

Uncertainty and Decision Making

BIO 591/GLG 591/ASB 591/POS 591

Fall 2008

Professor: Daniel Sarewitz

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Meeting Time: Thursdays, 1:30 – 4:30 p.m.

Meeting Place: Fulton Center 4440

Knowledge is always incomplete, yet decisions must be made. This seminar explores uncertainty and its relation to decision making, with a particular focus on the ways that science is applied in order to improve decisions. We will explore the many meanings and origins of uncertainty, using theoretical and case-based approaches. A central theme will be the relation among uncertainty, scientific prediction, and decision making, especially in politically charged issues, for example as related to management of the environment. Ultimately, we will want to understand how effective decisions can be made in the face of inevitable uncertainties.

The course will be conducted as a seminar, without formal lectures, and with students expected to participate centrally in not just the class discussion but in framing the issues that stimulate discussion. Obviously, then, it is critical that the week's readings all be completed prior to class. In order to facilitate productive discussion, for each class each student must write a brief (300-500 words) synthesis of key issues, problems, and questions raised by the week's readings. These weekly assignments should also strive to identify connections (contradictions, tensions, etc.) between the individual readings for that week, as well as with readings from previous weeks.

In addition to the weekly readings and synopsis, students, working in groups of two, will write a research paper on a current dilemma in public affairs characterized by high uncertainty and urgency to take action. More information on the paper is presented below, after the syllabus. A project proposal is due on Sept. 11, annotated bibliography on Sept. 25, draft of the paper on Oct. 30, and the final paper on Dec. 4.

Grading for the course will be based on weekly assignments (33%), class participation (33%), and a research paper (33%).

Syllabus

Required Texts:

1. Simon, Herbert A., 1983, *Reason in Human Affairs* (Stanford, CA: Stanford University Press)
2. D. Sarewitz, R.A. Pielke, Jr., and R.A. Byerly, Jr. (eds), 2000, *Prediction: Science, Decision Making, and the Future of Nature* (Covelo, CA: Island Press).
3. Course Reader
4. Plus additional readings during the semester as appropriate

August 28, 2008

Class 1. Introduction, orientation, expectations, requirements.
What are decisions?

September 4

Class 2. How we think; how we decide.

Readings:

- Simon, Herbert A., 1983, *Reason in Human Affairs* (Stanford, CA: Stanford University Press), chapters 1 and 3 (pp. 3-35; 75-107).
- James, William, 1948, "The Will to Believe," pp. 88-109; "What Pragmatism Means," pp. 141-158," in *Essays in Pragmatism* (New York: Hafner Press).
- March, James. 1982. Theories of Choice and Making Decisions. *Society*, Vol. 20, Nov-Dec: 29-39.
- Lane, D., F. Malerba, R. Maxfield, L. Orsenigo, 1996, Choice and Action. *Journal of Evolutionary Economics*, v. 6, pp. 43-59 (sections 1-4).

September 11

Class 3. Origins of uncertainty in human affairs

****Project Proposal Due**

Readings:

- Berlin, Isaiah, 1992, "The Pursuit of the Ideal," pp. 1-19, in *The Crooked Timber of Humanity* (New York: Vintage).
- Schwarz, Michiel and Thompson, Michael, 1990, "Recognizing and Analyzing the Inchoate," pp. 1-13, in *Divided We Stand: Redefining Politics, Technology and Social Choice* (Philadelphia, University of Pennsylvania Press).
- Scott, James C., 1998, "Nature and Space," pp. 11-52, in *Seeing Like a State* (New Haven: Yale University Press).
- Kahneman, Daniel and Tversky, Amos, 1982 "Judgment Under Uncertainty: Heuristics and Biases," pp. 3-20, in: D. Kahneman, P. Slovic, and A. Tversky, *Judgment Under Uncertainty: Heuristics and Biases* (New York: Cambridge University Press).
- Pielke, R.A. Jr., 2007, "Values," pp. 39-53, in *The Honest Broker: Making Sense of Science in Policy and Politics* (Cambridge, UK: Cambridge University Press).

