Patient Information Processing and the Decision to Accept Treatment

Robert M. Kaplan,
Bonnie Hammel, and Leslie E. Schimmel
Center for Behavioral Medicine
San Diego State University, San Diego, CA 92182

Patients are often presented with information about risks of treatment in terms of small probabilities. Several lines of evidence suggest that very small numbers are not processed optimally by human judges. We asked experimental subjects to estimate the probability that they would take a hypothetical vaccine given that the risks of serious complications were 1 in 1000, 1 in 10,000, or 1 in 100,000 (independent groups design). Two other variables were factorally combined with the information on probabilities. Half of the subjects were given a series of dots pictorally representing the probabilities while the other half were not. Finally, half of the subjects were shown pictures making the rare chance of a severe reaction more vivid while the others were not shown pictures. The results suggest that all three manipulations had strong effects upon the estimated likelihood of accepting the vaccine. The results suggest the need for health decision models which simplify complex decisions and allow patients to simultaneously consider the benefits and risks of treatments in simplified units.

Medical patients must make a continuous series of choices between complex alternatives. Each treatment is associated with a probability of success, a probability of failure, and probabilities of complications and side effects. Although patients are highly motivated to make the right choice, human decision makers may employ strategies that are not optimal in the achievement of their goals. A monograph by Nisbett and Ross (1980) presented extensive and convincing evidence that the information processor is hampered by one or more information processing limitations. The complexity of many decisions has forced people to use certain schemata to simplify the processing mode.

Authors' Note. This research was supported by Grants KO4HL00809 from the National Institutes of Health and SES-84-2041 from the National Science Foundation.
Address requests for reprints to the first author.

Journal of Social Behavior and Personality, January 1985, Vol. 1, No. 1, 113-120.

In a rapidly growing literature, cognitive psychologists have identified several factors that may result in judgmental error. One such factor is the *vividness criterion.* Nisbett and Ross (1980) argued that "vivid information is more likely to be stored and remembered than pallid information" (p. 45). If information is vivid, it will be easily remembered and it will come to be weighted heavily in judgment. One of the implications of this work is that vivid, but improbable events receive more than their due weight in the decision process. Quite apart from memory, there is a tendency for people to ignore pallid statistical distributions in order to give weight to unusual cases which can be clearly visualized. For example, pneumonia and influenza are among the top ten leading causes of death and the annual risk of death from these infectious diseases is very substantial for the elderly and the chronically ill. Analyses by the U.S. Congress Office of Technology Assessment (1979) demonstrate that the benefits of vaccination programs for the elderly clearly outweigh the risks. Yet, there has been decreasing interest and participation in vaccination programs.

One reason for the public distrust of vaccination programs may be that popular television programs such as "60 Minutes" provide vivid pictoral accounts of individuals who contracted a temporary form of paralysis known as Guillain-Barre syndrome as a result of the swine flu vaccine. The pallid statistical information reveals that the probability of this type of reaction is extremely rare (1 in 100,000 cases), and that the acceptance of an efficacious vaccine is still advisable. However, people can easily recall the "60 Minutes" portrayal of the rare side effect, and this image can come to be weighted heavily in the decision process. This is known as the availability heuristic (Kahneman and Tversky, 1973). According to the availability heuristic, a low probability event is judged to be more likely or frequent if it is easy to bring to mind instances or associations that are readily available in memory. As a result, improbable events will be judged as having a higher probability of occurring. Nisbett and Ross (1980) regarded vividness as one type of availability bias. However, they provided little empirical evidence that vivid presentations of information actually evoke the availability heuristic. Despite the appeal of the vividness argument, Taylor and Thompson (1982) noted that only a minority of studies support biasing from the effect of vivid presentations.

Another problem is that consumers may have difficulty processing information that involves very small probabilities. We suggest that many individuals do not understand very small numbers. Thus, a treatment with a side effect occuring in every 1 of 1,000 cases is ten times more dangerous than one having a side effect in one of each 10,000 cases. However, many consumers may perceive these two small probabilities as "very small" and quite similar. We suspect that the perception of small probabilities is a logarithmic function. In the present experiment, we provide subjects with visual aids to help them conceptualize more clearly the meaning of these very small fractions.

