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Contra Epstein, Good Explanations Predict

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Abstract

Epstein has argued that an explanation's capacity to make predictions should play a minor role in its evaluation . This view contradicts centuries of scientific practice and, at least, decades of philosophy of science. We argue that the view is not only unfounded but seems to arise from a mistaken fear that ABM models are in need of defense against the criticism that they don't necessarily forecast events in the natural or social world.

Keywords:
ABM, Agent Based Model, Modeling, Prediction, Explanation, Philosophy of Science

1.1

In a recent contribution to JASSS, Joshua Epstein (2008) argues that predictions are a dispensable product of scientific explanation and, that models should not be evaluated on the basis of their power to generate predictions. These views appear to contradict one of the most fundamental tenets of ordinary science: that respectable scientific theories lead to expectations of discovery. Is Epstein declaring war against the foundations of contemporary philosophy of science? If he is, then, given his eminence among computational scientists and the wide distribution of his views on this subject (JSSS, Second World Congress on Social Simulation, and addresses at George Mason University, the Institute of Medicine, the University of Michigan and the Santa Fe Institute), such a declaration would seem to demand a response.

1.2

Epstein's stated motivation for writing his piece is to defend the modeling enterprise against hypothetical critics who suggest that: (1) modeling is alienated from commonsense thought and ordinary science, (2) that a model must be realistic in all its particulars, and (3) that a model's chief purpose is fortune telling. We agree with Epstein that these suggestions are unworthy. Modeling is the systematic deployment of the human capacity for metaphor and is central to all scientific activity. Models don't stand or fall on their detailed verisimilitude, but on their capacity to capture the essence what is already known about a phenomenon and to generate expectations concerning what more might be discovered if the scientist were to look where the model pointed.

1.3

However unworthy the hypothetical criticisms may be, the arguments that Epstein brings against them are more unworthy still. "Explanation," he asserts, "does not imply prediction." Three examples are offered in support of this heterodox assertion:

1. "*Plate tectonics surely explains earthquakes, but does not permit us to predict the time and place of their occurrence.* "
2. "*Electrostatics explains lightning, but we cannot predict when or where the next bolt will strike.* "
3. "*[E]volution is accepted as explaining speciation, but we cannot even predict next year's flu strain.*"

1.4

These examples do not support the conclusion that predictive power is an inessential feature of good explanations. In fact, in each example, the explanation is strong just insofar as it can make predictions and weak insofar as it cannot. Plate tectonics both explains ***and*** predicts roughly where and when earthquakes occur but can neither explain ***nor*** predict that an earthquake of specific power will occur in a specific place at a specific time. Precisely the same point holds for the other examples—which, collectively, serve to confirm, not undermine, Carl Hempel's sixty-year old "Symmetry Thesis" concerning explanatory and predictive power (Hempel 1948). That these theories do not tell us *everything* about the timing, location and character of these events does not imply that giving expectations about the future is irrelevant to scientific explanation. And, indeed, if theory in each of the relevant literatures could be strengthened to the point where such predictions could be confidently made, scientists in those fields would be overjoyed. Their joy would arise not from the practical utility of such predictions, but primarily because a theory that can make more precise predictions is widely regarded as a better theory.

1.5

Although Epstein's comments on prediction and explanation are sweeping, they seem to be directed in particular towards a defense of Agent Based Modeling. No such defense is necessary. Agent based models (ABMs) are scientific models in good standing. They are simple systems that help us understand more complex phenomena. Models are chosen or designed to be in accord with what is already known about the phenomenon we are trying to explain in ways that our theories tell us are important. In ways designated as ***un***important by our theories, they may be in discord with previous knowledge. Models that are inconsistent with theoretically important elements of the phenomenon under investigation are not likely to be well-regarded. Honest scientists may disagree—and do disagree frequently (Thompson and Derr 1995)—about whether a particular discordant detail is theoretically important. What scientists almost universally agree on, however, is that a good model implies the existence of theoretically significant properties or behaviors of the modeled phenomenon that were not known or anticipated until the model was applied. The prediction of such theoretically significant properties or behaviors, and of the circumstances under which they can be observed, is what demonstrates a model's heuristic power (Hesse 1963).

