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Interactive graphics to demonstrate health risks: formative development and qualitative evaluation

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Abstract

Background—Recent findings suggest that interactive game-like graphics might be useful in communicating probabilities. We developed a prototype for a risk communication module, focusing on eliciting users' preferences for different interactive graphics and assessing usability and user interpretations.

Methods—Focus groups and iterative design methods.

Results—Feedback from five focus groups was used to design the graphics. The final version displayed a matrix of square buttons; clicking on any button allowed the user to see whether the stick figure underneath was affected by the health outcome. When participants used this interaction to learn about a risk, they expressed more emotional responses, both positive and negative, than when viewing any static graphic or numerical description of a risk. Their responses included relief about small risks and concern about large risks. The groups also commented on static graphics: arranging the figures affected by disease randomly throughout a group of figures made it more difficult to judge the proportion affected but was described as more realistic.

Conclusions—Interactive graphics appear to have potential for expressing risk magnitude as well as the affective feeling of risk. Quantitative studies are planned to assess the effect on perceived risks and estimated risk magnitudes.

INTRODUCTION

Communicating about risks is an important part of health promotion, decision support, informed consent, and other health communication activities. Perceived risk is a potential motivator of health behavior change in many health models (Becker, 1974; Weinstein 1988; Witte, 1992), and a recent meta-analysis confirmed that perceived risk has a strong relationship with behavior (Brewer et al., 2007). Patients should be able to understand and compare risks when making decisions such as choosing between treatments (Waters, Weinstein, Colditz, & Emmons, 2006), agreeing to screening tests (Woolf et al., 2005), understanding insurance alternatives or health-care quality indicators (Hibbard & Peters,

2003), and granting informed consent for treatment or research (Fuller, Dudley, & Blacktop, 2002).

Numeric and graphic descriptions of risk

Unfortunately, communicating accurately about risks is difficult. Numeracy skills such as arithmetic and ability to manipulate probabilities vary widely among the public (Ancker & Kaufman, 2007; Lipkus, Samsa, & Rimer, 2001; Schwartz, Woloshin, Black, & Welch, 1997). Numeracy and educational level are associated with comfort with (Gurmankin, Baron, & Armstrong, 2004; Weinstein et al., 2004) and understanding of (Grimes & Snively, 1999; Schwartz et al., 1997) probabilities, percentages, and rates.

Graphs can be useful in illustrating risks (Ancker, Senathirajah, Kukafka, & Starren, 2006; Lipkus & Hollands, 1999; Waters et al., 2006). However, graphical literacy skills often affect the ability to use information in graphs. For example, among samples from the general public, many were unable to calculate risks or differences between risks from survival graphs, a type of graphic used commonly for communicating with health professionals (Armstrong, Fitzgerald, Schwartz, & Ubel, 2001; Armstrong, Schwartz, Fitzgerald, Putt, & Ubel, 2002).

Matrices of squares, icons, or stick figures depicting the people affected by the hazard are generally considered more intuitive and less dependent on graphical literacy. Even in such matrix displays, format can strongly affect behavior and judgment. For example, graphs that display the number affected (numerator) without showing the total number at risk (denominator) are more effective in promoting risk-reducing behavior (Schirillo & Stone, 2005; Stone et al., 2003). Highlighting the figures affected by disease in a random arrangement produced larger estimates of risk magnitude than arranging them sequentially (Schapira, Nattinger, & McAuliffe, 2006). Elting et al found that physicians were more likely to act upon an association between a treatment and a negative outcome when data were presented as a matrix of squares than when they were presented as bar charts (Elting, Martin, Cantor, & Rubenstein, 1999). Interpretations and judgments of credibility can also be affected. Schapira et al found that some women viewing a matrix display thought the matrix showed the actual number of people from whom the information was derived, leading to judgments that the information was unreliable because it derived from a small sample (Schapira, Nattinger, & McHorney, 2001). Matrix graphs with randomly arranged figures were judged more “true” than those with sequentially arranged figures (Schapira et al., 2006).

As others have noted (Schapira et al., 2006), more systematic exploration of graphics is needed to delineate these format effects on comprehension, decision-making, and risk perception.

