Society for Chaos Theory in Psychology & Life Sciences

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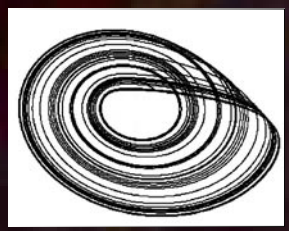
Abstracts to the 16th Annual International Conference, Baltimore, MD

2006



2006 CONFERENCE

SOCIETY FOR CHAOS THEORY IN PSYCHOLOGY & LIFE SCIENCES

August 4-6, The Johns Hopkins University, Baltimore, MD

PROGRAM ABSTRACTS*

Listed Alphabetically by First Author

Multidimensional Information Implies Higher Dimensional Chaos
Don Booker

Multidimensional Information Implies Higher Dimensional Chaos This presentation reports the results of simulations examining the symbolic dynamics of a multidimensional model of information based on Jan Kahre's mathematical theory of information, bounded by complex dynamical contexts. The dynamics exhibit higher dimensional chaos.

A Fractal Catalytic Theory of Perception and Action
Pat Carpenter, Carnegie Mellon University; Christopher Davia, University of Sussex

This talk describes a Catalytic theory of mind/body relations grounded in biology (Davia, 2006). It builds on the role of invariance in perception, emphasized by Gibson and Ecological psychologists, and resonating neural waves, the focus of Gestaltists and neuroscientists. Both behavioral and physiological measures characterize living dynamic systems: time-varying, nonlinear, and massively parallel processes that self-organize and manifest emergent properties. Such descriptions are from the perspective of an observer; from the organism s perspective, the processes correlate with the unfolding of its experience, the current focus. The essential theme of enzyme catalysis in metabolism involves overcoming structural constraints to dissipate energy. It is a vibrationally-assisted process thought to involve soliton-like waves -- localized, nonlinear waves whose form and duration depend on the symmetries (invariance) of the environment. Examples include neuronal action potentials. This theme can be generalized to the levels of the brain and entire organism. The brain is an excitable medium as a consequence of glucose metabolism. This energy gradient is dissipated by resonating neural activity that depends on the invariance arising from the organism s interaction in its environment; this plays the role of structural constraints. Through this generalized catalysis, the organism is unfolding its environment, not representing an independent environment. This proposal is supported by sensory substitution, in which individuals who are blind use other modalities to recognize visuo-spatial objects and events. Davia,C.J. (2006). Life, catalysis and excitable media: A dynamic systems approach to metabolism and cognition. In J. Tuszynski (Ed.). The Emerging Physics of Consciousness. Springer-Verlag.

Headfirst and On Purpose: Over the Catastrophe Shelf
Jane Davis, North Carolina A&T State University; Tom Smith, North Carolina A&T State University

University classes attempt to engage students in a discipline in such a way that promotes a deeper understanding of the concepts, issues and ideas that drive the content of any class. The authors sought to address this engagement through the application of chaotic principles within the classroom to create critical/creative thinking. This paper addresses the challenge of bring this dynamic into being and analyzes the depth of understanding achieved by the students involved. This experiment called on the basic principles of chaos theory: sensitive dependence on initial conditions, iteration, fractal nature, and the presence of strange attractors. Specifically, the authors sought to create catastrophe shelves or bifurcation points in a deliberate way which would advance student interaction through the first two levels of chaos and ultimately have them reach the third level, or deep chaos, that would enable students to move from the known with its certainties and predictable right answers to the unknown wherein they would construct their own belief systems and knowledge about an issue. Three university classes were used for this experiment, and this paper explains how the catastrophe shelves occurred and the results of this dynamic.

Some Interactive Determinants of Early Teen Goal setting
Martha Ross DeWitt, Medical College of Wisconsin

The design of the study focuses on the past experiences, current feelings, perceptions and relationships and future hopes and plans of eighth grade students. To assess the beginning of this transition to adulthood, a methodology is developed to sort out the multiple routes that students are likely to take, in environments that are often confusing and sometimes frightening. The methodology begins by using constructed typologies, based on choices of persons with whom to relate: in a variety of ways and for a variety of purposes. For each type, patterns of association with other variables are tested for conformance/nonconformance with a set of interrelated hypotheses of interactive effects, taken from a theoretical model: “Social context for life defining questions, mediated by self and other expectations, while searching for a place in the social order,” which posits the importance of statistical interactive effects as the central focus of analysis. Self and other expectations are key variables, having to do with perceptions of power differentials and potentials for negotiating one’s space. These are called “pattern variables” and are keys to predicting the choices that young teens make. Dependent variables are short term hopes and long term future plans, measured as indices. The theories were designed for causal analysis, and require the prediction of a coherent set of findings rather than a series of individual findings. This is a radical departure from methodologies of other social scientists, and can only be justified by successful, meaningful use.