1.6

Models may be natural or contrived—i.e., they may be systems with which we are already familiar—as when we use fruit-fly genetics to explain properties of human inheritance—or systems that we devise—as when we use tinker-toy like constructions to understanding the chemistry of compounds. Agent Based Models are wonderful examples of contrived models. Consider, as an example, the Schelling model of neighborhood segregation (Schelling 1978; as realized by Wilensky 1998). Like a tinker-toy model of a molecule, almost everything about it is artificial. Its neighbors are not subdivisions with streets, and automobiles and fences, and its agents are not human beings with lawns and lawnmowers and garden parties and backyard grilles. Its 'races" are not multiculturally and multiethnicly defined but a simple distinction between red and green turtles. Its neighborhood is a simple grid of patches occupied by "turtles"—agents that are capable of making a decision of whether to move or not given the constituency of the 8 patches that surround the patch on which they are living.

The model tests a theory that desire to live in segregated neighborhoods is a necessary or even sufficient condition for neighborhoods to be segregated. It shows that, on the contrary, neighborhoods can become segregated even when people prefer to live in integrated neighborhoods and that neighborhoods can be integrated when people would prefer to live in segregated neighborhoods. The model thus challenges the ideological assumption that neighborhood integration will necessarily be achieved by making people a bit more tolerant. Its positive implication is that that the problem of neighborhood segregation can arise simply from the desire of people to have just a few of their own kind living next door.

1.7

How can this counter intuitive result come about? Is it just an artifact of all the artificialities in the contrived model? Or does the model point to some fundamental flaw in our thinking about segregation? Modelers would rightfully claim the latter.

1.8

Let's consider, for purposes of simplicity a community that is dedicated to racial integration consisting of 50 percent black and 50 percent white inhabitants. An idealistic law is passed which says the inhabitants must distribute themselves randomly across the community. However, the law makes one concession to human failing. A family that is unhappy where it is living may move by rejoining the pool of unassigned families to be reassigned at random to the next available opening. Now, one imagines that after the first settlement, everybody would have approximately 50% white neighbors and 50% black neighbors. And, indeed, that would usually be the case. But randomness being what it is, it would be also the case that some white residents would find themselves "isolated" in black neighborhoods and some black residents would find themselves "isolated" in white neighborhoods. If these people feel isolated enough to move, then the dynamics of the model show that the community will move steadily toward segregation.

1.9

How does the model suggest we should desegregate our communities: one need only bring together people who desire to live in *segregated* ones! The very same dynamic that produces segregated neighborhoods from people who want to live in integrated ones, now produces integrated neighborhoods from people who would prefer to live in segregated ones. Randomness being what it is, most people are settled in neighborhoods that contain "too many" of the other kind. And when they return to the pool to be reassigned, they are likely to be reassigned to neighborhoods just as integrated as the ones they left. Consequently, almost everybody is living in integrated neighborhoods and almost everybody is trying to move out.

1.10

In what sense is such a model predictive? It suggests to me that, on the whole, integrated neighborhoods should consist of nasty intolerant people trying to escape and segregated neighborhoods should consist of nice tolerant people who are embarrassed to live there, but not embarrassed enough to move. We are not sociologists, but we suspect that research would confirm that expectation. At a more general level, the result warns us that social outcomes are not straightforward reflections of individual preferences. The result is therefore an appropriate caution against the view that bad (or good) things happen in society because bad or good people *will* them.

1.11

We hope that Joshua Epstein will qualify or even withdraw his remarks on the relation between prediction and explanation. Already computer science experts have echoed in our hearing his sentiment that the theoretical importance, precision, number, and accuracy of predictions flowing from an explanation are no grounds for its evaluation. We fear it will not be long before students in our classes with start arguing this case, and, unfortunately, arguing it on the highest authority.

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References

EPSTEIN, J M (2008) Why Model? Journal of Artificial Societies and Social Simulation vol. 11, no. 4 12; http://jasss.soc.surrey.ac.uk/11/4/12.html

HESSE, M (1963) *Models and analogies in science*. London: Publisher.

HEMPEL, C G (1948) Studies in the logic of explanation. *Philosophy of Science*, 15, 135-175.

SCHELLING, T (1978). *Micromotives and Macrobehavior*. New York: Norton.

THOMPSON, N S and Derr, P G (1995). On the use of mental terms in behavioral ecology and sociobiology. *Behavior and Philosophy*, Volume 23, Number 3/Volume 24, Number 1, Winter 1995/1996, 31-37.

WILENSKY, U (1998). NetLogo Segregation model. http://ccl.northwestern.edu/netlogo/models/Segregation. Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.

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