Interaction and involvement in risk communication

Graphics are often used to illustrate passive risk communications, that is, material to be read by patients or health consumers. By contrast, in active information processing, patients can engage with the information by manipulating it, elaborating on it, or acting on it. According to the elaboration likelihood model, attitude changes deriving from such active information

processing will be more stable and persistent than changes deriving from peripherally processed information (Petty & Wegener, 1999). Comprehension and other outcomes may also be affected. Emmons and colleagues found that a computer tool that allowed participants to input their own risk factors was effective in correcting misperceptions about personal risk for colorectal cancer (Emmons et al., 2004). In this study, patients using an active engagement version that allowed them to see the effects of altering their own modifiable risk factors were more accurate in their risk perceptions than patients using a passive version, although the effect was not statistically significant (Emmons et al., 2004). Natter and Berry invited participants to draw a graph to illustrate a numerical risk or to answer a reflective essay question about it. Such active processing improved understanding of and satisfaction with the information (Natter & Berry, 2005).

The experience of risk

A different perspective on the usefulness of active engagement with risk information comes from a recent set of choice behavior studies (Hertwig, Barron, Weber, & Erev, 2004; Weber, Shafir, & Blais, 2004). In these studies, experimenters assembled two decks of cards, each displaying the amount of money to be won by drawing that card. Participants could sample as many cards from the two decks as desired, then choose a deck to draw a card for a real monetary payoff. Decisions in this “learning from experience” paradigm were quite different from those made when risks were described in numbers or graphs. For example, as described in prospect theory (Kahneman & Tversky, 1979), people usually overweight the probability of rare events (for example, avoiding gambles that carry a small chance of losing a large sum, even if on average, such a gamble would be a good bet). However, they underweighted the probability of rare events when learning from experience (Hertwig et al., 2004; Weber et al., 2004). This effect has been suggested as a source of communication barriers between doctors, who may learn about medical events through personal experience, and patients, who learn about them through description (Hertwig et al., 2004).

Study purpose

Findings such as these suggest that dynamic, game-like graphics that permit user interaction may be an effective way of expressing quantitative risks for health communication. However, such laboratory findings do not provide specific guidance for the best design. In this project, we developed a prototype for an interactive risk communication module appropriate for Web-based health promotion. Our qualitative assessment was designed to explore consumer preferences for different interactive graphics, basic usability, and consumer interpretations of what they were seeing. These findings were also used to make changes in an iterative prototyping process, a type of formative research in software development in which the prototype is updated using user suggestions.

METHODS

We drew from two research traditions: social science qualitative methods with their focus on eliciting interpretations and meaning, and technology development with its focus on creating user-centered products (Ancker & Kukafka, 2007). Specifically, we sought to combine the advantages of traditional focus group research with those of a software development method

called scenario-based usability engineering (Nielsen, 1993; Rosson & Carroll, 2002). In scenario-based usability engineering, focus group participants meet with developers to discuss realistic stories (“scenarios”) describing individuals using a computer system to resolve real problems. The results are used to develop user-oriented specifications for the software and correct usability problems. Problems identified by one group of users are remedied immediately, so that the next group will test the changes and identify new issues. The goal is to maximize users’ contributions, not conduct a controlled experiment of usability. Small sample sizes are justified by Nielsen’s sample size formula: $P = 1 - (1 - p)^n$, where P is proportion of problems found, p is the probability an individual will find a problem, and n is the sample size (Nielsen, 1993). Under the assumption that any individual has a roughly 30% chance of finding a particular usability problem (an assumption based on Nielsen’s empirical findings with relatively simple systems), a sample as small as 3 can be expected to identify 67% of usability problems, and a sample of 5 should catch 84% of problems (Nielsen, 1993). We thus planned groups of 3-5 people. Small groups also meant that each participant could use a laptop, see others’ laptops during discussions, and get help with technical problems.

From a social science perspective, one limitation of scenario-based usability methods is that focus groups are typically conducted by software developers themselves, which seems likely to inhibit participants’ willingness to criticize the prototype. We therefore engaged an experienced focus group moderator who introduced herself as a mediator between the developer (JSA) and the participants, and probed participants’ responses to elicit both negative and positive criticism.