In this paper we report an experiment in which 12 independent groups of subjects received different information about the risks associated with a hypothetical vaccination. The twelve conditions represent three factors manipulated independently in a factorial design. The factors were: a) probability of side effects (1/1,000, 1/10,000, 1/100,000); b) the use of a visual aid (given or not given); and c) the dramatization of the improbable side effect (given or not given). The outcome measure was the estimated probability the subjects would take the vaccine. We expected these manipulations to affect the likelihood of accepting the preventative measure. The results may be relevant to programs designed to inform patients about risks (see Slovic, Fischoff, and Lichtenstein (1980) for a review of this problem). Taylor and Thompson (1982) argued that inconsistent findings in studies on vividness effects might be attributed to the effects of the manipulations upon attention. Manipulations that evoke differential attention might be most likely to stimulate a vividness effect. Both manipulations in the current experiment were designed to evoke differential salience of cues.

METHOD

Subjects

The subjects were 240 undergraduate students enrolled at San Diego State Univeristy. Sixty-seven percent of the subjects were female. Some of the subjects received credit toward a course requirement in an introductory psychology course for participating, while the others volunteered.

Design

Subjects were randomly assigned to one of twelve unique cells in a 3 x 2 x 2 factorial design. The independent variables were: a) risk; b) type of representation; c) vividness.

The subjects were given a description of the flu, including symptoms, duration of illness, probability of getting the disease, and positive aspects of being vaccinated. Following this information, the experimental information was presented.

Risk. Risk was manipulated by assigning different probabilities to the likelihood of a reaction to the vaccine. All subjects were told that the chances they would die of the flu were 1 in 1,000. There was no chance that they would get the flu if they received the vaccine, but there was a small probabilitiy they would have a reaction to the vaccination. The reaction was identified as Guillain-Barre syndrome. Symptoms consisted of partial paralysis of the head, face, neck, and upper body region. In the three different conditions, the subjects were told that the probability of this reaction was 1/1000, 1/10,000, and 1/100,000.

Visual Aids. In this manipulation, subjects were either given or not given visual aids to help them understand the probability of the reaction. One-half of the subjects received no visual aid while the others received a series of dots to help them interpret probabilities. Those shown the dots were told that the probability that they would get a reaction to the vaccine was one against the number of dots they saw represented on pages. Using an ordinary typewriter, it is possible to place 10,000 dots on a single piece of paper. Thus, subjects given the 1/1,000 information saw approximately 1/10 of a page covered with dots, those given the 1 in 10,000 information saw one solid page of dots, and those given the 1 in 100,000 information reviewed ten solid pages of dots.

Vividness. The vividness of the improbable side effect was manipulated in two ways. First, subjects were given alarming information about the side effects. They were told that Guillain-Barre syndrome consists of paralysis of the head, face, neck, and upper body region. In effect, they were told, the arms become uncontrolled, the head may become cocked to one side, the face may lose all muscle tone and control so that the tongue may hang loose, drooling may occur, and speech may be impossible or difficult at the very best. In addition, subjects given the vivid portrayal of the side effects were shown a picture of an individual afflicted with this severe reaction. One-half of the subjects received this vivid portrayal while the others did not.

Other Information. In addition to being asked the probability that they would take the vaccine, a variety of other information was obtained by questionnaire. This information included subjects' age, sex, major field of study, their orientation toward mathematics and linguistic studies, and whether or not they had had the swine flu.

RESULTS

After experiencing the manipulations, each subject was asked to indicate the probability that they would take the vaccine on a scale from 0 meaning "I absolutely would not take the vaccine" to 100 meaning "I am certain that I would take the vaccine." Means for this variable are shown in Figures 1 through 3. In all three figures, the line marked "control" shows the estimated probability of taking the vaccine for the subjects given probabilities but not given vividness information or visual dot representations. Figure 1 compares the control group with those given the probabilities with the dot representations. Figure 2 compares the control group with the group receiving the vividness manipulation. Figure 3 contrasts the control information with the combination of dot representation and vividness. As all Figures demonstrate, the probability that subjects would take the vaccine is a log linear function of the probability of a side effect. This finding is unremarkable although highly statistically significant ($F_{2,228} = 8.84$, $p < .001$).

