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Designing a Personalized Health Risk Communication Website to Motivate User Attention and Systematic Processing

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ABSTRACT

A web-based diabetes “risk calculator” is being developed and evaluated to determine the impact of personalized risk estimates and interactive feedback on user attention and systematic information processing. Preliminary experiments that randomized participants to two different health websites suggested that a risk calculator with personalized risk estimates did not increase (and may have decreased) systematic processing, focused immersion and information seeking. We describe a series of think aloud user studies which were conducted to provide a qualitative evaluation of the experimental protocol and explore alternate explanations for these unexpected findings. User study results suggested that the prior findings may have been driven by a lack of perceived novelty of the risk information, selective attention, and an expectation of personalization in both experimental conditions. Findings are consistent with satisficing in information search and have implications for the design of health information and future experiments that evaluate these types of interventions.

Keywords

consumer health informatics, information processing, information seeking, personalization, think-aloud

INTRODUCTION

Organizations advertise and publish e-health content with the goal of attracting and helping consumers make more informed health-related decisions and to motivate specific health-related behaviors. WebMD.com, a leading private e-health provider, offers an array of educational content that address topics including common ailments, acute and chronic diseases, fitness, and nutrition. Organizations such as the America Diabetes Association and the American Heart Association deliver information meant to motivate individuals to prevent and manage chronic disease. While much of the content provided by these organizations is similar to print health education materials, information technology allows designers to more effectively deliver personalized and interactive

content to consumers. For example, Microsoft’s HealthVault (www.healthvault.com) provides a central repository for a consumer to store information about physician visits, lab tests, prescriptions and other health records. This information can then be linked to third-party applications which provide tailored information such as blood pressure management, physician collaboration, or tracking of fitness and nutrition goals. These types of tools are increasingly important given shifts in health policy which emphasize informed patient decision making and patient ownership of personal health records. Given the unique nature of personal health decisions and related behavior, an important question remains: *How do the unique features of web-based health content influence users on important decision making and behavior-relevant dimensions such as attention, information processing, and perceptions?*

Generally, we assume that providers of online health information are interested in motivating users to systematically process, attend to, and explore the information being presented in their websites. Such usage behavior is more likely to lead to decisions that are consistent with preventive health objectives. In this paper, we discuss an ongoing line of work that aims to study how web-based instantiations of *personalized* pre-diabetes risk information and *interactive* feedback about that information influence important constructs of information usage. Pre-diabetes, a pre-cursor to diabetes, is a common and costly health condition that many people are initially unaware they suffer from.

According to the Heuristic-Systematic Model (HSM), systematic information processing is related to attitudes and behavior that are more resistant to change (Chaiken, 1980). Further, focused immersion, one dimension of Agarwal and Karahanna’s cognitive absorption model, describes the extent to which “attentional resources of an individual are focused on the particular task” (Agarwal and Karahanna, 2000). We believe these two theoretical constructs are relevant outcome measures for assessing the extent to which user’s are motivated to utilize the information contained in health risk websites. In addition

to these constructs which are typically measured using self-report scales, we are interested in an objective measure of information usage. We therefore measure user click activity as a means of assessing the extent to which people seek information within a health risk website.

Messages that are perceived as more relevant are more likely to be processed systematically and lead to stable attitudes and behavior (Petty and Cacioppo, 1986). Personalization has been used in health communication with the goal of increasing relevance and systematic processing and thus the impact of educational material (Kreuter and Wray, 2003). Researchers have also studied computer-based individually tailored interventions to improve health risk perceptions (Weinstein, Atwood, Puleo, Fletcher, Colditz and Emmons, 2004) and change behavior (Strecher, 2007). These studies often focus more on health behavior outcomes as opposed to interactions with technology and information seeking or processing. However both personalization and interactivity have been studied in e-commerce and computer-mediated-communication (CMC). Komiak and Benbasat show the positive effect of perceived personalization on cognitive and emotional trust and thus acceptance of product recommendations (Komiak and Benbasat, 2006). Real time responses, user control, connectedness, customization and playfulness have been discussed as attributes of technological interactivity (Dholakia, Zhao, Dholakia and Fortin, 2000; Kramer, Noronha and Vergo, 2000). We propose that both personalization and interactivity, in the context of health risk information, may work similarly to increase perceived relevance and motivate increased systematic processing, focused immersion and the amount of information explored. Previously, we hypothesized the following:

Hypothesis 1: Within a health risk calculator, Personalized estimates of pre-diabetes likelihood and interactive feedback about modifications to that risk will each motivate more systematic risk information processing, more focused immersion and more exploratory click activity (Harle, Padman and Downs, forthcoming).