An additional limitation of scenario-based usability engineering is that the group discussions are usually analyzed only very informally. Instead, we had all discussions professionally transcribed, and two researchers (JSA and CC) coded the transcripts using a grounded theory approach to content analysis (Strauss & Corbin, 1998). The two coders first reviewed the transcripts and produced tentative lists of codes at the level of the sentence fragment, sentence, or paragraph. They then reached consensus on a codebook. (The objectives of the study were used to develop the focus group facilitator guide, including probe questions asked by the facilitator, but not to develop the concept codes.) The coders then annotated the transcripts individually, and met again to reach consensus on the line-by-line coding of each transcript; codes were added to the codebook if both coders agreed they were needed. Coders used ATLAS.ti™ software (ATLAS.ti, Berlin, DRG). For the consensus discussions, the ATLAS.ti graphical interface was used to clarify the meaning and relationship of the concept codes by linking them into categories, forming a “semantic network” or graphical representation in which nodes represent concepts and links represent relationships between them (Sowa, 1992). For example, codes describing emotional responses were determined to be negative, positive, or mixed. They were then linked through *<is_a>* relationships to parent nodes, e.g., *<negative feelings>*. A focus group discussion about a topic, such as the quality of doctor-patient communication, could then be analyzed by examining the intersection between the set of passages coded with *<doctor-patient relationship>* and the set coded with *<negative feelings>* and its children codes, or *<positive feelings>* and its children. The sets could also be counted and several examples are provided in the results

section. However, these numbers should be interpreted cautiously as rough indicators of associations rather than as true quantitative measurements or survey data (participants were not polled and many expressed multiple opinions).

To recruit members of the public, we partnered with Harlem Health Promotion Center (HHPC), a community-based participatory research center in Harlem, NY, funded by the Centers for Disease Control and Prevention. The goal of community-based participatory research is to bring together community members with academic researchers to ensure that research serves the community's self-identified needs (Higgins & Metzler, 2001). We worked with HHPC's Digital Partners, a project to examine Harlem residents' use of technology and explore how technology can be used to promote community health goals. We conducted focus groups at HHPC's offices, invited the groups to provide feedback on early versions of HHPC's new community health web portal (Kukafka et al., 2007), and contributed our findings to the portal.

Focus groups were invited to discuss a "personalized risk scenario," modeled after stimuli used in recent studies of graphics (Royak-Schaler et al., 2004; Schapira et al., 2006; Schapira et al., 2001). In this scenario, "Michelle" goes to a doctor, who examines her, states her risks of developing heart disease, and gives her advice about prevention. Focus group members were asked to imagine that "Michelle" has asked them for help understanding the risk. For three of the focus groups, we also created an interactive cardiac risk calculator based on the National Cholesterol Education Program's guidelines (National Cholesterol Education Program, 2001) so that participants could input personal characteristics (age, sex, cholesterol level, etc.) and receive a numeric risk similar to the one in the Michelle story, as well as explore the effect of changing variables such as cholesterol level. Participants were also invited to discuss the utility of illustrating the risk with three static graphics: a simple bar chart, a matrix of stick figures with affected people scattered randomly throughout the group (Figure 1A), and a matrix of figures with those affected arranged sequentially (Figure 1B).

Participants then used laptops to explore the interactive risk communication module. This module went through several iterations, as described below, but all of them had the same basic structure. In this structure, the first risk presentation screen displayed text and a percentage risk (e.g., "It's impossible to tell exactly what will happen to you in the future. However, doctors do know what happened to other people just like you. A 6% chance means that in the past, when doctors examined 100 people like you, about 6 of them had a serious heart attack in the next 10 years. So we know how many people will be affected, but not which ones."). The second screen displayed a graphic (e.g., the random arrangement of stick figures, as in Figure 1A or the sequential arrangement as in Figure 1B). A display with 1000 small figures was selected so that it could show small risks as well as large ones, and so that it would convey the impression that the data came from a large sample of people (Schapira et al., 2006; Schapira et al., 2001). The colors (pale green and dark blue) were chosen to provide good contrast on the screen and to avoid any racial implications of using white, black, or brown. The final screen invited participants to interact with the graphic in some way (as in Figure 2). Participants could then finish or return to the start to explore different risk levels (e.g., by inputting a lower cholesterol level). The user advanced through the

program by clicking on large navigation buttons. No text passage was higher than the 9th-grade reading level by the Flesch-Kincaid scale (Kincaid, Fishburne, Rogers, & Chissom, 1975) and most were at the 6th-grade level.

