

PICTURING THE UNCERTAIN WORLD: How to Understand, Communicate, and Control Uncertainty through Graphical Display. Howard Wainer. xviii + 244pp. Princeton University Press, 2009. \$29.95

Most scientists must from time to time experience the frustrations of trying to engage with policy-making. "Evidence-based policy" sounds fine in principle, but in practice it may be hard if not impossible to come up with the kinds of evidence that point unequivocally to one policy option over another. The temptation to be selective, or to present data in a form that invites a particular interpretation, can sometimes be overwhelming. To quote Winston Churchill, "...when I call for statistics about the rate of infant mortality, what I want is proof that fewer babies died when I was Prime Minister."

Uncertainty is endemic in science. The uncertainties that result from measurement error sometimes pale by comparison with those introduced by varying interpretation, by poorly defined terms, by incomplete documentation, and by the ways data are presented to others. This problem can only get worse as the Internet increases our ability to share information across vast distances and cultures at electronic speed. If uncertainty is defined as the degree to which information leaves its recipient in doubt about the true nature of the world, then it is a property both of the information and of the recipient, and particularly hard for the originator to control or minimize, especially when the recipient, like Churchill, has a political agenda.

Howard Wainer approaches this world through stories, and every one is a gem. This is territory that has long been dominated by the books of Edward Tufte (*The Visual Display of Quantitative Information*, 1983; *Envisioning Information* (1990); *Visual Explanations* (1996), *Beautiful Evidence* (2006)), but the approach here is refreshingly different. Wainer has himself been involved in many policy debates, and is familiar with the ways in which the same information can be interpreted to support widely different positions. As an employee of the National Board of Medical Examiners he is particularly familiar with debates over large-scale testing of scholastic aptitude and its political ramifications.

The first chapter is devoted to the consequences of varying sample size, and De Moivre's equation predicting uncertainty in the mean. A map showing US counties with low kidney cancer death rates might induce one to move to the High Plains—but the same region also includes many counties with high rates, as one should expect given the low population density and low county populations typical of the area. Wainer shows how the Small Schools Movement of the late 1990s, which invested billions in breaking up large schools, was in part based on a similar misinterpretation of evidence. The chapter establishes the pattern of the book: well-written and well-illustrated stories, some of them grounded in the theory of statistics but most relying on intuition. Some center on graphical display, and the general principles Wainer extracts from these stories pay homage to Tufte, but also to the earlier work of the French graphical theorist Jacques Bertin and the even earlier work of William Playfair and Francis Galton. Not all address uncertainty, however. Chapter 18, "When Form Violates Function", recalls a 2003 *Wired* article in which the author mimicked Minard's well-known plot of Napoleon's 1812 campaign, described by Tufte as "the best graph ever produced", to illustrate the

corporate disaster that followed the AOL–Time Warner merger of 2000. None of the information presented is uncertain; what is at stake in this example is the effectiveness of specific graphic designs at communicating known information.

Despite the title, this is not a book solely about graphical display, and solely about uncertainty. Nor does it offer much in the way of guidance on controlling uncertainty, as the subtitle claims. Instead the reader is left largely to his or her own devices regarding the general principles to be extracted, and the lessons to be learned. But communication is both art and science, and principles are few and far between. The value of the book lies elsewhere, in the themes and rhetorical questions that crop up throughout the book, many having little to do with either uncertainty or graphical display. Why, for example, did the Scot William Playfair (1759–1823) invent many of the types of graphical display now in use, but miss the scatterplot (Chapter 17)? Compared to academics, why, asks Wainer citing the *New York Times*, do the news media often produce better graphs and plots that are less open to misinterpretation (Chapter 11)?

The final chapter, "Numbers and the Remembrance of Things Past", provides an appropriate capstone. Uncertainty is not the issue raised by the meticulous demographic statistics collected by the inhabitants of the Kovno Ghetto in Lithuania in 1941, and tables and graphs are equally effective at communicating the awful history. Rather, this is a story about the interplay between fact and emotion, about the human need to create a factual record even in the direst of circumstances, when the creators of the record knew full well that they were about to become statistics themselves. Emotions do not necessarily scale with objective measures of the magnitude of an event; the memorial to the 168 victims of the Oklahoma City bombing of 1995 may be every bit as moving as the Vietnam memorial with its 58,195 names. As Wainer writes, "Worthy memorials draw on both fact and emotion. We should not underestimate the power of even simple numerical displays to help bridge the gap between a statistic and a tragedy."

In the final analysis, then, the book is not so much about uncertainty or graphical display as about the communication of facts, and its interplay with interpretation, emotion, and the many other subjective dimensions of the human experience. The book will appeal to a wide audience, because its arguments are always accessible and intuitive, and the occasional references to statistical theory are handled very gently. Like Wainer's earlier books *Visual Revelations: Graphical Tales of Fate and Deception from Napoleon Bonaparte to Ross Perot* (1997) and *Graphic Discovery: A Trout in the Milk and Other Visual Adventures* (2005) it makes for very fine reading, and would be an excellent basis for a general-education seminar.

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