How to Reduce the Effect of Framing on Messages About Health

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BACKGROUND: Patients must be informed about risks before any treatment can be implemented. Yet serious problems in communicating these risks occur because of framing effects.

OBJECTIVE: To investigate the effects of different information frames when communicating health risks to people with high and low numeracy and determine whether these effects can be countered or eliminated by using different types of visual displays (i.e., icon arrays, horizontal bars, vertical bars, or pies).

DESIGN: Experiment on probabilistic, nationally representative US (n=492) and German (n=495) samples, conducted in summer 2008.

OUTCOME MEASURES: Participants' risk perceptions of the medical risk expressed in positive (i.e., chances of surviving after surgery) and negative (i.e., chances of dying after surgery) terms.

KEY RESULTS: Although low-numeracy people are more susceptible to framing than those with high numeracy, use of visual aids is an effective method to eliminate its effects. However, not all visual aids were equally effective: pie charts and vertical and horizontal bars almost completely removed the effect of framing. Icon arrays, however, led to a smaller decrease in the framing effect.

CONCLUSIONS: Difficulties with understanding numerical information often do not reside in the mind, but in the representation of the problem.

KEY WORDS: risk communication; risk perception; numeracy; framing; visual aids; medical decision making.
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INTRODUCTION

Many professionals in health care provide information about risks to enhance patients' informed choices. Recently, the structure and content of these health messages have received substantial attention in the literature in judgment and decision making.[1] A prominent example is the impact of how the messages are framed on people's attitudes and behaviors.[2–6] Following the work of Kahneman and Tversky in the 1970s and early 1980s,[7–10] framing is defined as the presentation of two logically equivalent situations, where one is presented in positive or gain terms and the other in negative or loss terms.[5,11] Examples of framing are chances of mortality versus survival from surgery and a focus on the risks or disadvantages of not agreeing to a medical screening versus emphasis on the benefits or advantages of doing so.[2,12]

Framing studies dealing with health messages have shown mixed results. In line with Kahneman and Tversky's[7,8] conclusion that people show risk aversion under gain framings and risk-seeking behaviors under loss framings, several authors[2,4,6,11,13–15] suggested that gain frames might be more effective in promoting disease prevention behaviors, whereas loss frames might be more effective for disease detection behaviors. In line with this hypothesis, gain frames have been more effective when promoting exercise,[16] reduced alcohol use,[17] parental use of children's car seat restraints,[18,19] skin cancer prevention behaviors,[20,21] and use of condoms to prevent HIV[22]; loss frames have been more effective at encouraging individuals to engage in breast self-examination,[23,24] mammography screenings,[25–30] blood-cholesterol screenings,[31] HIV screenings,[32,33] and skin cancer detection.[20,34] Finally, for decisions about surgical procedures and treatments, gain frames (probability of success or survival) induce greater compliance than loss frames (probability of failure or death[10,35–38]).

Previous research has also shown important individual differences in susceptibility to framing.[39–41] Individuals who have low educational attainment demonstrated a stronger framing effect than did highly educated individuals.[42] Similarly, people with low numeracy—who have difficulties grasping numerical concepts necessary for understanding risk communications[43–45]—are more susceptible to framing than those with high numeracy.[46,47] Other studies, however, reported no differences between framing conditions or even found framing effects in the opposite direction to that hypothesized ([48–54]; see[55,56] for reviews), leaving open a number of important questions related to the effects of different health message frames.

First, to the best of our knowledge all the studies about framing were conducted on convenience samples of specific groups of participants (e.g., patients with particular diseases or students[2–6]). These studies provide valuable information about the influence of framing in these participants. Framing variations, however, have different effects depending on factors such as participants' demographic characteristics

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and previous experiences.[2,6,32,57] Differences between studies in these factors might explain the contradictory results in the literature. Moreover, due to nonprobabilistic sampling methods, results in the published literature cannot be generalized to a wider population. In this study, we examine the effect of different information frames using probabilistic, nationally representative samples. To test the generalizability of our findings, we conducted a study in two countries—the United States and Germany.

