8-1997

Evolution and Nebulousness in Theories

Barry N. Markovsky
University of South Carolina - Columbia, barry@sc.edu

Publication Info

Published in *Current Research in Social Psychology*, ed. Michael Lovaglia, Volume 2, Issue 3, 1997, pages 24-29.
http://www.uiowa.edu/~grpproc/crisp/crisp.html

CURRENT RESEARCH IN SOCIAL PSYCHOLOGY

Volume 2, Number 3
Submitted March 5, 1997
Resubmitted July 29, 1997
Accepted July 29, 1997
Published August 9, 1997

EVOLUTION AND NEBULOUSNESS IN THEORIES

Barry Markovsky

University of Iowa

ABSTRACT

Social scientists have a clear choice in how they may approach theory development. One path leads to "nebulous" theories that lack any real explanatory power. The other path capitalizes on evolutionary principles of variation and selection, vastly increasing the chances for explanatory success. I illustrate these ideas by reference to "artificial life" programs, and discuss the implications for theory construction in the social sciences.

[24]
---
[25]

In social psychology as in other scientific disciplines, the subject of evolution and natural selection processes is not so distant as it may first appear from the work we do and the substantive issues we address. Because these processes affect the way theories grow and change, they influence (1) what we are justified in asserting as claims to knowledge, and (2) how those claims must be formed and treated in order for them to fulfill their explanatory purposes. In fact, if one is indifferent to the evolutionary dynamics of theories and especially to the sort of logical and semantic standards that allow those dynamics to operate, then one's claims to knowledge will be prone to fatal deficiencies.

In 1959 Donald T. Campbell coined the term "Evolutionary epistemology." (See Campbell 1974 for a more widely-available source.) This is the study of evolutionary processes, concepts, and explanations. Evolutionary epistemologists like to explore the generality of evolutionary principles, and discuss them not only in the contexts of biology and archeology, but also as applied to such problems as the evolution of human cognition, culture, and science. It is the last category--the evolution of scientific knowledge--that connects us to issues of cumulative theory-building.

Our field generally lacks the shared logical and semantic standards for constructing and evaluating theories--standards that characterize more scientific disciplines and that promote cumulative theorizing. As a result, the majority of sociological knowledge claims emanate from theorists who do not attend to such issues. This means that nearly all theories are expressed discursively. Moreover, programs of explicit, sound, cumulative theoretical development are so rare in our field that those who involve themselves in such work often are marginalized or even denigrated.

Elsewhere (Markovsky 1994) I presented criteria for theory-building and argued that theories must develop incrementally and cumulatively. There I concluded with the idea that *nebulousness* rather than knowledge is the inevitable product unless a discipline's members apply rigorous semantic and logical standards to its theories. Nebulous theories are at odds with what arguably is the intent of all theorists: to produce abstract and general statements that explain and predict classes of empirical phenomena.

Social psychology's overall lack of scientific standards for theoretical logic and clarity is its most important and far-reaching problem *by far*. We are in the business of explaining and predicting things. It is a sure bet that unless we can train our theories to develop evolutionarily, they will never get better at explaining and predicting.

EVOLUTION AND THEORY GROWTH

Following are several important insights offered by an evolutionary epistemology applied to the growth of theories.

(1) Cumulative theories manifest deductive subsumption (Freese 1980). Useful components of an earlier version of a cumulative theory (e.g., statements having high predictive power) are retained in, or derivable from, later versions of the theory. The reverse is not true. Later versions of the theory, presumably having broader and

deeper coverage than earlier versions, will not be derivable from those earlier versions.

(2) Explanations that do not show any evolutionary growth cannot be scientific theories. At best they are proto-theories awaiting further development--as when the "theory" consists of little more than generalizations induced from a limited set of observations. At worst, non-evolving explanations are pseudo-theories, posing as scientific theories but failing to satisfy appropriate criteria when examined skeptically. Proto- and pseudo-theoretical explanations are unlikely ever to provide precise, reliable, accurate, and robust predictions for empirical phenomena. There are just too many ways for them to be wrong in a complex world, and too weak a mechanism for self-correction. Without the benefit of the empirical and theoretical methods of science, chances are remote that the theorist will guess correctly.

(3) Cumulative or evolutionary development depends on selection processes. More specifically, as Toulmin (1967) noted, theory evolution depends on generating competing intellectual variants that are carried, diffused, and selectively retained by populations of scientists. Popper (1972) is famous for emphasizing that selection should be based on a theory's ability to survive strong empirical tests, but that is not enough. He presumed a shared understanding of how to derive valid predictions and conclusions from the theory. In the social sciences, theorists often couch their arguments in vague terms, then proceed as if nobody else is qualified to derive and test hypotheses from their theories. This practice is pervasive and tolerated, and undermines the communality and intersubjectivity of the selection processes that must be at the heart of any scientific discipline.