Health risk calculators are personalized and interactive websites that collect personal health information and use that information to estimate a user’s likelihood of developing one or more conditions. These risk estimates

are typically presented using text and graphics. In our studies, we focus on interactivity that lets users find the marginal impact of hypothesized changes in their health status (such as losing 10 lbs or lowering blood pressure) on their risk estimates.

The diabetes risk calculator used in our studies collects information including age, sex, and weight and predicts the likelihood that the user currently has pre-diabetes. Inconsistent with our hypothesis, early results suggested that users who were randomized to personalized risk calculators read less health information, did not process information more systematically, and were not more attentive than users of a non-personalized condition. In the present study, six think-aloud user studies were conducted with layperson health consumers to further investigate these findings and inform the re-design of the personalized risk calculator. The think-aloud studies suggested the personalized website may have led users to attend to and process information less systematically due to selective attention to website features, a lack perceived novelty of the website as well as an expectation of personalization in the non-personalized condition. These results will be used to inform the re-design of our risk calculator intervention and supporting experimental design. Findings also have general implications for the design and evaluation of personalized and interactive educational websites.

METHODS

In prior work, we designed an experimental diabetes risk calculator website called “My Diabetes Risk” to mimic the layout and functionality of publicly available health risk calculators (e.g. www.diabetes.org/phd and www.yourdiseaserisk.wustl.edu). Within the calculator, the presence of personalized risk estimates and interactive risk feedback were manipulated in a series of web-based experiments which are described in (Harle, Padman and Downs, 2008, forthcoming; Harle, Padman and Downs, 2009, forthcoming). The design of those experiments is shown in Figure 1. (The conditions and outcomes that are relevant to the present study are bolded.) The experiment consists of a pre-intervention assessment, random assignment to one website version, and a post-intervention assessment. Participants were asked to complete the entire experiment in one sitting. Six

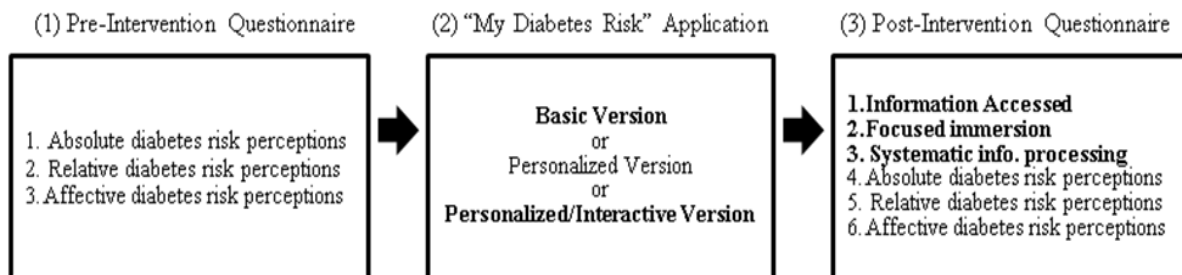


Figure 1. Experimental Design Overview

participants with no history of diabetes were recruited using e-mails sent to university staff members and to a research study participant pool. Participants were compensated with \$10 and followed the same basic protocol shown in Figure 1 except that participants completed the experiment in the presence of an experimenter and followed a think-aloud protocol (Ericsson and Simon, 1992). Three participants were assigned to the (A) *Basic* version (control condition) and three participants to the (B) *Personalized/Interactive* version (experimental condition). No users were assigned to the *personalized* version because all features of this version are contained within the *Personalized/Interactive* version. Both conditions consisted of a two-page website intervention where the first page was identical. Page 1 described pre-diabetes and the fact that many Americans are unaware that they have the condition. Page 1 also elicited the following personal health information: age, sex, race, height, weight, blood pressure, HDL cholesterol, history of hypertension, exercise frequency, diabetes family history, and smoking status. Page 2 differed between conditions. The *Basic* version gave users the average person's risk estimate (non-personal) and no interactive feedback about changing their risk (Figure 2). The *Personalized/Interactive* version used the personal health information to calculate and display the user's risk of currently having pre-diabetes (Figure 3). Predictions were generated using a logistic regression model described in (Harle et al., 2009, forthcoming). This version also provided interactive feedback that allowed users to change their weight, blood pressure, and cholesterol and activity level in order to see how changes to these values would affect their estimated risk of pre-diabetes.

