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Generative Social Science: Studies in Agent-Based Computational Modeling

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interesting that the ethnographic voices presented by Haberman do not raise these issues, but seem to neatly fit into his overall narrative. Haberman’s study thus produces silences as much as it seeks to illuminate Hindu environmentalism around the Yamuna.

This book will be useful across a wide range of scholarly endeavors, from South Asian to environmental studies. Written in a personable style, it is also likely to draw in readers whose primary interests are not academic, since it is a remarkable description of travel along the Yamuna river and provides an opportunity to follow an expert scholar into Hindu cultural texts and contexts. However, though a compelling read by itself, the book is likely to be even more useful when combined with critical understandings of religious environmentalism in India.

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**Generative Social Science: Studies in Agent-Based Computational Modeling**

Joshua M. Epstein
352 pp. Cloth $49.50

Reviewed by Eric C. Jones

This book calls for a generative social science. Generative social science rests on the idea that you cannot explain current phenomena without describing the rules or preceding conditions that produced these current phenomena. In other words, the author believes that we must not only explore causality in terms of ‘A affects B,’ but also in terms of how a specific suite of physical, biological, social or cultural tendencies play out across time for a given population, producing some observed state or phenomenon. Epstein argues that anything short of being able to model the flow between prior and present conditions is mere description. He says his naming of the Generative approach took inspiration from Chomsky’s *generative* syntactic structures.

Generative social science is tightly wed to the methodology of Agent-Based Modeling made more feasible lately by faster computers. However, Epstein warns against its identification solely as a computer-driven technique. His point is that past behavior of individuals, households, firms or other agents must be accounted for when understanding a phenomenon. Following the lead of mathematicians and most modelers, the author seeks parsimonious or small sets of rules to explain the arrival at any current condition.

This ‘new’ kind of social science is probably too mathematical for most ethnographically oriented social scientists to adopt, although this historicist/evolutionary approach is one that must regularly be
injected into the social sciences in order to augment
the complimentary yet more dominant functionalist
and ideationist approaches. Ecosystem researchers
would certainly be able to make use of the agent-
based modeling approach, perhaps even being able
to better account for the individual agents in their
systems. Population researchers similarly could better
develop models and parameters for animal/plant/
agent behaviors.

Generative Social Science is generally an up-
date to the 1996 book Growing Artificial Societies
(Brookings Institution and MIT Press) by Epstein
and Robert Axtell, although this new book is a
compilation of works with all but three chapters
(Introduction, Chapters 2 and 13) published sepa-
rately elsewhere in books or journals. Preludes by
Epstein for each chapter make the flow awkward,
but provide contextual insights or connections
between chapters. All chapters have Epstein as an
author—typically the primary author—and half of
the chapters are single-authored by Epstein; as such,
the publisher considers the book a single-authored
work. A CD with several of the models accompanies
the book, so that you can change a few of the pa-
rameters and graphically view the results (hundreds
of colored pixels on a square space).

The agent-based modeling technique is one
way to bridge the micro-macro gulf, producing
non-intuitive macro results along the way. Epstein
is careful to define such emergence as the comput-
able result of agent actions, and not as the old (and
even contemporary, in some cases) idea of emer-
gence as something that can never be reduced to its
parts. Despite proposing this form of reductionism,
the book allows that emergent properties maybe
something that the individuals themselves might
not possess, so emergence is not so much a sum of
parts as a product of parts. Different agent-based
models with different suites of variables might
produce the same social phenomena, in which
case field data and theoretical plausibility assist in
determining which model to pursue. Models can
also be used to find out which rules will not account
for observed behavior.

The first three chapters constitute the introd-
tory material, primarily advocacy for the approach
as well as delimiting the domain. The domain of
generative social science is based upon the following:
heterogeneous agents, bounded rationality, explicit/
geographic space, local interactions, non-equilibrium
dynamics and initial autonomy of agents. There
is much attention to philosophy of science in this
section, such as seeking generality, comparing this
approach to mathematical models in general, dis-
cussing deductive and inductive explanation, and
dealing with incompleteness and incomputability
in mathematical social science.

Chapters 4-6 take up the Artificial Anasazi
Project in which an agent-based model relatively
accurately predicts settlement location for several
hundred years in Long House Valley in northeast
Arizona. The model considers actual soil type, slope,
corn production, precipitation drawn from ethno-
graphic, ethnohistorical, climatological and mainly
archeological data. Since the model shows that the
valley could have continued to support population,
albeit considerably reduced, the model does not ac-
curately predict the evacuation of the valley around
1300 C.E. As a result, the authors invoke the pos-
sibility that unconsidered cultural factors may be
responsible for the total depopulation—an interest-
ing hypotheses for collapse researchers to work with.
This really is the only chapter in the book that uses
real diachronic field data.