Second, several authors have suggested that using framing to enhance the effects of health messages is not consistent with truly informed decision making and, consequently, should be avoided.[2,11] Others have suggested that encouraging people to become aware of framing effects, rather than trying to eliminate them, might lead to sustained improvements in patient care.[58] To our knowledge, however, few empirical studies have evaluated methods for avoiding or making salient the effects of framing.[59] Visual aids have been proposed as a potentially promising method for communicating risks. They can improve understanding of risks associated with different treatments, screenings, and lifestyles ([60–66]; but see[67]) and promote consideration of beneficial treatments that have side effects.[68] Visual aids are also effective in eliminating errors induced by anecdotal narratives[69] and biases.[70,71] In addition, risk information presented via visual aids is perceived as easier to understand[72,73] and has been shown to substantially increase risk avoidance.[74] What is still an open question is whether visual aids can reduce framing effects. Which visual aids, if any, are particularly effective has also not been investigated.

Last but not least, people differ in the extent to which they benefit from visual aids. For instance, icon arrays—that is, visual representations symbolizing patients[11,59,65]—are useful for enhancing comprehension of risk reduction in people with low numeracy skills.[61–65,68,69,75,76] Adding icon arrays to numerical information about risk reduction helps these people make more accurate assessments. Individuals with fewer difficulties with numerical concepts, by contrast, often make accurate estimates even if icon arrays are not provided. It is still an open question whether visual aids are more effective at eliminating framing effects in low-numeracy individuals—who are at the same time more susceptible to framing than those with high numeracy.[46,47] In a similar vein, it is not known whether certain types of visual aids are more appropriate for low-numeracy individuals and other types for those with high numeracy.[46] The present study sought to address these questions.

METHODS

Sample

The study was conducted with probabilistic, nationally representative samples in the US (n=1,009) and Germany (n=1,001), using panels of households selected through probabilistic random-digit-dial telephone surveys and supplied with equipment that enabled them to complete computerized questionnaires. These panels, maintained by the companies Forsa (Germany, 20,000 or 11% of initially contacted households) and Knowledge Networks (US, 43,000 or 16% of initially contacted households), allow for statistical inference to the general population. These panels were already used successfully in a number of studies in the areas of health and medicine, political and social sciences, and economics and public policy.[77–81] Methodological studies have shown that data from such panels are comparable to the results obtained through traditional probabilistic surveys.[82]

A random half of the individuals in each country participated in this study, resulting in 495 participants in Germany and

Table 1. Structure of the Sample in the Study by Gender, Age, and Education

	Germany			United States		
	Sample size (unweighted)	Sample % (weighted)	Population %[a]	Sample size (unweighted)	Sample % (weighted)	Population %[†]
Total	495			492		
Gender						
Male	254	50.3	49.9	236	48.4	49.2
Female	241	49.7	50.1	256	51.6	50.8
Age						
25–39	125	31.4	32.5	120	31.2	35.7
40–54	210	39.0	39.9	194	40.6	38.3
55–69	160	29.6	27.7	178	28.2	26.1
Education						
High school or less	393	74.1	72.3	356	44.5	44.6
At least some college	102	26.0	27.7	136	55.5	55.4
Numeracy skills	69% (SE=1.1%)[♣]			65% (SE=1.3%)[♣]		

[a]*Source: Statistisches Bundesamt Deutschland, Microcensus, 2007 (https://www-genesis.destatis.de/genesis/online; accessed September 15, 2008)*
[†]*Source: US Census Bureau, Current Population Survey, 2008 Annual Social and Economic Supplement (http://pubdb3.census.gov/macro/032008/perinc/toc.htm; accessed September 15, 2008*
[♣]*Percentage of items answered correctly*

492 participants in the US. The sample structure is shown in Table 1. According to official statistics, the percentage of less educated people is much higher in Germany than in the US. We then oversampled the less educated population in the US to ensure equivalent sample sizes of less educated participants in both countries. This was important because the study was conducted within a project that focused specifically on people with low educational attainment. To adjust for this, as well as for minor discrepancies due to nonresponse, post-stratification weights were used to bring the sample proportions in line with the population proportions. The Ethics Committee of the Max Planck Institute for Human Development approved the methodology, and all participants consented to participation through an online consent form at the beginning of the study.

