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The Legacy of Howard Raiffa

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Howard Raiffa was a mathematician and statistician before he became a decision analyst, though to judge from his PhD thesis in 1951 on solution procedures for noncooperative games, his interest in solving real-world problems, even if stylized, occurred very early.

Howard was a Bayesian when such a view was regarded as heresy by traditional (classical) statisticians. Classical statisticians believed that probability estimates had to be grounded in data, or in a logical argument (like using symmetry to conclude the probability of a coin landing heads). The key was that two people considering the same evidence should necessarily come up with the same probability. Bayesians believed that people could differ because of their own *prior* beliefs. It may be that I think people lie more often than you think they do. Maybe this is because the sample of people I have met was less trustworthy than the ones you have met. Maybe my father taught me never to trust anyone. If you behaved classically there was no reasonable way to operationalize probability in this case unless you could identify a statistically proper survey of truthfulness.

Frank Ramsey (d. 1930) cut this Gordian knot by arguing that if a person is equally willing to take a gamble that offers a prize if it rains or a gamble offering the same prize if a coin lands heads, then we can, and might as well, conclude that the person is prepared to act on the assumption that the probability of rain is 0.5. One can still apply the apparatus of probability and statistics (through the famous result of Thomas Bayes, d. 1761) but not in a way that overrules the subjective viewpoint of the decision maker. The overriding principle is pragmatic—a person making a decision cannot always wait for a thorough analysis

that satisfies the purists, he or she has a deadline and must act.

This philosophy was Howard's guiding principle during his entire career. What practical advice can a mathematically/statistically/numerate person give to help someone who must make an important decision in the near future?

At Harvard Business School (HBS) we teach by the case method. In each case a manager faces a dilemma. The question always asked of the students is "What should the manager *do*?" The idea is to train students to make decisions in the face of incomplete information, as is necessary in the real world. I recall a mathematically trained MBA student coming to me perplexed about how he was supposed to proceed analytically when the level of a key variable was expressed by the manager (in the case) as "between 5 and 10 percent." In the real world managers (all of us) have to make decisions without all the information we might like.

Howard describes the influence the HBS case method had on him. In *The Art and Science of Negotiation* he writes the following: "I began by studying loads of case studies of real-world problems. Practically every case I looked at included an interactive, competitive decision component, but I was at a loss to know how to use my expertise as a game theorist" (Raiffa 1982, p. 2). This is a sobering admission from the coauthor of the landmark, still-in-print-60-years-later book *Games and Decisions* (Raiffa and Luce 1957).

Decision analysis uses both probability, to measure uncertainty, and utility, to measure preferences. The origins of utility theory began at least two hundred years before Howard's doctorate, with Daniel

Bernoulli (d. 1782), who speculated on an appropriate interpretation of the famous St. Petersburg paradox. (A fair coin is tossed many times; your payoff is 2^n dollars if the coin first lands heads on the n th toss: the paradox is that people are willing to pay very little for this opportunity.) His conclusion was that people behaved as if they cared less and less about each successive increase in prize money. You cannot *prove* that people *should* behave this way (there are good arguments, but no proof). Again the dilemma (for scientists) is how to proceed when preferences are subjective.

I was fortunate to be in many discussions with Howard and Amos Tversky about the matter of reconciling Tversky's compelling findings on prospect theory with the more traditional assumptions of decision making as used by Howard, and also with that of more theoretical writers such as, say, Peter Fishburn. Normative theories are useful for idealized humans; literally for people who take a "utilitarian" view of life. Descriptive decision making is about what real people actually do when making decisions. Not only is it a useful science in its own right but it is good fodder for normative theories (Bernoulli was ahead of his time). Prescriptive decision making is about using the information currently available, on both uncertainties and values, to give advice to people about *what to do now*.

This trichotomy was not news to Howard. Below is the first paragraph of his 1968 book (*italics in original*):

For many years, I have discussed and argued the foundations of probability, statistics, and decision theory, and have found that most people argue as though they are passive observers on the sidelines, as it were. They talk as though someone else, someone none too bright, some disembodied character, were the decision maker. Since there is no point in your getting prematurely embroiled in the psychological foibles of others, let us first concentrate on what choice *you*, the reader, would want to make in a given situation. Therefore let us discuss a concrete decision problem under uncertainty with *you* cast in the role of the decision maker, a decision problem in which *you* are asked to make the choice.

In addition to being about as good an implicit definition of prescriptive decision making as you are likely to find, note the distinctive Howard Raiffa writing

style: a scholar, a teacher, a mentor, a family friend, all rolled into one.

Howard preferred books because he could explain himself better and do his readers more justice. I think it is no exaggeration to say that Howard's books were path breaking. *Games and Decisions*. *Applied Statistical Decision Theory*. *Decision Analysis*. *Decisions with Multiple Objectives*. *The Art and Science of Negotiation*. Each of them established a field, a subfield if you like, of decision making. For most scholars, any one of these books would be a career-defining work. The dates on these books are, in order, 1957, 1961, 1968, 1976, and 1982: what an amazing period of creativity.

The editor of this journal charged me to write a piece on Howard's academic legacy (he gave me two weeks). Ideally I would have liked a three-year lead time so that I could do credit to Howard's work. How I wish Howard had been here to advise me what I should do *now* in the time available. Fortunately, there are other sources. Irving LaValle, one of Howard's many doctoral students, wrote an excellent account of Howard's work that appeared in the book *Wise Choices* (1996). For more background on Howard's distinctive approach to problems, there is his memoir (Raiffa 2011), available in book form on Amazon. I highly recommend both.

But the real legacy of Howard's work is the enormous impact he had on the world. Decisions will be made better in the future because of him, whether by experts, whether by students who have been exposed to his ideas, or by the general percolation of his approach to others. His legacy will be there, guiding us, forever.

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