Emergent Project Management: The Time-scaling of Work Routines
Kevin Dooley, Arizona State University

Many large-scale projects cannot be planned and controlled in a conventional manner because of the uncertainty associated with project execution, and the complex nature of interactions between project participants. In such projects the sequence of activity is better thought of as emergent from the local interaction of project members. In order to examine what patterns of activity emerge from such situations, I examine two cases: the development of electronic business standards (ebXML) as performed by a consortium of companies operating in a virtual environment, and the societal reaction to the California energy crisis which included both significant energy shortages and the beginnings of Enron s tragic narrative. I find that these large-scale social processes have many of the same sequential patterns as that prescribed and executed in smaller-scale projects. I introduce a theory of time-scaling of work routines in human systems to explain this phenomenon.

Valuing Forest: a Nonlinear Approach
Mohammed H. Dore, Brock University

In economics, an exhaustible resource is said to have a scarcity value or a scarcity rent over and above its market price. A forest is of course renewable but as the period required to renew a forest is long (a hundred years or more), it is also said to have a scarcity rent. What determines the scarcity rent? Clearly some sort of logical framework is required from which such a scarcity rent can be derived. In the standard Hotelling model of exhaustible resources, it is argued that the scarcity rent rises monotonically over time at the social rate of discount. In this we draw attention to a dynamic (i.e. time-varying) method of deriving a scarcity rent which is then estimated using ARIMA methods. The model is nonlinear dynamic optimization that uses Pontryagin's Maximum Principle and its properties. The costate variable (with respect to the forestry constraint) in the optimization model can be interpreted as the derived scarcity value, or shadow price. With a few added assumptions, this scarcity value can then be numerically estimated using ARIMA methods. The estimated value is shown to be fundamentally non-monotonic and nonlinear.

SOC and HSD: A Case Study
Glenda Eoyang, HSD Institute

Self-organized criticality (SOC) describes the internal dynamics of a complex system in which the frequency and size of disruptions hold a special inverse relationship to each other. On the one hand, SOC is intuitively obvious Of course there would be more small disruptions and fewer big ones. On the other hand, the constant ratio between magnitude and frequency and its application in a wide variety of settings (words in poetry to avalanches) make SOC a fascinating and perplexing phenomenon in complex systems. This session addresses two questions: How might SOC influence learning in a human system? What lessons does SOC teach us about designing and sustaining human systems? The case under investigation in this session concerns the birth and growth of the Human Systems Dynamics Institute (HSD Institute). Founded in 2003, the mission of the HSD Institute is to facilitate the development of theory and practice in human systems dynamics. Human systems dynamics is the emerging field of research and practice at the intersection between the nonlinear sciences (including chaos and complexity) and the social sciences

(including, for example, organization development, psychology, and anthropology). Since its founding, the HSD Institute has evolved from the hopes of a few into the diverse praxis of many. Principles of nonlinear dynamics helped shape the self-organizing path of the Institute and the praxis of individuals who engaged with it. In this session, Glenda Eoyang, founding Executive Director, uses the metaphor of SOC to reflect on the unpredictable and sometimes frustrating journey of the past and hopes for the future.

Past, Present, and Future: What are we learning?
Glenda Eoyang, Human Systems Dynamics Institute; Kevin Dooley, Arizona State University; Jeffrey Goldstein, Adelphi University; Stephen Guastello, Marquette University; Patricia Keithan, Ameriprise; Mark Michaels, Neesa Sweet, Braided River Group