Chapter 7 looks at a model explaining why it
took three decades for retirees in the United States to
adapt to the retirement age of 62, which was made
law in 1961. The model suggests that imitation
of people in one’s social networks—a sort of slow
contagion effect—explained the delay in adoption,
as long as there was at least a small percentage of
rational individuals who chose to retire at 62 (that
were then imitated). Parameters for one model in-
cluded a life span of 80 years, networks consisting
of 10-25 individuals up to five years younger/older
than each agent, five percent of individuals reti-
ring at 62 via rational decision making, and 10 percent
of individuals acting totally randomly.
Chapter 8 considers the development of socioeconomic classes, using Nash games involving dyadic interaction and choices of high, medium and low rewards. The concern is that people don’t choose to cooperate to the benefit of both. Class is a particularly important social problem. Epstein calls it a hard social problem. The theoretical computations for hard social problems suggest that many problems exist for which a solution would take too long to achieve. For example, in this case, equality is the most stable strategy and inequality the least stable, but often it surpasses human time scale to achieve equality, plus model parameters are likely to have changed over such a long time. The model introduces memory—agents remember certain number of behaviors of past opponent—and in many cases equality is achieved in a reasonable time frame, but initial conditions are paramount. The problem with this model is that it is quite a stretch to see how a Nash game approximates the interactions between individuals in everyday life—there appear to be many currencies in the process of discrimination or class formation.

Chapter 9 provides a variant on the Prisoner’s Dilemma, which is a game between any number of people, in which the winner in any dyadic interaction gains a lot and the loser loses a lot, but through which cooperation produces modest gains for both participants. Defection (i.e., not cooperating) is the norm in Prisoner’s Dilemma—people shoot for the higher payoff, and also become vengeful. The variant in this book is the Demographic Prisoner’s Dilemma, which tries to add memory, modeled geographic space, and population growth. Memory involves participants have offspring that usually repeat the parent’s strategy of cooperation or defection, although misbehavior or accidents or rebellion occurs at a specified rate. Having offspring results in population growth. The use of physical space limits probable interaction spheres. In the demographic version, clusters of cooperation develop based on local norms (brought largely about through parenting offspring) and based on the opportunity for payoffs to accumulate. This variant describes how various kinds of people/strategies always exist, that there are oscillations between them (especially when payoffs are low), and how cooperators basically separate defectors who otherwise kill each other off. The take home message might be that it takes a sufficient percentage of compliant and good-willed people residing in a place for at least modest time periods to make society work. However, if people live long enough (have long memory), there is no deviation of parental strategies by offspring (total conformity), and payoffs are high enough, it looks like everyone will defect.

Chapter 10 follows up on how norms might develop among social groups, and Epstein invokes a normostat, or people’s basic unthinking adherence to norms. Thus, in addition to the well-established fact that norms are self-reinforcing patterns of behavior, Epstein argues that norms are comprised of non-thinking behaviors and thus most behavior does not involve choices or decisions. This is proposed largely as an antithesis to rational choice theory that assumes people make decisions or consider alternatives. The agent-based model in this chapter produces local conformity, global diversity, and punctuated equilibrium.

Chapter 11 considers two cases of social violence: 1) rebellion resulting from perceived hardship, questionable legitimacy, and free assembly, and 2) ethnic conflict resulting from low levels of legitimacy and low levels of peacekeeping forces. Here, in the case of rebellion, the author allows bounded rationality in the forms of risk aversion and negative utility (doesn’t pay to ‘take it’ anymore), although agents’ utility calculations do not include the social implications of their rebellion.

Chapter 12 introduces a new kind of agent to the social setting—an infectious disease—and properly assumes that, although vaccination might increase deadliness due by producing resistant pathogens, deadly diseases are typically inefficient at spreading themselves (i.e., death before transmission). An exception the authors consider is smallpox, which is both deadly (30% death rate) and highly communicable. They take up vaccination models to deal with smallpox as a potential bioterrorism weapon. Their optimal model is both
preventative (preemptively vaccinating all hospital
works and voluntary revaccination of those who
were successfully vaccinated in the past) and re-
active (hospital isolation of confirmed cases, and
making family members of infected individuals
be vaccinated and stay home). Although similarly
based on hypothetical model runs, this simulation
seemed to get more of a gut reaction from me than
the others, but in doing so made me think even
more seriously about the other social phenomena
generated through the models in the other chap-
ters—although the models are easy manipulated
don’t involve real data, the phenomena studied
are quite the opposite, they are gripping contem-
porary questions.

Chapter 13 covers the growth of adaptive
organizations. True to the generative approach, the
authors “want a single fixed set of operating rules
and parameters at the individual agent level that
will generate, or ‘grow,’ and entire optimal history
of structural adaptation ‘from the bottom up,’” in-
cluding the creation of hierarchies when necessary
and their dissolution when disadvantageous—based
on labor scarcity vs. abundance.

The contributions from the book’s generative ap-
proach and agent-based models appear to be fourfold.
First, the rules in the models include some simple
yet sophisticated additions to games or other utility
models, and these additions are geographic space,
cloning of offspring (providing both for population
growth and ‘recruitment’ of participants in a strategy),
influence from social networks, and allowing for death
of participants. Second, the book shows how well-
known and intriguing phenomena (e.g., classes, civil
violence, cooperation, conformity) can be grown or
produced based on realistic and small sets of variables
and variable parameters. Third, the book pushes for a
historical/evolutionary causal accounting for observed
phenomena, which is valuable even if you don’t go
down the agent-based modeling road. Finally, the
books assumes that conscious decision making among
alternatives by individuals is the exception not the rule,
and such decision making typically is witnessed only
when we account for more fundamental biological,
physical and interactional constraints.