September 18

Class 4. Origins of uncertainty in science

Readings:

- Popper, Karl, 1968 “A Survey of Some Fundamental Problems,” pp. 27-48, in *The Logic of Scientific Discovery* (New York, Routledge).
- Wilson, E.O., 1998, “The Natural Sciences,” pp. 45-65, in *Consilience: The Unity of Knowledge* (New York: Knopf).
- Dupre, John, 1993, “Methodological Unity,” and “Science as a Process,” pp. 229-243, in *The Disorder of Things* (Cambridge, MA: Harvard University Press).
- Cartwright, Nancy, 1999, “Introduction,” pp. 1-19, *The Dappled World: A Study of the Boundaries of Science* (New York: Cambridge University Press).
- Herrick, Charles, 2000, “Prediction Modeling of Acid Rain: Obstacles to Generating Useful Information,” pp. 251-268, in: D. Sarewitz, R.A. Pielke, Jr., and R.A. Byerly, Jr., 2000, *Prediction: Science, Decision Making, and the Future of Nature* (Covelo, CA: Island Press).

September 25

Class 5. The Prediction Problem

**Annotated Project Bibliography Due

Readings:

- Toulmin, Stephen, 1961, “Forecasting and Understanding,” pp. 18-43, in *Foresight and Understanding* (New York: Harper Torchbook).
- Sarewitz, D. and Pielke, R.A. Jr., 2000, “Prediction in Science and Policy,” in *Prediction*, pp. 11-22.
- Oreskes, N., 2000, “Why Predict? Historical Perspectives on Prediction in Earth Science,” in *Prediction*, pp. 23-40.
- Jamieson, D., 2000, “Prediction in Society,” in *Prediction*, pp. 315-325.
- Fischhoff, Baruch, 1994, “What Forecasts Seem to Mean,” *International Journal of Forecasting*, vol. 10, pp. 387-403.
- Chapman, Clark, 2000, “The Asteroid/Comet Impact Hazard: Homo Sapiens as Dinosaur,” in *Prediction*, pp. 107-134.

October 2

Class 6. Reality-Based Interlude: Cost Risk Management

Guest Speaker: Rick Shangraw, Ph.D., ASU VP for Research and Economic Affairs

Readings:

- Frame, J. D., 1994. “Managing Risk: Identifying, Analyzing, and Planning Responses,” *The New Project Management* (San Francisco: Jossey-Bass) pp. 74-94.
- Shangraw, Jr., R.F., 1993, “Contingency Estimating for Environmental Projects,” in: Selg, R.A., ed., *Hazardous Waste Cost Control* (New York: Marcel Dekker), pp. 139-156.
- Hillson, D.A., and Hulett, D.T., 2004. “Assessing Risk Probability: Alternative Approaches,” 7 p.
- Hulett, D.T., 2002. “Project Cost Risk Analysis,” 13 p

October 9

Class 7. Predictions and Uncertainty

Readings:

- Thompson, M., M. Warburton, and T. Hatley, 2007 (orig. 1987), “Which Way the Spiral?” pp. 11-29, in: *Uncertainty on a Himalayan Scale* (Patan Dhoka, Nepal: Himal Books).
- Kahneman, Daniel and Tversky, Amos, 1982, “Variants of Uncertainty,” pp. 509-520, in: D. Kahneman, P. Slovic, and A. Tversky, *Judgment Under Uncertainty: Heuristics and Biases* (New York: Cambridge University Press).
- Moss, R.H. and Schneider, S.H., 2000, “Uncertainties in the IPCC TAR: Recommendations to Lead Authors for More Consistent Assessment and Reporting,” pp. 33-39, available at: http://stephenschneider.stanford.edu/Publications/PDF_Papers/UncertaintiesGuidanceFinal2.pdf
- Oreskes, N., K. Shrader-Frechette and K. Belitz, 1994. “Verification, validation, and confirmation of numerical models in the earth sciences,” *Science*, Vol. 263: 641-646.
- Stewart, Thomas R., 2000, “Uncertainty, Judgment, and Error in Prediction,” in *Prediction*, pp. 41-57.
- Pielke, Jr., Roger. 1999. “Who Decides? Forecasts and Responsibilities in the 1997 Red River Flood.” *American Behavioral Science Review* Vol. 7, No. 2: 83-101.

October 16

Class 8. Constructing Uncertainty

Readings:

- Pinch, Trevor J., 1981, “The Sun-Set: The Presentation of Certainty in Scientific Life,” *Social Studies of Science*, vol. 11 (1): 131-158.
- Moran, Robert, 2000, “Is This Number to Your Liking? Water Quality Predictions in Mining Impact Studies,” in *Prediction*, pp. 185-198.
- Pilkey, Orrin H., 2000, “What You Know Can Hurt You: Predicting the Behavior of Nourished Beaches,” in *Prediction*, pp. 159-184.
- Taubes, Gary, 1998, “The (Political) Science of Salt,” *Science*, vol. 281, No. 5379, pp. 898-907.
- Ioannidis, J.P.A., 2005. “Why Most Published Research Findings are False,” *PloS Medicine*, Vol. 2, No. 8, p. 101-106.

