Nonlinear Dynamics, Psychology, and Life Sciences Special Issue: The Impact of Edward Lorenz

Edward Lorenz's work had a profound impact on the way we understand chaos and other nonlinear dynamics. He is credited with the articulation of The Butterfly Effect which has had an important stream of influence on society beyond science. This special issue, which commemorates his passing last year, takes stock of how many ways his work impacted on a broad spectrum of science.

The special issue will be released in July, 2009, and comes as part of your individual (or institutional) subscription to NDPLS. Subscriptions to the 2009 volume year also include the special issue on Psychomotor Coordination and Control.

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Abstracts to the articles in this special issue appear below:

Introduction to the Special Issue: The Impact of Edward Lorenz
Mohammed H. I. Dore, Guest Editor

The State of the Science of Nonlinear Dynamics in 1963
Vol. 13, No. 3, pp. 249-256.
Stephen J. Merrill, *Marquette University, Milwaukee, WI*

Abstract: When Edward Lorenz published his paper in 1963 on the deterministic nonperiodic solutions present in what is now called the "Lorenz Equations," he did so in the context of a rich theory of nonlinear dynamics beginning with the work of Poincaré. Here we trace the influences present in his work as well as provide a snapshot of the nonlinear world in 1963 to explain why his paper had such a pervasive effect on the science of nonlinear dynamics and its applications. In doing this, we also discover the critical timing of the development of the computer in this effort.

Chaos Theory Before Lorenz
Vol. 13, No. 3, pp. 257-269.
J. Barkley Rosser, Jr., *James Madison University, Harrisonburg, VA*

Abstract: We consider the precursors to the discovery of sensitive dependence on initial conditions by Edward Lorenz (1963) in his model of climatic fluid dynamics. This will focus on work in various disciplines that imply either such sensitivity, irregular endogenous dynamic patterns, or fractal nature of an attractor, as is also found in the attractor underlying the model Lorenz studied. Going from ancient hints in Anaxagoras through nineteenth century mathematics and physics, the main areas of such development will be argued to have been in celestial mechanics, oscillators, and economics.

Simplifications of the Lorenz Attractor
Vol. 13, No. 3, pp. 271-278.
J. C. Sprott, *University of Wisconsin, Madison*

Abstract: The Lorenz attractor was once thought to be the mathematically simplest autonomous dissipative chaotic flow, but it is now known that it is only one member of a very large family of such systems, many of which are even simpler. Even the system originally proposed by Lorenz is not in its simplest possible form. This paper will describe a number of simplifications that can be made to the Lorenz system that preserve its dynamics as well as a number of chaotic systems that are much simpler and hence can serve as alternate models of chaos.

The Butterfly Effect of the "Butterfly Effect"
Vol. 13, No. 3, pp. 279-288.
Kevin J. Dooley, *Arizona State University, Tempe, AZ*

Abstract: The "Butterfly Effect" metaphor states with variance that the flap of a butterfly's wings in Brazil can cause a tornado in Texas. This metaphor has become part of the common vernacular of Western culture. In this paper I discuss the origins of the metaphor, examine its current usage within popular culture, and present an argument as to why it is popular. I propose that the metaphor is a type of semantic attractor, a narrative device with invariant meaning but audience-specific contextualization. Finally I address whether the Butterfly Effect metaphor is a good example of itself.

Chaos as a Psychological Construct: Historical Roots, Principal Findings, and Current Growth Directions
Vol. 13, No. 3, pp. 289-310.
Stephen J. Guastello, *Marquette University, Milwaukee, WI*

Abstract: The landmarks in the use of chaos and related constructs in psychology were entwined with the growing use of other nonlinear dynamical constructs, especially catastrophes and self-organization. The growth in substantive applications of chaos in psychology is partially related to the development of methodologies that work within the constraints of psychological data. The psychological literature includes rigorous theory with testable propositions, lighter-weight metaphorical uses of the construct, and colloquial uses of "chaos" with no particular theoretical intent. The current state of the chaos construct and supporting empirical research in psychological theory is summarized in neuroscience, psychophysics, psychomotor skill and other learning phenomena, clinical and abnormal psychology, and group dynamics and organizational behavior. Trends indicate that human systems do not remain chaotic indefinitely; they eventually self-organize, and the concept of the complex adaptive system has become prominent. Chaotic turbulence is generally higher in healthy systems compared to unhealthy systems, although opposite appears true in mood disorders. Group dynamics research shows trends consistent with the complex adaptive system, whereas organizational behavior lags behind in empirical studies relative to the quantity of its theory. Future directions for research involving the chaos construct and other nonlinear dynamics are outlined.

Chaos and Predictability in Population Dynamics
Vol. 13, No. 3, pp. 289-310.
Alexander B. Medvinsky, *Institute of Theoretical & Experimental Biophysics, Russia*

Abstract: This article reviews recent case studies that demonstrate with the use of mathematical simulations some ecological consequences of the competition between chaos and other, non-chaotic types of population dynamics. Specifically, the results obtained testify that competition between different dynamical regimes can make predictability of the population dynamics more complicated than that of chaotic population dynamics. In the case where the structure of the basins of attraction to each of the competing dynamical regimes is fractal, estimation of the horizon of predictability can even lose its significance.

Chaos and Chaotic Dynamics in Economics
Vol. 13, No. 3, pp. 327-340.
Marisa Faggini*University of Salerno, Fisciano, Italy*

Abstract: Proponents of chaos theory attempted to articulate a new, more realistic, scientific world-view contradictory to the fundamental notions of the Newtonian view of science. Nonlinearity and chaos give the opportunity of a reconciliation of economics with a more realistic representation of its phenomena. Chaos theory represents a means for enhancing both the methodological and theoretical foundations for exploring the complexity of economic phenomena. This paper offers an overview of the applications of chaos theory in economics highlighting that recognizing the existence of deterministic chaos in economics is important from both a theoretical and practical point of view.

Science and Art: Emergence of Patterns from Nature's Chaos, Through Parallels Between Edward Lorenz and Yves Klein

Vol. 13, No. 3, pp. 341-348.
R. P. Taylor, *University of Oregon, Eugene, OR, and University of Canterbury, Christchurch, New Zealand*

Abstract: Famous stories achieve their enduring appeal because they capture the essence of the times from which they emerge. This is true for both art and science. At critical moments in history, these two worlds become intertwined through a shared quest to understand the world around them. Questions hang in the air and, remarkably, accidents deliver the answers. In this chapter, I will explore the relationship between science and art as Edward Lorenz's discoveries unfolded to shed new light on the sensitive patterns hidden within nature's processes.