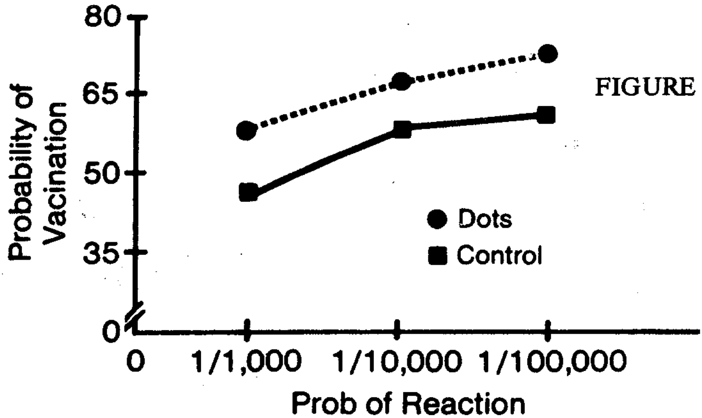

FIGURE 1

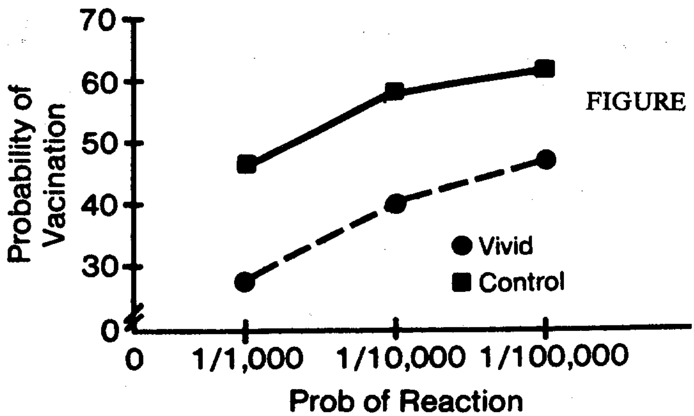

FIGURE 2

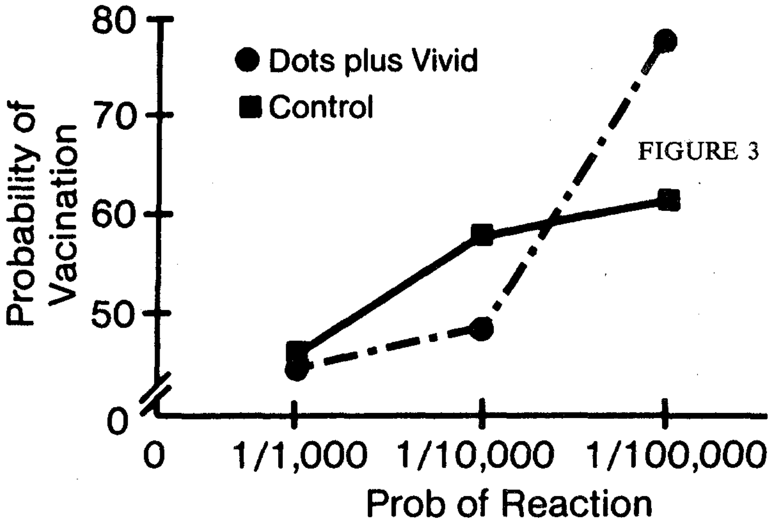

FIGURE 3

A very potent effect was associated with the use of dots. At all levels of probability of side effects, visual representation of probabilities using dots increases the probability that a patient would take the vaccine (F 1,228 = 13.15, $p < .001$). This effect is shown in Figure 1. Finally, there was also a strong main effect for vividness of portrayal of the side effect. This result suggests that the more vivid the effect, the less likely it is that a patient would take the vaccine independent of the probability of this effect (F 1,228 = 10.23, $p < .002$; see Figure 2.)

All of the interactions between the three variables were nonsignificant. The interaction term for the disordinal relationship shown in Figure 3 was not statistically significant by conventional criteria. In addition, background variables such as age, mathematic versus linguistic orientation, and history of the flu were not significantly related to the outcome. One interesting interaction involving sex did emerge in a more complex analysis of variance. There was a significant interaction between sex and probability of having a reaction (F 2,216 = 5.31, $p < .01$). This interaction is shown graphically in Figure 4. The Figure suggests that male subjects were more influenced by the probability of a reaction than were female subjects. In other words, for males the chances of accepting the vaccine were inversely related to the chances of a reaction. Although this same trend was apparent for female subjects, the effect of the probability information was much weaker.