In 1990, forty curious researcher/practitioners met for the first time in Washington, D.C. Mark Michaels brought them together, under the banner of the Chaos Network to share their emerging insights about chaotic dynamics in organizations. The meeting was an opportunity to connect with others who were pushing theory and practice beyond the traditional, Newtonian models of the past. For many, that meeting was a milestone in a life-long journey of experimentation and discovery. Fifteen years have passed. Each one of that merry band has continued to learn and teach; research and practice. This session provides an opportunity for those old-timers and the growing network of like-minded folks to share emerging insights and questions. This half-day session will be designed and facilitated by volunteers from the early Chaos Network days. The free-flowing conversation will be structured around the following questions: What have you observed about how complex and chaotic dynamics influence you and the organizations you care about? How do you feel about the current state of the field and your role in it? What are your emerging questions about the nonlinear dynamics and organizations? What are some opportunities for action for us individually and collectively? The session will include individual reflection, large, and small group discussions. At the end of the session, participants will: Connect (or reconnect) with colleagues. Gain an overview of the theory and practice of applying nonlinear dynamics to organizations. Develop an historical perspective on applications of nonlinear dynamics to organizations. Share personal perspectives about past, present, and future in this work. Explore opportunities to make a difference in the future. The session is not limited to Chaos Network old timers. You should attend if you are interested in-- Discussing how nonlinear dynamics affect organizational life. Developing relationships with others in the field. Exploring a wide range of viewpoints. Thinking about how self-organizing processes move forward through time. Reflecting on your personal experiences in a new and emerging field of practice.

Bifurcation and Stability Analysis of Long-Run Fish Stock in a Two Dimensional Imperfectly Competitive International Commercial Fishing
Gholamhossien Erjaee, Associate Prof. in Mathematics; Koji Okuguchi, Prof. in Applied Economics

In this article we will study the numerical bifurcation and stability analysis of international commercial fishing system. This system consists of two equations which are formulated under the condition of imperfect competition where two countries harvest fish of a single species in an open-access sea. The sufficient conditions on which the fish stock may become extinct, converge to a single or double equilibriums, periodic, double periodic and finally chaotic are investigated. Deferent numerical examples are presented for various values of considered parameters, namely the parameters exist in the fish s biological growth equation, of the harvesting costs and of the demand functions for the fish in two countries.

The Dynamics of an Organization in Crisis: Enron, a Case Study
Terrill Frantz, Carnegie Mellon University; Kathleen Carley, Carnegie Mellon University

We explore the fluid dynamics of a social network within a business organization during momentous personnel turnover events -- by applying dynamic network analysis techniques to the Enron email corpus. We investigate how the complex network structure of a real-world organization, namely Enron, responds when the appointment of a new CEO is announced, then later resigns; as well as, when the organization is in crisis and ultimately announces its bankruptcy accompanied by massive layoffs. We present our findings of the network-level dynamics, individual actors' behaviors, and the nonlinear dynamics of the changing topic of their communications.

The Intellectual Challenge of Dynamic Themes: Meanings Beyond Sequential, Additive Curriculum
Doris Fromberg, Hofstra University

This session takes the position that there is a relationship between play and meaning. A dynamic theory of play in early childhood can support teachers' use of dynamic themes as a basis for a meaningful curriculum in early education. This session will apply nonlinear dynamical systems concepts such as SDIC, fractals, self-organization, and phase transitions to and cross-disciplinary, and enable children to make connections among diverse entities in ways that are tied into the reality of children's individual learning styles. The theoretical and practical perspectives presented contrast with current primary practices that feature a linear approach: the presentation of an adult

conception of knowledge in uniform, narrow and additive ways with the emphasis on rote memory, an approach that not only does not resonate with the reality of how young children learn, but also limits the degree to which they truly understand and integrate what is being taught into meanings. Outline: -contemporary context of early childhood education -nonlinear theories that function like play (script theory; Theory of Mind and Brain research; and Chaos and complexity theory) -chaos and complexity theory in particular -sample dynamic themes.

Complexity and Sufficiency of Equations Used to Model Biomedical Phenomena
Joe Fusion, Portland State University; Wayne Wakeland, Portland State University

Differential equation-based models provide a compelling method for simulating nonlinear, dynamic physiological systems. One difficulty with such models is how to determine the appropriate level of complexity. High complexity may better approximate the real system, and may therefore exhibit more complex and realistic behavior. However, such complexity can negatively affect pragmatic aspects of a model, including understandability, performance, and maintainability. Further, the emergent behavior of even very simple models can be quite rich, evocative, and fully sufficient for improving understanding. We explore the problem of model complexity in a medical context, specifically the acute inflammatory response. What makes this context interesting is the presence of a dramatic tipping point. Beyond this point, the body s autoimmune response does so much collateral damage that the body is not able to recover, even though the initial infection has been eliminated. Two models are considered: 1) a published differential equation model with 18 state variables and 80 parameters that exhibits promising results when used to simulate subject response in an in silico randomized clinical trial, and 2) a much simpler system dynamics model of our own creation. We compare technical, pragmatic and functional aspects of the two models, and conclude that while both are able to express similar behavior on a large scale, the strengths and weaknesses of the models are quite different. As one might expect, the appropriate degree of model complexity strongly depends on the specific purpose of the model.