As seen above, major questions in many fields
of social science might be approached with gener-
ative social science using agent-based modeling. The
book’s scope is broad. The author does not use cases
with real field data, except in the Anasazi study which
is constrained more by biophysical parameters than
by interactional ones—the only interactions for the
Anasazi case are the unavailability of specific pieces
of land due to occupation by neighbors, and a matri-
local residence rule. However, the author numerous
times restates that the goal of the book’s chapters is
to investigate how simple models based on aggregate
individual behavior can produce the primary char-
acteristics of compelling social phenomena, and not
to test hypotheses against real data. Epstein calls for
further improvements in agent-based model research
by creating a more explicit or standard formalism for
practitioners (e.g., stochastic vs. uniform or synchro-
nous vs. asynchronous updating of agents), using
agent models to explore social network dynamics,
making agents more psychologically real with all the
competing motivations a person experiences, and
examining the performances of models across various
realistic spatial and time scales. It is surprising that
the book does not call for greater use of real data.

There is an unfortunate physics envy that
motivates the author to defend the generative social
science research strategy. For example, the book says
that the generative approach is deductive and not
inductive. By strict definition, that is true—Agent-
Based Models are not data mining, but are theoreti-
cally driven equations/models. However, in practice,
all of the model parameters are tinkered with dozens
or hundreds of times until they produce interest-
ing results. That is the inductive process. And it is
certainly appropriate for a young field like this to
be spending more time in inductive inquiry than
in deductive inquiry.

Despite the book’s religious invocation of
parsimony, and its frequently dismissive attitude
toward non-generative social science, the util-
ity of agent-based modeling is compelling. Most
ethnographically oriented social scientists will be
concerned about the determinism and the mindless
agents depicted in this approach. As already noted,
the author similarly wants to see agents with more complicated motivation sets than currently have been modeled. However, the current Agent-Based Modeling approach does already provide the potential for clear examination of when individual agents, in concert or in parallel, can produce fundamental change in social systems. In other words, tipping points, oscillations, punctuated equilibrium, lock-ins/run-aways, and persistent cohesion all can be studied via the probabilistic behaviors of individuals over time. What is lacking, then, is validation, or being able to detail the story of exactly how those specific people participated in that specific social change, given just a few simple maxims of human behavior. And that, of course, will have to wait until social scientists regularly team up with ethnographers, historians and mathematical modelers.

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Do Glaciers Listen? Local Knowledge, Colonial Encounters, and Social Imagination

JULIE CRUIKSHANK
University of British Columbia Press, Vancouver, BC, 2005
328 pp. $32.95 Paperback

Reviewed by Rebecca K. Zarger

This fascinating book weaves together a study of memory, oral history and transformations through a series of encounters between people and glaciers in the region where the Saint Elias Mountains and the Alsek River converge in the southwest Yukon Territory and Alaska. I recently selected Cruikshank’s award winning book (winner of the 2006 Julian Steward Award, given by the American Anthropological Association’s Anthropology and Environment section, a 2007 Clio Award from the Canadian Historical Association and the 2006 Victor Turner Prize in Ethnographic Writing, awarded by the Society for Humanistic Anthropology) for required reading in a graduate seminar in environmental anthropology. This review is framed within the discussion and critique that emerged from the seminar, with the aim of providing not just a synopsis of the intellectual and practical contributions of the book, but its pedagogical value as well.

One compelling illustration of the impact of this book is the attention that has been paid to it across a variety of disciplines, including anthropology, sociology, history, and science and area studies. Clearly Cruikshank is speaking across chasms of inquiry as she writes about stories of glaciers’ connections to human communities and oral traditions as local people, explorers and scientists negotiate meanings in a particular, out-of-the-way cultural landscape. Another reason this book was chosen for the graduate seminar was the way the author engages with the topics of local (or traditional) environmental knowledge, environmental change, and social memory. Historical documents, carefully presented Tlingit and Athapaskan oral histories, 19th century explorer’s accounts, and the current politics of conservation, identities and territories are analyzed with equal intensity. As the author links these lines of evidence together (in some chapters more seamlessly than others), bridges are created between types of inquiry, voices of local elders, the human-nature divide, and local and global histories.

Do Glaciers Listen? is divided into three sections. Part one, “Matters of Locality” situates the reader in time and space (during the Little Ice Age) as well as within current theories of the nature of knowledge and its representations. The three chapters in the first section convey, through tales of the actions of both glaciers and humans in response to one another, the distinctions between narratives of Athapaskan/Tlingit elders and geophysical scientists. Extensive passages from “glacier stories” of three women, including excerpts from thirteen different stories shared by Kitty Smith, Annie Ned and Angela Sidney, tell us of the dangers of falling through glaciers, traveling under