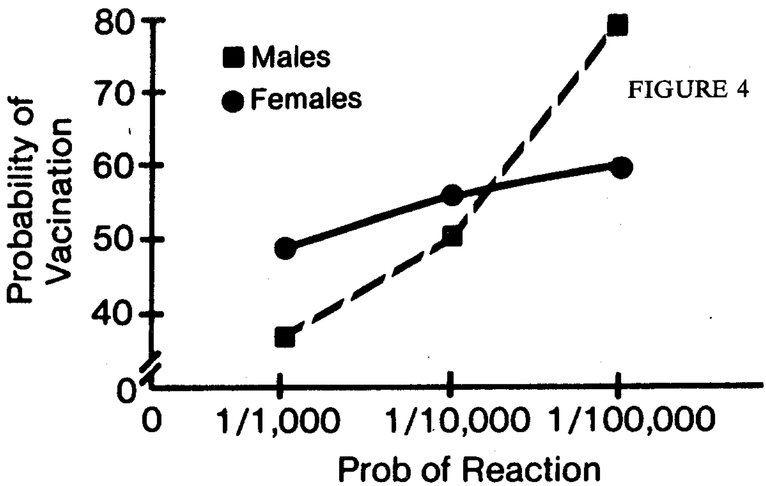

FIGURE 4

DISCUSSION

The results show that the probability that a subject will take a vaccine in a hypothetical situation can be influenced by several variables. First, a logarithmic function relates the probability of accepting the vaccination to the probability of a reaction. Each tenfold decrease in the risk of a reaction appears to be related to approximately equal unit changes in estimated probability of taking the vaccine. More investigation is necessary in order to determine if the logarithmic function holds using more levels of risk.

We had hypothesized that two variables would influence the probability that a vaccine would be accepted. One of these variables was the visual representation of the probabilities of a reaction. Indeed, portraying small probabilities of the reaction using a visual (dot) analogue greatly increased the chances that someone would accept the hypothetical vaccination. Second, as several psychologists have demonstrated (Nisbett & Ross, 1980), vividness of improbable side effects biases judgment—making it less likely that subjects will accept the hypothetical treatment.

In concert with other studies on the fraility of human judges to process information (Nisbett & Ross, 1980), our data suggest that small probabilities are not easily processed by the average observer. This presents a problem because health care consumers, health policy makers, and health services practitioners must make a continuous series of decisions in which they trade off alternatives involving small probabilities.

How might this problem be remedied? Two approches might be considered. Both approaches assume that low probability information, as usually presented, is not optimally processed by human decision makers. In this paper, we suggest that visual devices, such as dots and vivid portrayals of side effects, may shift the chances of accepting a certain alternative in one direction or the other. One approach, then, is to provide aids to help decision makers interpret probability information.

Another alternative is to translate probability information into units more easily understood by the human information processor. Kaplan (1982, 1985), for example, suggested that a general health decision model (Kaplan and Bush, 1982) can be used. This integrates small probabilities of side effects and benefits of treatments into equivalent units of well years of life. Using this type of system, the Office of Technology Assessment (1979) was able to put together complex probability information on the advantages of pneumonical vaccine in order to make the recommendation to Congress that the vaccine be given a product license.

Considerably more research will be necessary before we will be able to make productive suggestions about the representation of information about risk (Slovic et al., 1980). This research should be informative with regard to presentation of risk information to patients by physicians and through patient package inserts. Systematic models should also be of advantage to policy makers who make careers out of synthesizing information which may be beyond the human capacity to comprehend.

REFERENCES

Kahneman, D., and Tversky, A. (1973). On the psychology of prediction. *Psychological Review, 80,* 237-251.

Kaplan, R.M. (1982). Human preference measurement for health decisions and the evaluation of long-term care. In R.L. Kane and R.A. Kane (Eds.), *Values and long-term care.* Lexington, MA: Lexington Books, pp. 157-188.

Kaplan, R.M. (1985). Quantification of health outcomes for policy studies in behavioral epidemiology. In R.M. Kaplan and M.H. Criqui (Eds.) *Behavioral Epidemiology and Disease Prevention.* New York: Pleum, pp 31-54.

Kaplan, R.M., and Bush, J.W. (1982). Health-related quality of life measurement for evaluation research and policy analysis. *Health Psychology, 1*(1), 61-80.

Nisbett, R., and Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment.* Englewood Cliffs, NJ: Prentice Hall.

Office of Technology Assessment, United States Congress. (1979). *A review of selected Federal vaccine and immunization policies: Based on case studies of pneumococcal vaccine.* Washington, D.C.: U.S., Government Printing Office.

Slovic, P., Fischoff, B., & Lichtenstein, S. (1980). Informing people about risk. In L. Morris, M. Mazis, & B. Barofsky (Eds.) *Product labeling and health risks.* Banbury Report 6, Cold Spring Harbor, NY, pp. 165-181.

Taylor, S.E., & Thompson, S.C. (1982). Stalking the elusive "Vividness" effect. *Psychological Review, 89,* 155-181.