The study was approved by the Columbia Institutional Review Board. Participants were recruited through fliers at public clinics, libraries, recreation centers, and other organizations in Harlem. All provided written informed consent and were reimbursed with movie ticket vouchers and subway passes.

RESULTS

Five focus groups were held between October 2006 and March 2007 with 16 participants (Table 1). Group size ranged from 3 to 5, except in one group conducted during a heavy rainstorm when only 2 participants arrived; we proceeded because they were eager to continue and did not want to reschedule.

Themes

Several major themes arose in the qualitative analysis. In describing them, we have attempted to represent the differing opinions and perceptions throughout the discussions.

Emotional impact—The coding for emotional responses showed that the interactive program was associated with more expressions of emotion by the participants than the other graphics and visuals (for example, 17 comments were coded as emotional responses for the interactive program, compared to 4 for the bar chart). Several participants, when playing with the computer program, expressed dismay when a stick figure icon “got the disease.” One woman said she didn’t want to “play” anymore. Conversely, a participant who was exploring a low risk said she was relieved because she clicked so many times without finding a figure with the disease. Some people expressed impatience that the interaction took too long, delaying their arrival at the page with risk-reducing advice. The participants rarely expressed any emotional reaction to the printed illustrations of stick figures or to the bar chart, and only one person expressed an emotional reaction to a percentage (she cheered when she saw that her 10-year risk of heart disease was “less than 1%”).

Impersonal numbers—Participants tended to describe quantitative information as impersonal and irrelevant, saying for example, “It’s not warm,” and “Percentages always have to do with other people.” One said that if she had a doctor who told her nothing but percentages, “it’s going to make me want to go online or go make another appointment with a doctor who can make it clearer.” However, another said that personalized risk information in the form of numbers “says a lot to me.”

When invited to describe a percentage risk to another person such as one of the characters in the scenarios, most participants suggested describing them in terms of numbers of people even before seeing any of the stick figure illustrations.

Stick figures—Most participants preferred the matrix of stick figures to the bar chart because it was “clearer that you’re talking about human beings and not statistics.” However,

other participants felt that the stick figure display was somewhat overwhelming and “a lot to look at,” and that the bar charts were “straightforward.” Most thought the random arrangement (Figure 1A) was more difficult to count than the sequential arrangement (Figure 1B). However, positive comments about the random arrangement outnumbered negative ones (8 positive to 2 negative). Many described it as realistic, e.g., “the more realistic way to depict the chance.” One said that the sequential arrangement “can give a person a false reading” because it made it too easy for her to imagine that she would *not* be affected by the risk.

Interaction—The interactive process of clicking squares to see the icons underneath was interesting to some of the participants. One said, “It’s like a game because you’re playing around with it. That’s what I like about it. Because you learn too.” However, some others were impatient with the interaction, either because they said they already understood the percentage, or because the module emphasized the negative (getting the disease) too strongly. Most said they enjoyed the interactive aspect of being able to input personal information and get tailored output.

Physician-patient communication problems—Many of the passages in which participants mentioned their physician or their relationship with their physician were coded with negative emotions and with a code indicating that they felt a need for more information. In particular, participants offered stories in which they had received information from a doctor and not fully understood it, as depicted in the scenarios. One woman recalled having a serious medical condition that had not followed the disease course she had expected, and said, “Instead of me pushing further with the doctor in conversation, I decided to seek information on my own.” She also said: “You don’t want to seem stupid so you just don’t ask.” Another said: “I feel like sometimes the doctors are intimidating... they kind of rush you.” Participants said they would go to other sources to find more information, most often mentioning the Internet and the library. There were some expressions of distrust of both medicine and doctors, e.g., suggestions that prescription drugs were riskier than herbal preparations, and that doctors avoided explaining the risk of drug side effects for fear of being held liable for those side effects.

