Heuristics and Biases in Medical Decision-Making

Don E. Detmer, M.D., Dennis G. Fryback, Ph.D., and Kevin Gassner

A physician's judgment is human judgment and susceptible to human limitations. Recent publications by Tversky and Kahneman (1-3) indicate that when humans make judgments under uncertainty, they rely on identifiable heuristics. A heuristic is a rule or guideline that is easily applied to make complex tasks more simple. While the heuristics for the most part lead to appropriate judgments, they may not always do so.

The purpose of the study reported here was to test for evidence of biasing in judgments made by physicians. Thirty-eight university surgeons were individually interviewed and completed a written questionnaire (available upon request).

Availability Heuristic

People are said to rely on the availability heuristic whenever they assess the frequency of a class of events by using the ease with which instances come to mind (1). By and large, frequent events are more easily recalled than less frequent events. But judgments may be distorted—biased—if some relatively infrequent events are particularly salient and hence more easily recalled or if one attempts to generalize from personal experience to a larger population where personal experience may not be representative. In order to test for this bias, the investigators asked each surgeon to estimate six quantities: his own number of major procedures during the past year, that of his specialty, and that of the entire service. Similarly, the surgeon estimated personal in-hospital mortality, that of his specialty, and that of the entire service. Availability leads us to expect that high-volume surgeons will estimate a higher volume for the entire surgical service than will relatively low-volume surgeons. In fact, results were mixed. The correlation between individual and specialty work load, 0.19, was not significant, while that between individual and total volume was ($p < .05$). Mortality rate estimates were much more suggestive of an availability bias (Table 1).

Another potential bias was dubbed the "it didn't happen because of me" phenomenon. The average of the estimated individual mortality rates (1.78 percent) closely approximates the actual rate (1.44 percent). However, the constructed mortality rate from total service estimates is inflated (4.06 percent). Sixty percent estimated a total service mortality higher than his own. The spurious inflation may result from a need to see oneself in a good light and yet not distort one's self-image. Hence, perceptions of others are distorted.

TABLE 1

Actual In-Hospital Mortality Rates and Mean Personal Estimates Between High and Low Mortality Specialties (in Percentages)

Mortality Rates	Specialty* High Mortality (n = 27)	Specialty* Low mortality (n = 10)
Estimates for personally performed operations†	2.35	0.25
Operations performed in surgeon's specialty		
Estimated†	3.87	0.93
Actual	2.42	0.44
Estimates for total service (actual = 1.44 percent)‡	4.79	2.10

* High mortality specialties were cardiovascular, neurosurgery, and general surgery. Low mortality specialties were plastics, orthopedics, and urology.

† Difference between mean estimates significant ($p < .01$, t test).

‡ Difference between mean estimates significant ($p < .05$, t test).

Dr. Detmer is director of administrative medicine, director of the peripheral vascular evaluation laboratory, team physician, and associate professor of preventive medicine and surgery at the University of Wisconsin Center for Health Sciences, Madison, Wisconsin. Dr. Fryback is assistant professor of preventive medicine also in Madison. Mr. Gassner is a second-year medical student at the University of Wisconsin.

Biases

Tversky and Kahneman (3) report a number of specific biases resulting from their heuristics. The present authors report here their results concerning three biases: insensitivity to sample size, gambler's fallacy, and the hindsight phenomenon (4).

INSENSITIVITY TO SAMPLE SIZE

Relying completely on representativeness to judge the likelihood of obtaining a particular sample from a specified population (process B generating event A) completely disregards the importance of sample size. It is a statistical fact of life that variability in sample statistics is greater for small samples than for large samples. A medical question was designed to test for this bias and 20 of the 38 gave answers inconsistent with sampling theory.

GAMBLER'S FALLACY

The gambler's fallacy arises when a series of events seems "one-sided," for example, 10 heads in a row while tossing a coin. Subjectively, it seems that "tails is due" for the 11th toss, that is, that the probability of tails on the 11th toss is substantially greater than 1:2. This subjective feeling is the gambler's fallacy—a belief that chance processes are self-correcting. A medical situation inviting the gambler's fallacy was presented to the surgeons by a question concerning a hypothetical hospital. One-third answered as one would predict if the gambler's fallacy were operating.

HINDSIGHT

The light of hindsight is very revealing. The occurrence of events which seemed unpredictable in prospect may, examined in retrospect, appear quite predictable. For example, the existence of such a bias may distort retrospective review of medical diagnoses and care. To test for this phenomenon, the authors randomly assigned the surgeons to three groups. All groups were given a case description compatible with a leaking abdominal aortic aneurysm (AAA). Group 1 was then informed that an AAA was found and resected. Group 2 was informed that a tortuous aorta was noted at operation. The third group was given no additional information. All three groups were asked: "Based on the information available before the operation, what would you have estimated as the probability that this patient had a leaking abdominal aortic aneurysm?" Outcome information had an obvious effect. The median probabilities given by the group with no outcome information and the group told an AAA was found were both .9; but the group told a tortuous aorta was found gave a median probability of .7. These distributions of responses differ significantly ($p <$ .05, Kolmogorov-Smirnov test).

Conclusion

Medical educators and students should be aware of these common heuristics and misconceptions of statistical theory. More research is needed to provide other more appropriate information processing strategies for situations where intuitive heuristics break down.

References

1. KAHNEMAN, D., and TVERSKY, A. On the Psychology of Prediction. *Psychol. Rev.*, **80**:237–251, 1973.
2. TVERSKY, A., and KAHNEMAN, D. Availability: A Heuristic for Judging Frequency and Probability. *Cognitive Psychol.*, **5**:207–232, 1973.
3. TVERSKY, A., and KAHNEMAN, D. Judgement under Uncertainty: Heuristics and Biases. *Science*, **185**:1124–1131, 1974.
4. FISCHOFF, B. Hindsight and Foresight: The Effect of Outcome Knowledge on Judgement under Uncertainty. *J. Exp. Psychol. [Hum. Percept.]*, **1**:288–299, 1975.