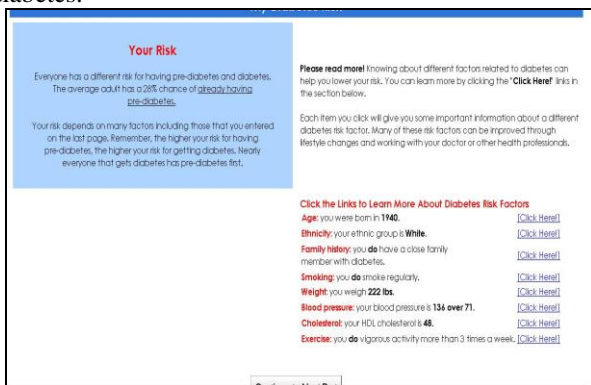


Figure 2. My Diabetes Risk – Basic condition (A)

Participants were instructed that the experiment was being tested (not the participant themselves) and that they should clearly express any thoughts about the survey questions or risk calculator. Before beginning, all six users indicated that they were comfortable with providing personal health information in the presence of an experimenter. After completing the experiment, participants were given the opportunity to use the

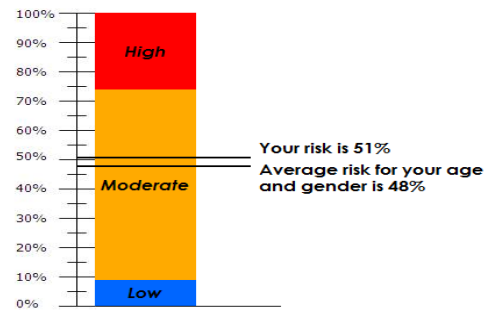


Figure 3. Risk graph for version B

alternate condition's risk calculator and provide any additional feedback about either website or the experimental protocol generally. Of primary interest in this evaluation was the content that the users focused on, the number of hyperlinks users clicked and self-reported systematic information processing and focused immersion. The number of links clicked refers to eight links on page 2 in both conditions. Each link opened a pop-up that contains basic educational text about a single diabetes risk factor. This provided an objective measure of the extent to which users sought additional information while using the website. Systematic processing was measured using a multi-item scale from prior risk communication studies (Kahlor, Dunwoody, Griffin, Neuwirth and Giese, 2003), and attention was measured using the focused immersion dimension of the cognitive absorption construct found in (Agarwal et al., 2000).

RESULTS

Table 1 details the outcomes of interest for the six participants. All were female perhaps due to the predominance of females in the recruitment pool. In terms of the number of risk factor links clicked, this small sample reflected a pattern found in earlier studies. Participants assigned to the control condition clicked more informational links than did users in the experimental condition. In terms of systematic processing and focused immersion, users were similar across conditions, but we see more links being clicked in the control condition. Clearly, definitive conclusions cannot be drawn from this sample, but qualitative results from the think-aloud interviews are given below.

Website Version	Age	Risk Estimate	Link Clicks (0-8)	Syst Info Proc (0-7)	Focused Immers. (0-7)
1. B	55	10%	3	5.2	7.0
2. A	38	13%	8	4.6	6.0
3. B	47	15%	3	5.6	6.2
4. B	53	24%	0	5.8	4.6
5. A	54	29%	7	6.4	7.0
6. A	60	27%	2	5	7.0

* A (control) condition users did not see risk estimate

Table 1. Participant Characteristics

Personalized/Interactive version (B)