Comparisons—Participants using the interactive tool did not suggest adding interpretive information such as “this is a high risk,” or comparative information such as “this risk is higher than average.”

Formative development

Participant suggestions and observations of participant behavior were used to update and develop the software prototype throughout the project. Most participants found the prototype easily usable, although one who had virtually no experience with computers found it intimidating and declined to try using the computer at all.

Examples of changes to the prototype include:

Stick figure arrangement—All groups saw both randomly arranged and sequentially arranged stick figure illustrations. As described, participants generally agreed that it was

easier to judge the proportion in the sequential arrangement of stick figures (Figure 1B) but described the random arrangement as more “realistic.” The final version displayed the sequential arrangement first (Figure 1B) so that viewers could easily see the proportion. When viewers advanced to the next screen in the module, they saw the random arrangement of the same quantity (Figure 1A).

Repeated sampling—The first two focus groups saw an early prototype allowing users to click multiple times to see multiple versions of Figure 1A showing different random arrangements, in an interaction designed to simulate the process of drawing different samples from a population. In general, however, participants said they did not understand this interaction or like it. For the third group, we replaced the repeated sampling (which could be repeated as long as the user wanted) with a sequence of two screens showing different randomly arranged “samples.” However, many of the participants still did not find this very useful. In the end this interaction was removed.

Action steps—In early groups, we described possible steps people could take to reduce their risk as part of the scenarios presented orally. However, the oral descriptions did not appear to be as salient to the participants as the visual materials. Several participants criticized the doctor characters in the scenarios for not describing preventive actions in sufficient detail. We therefore integrated the “action steps” into a page appearing after the final graphics for the final focus group. For example, after the heart disease risk assessment, the “action steps” page provided messages about local exercise groups in Harlem, local clinics for cholesterol checkups, and diet advice.

Interaction—The prototype for the first three groups showed a grid of squares with one of them colored blue (Figure 2). The user was invited to imagine that he or she was standing underneath it; clicking that square revealed all the stick figures including the one representing “you.” The user could then reset the grid of squares and try again. As mentioned, this sometimes elicited a strong emotional response. We were concerned that if the image was too threatening, people might refuse to use the program or reject its message (Witte, 1992). To attenuate the impact somewhat, we changed the wording after the third focus group so that the illustration was described as showing someone among “a group of people” rather than “you.” This appeared to reduce the negative emotional responses in later groups without eliminating them. After reviewing the final focus group transcript, we also developed a potential modification that would allow users to click on multiple squares as shown in Figure 3, rather than only a single square. The goal was to satisfy participants’ desire to reach the “action steps” advice more quickly while still encouraging them to interact with the graphic, but this version was not assessed.

Text—Participants frequently critiqued and offered suggestions about the explanatory text on each page of the interactive program. For example, the early versions explained the percentage risk as “6 in every 100 people,” but the subsequent illustration showed 1000 stick figures. Although some participants thought that the phrase “every 100” was clear enough, others found it confusing. We expanded the text after the second focus group to read: “A 6% chance means in the past, when doctors examined 100 people like you, about 6 of them had

a serious heart attack in the next 10 years. And among 1000 people, about 60 had a serious heart attack.”

DISCUSSION

The study allowed us to pilot different types of game-like interactive risk graphics, reject types (such as repeated sampling) that were unlikely to be acceptable, and explore participants’ interpretations of what they were seeing and experiencing. We designed the study to examine usability, user preferences, and user interpretations, and to incorporate these findings into software modifications. The designs seemed to be highly usable. However, one of our interactive graphics, the repeated sampling graphic, did not appear to be very helpful or clear. The concept of sampling, familiar to people with statistical training, might be too foreign to everyday conceptions of chance. More concrete visual metaphors might be helpful, such as bird’s eye views of cities or sports arenas. Alternately, it is possible that the graphics were successful in demonstrating sampling but unsuccessful in making this concept seem relevant to a consumer’s personal health risks and goals. By contrast, the game-like interaction of clicking on squares to look at the people underneath seemed to be more engaging and interesting. It is possible that this interaction encouraged users to think about how the abstract information applied to themselves.