The Period of Financial Distress in Speculative Markets: Interacting Heterogeneous Agents and Financial Constraints
Mauro Gallegati, Polytechnic University of the Marches; Antonio Palestrini, University of Teramo;
Barkley Rosser, James Madison University

We investigate how stochastic asset price dynamics with herding, financial constraints, and variations in switching strategies in heterogeneous agents' decisions explain for the first time the presence of a period of financial distress (PFD) following the peak and before the crash of a speculative bubble, documented by Kindleberger [2000, Appendix B] to be the most common pattern observed among major historical speculative bubbles. Simulations show the phenomenon is due to agents' wealth distribution dynamics, selling because of financial constraints after the bubble's peak in relation to switching behavior by the agents. An increase in switching tendency increases the length of the PFD and decreases the bubble amplitude, while increasing strength of herding (interactions between agents) increases bubble amplitude.

Chaos in Human Psychomotor Data
Brian Goldiez, Institute for Simulation and Training, University of Central Florida; Thomas Clarke,
Institute for Simulation and Training, University of Central Florida

This paper discusses and presents psychomotor data collected in two separate studies that suggest hypotheses about relationships between chaos and human performance. One study was conducted approximately fifteen years ago using experienced pilots operating flight simulators. The second study was recently conducted using participants who traversed a maze using augmented reality equipment to facilitate a search and rescue task. Participants' positions were tracked and qualitatively compared to several different performance parameters including two measures of time in the maze and percentage of maze traversed. Control stick activity data gathered from the older flight simulator study was processed using the first moment of the power spectrum to define a measure termed the frequency weighted task complexity index (FWTCI). We believe this term can indicate the onset of chaotic activity by the operator due to the interplay between equipment performance, operator experience, and task difficulty. The measure was able to discriminate between two modes of behavior in the early simulator study. Data from the maze traversal experiments currently is being qualitatively assessed for features similar to FWTCI, that is, some relationship between performance and the onset of chaotic behavior as exhibited by traversal tracks. Results of this analysis will be presented. The paper concludes with a discussion of how fractal dimension estimators could be applied to simulator and game-play data to assess the human machine interplay characterizing the chaotic nature and complexity of the tasks involved as well as suggested mechanisms to control the onset of these behaviors.

Cross-cultural Generalizability of a Cusp Catastrophe Model for Binge Drinking Among College Students
Stephen Guastello, Marquette University; Yuji Aruka, Chuo University; Meghan Doyle, Marquette University; Kelly Smerz, Marquette University

This research examined whether a cusp catastrophe model for binge alcohol consumption by college students that was reported on an earlier occasion (Kulkoski & Guastello, SCTPLS 2004) could generalize to another culture. Participants were 127 undergraduates enrolled in economics courses at a private urban Japanese university. They completed the same questionnaire items that were used in the US study. Results showed essentially the same results that were obtained from the US sample: Binge drinking can be modeled as a cusp catastrophe with two stable states of behavior low to moderate consumption and binge level consumption. The two control parameters were peer influence (bifurcation) and attitude toward alcohol use (asymmetry). The nonlinear model (R-sq = .81) accounted for considerably more variance in the alcohol consumption data than the comparison linear model (R-sq = .05). An important difference between the two samples was that the level of consumption that constituted binge drinking in the Japanese sample was not as extreme as the level found in a case-controlled US sample.

Nonlinear Dynamics in Human Factors and Ergonomics
Stephen Guastello, Marquette University

Human factors engineering is the psychology of people-machine interactions, which in contemporary times has expanded to include ergonomics, which concerns the impact of the broader aspects of the nonliving work place on human performance, safety and health. Specific topics in this realm include psychophysics; the design of visual, auditory, and tactile displays; cognitive processes, motor control and control design; stress, health, and accident analysis and prevention; controls and displays for computer-based machines and virtual reality systems; artificial intelligence and collective intelligence, and the impact of micro- and macroenvironmental influences on performance. Most of these areas have become influenced by nonlinear dynamics systems theory to varying extents. The goal of this workshop is to convey some of the known nonlinear findings and to develop new ideas and directions for nonlinear research in human factors engineering and ergonomics.