October 23

Class 9. Constructing Certainty

Readings:

- Gautier, Donald, 2000, “Oil and Gas Resource Appraisal: Diminishing Reserves, Increasing Supplies,” in *Prediction*, pp. 231-249.
- Metlay, Daniel, 2000, “From Tin Roof to Torn Wet Blanket: Predicting and Observing Groundwater Movement at a Proposed Nuclear Waste Site,” in *Prediction*, pp. 199-228.

- Tufte, Edward, 1997, "The Decision to Launch the Space Shuttle Challenger," pp. 38-53, in: *Visual Explanations: Images and Quantities, Evidence and Narrative* (Cheshire, CT: Graphics Press).
- Tetlock, Philip E., 2005, "Honoring Reputational Bets: Foxes Are Better Bayesians than Hedgehogs," pp. 121-143, in: *Expert Political Judgment* (Princeton, NJ: Princeton University Press).
- Van der Sluijs, Jeroen, J. van Eijndhoven, S. Shackley, and B. Wynne, 1998, "Anchoring Devices in Science for Policy: The Case of the Consensus around Climate Sensitivity," *Social Studies of Science*, vol. 28, no. 2, pp. 291-323.

October 30

****Project Draft Due**

Class 10. Risk--1

Readings:

- National Research Council, 1983. *Risk Assessment in the Federal Government: Managing the Process* (Washington, DC: National Academy Press), pp. 1-8.
- Posner, Richard A., 2004, *Catastrophe, Risk and Response* (Oxford, UK: Oxford University Press), pp. 165-198.
- Perrow, Charles, 1982. *Normal Accidents: Living with High Risk Technologies*, pp. 3-12.
- Adams, J., 2006. "The Failure of Seat-Belt Legislation," pp. 132-154, in M. Verweij and M. Thompson, eds., *Clumsy Solutions for a Complex World* (Houndmills, UK: Palgrave Macmillan).
- Barke, Richard P., and Hank C. Jenkins-Smith. 1993, "Politics and Scientific Expertise: Scientists, Risk Perception, and Nuclear Waste Policy." *Risk Analysis*, vol 13 (4), 425-439.

November 6

Class 11. Risk—2

Readings:

- Beck, Ulrich, 1992. "On the Logic of Wealth Distribution and Risk Distribution," *Risk Society: Towards a New Modernity* (London: Sage), pp. 19-50.
- Douglas, Mary, and Wildavsky, Aaron, 1982. *Risk and Culture* (Berkeley, CA: University of California Press), pp. 29-48 (chapter II) and 67-82 (chapter IV).
- Schwarz, Michiel and Thompson, Michael, 1992, "Dissolving Risks into Technologies and Technologies into Ways of Life," pp. 103-122, in *Divided We Stand: Redefining Politics, Technology and Social Choice* (Philadelphia, University of Pennsylvania Press).
- Slovic, Paul, 1993. "Perceived Risk, Trust, and Democracy," *Risk Analysis* vol. 13 (6): 675-682.

November 13

Class 12. Decision Making and Uncertainty—1

Readings:

- Lindblom, Charles, "The Science of Muddling Through," *Public Administration Review*, Vol. 19 (1959), 79-88.

- Holling, C.S., 1995, "What Barriers? What Bridges," pp. 3-34, in: L. Gunderson, C.S. Holling, and S.S. Light (eds.) *Barriers and Bridges to the Renewal of Ecosystems and Institutions* (NY: Columbia University Press).
- Rayner, S. and E. Malone, 1998. "Ten Suggestions for Policy Makers," pp. 109-138, in S. Rayner and E. Malone, eds., in *Human Choice and Climate Change, Vol. 4: What Have We Learned*, (Columbus, OH: Battelle Press).
- Lempert, R.; Popper, S. and Bankes, S., 2003, "Robust Decisionmaking," pp. 39-67, in *Shaping the Next One Hundred Years* (Santa Monica, CA: Rand).