One unexpected finding was that this interactive software appeared to produce an affective response not found with other risk graphics; this response will be explored through follow-up studies now under development. Others have argued that the feeling of risk, rather than solely its perceived quantitative magnitude, is an essential component of risk-related decision-making (Loewenstein, Weber, Hsee, & Welch, 2001; Slovic, Peters, Finucane, & MacGregor, 2005). The feeling of risk, or perceived threat, is an essential component of health behavior models such as the health belief model (Becker, 1974), the precaution adoption process model (Weinstein 1988), and the extended parallel process model (Witte, 1992, 1998). The feeling of risk predicts subsequent influenza vaccination better than the perceived risk magnitude (Weinstein et al., 2007). Thus, a risk communication modality that carries an affective impact could potentially be useful in increasing perceived threat of high risks, calming fears about low risks, or helping patients compare risks. A potential application might be in patient-oriented decision support. In some situations such as cancer therapies, there are no risk-free options, and the patient may be asked to make a choice based upon his or her feelings about the various risks. Our findings may be particularly applicable in providing decision support for people with poor numeracy skills, in light of research showing that people with poor numeracy are less likely to derive meaningful affective information from numbers and numerical operations (Peters et al., 2006). It is, however, important to consider the potential for misusing affective risk communication. For example, in health promotion, increasing perceived threat can increase motivation to take protective action, but it can also inhibit action if respondents believe the action will not be effective against the threat (Witte, 1992, 1998). Thus, in health promotion, efforts to increase perceived threat should be accompanied by efforts to increase the perceived efficacy of actions against the threat. Also, reducing perceived threat may not be ethical if it causes patients to ignore legitimate health risks, such as the risks of adverse effects of a medication.

As other studies have shown (Ancker et al., 2006; Royak-Schaler et al., 2004; Schapira et al., 2001), participants suggested that the sequential arrangement of stick figures (Figure 1A) was better for expressing the magnitude of the risk. Cognitive psychology studies suggest that when an illustration shows a shape with a portion highlighted, judging proportions is an automatic and fairly accurate process (Hollands & Spence, 1998). Our finding that focus group participants judged the random arrangement (Figure 1A) more “realistic” appears consistent with recent work by Schapira and colleagues showing that the random arrangement was perceived as more “true” (Schapira et al., 2006). Future work might explore the effect on the credibility of the risk communication, which is relevant in light of findings that patients often reject the results of risk calculators (Weinstein et al., 2004). Schapira et al also found that the random arrangement increased the size of the estimated risk (Schapira et al., 2006), but we did not assess quantitative judgments. Our participants’ preference for human figures as more personal than numbers or bar charts is similarly consistent with preferences found in other studies (Schapira et al., 2006). Our participants suggested that the random arrangement was better for expressing unpredictability, or a sense that the disease might strike anybody, a finding that appears to be novel. Future work might examine whether perceived vulnerability is increased by a random arrangement.

Patients’ well-documented difficulty with numerical information (Ancker & Kaufman, 2007; Grimes & Snively, 1999; Lipkus et al., 2001; Schwartz et al., 1997) might appear to suggest either that numerical risks should be avoided when possible in health communication, or that such numbers should always be accompanied by interpretations such as “high risk” or comparative information such as “higher than average.” In fact, such qualitative descriptions are the only risk information provided by many health communication materials and studies (Greene & Brinn, 2003); an example is the personal risk assessments on the Harvard School of Public Health’s www.yourdiseaserisk.harvard.edu site. When people estimate their own personal risk of an illness, they tend to have a difficult time providing an absolute risk, and their relative or comparative estimates are better correlated with objective risk factors than their absolute estimates (Weinstein et al., 2004). Providing patients with absolute risks produced a better improvement in self-estimated absolute risk, whereas giving patients a combination of absolute and relative risks produced a better improvement in self-estimated relative risk (Emmons et al., 2004). Worry about cancer is related independently to both absolute risk perception (the individual’s estimated likelihood of getting cancer, measured on a qualitative scale from “very low” to “very high”) and relative risk perception (how the individual believes his or her risk compares to that of others) (Zajac, Klein, & McCaul, 2006). Gurmankin et al found that consumers with high scores on a numeracy assessment tended to prefer and trust risk communications that included a numerical risk, although consumers with lower numeracy scores placed more trust in communications containing only verbal descriptions (Gurmankin et al., 2004); a relationship between communication preference and computational accuracy was also found by Waters (Waters et al., 2006).