While the measures of systematic information processing and focused immersion seemed to indicate that all of the users thoughtfully considered the content, their comments suggested more variance in their experiences. Instead of information usage being driven by differences in personal relevance between conditions, general relevance of diabetes and novelty of information were reported as the primary contributors to decisions to follow links, attend to and systematically process health information. Participant 1 remarked that diabetes was simply “not on the radar” relative to other health concerns. She reported clicking risk factor links out of curiosity. She spent time reading and talking about how family history and ethnicity impact risk, and she remarked she was interested because it was new information, not because it impacted her personally. It should also be noted that in the experiment’s pre-intervention survey, users were asked questions about their knowledge of the relationship between ethnicity, family history and diabetes risk. Participant 1 and 3’s comments suggested this pre-assessment may have biased their attention towards the ethnicity risk information in the risk calculator. They specifically commented that they read the ethnicity information because they were curious whether or not their survey answers were correct. In reference to the risk graph, Participant 1 said she “glanced at the graph ... understood it ... but didn’t dwell on it.” Participant 4, the third user of the personalized/interactive site, suggested the website content provided her with little new information. Having a husband with diabetes, she believes she is already well informed about diabetes. She did not click any of the risk factor links, believing that she already knew the information they contained. In terms of the website layout, she specifically commented that page 2 presented too much information, causing her to be selective in what she attended to.

Basic version (A)

Users of the basic version website expressed that much of the website information was uninteresting because it was

not novel. Participant 2 commented that the messages were important but “commonly known.” While she did click all eight risk factor links, her remarks suggested this was due to an expectation that the content would be personalized: “*Simply because it was an evaluation of my personal risk, I thought they would tell me something that I didn’t know.*” Participant 5, the second user assigned to the *Basic* condition read all eight risk factor links and also expressed belief that they would contain personalized information. For instance, she commented that the website was going to “yell at her” about her weight when she clicked the weight link. Participant 6 was the most adamant that she was uninterested in the website’s content. She commented that she preferred to skip all of the instructions and introductory information on page 1 and became “irritated” when the website did not allow her to continue without entering valid health values. When she arrived at page 2, she was initially interested, also expressing the belief that she would obtain personalized information. However, once she identified that the content was relatively non-personal, she skimmed over the risk factor links, repeatedly commenting “[I] don’t care” and clicked on only two links.

DISCUSSION

Consistent with prior work in psychology and tailored health messages, our ongoing line of research has hypothesized that website users who are provided with risk estimates that are personalized to their health status and with interactive feedback about ways to improve that risk would seek more information, be more immersed, and be more likely to systematically process messages. The current study sought to investigate why this hypothesis was not confirmed in prior online experiments. Six in-depth think-aloud interviews suggested that both website design and experimental design may at least partially explain these findings. First, the *Basic* version users may have been primed to seek out personalized information on page 2 of the risk calculator. It is plausible that entering a website called “My Diabetes Risk” and reporting personal health information may have created the expectation that the website was going to deliver customized feedback. Participants assigned to the *Basic* condition expressed this expectation while completing the study. This expectation may have then led them to click more informational links in search of customized content. On the other hand, participants in the personalized condition were immediately presented with their “personal risk estimate.” In this case, this estimate may have satisfied their expectations, making them more likely to exit the website without clicking as many risk factor links, immersing themselves in the website or systematically processing the risk messages. Also, one user of the personalized/interactive website commented that there was too much information, suggesting that the personalized risk estimates may not have motivated users to read more about diabetes risk factors. Instead, attending

to the graph may have satisfied the user's information needs and led her to decline to seek more information. These observations are consistent with the idea that users satisfice in information seeking (Simon, 1955).

Multiple design changes will be employed before re-testing our risk calculator in large sample studies to determine the effects of personalization and interactivity on information usage. The first change is to split up the website content so that it covers more than two pages. Each page will be dedicated to a specific task such as "introduction to this website," "see your personalized risk estimate" and "learn more about diabetes risk factors." Separating each component may ensure that users are less likely to be overloaded and selectively attend to specific elements. Further, only key instructional and educational messages will be highlighted in order to reduce the potential for confusion or misunderstanding about each condition's content and purpose, providing a cleaner manipulation.