(4) There are many different types of theory selection processes, but most lead nowhere. Too often selection is based on the whims of authorities, politics, wishful thinking, political correctness, etc. Knowledge in non-scientific disciplines changes over time in various ways, and selection processes of various sorts are imposed on them. Despite such changes, however, the work does not exhibit*evolutionary* growth and cannot deductively subsume earlier efforts. The best products of today's artistic and literary disciplines certainly are different from those a half-century ago. However, there is no objective criterion by which it makes sense to assert that the work has come closer to achieving shared intellectual goals.

(5) For a selection processes to operate rationally and efficiently, individual theories must satisfy a set of eight semantic, logical, and empirical criteria (Markovsky 1996): They must be free of contradictions, free of ambivalence, communicable, abstract, general, precise, parsimonious, and conditional. So even if our field embraced the idea that our theories must be cumulative and evolve through a process of variation and selection, the individual theories still must be well-formed to make this process work.

This is because when we talk about "rational" selection among theoretical alternatives, we mean selecting for further enhancement only those theories that are the most precise, parsimonious, communicable, etc.

(6) Finally, evolutionary epistemology applied to theories is more than mere metaphor. Theories are phenomenal entities that actually can and do evolve. (See Berger and Zelditch, 1993, for a number of examples.)

[26]
---
[27]

THE "ARITIFICIAL LIFE" OF THEORIES

Even more remarkable and exciting than the applicability of basic Darwinian ideas to theory growth, contemporary developments in the study of evolutionary processes also apply. Work in the area of "artificial life" may have special relevance. Much of the interest in the area traces back to John Conway's famous game "Life," popularized by Gardner (1970) in his *Mathematical Games* columns in *Scientific American.* Life, is a "cellular automata" model, the output of which is best viewed on a computer screen. The image is a matrix of cells, each of which can light up (come to life) or blink off (die), depending on the states of other cells in their immediate environments. A remarkable array of patterns and dynamics is exhibited by Life, depending only on the starting arrangements of cells and simple rules for when a cell turns on and turns off.

Life was only the beginning. Now there are programs that illustrate or simulate evolutionary processes in a variety of ways (Prata 1993), and others that use evolutionary learning to solve complex problems (Bainbridge, Brent, Carley, Heise, Macy, Markovsky and Skvoretz 1994). Unlike evolutionary biology, artificial life is not restricted to the single case-study of terrestrial evolution.

Evolutionary learning models are especially relevant for us. Social phenomena are complex, and we are unlikely to induce full-blown explanations in only one or a few initial attempts. However, if we establish the conditions for evolutionary learning via the theories we construct and the tests we perform, then our theories can only improve. This is demonstrated by a program called WORDEVOL (Prata 1993). Take the 19-character phrase "this is a fine time". We want our "theory" to correctly induce 19 corresponding elements letters and spaces. The total number of 19-character strings is 27 raised to the 19th power. Using a personal computer to generate random 19-character strings at 8,000 per second, there is a 50-50 chance of hitting the correct target string in 6 quadrillion years. This is the monkeys-at- typewriters approach, and it also describes non-cumulative theorizing in sociology. In general, sociology

rewards those who produce never-before-seen theories--or things called "theories" by their authors--and generally punishes those who work on incremental, evolutionary developments, never pretending to make huge strides in fell swoops.

The evolutionary learning computer program takes a different approach. WORDEVOL uses a simple algorithm to match the 19-character string: Generate 20 random strings, find the best-fitting one, generate 20 mutated offspring from it, choose the best-fitting one, and so on. Instead of a 50-50 chance in 6 quadrillion years, the expected time until a perfect match is around one-fifth of a second.

[27]

---

[28]

IMPLICATIONS FOR THEORY-BUILDING

Imagine how much more efficient our theoretical learning could become if we collectively generated theoretical variants and culled only successes by applying rational selection criteria. A bottom-up approach to theory-building would be analogous to this bottom-up approach of artificial life models: Start with relatively simple abstract and general theories, and test, revise and re-test their consequences against selected natural settings that fall within theoretical scope conditions. It does not matter if the theory starts small. As Campbell (1974) points out, a research tradition working with even a trivial topic, to which are applied strong selection criteria, advances more rapidly than research focused on a more important problem but whose researchers lack a sharp and consistent selection system. The problem-centered orientation to which Campbell alludes is the top-down approach: start with observations from the natural world and try to model them.