November 20

Class 13. Decision Making and Uncertainty—2

Readings:

- Scott, James C., 1998, "Thin Simplifications and Practical Knowledge: Metis," pp. 309-341, in *Seeing Like a State* (New Haven: Yale University Press).
- Rochlin, G., La Porte, T., and Roberts, K., 1987. "The Self-Designing High-Reliability Organization: Aircraft Carrier Flight Operations at Sea," *Naval War College Review*, vol. 40, no. 4, pp. 76-90.
- Lach, Denise; Rayner, Steve; and Ingram, Helen, 2005, "Taming the Waters: Strategies to Domesticate the Wicked Problems of Water Resource Management," *International Journal of Water*, vol. 3, no. 1, pp. 1-17.
- Sarewitz, D., D. Clapp, C. Crumbley, P. Hoppin, M. Jacobs, D. Kriebel, and J. Tickner, 2008. *The Sustainability Solutions Agenda*, unpublished ms., 11p.

December 4

Class 14. Project Presentations

**Final Project Due

Research Project

The project will be done by groups of 2 students (if there are an odd number of students in the class, then there will be one group of 3). To the extent possible, the duos will comprise students from different disciplines/departments.

The goal of the project is to explore the origins, characteristics, and role of uncertainty in a current public policy dilemma that must be resolved despite incomplete and inconclusive (yet perhaps overwhelmingly abundant) information about the future. The title of the paper should be expressed as a normative question that encapsulates the specific dilemma, for example:

Who should receive smallpox vaccinations in the U.S.?

How should the U.S. protect against the Avian Flu Virus threat (or the bioterrorism threat)?

Is the Yucca Mountain nuclear waste repository safe?

Can the U.S. halve its greenhouse gas emissions by 2025?

Should the U.S. open the Arctic National Wildlife Refuge to oil drilling?

Is the Endangered Species Act protecting biodiversity?

Should human germ-line engineering be permitted?
What would be the most effective way to reduce cancer deaths in the U.S.?
Etc. etc.

The paper is not an exercise in supporting one particular answer to the question; on the contrary. Yet neither should it be a summary of, say, competing political positions regarding the dilemma. Rather, it is an exploration of sources of multiple potential answers to the question—i.e., uncertainty—and the consequent implications for action. The conclusion to the paper should include a series of reasonable policy options in the context of existing uncertainties.

Needless to say, the paper should build on and be informed by ideas explored in the class, but the substance of the paper should be based on independent research.

During the semester, you will first submit a brief (1-page) project proposal, followed by an annotated bibliography (minimum 10 published (i.e., not just on the web) sources with a paragraph or two of annotation for each), followed by a draft of the paper, before submitting the final paper. Deadlines for each assignment are noted in the syllabus, above, and also listed below. The final paper should be no more than 20 double-spaced pages in length (plus notes and references).

All research papers should properly reference their source material. The annotated bibliography should demonstrate a familiarity with a variety of sources, e.g., peer-reviewed journal articles, books, government documents, press accounts, web sites, etc.

Appropriate attribution of material is critical in all academic writing. General guidelines include:

- If the text you are writing has 3 or more important words consecutively taken from a source, you must use quotation marks around that text AND cite that source and its page number.
- If the text you are writing makes a specific and not commonly known point that is derived from a source, you must cite that source. Paraphrasing, no matter what the source, requires citation.
- If the text you are making makes a point, even a specific one, that is commonly known (e.g., if you could find that same point in at least several different sources), you do not need to cite that source. But you still must cite the source if you are using its own language to make the point.

There are two important reasons for rules for attribution. One is, again, to help your reader find anything he or she might want to pursue in greater detail. The other is to give credit where credit is due. Just because something is on the web or “in public domain” does not relieve the responsibility of providing appropriate attribution. Attribution is not about the legalities of copyright – it is about the integrity of scholarship.

With regard to style and grammar, your writing should, above all, be clear and correct. Aim for clarity first and elegance later. If you have questions about grammar and style,

please consult the Writing Center, which has a set of handouts that are very helpful (<http://www.asu.edu/duas/wcenter/handouts.html>). You should be absolutely sure to proofread your final version at least twice – do not rely on your word processor’s spell check, as there is more to good grammar and good style (and, indeed, good spelling) than spell check.

During the last class, students will briefly present the results of their projects.

Timeline:

The brief (1-page) project proposal is due on Sept. 11.

The annotated bibliography (minimum of 10 sources) is due on Sept. 25.

The first draft of the paper is due on October 30.

The final paper is due on the last class.