Prior experiments were designed to address the specific marginal impact of receiving a personalized risk estimate. However, this led us to design a control website that used language and features which may have created an expectation of personalization where one was not intended. Think-aloud interviews suggest that this expectation may have increased information seeking. Future studies will employ a completely non-personalized condition that avoids this expectation. This may help clarify the effects of different depths of personalization on information usage. Future experiments will also minimize the potential for pre-intervention assessments to bias immersion, information seeking and processing.

Interestingly, current and prior results may suggest one unexpected motivator of attention and systematic information processing. It may be that simply asking users questions about their health status and then *not* providing them with personalized summary information could be a useful strategy for engaging users, at least initially. We observed that giving users personalized risk estimates may have induced the perception that they completed the intended task when in fact they may have benefited from reading more detailed information that gives them a better understanding of how to mitigate health risks. These findings are, of course, preliminary and will be formally tested in future large sample experiments.

CONCLUSION

Results from think-aloud interviews helped to clarify early results that were inconsistent with hypotheses on the value of personalization and interactivity in motivating information usage within a health risk calculator website. Findings suggest it may be important to complement personalized risk estimates with simple designs, instructions and clear objectives and to guide users not

only to attend to the personally relevant content but also to engage with non-personal messages that are written to complement personalized information. These results have implications for future evaluations of health information websites that utilize personalized and interactive content.

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REFERENCES

1. Agarwal, R. and Karahanna, E. (2000) Time Flies When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage, *MIS Quarterly*, 24,4, 665-694.
2. Chaiken, S. (1980) Heuristic versus systematic information processing and the use of source versus message cues in persuasion, *Journal of Personality and Social Psychology*, 39,5, 752-766.
3. Dholakia, R. R., Zhao, M., Dholakia, N. and Fortin, D. R. (2000) Research Institute for Telecommunications and Information Marketing.
4. Ericsson, K. and Simon, H. (1992) *Protocol analysis: verbal reports as data*, MIT Press, Cambridge, MA.
5. Harle, C., Padman, R. and Downs, J. (2008, forthcoming) The Impact of Web-Based Diabetes Risk Calculators on Information Processing and Risk Perceptions, *Proceedings of the 2008 American Medical Informatics Association (AMIA) Symposium*, Washington, DC.
6. Harle, C., Padman, R. and Downs, J. (2009, forthcoming) Design, Implementation, and Preliminary Evaluation of a Web-based Health Risk Calculator, *Proceedings of the 42nd Annual Hawaii International Conference on Systems Sciences (CD-ROM)*, Big Island, Hawaii.
7. Harle, C., Padman, R. and Downs, J. (forthcoming) Design, Implementation, and Preliminary Evaluation of a Web-based Health Risk Calculator, *Hawaii International Conference on Systems Sciences*, Big Island, Hawaii.
8. Kahlor, L., Dunwoody, S., Griffin, R. J., Neuwirth, K. and Giese, J. (2003) Studying Heuristic-Systematic Processing of Risk Communication, *Risk Analysis*, 23,2, 355-368.
9. Komiak, S. Y. X. and Benbasat, I. (2006) The Effects of Personalization and Familiarity on Trust and Adoption of Recommendation Agents, *MISQ*, 30,4, 941-960.
10. Kramer, J., Noronha, S. and Vergo, J. (2000) A User-Centered Design Approach to Personalization, *Comm of the ACM*, 43,8, 45-48.
11. Kreuter, M. W. and Wray, R. J. (2003) Tailored and Targeted Health Communication: Strategies for

- Enhancing Information Relevance, *American Journal of Health Behavior*, 27, Supplement 3, S227-S232.
12. Petty, R. and Cacioppo, J. (1986) *Communication and Persuasion: Central and Peripheral Routes to Attitude Change*, Springer-Verlag, New York.
 13. Simon, H. (1955) A behavioral model of rational choice, *Quarterly Journal of Economics*, 69,1, 99-118.
 14. Strecher, V. J. (2007) Internet methods for delivering behavioral and health-related interventions (eHealth), *Annual Review of Clinical Psychology*, 353-76.
 15. Weinstein, N., Atwood, K., Puleo, E., Fletcher, R., Colditz, G. and Emmons, K. (2004) Colon Cancer: Risk Perceptions and Risk Communication, *J. Health Comm*, 9,1, 53-65.