Importantly, the evolutionary development of theories via the bottom-up approach cannot be sustained without a critical mass of theories that satisfy the logical and semantic criteria described above. If the meanings of theoretical terms are muddy, or if an argument does not possess logical integrity, then the conformity of evidence with the predictions of such a theory is immaterial. Although it is more work to develop a highly coherent and comprehensible theory than to offer one faring more poorly on such criteria, there is a benefit: even a relatively simple bottom-up theory, when well-crafted, can generate predictions for emergent behaviors that are far more numerous and complex than the assumptions that compose the theory. In contrast, top-down approaches tend to become encumbered over time with numerous ad hoc assumptions. With no consistent selection criteria, there is no point of criticality at which the ponderous, non-parsimonious approach becomes extinct in favor of the simpler, more powerful competitor.

Punctuated equilibria, an idea popularized by Stephen J. Gould, also can emerge in the process of theory evolution. The idea is that the outward manifestations of genetic instructions exhibit punctuated equilibria--periods of relative quiescence separated by periods of rapid change. In working with network exchange theory for more than a decade, I can attest to such a process. Generally the theory changes almost imperceptibly most of the time, but occasionally one tiny alteration helps to explain an entire new range of phenomena. If the theory's terms and assumptions are its "genes," then it is the suddenly expanded range of derived hypotheses regarding observable phenomena that represent the theory's "outward manifestations."

Another modern evolutionary view is that selection and evolution occur simultaneously at different levels of analysis. Cell structures evolve, organs evolve, organisms evolve, and populations evolve. Each operates within its own environment, subject to corresponding selection pressures, and nested within other environments. So it is with theories. We cannot assemble words within statements capriciously. We define and arrange terms in ways that seem best suited (or most "fit") to express the ideas we wish to communicate. If meanings are not communicated unambiguously, then we modify terms, rearrange our phrasing, and/or clarify definitions. At the same time, at a "higher" level, we compose statements into theoretical arguments. This also requires great care, for at this level statements must integrate into a coordinated where rules of logic impose selection pressures. At a still higher level, this set of statements operates in an environment that may include other sets which are variants, elaborants, proliferants or competitors vis-a-vis one another (Wagner 1984).

CONCLUSION

Thinking about theories from the perspective of the evolutionary epistemologist should motivate us to establish conditions and engage in practices that promote cumulative theoretical growth. Such changes would affect how social scientists theorize, moving them toward the programmatic study of theoretically-motivated problems. Importantly, it also would affect the collective evaluation of those individual products. Among other emphases, special attention would have to be paid to the consistent application of rational selection criteria for publications, along with the encouragement of competing research programs. If we truly want our field to have better theories, then it would seem that we have little choice in these matters.

REFERENCES

Bainbridge, William Sims, Edward E. Brent, Kathleen M. Carley, David R. Heise, Michael W. Macy, Barry Markovsky and John Skvoretz. 1994. "Artificial social intelligence." Annual Review of Sociology 20:407-436.

Berger, Joseph and Morris Zelditch, Jr. (eds.), Theoretical Research Programs: Studies in the Growth of Theories. Stanford, CA: Stanford U. Press.

Campbell, Donald T. 1959. "Methodological suggestions from a comparative psychology of knowledge processes." Inquiry 2:152-182.

-----. 1974. "Evolutionary epistemology." Pp. 413-463 in The Philosophy of Karl Popper, Book I, edited by Paul Arthur Schilpp. La Salle, IL: Open Court Press.

Freese, Lee. 1980. "The problem of cumulative knowledge." Pp. 13-69 in Theoretical Methods in Sociology: Seven Essays, edited by Lee Freese. Pittsburgh: University of Pittsburgh Press.

Gardner, Martin. 1970. "Mathematical games: The fantastic combinations of John Conway's new solitaire game "Life." Scientific American (October) 120-123; (November) 116-118.

Langton, Christopher G. (ed.) 1995. Artificial Life: An Overview. Cambridge, Mass.: MIT Press.

Markovsky, B. 1994. "The structure of theories." In Martha Foschi and Edward J. Lawler (eds.), Group Processes: Sociological Analyses. Chicago: Nelson-Hall.

-----. 1996. "Theory, science, and 'micro-macro' bridges in structural social psychology." Current Research in Social Psychology 1(4):30-42, http://www.uiowa.edu/~grpproc.

Popper, Karl. R. 1972. Objective Knowledge: An Evolutionary Approach. Oxford, England: Clarendon Press.

Prara, Stephen. 1993. Artificial Life Playhouse. Corte Madera, CA: The Waite Group Press.

Toulmin, Stephen E. 1967. "The evolutionary development of natural science." American Scientist 55:456-471.

Wagner, David G. 1984. The Growth of Sociological Theories. Sage.

AUTHOR BIOGRAPHY

Barry Markovsky professor of sociology at the University of Iowa where he directs the Center for the Study of Group Processes. In addition to writing in the area of theory, he conducts research in a number of areas in group processes including status, power, justice, and popular beliefs. His email address is barry-markovsky@uiowa.edu.