Response Rates

Of the panel members who were invited to the present study, 52% in Germany and 54% in the US completed the questionnaire. As shown in Table 1, the demographic structure of the sample corresponds to that of the general populations in both countries, and there were no obvious nonresponse biases.

Stimuli and Procedure

All participants completed a computerized questionnaire that was developed in English and translated into German. The materials in English and German were back-translated, and any inconsistencies were resolved by a bilingual speaker to ensure that the two versions were comparable. All translations were performed by skilled translators. When programming the questionnaire, special care was taken to ensure the interface looked the same in the German and American versions.

All of the participants in the study completed a numeracy scale consisting of nine items developed by Schwartz, Woloshin, Black, and Welch,[83] and by Lipkus, Samsa, and Rimer.[84] An example of an item is “Imagine that we flip a fair coin 1,000 times. What is your best guess about how many times the coin would come up heads in 1,000 flips?” In the analyses that follow, we split the participants into two groups according to their group’s median numeracy scores. The low-numeracy group includes participants with six or fewer correct answers, while the high-numeracy group includes those with seven or more correct answers (see Peters et al.[47] for a similar procedure). US and German participants were evenly distributed in the high- and low-numeracy groups. The German participants had somewhat higher scores on this scale: They answered on average 69% of the items correctly, while Americans answered 65% of the items correctly.

Participants were presented with two medical scenarios expressing the risk associated with a surgical procedure in either negative (i.e., chances of dying) or positive (i.e., chances of surviving) terms. Following Schwartz, Woloshin, and Welch,[85] participants received the following information when the risk was expressed in negative terms: “Mr. Roe needs surgery: 9 in 1,000 people die from this surgery.” When the risk was expressed in positive terms, participants were told: “Mr. Smythe needs surgery: 991 in 1,000 people survive this surgery.” The participants were then asked to evaluate the perceived risk of the surgical procedure on a 4-point scale, ranging from 1 (*not risky at all*) to 4 (*very risky*). Half of the participants were randomly assigned to answer the negatively framed question first, while the remaining participants answered the positively framed question first. Between the two scenarios, all participants answered a set of unrelated problems involving risks (for more details on these problems, see[75]). The order of the questions did not have any effect on the results and the orderings were combined for further analyses.

The provision of visual aids—in addition to the numerical information about the risk—was manipulated between groups with five conditions. In the four visual aids conditions, participants were told that the numerical information was also represented in the picture that appeared on the same page, and the number of patients who died and survived from surgery were represented using an icon array, a horizontal bar graph, a vertical bar graph, or a pie chart (see Fig. 1). We used circles to represent patients in the icon arrays because previous research did not find differences in effects of arrays with faces compared to more abstract symbols.[86] Finally, participants in the numerical condition did not receive visual aids, but got only the numerical information.

RESULTS

Do People Show Framing Effects in Their Risk Perceptions? Do People with Low Numeracy Show More Susceptibility to Framing than Those with High Numeracy?

Figure 2 shows the average difference between perceptions of the medical risk expressed in positive and negative terms in participants with low and high numeracy. The larger the difference, the stronger is the framing effect. When only numerical information was provided, participants with low numeracy often perceived the surgical procedure as less risky when the associated risk was presented in positive (i.e., chances of surviving) than in negative (i.e., chances of dying) terms. In contrast, participants with high numeracy often provided equal estimates when the risks were expressed in positive and negative terms. Participants with low numeracy, therefore, were more susceptible to framing than those with high numeracy. Consistent with this result, an analysis of variance (ANOVA) with numeracy as a between-subjects factor on the average difference between perceptions of the medical risk expressed in positive and negative terms showed a significant main effect of numeracy ($F_{1,166}$=34.19, p=0.001). This effect held in both the German and the American sample.

