Applying Complexity Science to Organizational Dynamics

Instructional Challenges and Benefits

Jeffrey Goldstein, Ph.D.

Robert B. Willumstad School of Business. Adelphi University, Garden City, NY 11530 USA
e-mail: goldstei@adelphi.edu

Abstract

The study of complex systems, otherwise known as "complexity science", "complexity theory", or simply "complexity" has been expanding rapidly over the past thirty years. Methods, constructs, and insights developed in the natural sciences and mathematics are concomitantly being applied to various aspects of organizational research, theorizing, and practice. Emanating from such fields as nonlinear dynamical systems theory (the granddad of "chaos" theory), complex adaptive systems, synergetics, far-from-equilibrium thermodynamics, artificial life, social network analysis, and related areas, findings are offering novel perspectives on innovation, organizational change and resistance to change, leadership, strategy and strategic adaptation, organizational culture, and other key issues in the study of organizational dynamics.

As one of the early and continuing proponents of this application of complexity theory (for example, see Goldstein, Hazy, and Lichtenstein, 2011; Goldstein, Hazy, and Silberstang, ; and Hazy, Goldstein, and Lichtenstein)., I have faced the persistent challenge of rendering the subject matter of complex systems research and theory accessible and hopefully understandable to my students as well as participants in diverse types of workshops and similar forums. The challenge of teaching novel constructs which are unfamiliar to students is of course part and parcel for teachers the world over: students are being exposed to new terminology, new ideas, new methods, and new findings much of which are discontinuous with what they already know for otherwise they presumably would not be taking these courses.

However, in my experience as a university professor, when it comes to complexity science, instructional difficulty is magnified not only because of the technical nature of the new material but also because it includes branches of math most students or participants have never encountered before. For instance, although most students in business schools have mandatory courses which cover some elementary statistics, algebra, calculus, computer applications, and linear equations, it is not very common to find they have also been exposed to the complexity mainstays of nonlinear dynamical systems theory, computational complexity theory, power law distributions, recursive and iterative functions, graph and network theory, catastrophe theory and associated areas concerning critical phenomena. Moreover, complexity science also invokes

sophisticated philosophical issues pertaining to epistemology, ontology, phenomenology, and so forth.

In this paper, I explore the chief challenges involved in the teaching and training of complexity science applied to various aspects of organizational dynamics. There are three target audiences pertinent here: undergraduates; graduate students in a MBA or related program such as an MSN or MS in Sports Management; and seminar/workshop attendees. The educational backgrounds of these three audiences, of course, differs, running the gamut from juniors in a four year program to baccalaureate degree holders (along with work experience and any technical training pertinent to their careers) to advanced degree holders such as Ph.D.'s and M.D.'s. I bring up this issue since, although it might seem that the technical nature of a large part of complexity science would be more easily assimilated by those with higher level education or backgrounds, it turns that this is not the case primarily due to the need to bring in the kinds of mathematics mentioned above.

One of the impediments in needing to bring in needing to present sophisticated mathematics is the widespread "mathophobia", at least in the USA. Without needing to venture into the many reasons for this, there's no doubt it can contaminate the classroom atmosphere and therefore it is something the professor must come to terms with right at the start. Fortunately, complexity science itself provides various ways to surmount the off-putting reaction to this new math by way of numerous types of graphical displays of the more arcane mathematics in the form of videos, software, and related media which have the potential of stimulating student interest. There are quite a few very good educational aides in each of the branches of math (the list is included under references below) such as:

- Nonlinear dynamical systems can be visualized via various chaos data analyzers (Sprott 1),
- Fractal graphics generators (Fractal 1 and 2; and Sprott 2);
- Cellular automata exhibiting computational emergence (e.g., golly);
- Graph and Network theory social network analysis software;
- Videos at youtube on emergence, complexity, and various self-organizing physical systems (for far-from-equilibrium thermodynamics and synergetics);
- Tutorials available at many websites, particularly at The Society for Chaos Theory in Psychology and the Life Sciences (which publishes the quarterly empirical journal *Nonlinear Dynamics, Psychology, and Life Sciences*) and The Plexus Institute.

I try to include as many as possible of these graphical portrayals of complexity theory in every class or workshop. Moreover, I make heavy use of these graphics in the many power point presentations I use in class. In addition I give assignments which consist of students hunting around for these kinds of resources as well as articles and books covering complexity science,

particularly in application to social science and organizational studies. It was in large measure because of the challenges faced by teaching complexity science that myself and several.

References

Goldstein, J., Hazy, J., and Lichtenstein, B. (2010), *Complexity and the Nexus of Leadership: Leveraging Nonlinear Science to Create Ecologies of Innovation*. New York and London: Palgrave Macmillan.

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Fractal 1. http://www.fractint.org/

Fractal 2. http://www.nahee.com/spanky/www/fractint/

Golly. http://golly.sourceforge.net/

Sprott 1. http://sprott.physics.wisc.edu/cda.htm

Sprott 2. http://sprott.physics.wisc.edu/fractals.htm