely to perform most often in the next 30 days with the least amount of efficacy to wear sunscreen while they are doing it. The tailored messages that each treatment group participant received specifically addressed that participant's target risk behavior.

A number of items were administered at the end of the follow-up survey to assess how participants' processed the web-based messages. They were first asked if they read any of the web-based messages. If they did read any of the web page, they were asked how much time they spent reading the web page, how much they liked the web page, how much they liked the message source, how personalized and relevant they found the web page, whether they followed any links from the web page, and the location from which they accessed the web page.

Sunscreen wearing behavior and self-efficacy to wear sunscreen also were assessed at follow-up for the six previously listed sun exposure risk behaviors. Behavior was assessed with a question that asked, "In the last 30 days, how often did you wear sunscreen while you were doing each of the following?" Answers ranged from "never" to "always" or "not applicable." These six items were combined to form a sunscreen behavior index (Cronbach's alpha = .76). Self-efficacy was assessed by asking, "In the future, how easy will it be for you to use sunscreen when you are doing each of the following?" Answers ranged from "very hard" to "very easy" or "not applicable." These six items were combined to form a sunscreen efficacy index (Cronbach's alpha = .81). The levels on these two

follow-up variables were examined specifically for each participant's target risk behavior variable.

Expected outcomes of wearing and not wearing sunscreen were assessed using the same questions at baseline and follow-up. Participants were asked "If you were to wear sunscreen regularly when out in the sun, how likely would you be to experience the following?" and "If you were NOT to wear sunscreen regularly when out in the sun, how likely would you be to experience the following?" The same three outcomes were listed for each question and were derived from the focus group data as things that the participants feared about sun exposure. They included "getting a sunburn," "getting wrinkled skin," and "getting skin cancer." Answer choices for each outcome ranged from "very unlikely" to "very likely." The outcomes under each question were combined into two three-items indices with Cronbach's alpha scores of .88 (wearing sunscreen) and .81 (not wearing sunscreen).

Barriers to wearing sunscreen were asked using the same questions at pretest and posttest and were based on focus group data and items from Parrott and colleagues (1998) and Hillhouse and colleagues (1996). Participants were asked, "How much do you agree or disagree with each of the following statements?" and could select answers ranging from "strongly disagree" to "strongly agree." The following barriers were assessed: "It is very important to be tan," "I feel more attractive when I am tan," "It takes a lot of effort to put on sunscreen," "It is hard to remember to put on sunscreen," and "I don't like the way sunscreen feels on my skin."

Data Analysis

All data were automatically stored in tab-delimited databases that were downloaded and imported into SPSS 9.0 for analyses. Hypothesized differences in message processing variables and sunscreen-related outcome variables were tested using either Chi square tests or F tests to compare differences of means.

Results

Participants

The average age in years of the participants was 21.6 (S.D. = 2.01) with a range of 19 to 30 years old. More than half of the participants (59%) were female. The self-reported racial/ethnic breakdown of the participants was 86% White, 8% African American, 2% Asian or Pacific Islander, 1% Hispanic, and 2% other race or ethnicity. When assessing their own skin types, 12% reported that they burn easily, 35% burn moderately, 29% burn minimally, and 24% rarely or never burn. At baseline, 19% of participants reported

that they never or rarely think about protecting their skin, 34% of participants sometimes think about protecting their skin, and 47% think about skin protection often or every day.

After random assignment, there were 47 participants in the treatment group (57%) and 36 participants in the comparison group (43%). There were no statistically significant differences between the groups by participant sex, race, age, skin tone, or personal involvement in sun protection. Most participants completed the baseline survey (53%) and the follow-up survey (49%) from a home computer. Slightly fewer used a computer at school for the baseline (43%) and the follow-up (43%), and small percentages used computers at work or other locations for completing the baseline (4%) and follow-up (7%) surveys.

Design Tailoring Variables

The most common "target behavior" for participants (i.e., the behavior for which they were at highest risk that was used for selecting the tailored message in the treatment group) was playing sports outdoors (40%), followed by sunbathing (19%), exercising (10%), yard work (7%), swimming (6%), and other unspecified behaviors (18%).

Treatment group participants selected their preferred message source, colors, and fonts at baseline and these choices were used to tailor the design of their web page. The most common source selected was dermatologist (83%), followed by a skin cancer patient (11%), a parent (4%), and an older person (2%). Two-thirds of the participants picked blue as the color for their messages and the rest evenly split between orange and pink (17% each). The vast majority of participants selected the simple san-serif font face called "impact" (89%), while 9% selected the artistic font called "matisse" and 2% selected the curvy font called "curlz."

Process Variables

A higher percentage of participants in the treatment group (81%) reported reading the information on their web page than did participants in the comparison group (61%). This difference was statistically significant ($P^2=3.97$, p<.05). For those that reported having read the page, there were no significant group differences with respect to the time spent reading the page or the extent to which they reported liking the page.

Participants in the treatment group reported a higher level of liking for the message source and this difference was approaching statistical significance (F=3.89; P<.055). Additionally, far more treatment group participants (29%) than comparison group

participants (13%) reported following one or more of the links from their web page. Treatment group participants reported that their web page had a higher degree of personalization than did comparison group participants (F=4.66, p<.05), however, comparison group participants reported that their web page had a higher degree of relevance (F=16.2, P<.001).