Do Visual Aids Help Reduce the Framing Effect? Are Visual Aids Especially Helpful for Participants with Low Numeracy?

As Figure 2 shows, when visual aids were added to the numerical information, the effect of framing was reduced or disappeared in low-numeracy participants. Not all visual aids, however, were equally effective: Pie charts and vertical and horizontal bars almost completely removed the effect of framing. Icon arrays, however, led to a smaller decrease in the framing effect. Furthermore, in contrast to participants with low numeracy, participants more skilled in using quantitative information benefitted less from visual aids: For these

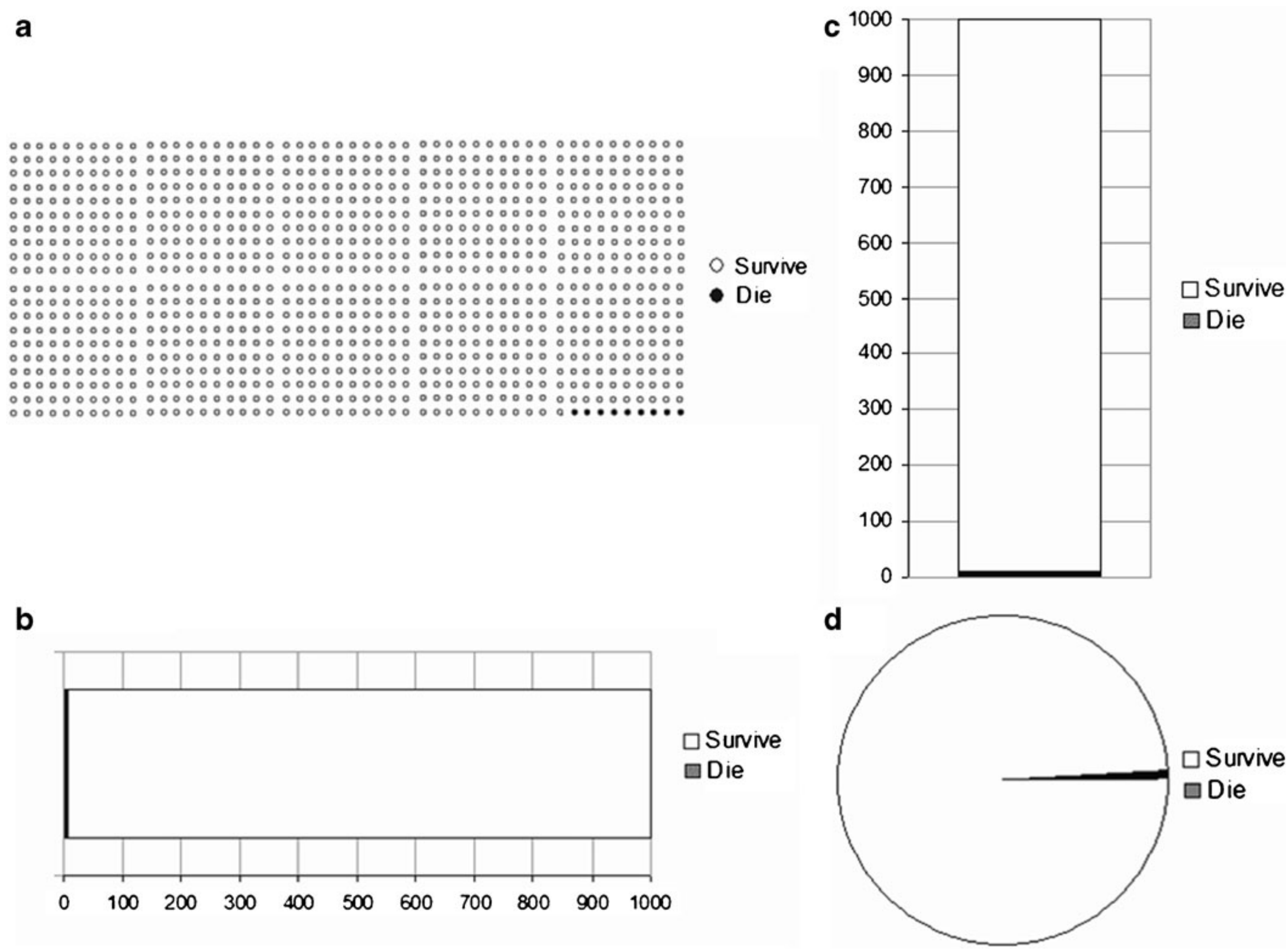

Figure 1. (a) Icon array presented in Condition 1. (b) Horizontal bar graph presented in Condition 2. (c) Vertical bar graph presented in Condition 3. (d) Pie chart presented in Condition 4. All figures represented the number of people who died (i.e., 9) and survived (i.e., 991) from the surgery. Original material was in either German or English.

participants, the average difference between perceptions of the risk expressed in positive and negative terms was similar when they received and did not receive visual aids. Similar results were obtained regardless of which visual aid was provided. Consistent

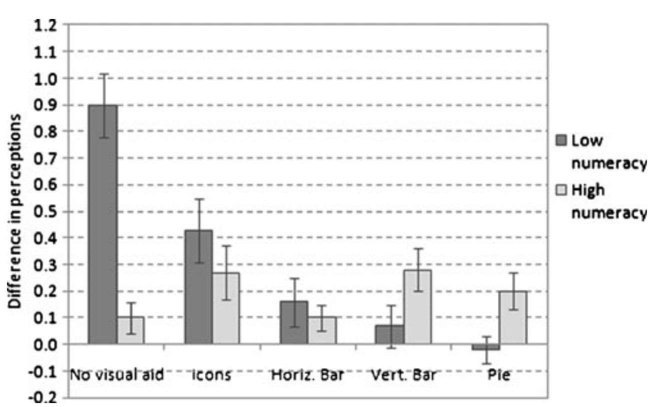

Figure 2. Average difference between perceptions of the medical risk expressed in positive and negative terms, by visual aid condition and numeracy. The larger the difference, the stronger is the framing effect and vice versa. Error bars represent one standard error.

with these findings, the ANOVA with visual aids and numeracy as between-subjects factors on the average difference between perceptions of the risk expressed in positive and negative terms showed a main effect of visual aids ($F_{4,967}$=8.15, p=0.001), and a significant interaction between numeracy and visual aids ($F_{4,967}$= 12.23, p=0.001). These effects were present in both the US and Germany. For all the analyses, the inclusion of participants' sex, age, and level of education as covariates did not systematically influence the pattern of results.

DISCUSSION

Informed consent laws mandate that patients must be informed about risks before any treatment can be implemented. Our research confirms that problems in communicating these risks result from the effects of using different information frames, especially in people who are more vulnerable to having difficulty when making decisions. Low numeracy participants both in the US and Germany perceived a surgical procedure as less risky when the associated risk was expressed as chance of surviving than of dying, whereas participants with high numeracy did not differ in their perceptions. These results are in line with previous research showing that people with low numeracy also have less accurate perceptions of the risks and benefits of screening[83,87,88] and are more susceptible to biases in judgments and decisions than those with high numeracy,[44,70,71,89,90] which reduces medication compliance, impedes access to treatments, impairs risk communication, and adversely affects medical outcomes.[44] Our results are also consistent with previous literature supporting the notion that gain frames induce greater compliance for surgical procedures than loss frames.[10,35–38] Our research extended this literature. In particular, it revealed the significant influence of people's numeracy skills on the effects of framing information about health, which could shed light on the mixed results in the literature on the issue. Differences between studies in participants' numeracy skills because of the use of convenience samples and nonprobabilistic sampling methods could possibly explain why some reported no framing effects,[48–54] whereas others found strong effects of message frames.[10,35–38]