Nevertheless, when our focus group participants were using the interactive graphic, which showed absolute risk only, they did not ask for interpretation or comparative information. This might be an artifact of the rapid pace of the focus group discussions or other group effects, or it might indicate that such information was not needed with this risk

communication modality. Future work might explore when qualitative or comparative descriptors are helpful in helping people derive meaning from absolute risk information or other types of quantitative estimates.

Distrust of medical research, as well as of the medical system, remains high among African-Americans; for many, the Tuskegee syphilis study has come to symbolize a hostile medical system (Corbie-Smith, Thomas, & St. George, 2002; Freimuth, Quinn, Thomas, Cole, & Zook, 2001). Several of our focus group participants expressed distrust of doctors' motives or described medical drugs as risky. It is possible that such distrust might have contributed to the doctor-patient communication problems mentioned by our participants. The repeated references to information-seeking on the Internet underscore the need for on-line sources of reliable, trusted, and comprehensible information for the public, and particularly for the African-American community.

Our study was limited by a small sample size and overrepresentation of women and of well-educated participants. This study also focused heavily on user preferences for communication format, which may promote patient engagement and satisfaction (Wiljer & Catton, 2003) but do not necessarily ensure comprehension (Feldman-Stewart, Kocovsky, McConnell, Brundage, & Mackillop, 2000), learning (Bader & Strickman-Stein, 2003) or optimal decision-making (Elting et al., 1999; Waters et al., 2006). We are currently conducting a questionnaire study to assess the effect of these graphics on such constructs as perceived risk, information credibility, and risk-related decision-making. The current study focused on comprehension of individual risks, not risk trade-offs or comparisons (Waters et al., 2006). The current version of our software has the limitation that it would be unlikely to be useful for expressing extremely rare risks, such as 1 in a million.

Nevertheless, this study provided guidance in the transition from laboratory finding to a useful consumer health communication application, and explored lay interpretations of interactive risk and probability graphics in health communication. Interactive graphics may be a new medium for conveying comprehensible, credible, and motivational health and health promotion information, which may help improve health-related decision-making and outcomes.

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Figure 1A.

A random stick figure graphic used in focus groups; the blue figures represent those with the disease and are randomly distributed throughout the group. (The illustrations used in the focus groups showed 1000 stick figures; for clarity, illustrations in this article contain fewer than 200.)

Figure 1B.

A sequential stick figure graphic; blue figures representing people with disease are arranged sequentially.

Figure 2.

In this portion of the interactive prototype, viewers were shown a grid of green squares with one blue square (left). Using the mouse (depicted here by an arrow) to click on the blue square revealed the stick figure underneath as well as all the other figures. If the central figure was affected by disease, it appeared in blue; if not, it was green. (The software showed 1000 stick figures; for clarity, this illustration contains fewer than 200.)

Figure 3.

In this potential modification, the viewer would click many squares, revealing the figures underneath one by one (left). Only when a blue figure is found would the entire grid of squares “flip” to reveal all the figures (right).

Table 1

Characteristics of focus group participants

Characteristic	Number
Self-described race and ethnicity	
black or African-American	7
white or Caucasian	4
Latino or Hispanic	3
black and Latino/Hispanic	1
white and Latino/Hispanic	1
Sex	
women	13
men	3
Education	
college or graduate degree	11
vocational school or some college	3
high school or less	2
Age bracket	
20-34	5
35-44	4
45-54	4
55-64	2
65+	1
Income *	
<\$15,000	5
\$15-49,999	3
\$50,000	5

* Only 13 answered this question