Outcome Variables

No significant differences were found between treatment and comparison groups at follow-up for sunscreen wearing behaviors, self-efficacy to wear sunscreen, or expected outcomes of wearing or not wearing sunscreen. Significant differences were found, however, for two of the five barriers to wearing sunscreen. Participants in the treatment group were less likely than participants in the comparison group to report that it is very important for them to be tan (F=7.59, p<.01) and that they feel more attractive when they are tan (F=5.95, p<.05).

Discussion

Skin cancer needlessly affects many Americans because it is a form of cancer that is completely preventable. The Internet now provides a means to deliver health information about skin cancer that is tailored to each individual's needs and preferences, and possibly more effective than other methods of health education, online or otherwise. This is the first known study to evaluate the effects of a web-based skin cancer prevention intervention with tailored messages and design.

Most previous computer-tailored interventions have measured each participant's characteristics on several psychosocial constructs and delivered messages, usually print-based, matched to those values (Kreuter, Oswald, Bull, & Clark, 2000). The current study integrated similar psychosocial-construct tailoring informed by Social Cognitive Theory with participant selections on several message design factors. Preferred message source, colors, and fonts were selected at baseline by treatment-group participants and incorporated into their tailored websites. By giving treatment group participants an opportunity to choose these aspects of their messages, they each received messages that reflected their own personal design preferences.

Although the participants' selections were heavily weighted towards a few specific choices (i.e., dermatologist, blue, and "impact"), the alternative choices reflected 17%, 34%, and 11% of the participants, respectively. In other words, if source, color, and font had been pre-selected by researchers

instead of selected by the participants, many participants would have received messages that were not as well matched to their personal needs or preferences. Furthermore, if the researchers had failed to select the *most popular* message aspects, then most of the participants would have received poorly matched messages. Additional research is needed to determine the differential effects between tailored messages informed by participant preferences versus tailored messages restricted to expert selections. Research also should explore the relative effects of allowing participants to select different aspects of their messages and should determine which message factors, if any, are most important to base on participant preferences.

In the present study, it was hypothesized that more people who received a skin cancer prevention web page with tailored messages and design would pay attention to the message than would people who received a non-tailored web page. This hypothesis was confirmed. About 80% of the participants reported reading the tailored web page compared to about 60% who reported reading the non-tailored web page. These findings are consistent with previous studies of print-based tailored interventions (Bull, Kreuter, & Scharff, 1999; Kreuter & Strecher, 1996; Campbell et al., 1994) and are significant because reading and attending to the message are necessary steps for the message to have any affect on one's beliefs and behaviors. Although there is an enormous amount of useful and worthwhile health information available on the Internet, virtually all of it is delivered in a non-tailored manner. If tailoring messages and design can increase the likelihood that these messages will be read, then information seekers would benefit from health information websites that incorporate a tailored approach. Further research should experiment with different aspects of tailoring messages and design to determine the simplest and least expensive approach to web-based tailoring that can have similar effects.

Another finding from this study was that significantly more treatment group participants reported that they followed a web link from the page, liked the source of the message, and perceived the page as personalized, than participants who received the generic web page. However, comparison group participants reported a higher level of perceived relevance for their skin cancer prevention web page than treatment group participants. One possible explanation for this unexpected finding is that because treatment group participants paid closer attention to their tailored web pages than comparison group participants did to their

generic web pages, the treatment group web pages were more heavily scrutinized. By processing the tailored message more centrally, treatment group participants may have been more likely to find aspects of the web page that they did not perceive as personally relevant (despite our best efforts to make them so). Conversely, information in the generic message may have been less thoroughly scrutinized because it was intentionally designed to be appropriate for everyone. Further research is needed to explore whether perceptions about relevance mediate message effects and if tailored and non-tailored messages are, in fact, processed differently.

Finally, it was hypothesized that people who received a skin cancer prevention web page with tailored messages and design would have healthier skin cancer prevention beliefs than people who received a non-tailored skin cancer prevention web page. This hypothesis was partially confirmed. Although there were no differences on sun protection behaviors, self-efficacy, or outcome expectations, there were significant differences between the groups on two sun protection barriers related to being tan. It is not surprising that the tailored intervention did not produce differences on the behavioral or Social Cognitive Theory variables because the overall "dose" of the intervention was so small. Nonetheless, the significant differences that were found on the two barrier variables, while not sufficient to produce behavior change, do demonstrate the potential of web-based tailored messages and design to positively affect beliefs. Future research should seek to replicate and expand this finding and should explore the potential effects of "higher dose" interventions that feature more information, interactivity, and exposure points.

There are a number of limitations that should be kept in mind when considering these findings. First, data were collected using self-report surveys on the World Wide Web and participants may have felt pressure to over report sun protection behaviors and underreport risk behaviors. These potential social desirability effects would have been mitigated, however, by the randomly-assigned experimental design, the confidentiality provided to the participants, and the fact that studies have found that people are more likely to accurately disclose sensitive information via computer-based data collection compared to interviews or paper and pencil surveys (Turner et al., 1998).

Another potential limitation of this study was the small dose of the intervention and the relatively small

sample size. The tailored message and design effects may have been stronger if the intervention had consisted of more than a single exposure to a mostly text-based web page. Additional power might have permitted the detection of additional differences between the groups and the exploration of within group differences. Nonetheless, the fact that several statistically significant differences were detected despite these limitations demonstrates the strong promise of web-based tailored messages and design for skin cancer prevention. Future research should build upon these findings and conduct larger studies with more comprehensive tailored interventions.

Acknowledgments

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