More importantly, our study is unique in its efforts to investigate whether visual aids can overcome framing effects when communicating important health information in participants who were disadvantaged by their lack of numerical skills: When visual aids were added to the numerical information about the risk of the surgical procedure, framing was reduced or disappeared in participants with low numeracy. These results extend our own and others' previous findings about the usefulness of visual aids to enhance comprehension of medical risks, especially in people with low numeracy.[1,46,61–65,68–71,73,75,76] They also support the notion that problems in communicating risks occur because inappropriate information formats are often used and not because of cognitive biases.[91,92] Similar reductions in what superficially looked like biased thinking were observed in the case of conditional probabilities (when expressed as natural frequencies,[93]), relative risk reductions (when expressed as absolute risk reductions,[94]), and single-event probabilities.[95]

In line with previous research,[46] our results also show that not all visual aids are equally effective in communicating risk information: Although all visual aids were useful, larger reductions in the effect of message frames were achieved when low-numeracy participants were provided with pie charts or bar graphs than when they received icon arrays. This result is in contrast with our previous research[75] in which we measured participants' accuracy of risk understanding after reading a medical scenario about the usefulness of a new hypothetical drug. In this research, icon arrays and bar graphs were equally useful. A possible explanation of these contradictory findings is that pie charts and bar graphs might have promoted "gist" processing (e.g., the relative size of different areas in the visual aid), whereas icon arrays might have encouraged more precise, quantitative processing (e.g., the number of patients who died and survived after the surgery[96]). Although equally precise in the short run (i.e., after reading the health information; a[61,70,71,75]), the latter type of processing may make it more difficult to retain the information over a long period (i.e., in the second phase of the current study)—in particular for participants with low numeracy. Consequently, the low numeracy participants who received icon arrays, compared to those who received pie and bar charts might have been less likely to recognize that the information presented was the same in both scenarios in the current study.

At the same time, our research has several limitations. Our research focused on the factors that moderate the effect of framed messages. However, it did not investigate the processes that mediate the influence of framed messages on people's risk perceptions and risky behaviors and why visual aids reduce the effect of framed messages. Preliminary research by Garcia-Retamero and Cokely[97] suggested that visual aids might modify the effect that the message frame has on people's attitudes, which ultimately impact their behavioral intentions. More research in this line is needed. Another limitation relates to the fact that our study did not involve real patient-doctor interactions. Although our experiment enabled us to draw clear conclusions, it is possible that visual aids would show additional benefits in clinical settings. Finally, in our experiment we only focused on *attribute framing*. That is, the object of the framed message was an attribute of the decision options (e.g., the risk associated with a surgical procedure) and measured risk perceptions. It would be interesting to explore the effectiveness of visual aids in *goal framing*, that is, when the health message frames the relationship between certain behaviors and goal attainments—e.g., a message promoting condom use can emphasize either the benefits of this practice or the costs of avoiding this practice[4,14,15]; see also[98]—and in choice behavior (i.e., the standard dependent variable in previous studies on the issue). Future research could also explore whether the impact of visual aids on the effect of framed messages depends on other important factors such as people's topic knowledge[99] or graphical skills,[62] and on the target of the behavior (i.e., whether people make decisions for themselves or for others[100]).

Our findings have important implications for medical practice as they suggest suitable ways to communicate quantitative medical data to people who are more disadvantaged by their lack of numerical skills: To communicate information about risks in a way that is truly consistent with informed decision making, health information could be framed in either positive or negative terms as long as visual aids representing the information are provided. In contrast, if the goal is to persuade patients rather than enhance their informed decision making (e.g., cessation of smoking), framing the risk information in positive terms for disease prevention or treatment selection, and in negative terms for disease detection would be most effective.[4] Perhaps this is justifiable in some situations to achieve the greatest health gain.

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