Complexity and Chaos Theory as Applied to Executive Coaching: A Cross-national Study Surveying Business Executives' Perceptions in Greece, Lebanon and Egypt on Working with Coaches Using an Edge of Chaos Perspective
Daphne Halkias, American College of Greece; Nicholas Harkiolakis, Hellenic American University, Greece; Geofrey Mills, Notre Dame University, Lebanon; Sam Abadir, INSEAD, France

The Edge of Chaos refers to the critical point of a system, where a small change could either set the system into chaotic behavior or secure the system into a set behavior. The system can be seen as dynamically unstable to some perturbations, yet stable to others. Most living systems are understood to operate within in this region (Lucas, 1999). It is this region, which Marion (1999) believed could be best understood through Complexity Theory. In executive coaching, working at the edge of chaos can be powerful. It is a high leverage point where maximum change can occur with minimal effort. Many times executives come to or are referred for coaching because they are either stuck and appear unable to change or are out of control, in a state of internal or external chaos, having trouble adapting, developing, growing or changing. It can be through an effective coaching relationship that these individuals get back into balance with their systems and as a result achieve greater bottom-line results for every aspect of their internal system and external environment. Using an edge of chaos perspective, the coach can use effective questioning and other resources to encourage the executive to allow creativity and efficiency to emerge naturally within organizations rather than imposing their own solutions on employees. Complexity Theory can best be applied in executive coaching by guiding the executive to a renewed perspective of his role as a leader by redefining working relationships as nonlinear and containing feedback loops, realizing that complex challenges in organizations are best dealt with by understanding their history, treating them as naturally open system, with fluid boundaries and dynamically interwoven within a network of other complex sub-systems. In this research, a survey was developed to present perceptions of executives working in the regional business environment of the Eastern Mediterranean on working with executives' coaches utilizing a complexity and chaos theory orientation. This investigation begins to addresses two key research needs cited in previous writings on the study of executive coaching as a science: the lack of field research in the area of executive coaching and the introduction of cross-national/cross-cultural/ research studies in this area-- greatly needed for executives interacting in regional economic markets and within the global economy. Recommendations for future research are outlined.

A Nonlinear Delivery of Instruction as Applied to the Evolution of Learning in a MBA Information Technology Course
Nicholas Harkiolakis, Hellenic American University

Traditional approaches to instruction involve the delivery of the subject matter in steps of increasing difficulty and complexity. This approach is ideal for science, math and language courses where prerequisite knowledge is required for advancement into new knowledge. This paper will demonstrate a nonlinear approach to the delivery of instruction with the use of a case study. This refers to an MBA course on E-Business Technologies that was taught during the 2006 Winter Semester at a private American university in Athens, Greece. The challenge of specialized IT courses at the MBA level is accommodating the varying non-technical backgrounds of the students enrolled in such courses. For the course in question students had to understand client-server architectures, multi-tier architectures, current technology trends and produce a realistic draft of an e-business infrastructure at the end of the course. Following an incremental approach would mean introducing technology concepts, evaluate student understanding and progressively move to the next level. Due to the time limitations (12 weeks) assigned for the course and the varying student backgrounds, a linear/progressive introduction of the concepts would deem it impossible for the students to work on the required assignments before the end of the course. To counter the limitations imposed on the course a nonlinear approach to the delivery of the subject matter was adopted. The process resembled the discovery or the solution to a puzzle, where enlightenment happened explosively after students spend time on what appeared to be a chaotic search for knowledge on the course subject. A content analysis on student responses was done and the results will be presented.

Mapping Person and Event-Related Biopsychosocial Rhythms for Research and Clinical Practice
Ray Hawkins, Fielding Graduate University; UT Austin

Chaosticians have developed metaphorical and mathematical models for complex, nonlinear time series, and have appreciated temporal variability as data more meaningful than error variance. Recent research has revealed the utility of measuring daily mood and performance variability as a marker for bipolar disorder risk. Frank s (2005) Interpersonal and Social Rhythm Therapy (IPSRT) theorizes disruption of social rhythms as an antecedent and maintaining factor in mood swings in individuals with fragile biological clocks, and reports clinically significant improvements in mood stability over time in randomized controlled studies of IPSRT as an adjunct to medication vs. medication alone. In this session IPSRT will be described as an example of the utility of mapping individual (e.g., temperament) and event-related (e.g., social zeitgeibers and zeitstorers) differences in biopsychosocial rhythms for basic research in psychology and for clinical applications (e.g., the assessment and treatment of so-called bipolar spectrum syndromes; understanding the timing of and management of crisis calls).

How Cooperative Interactions among Autonomous Agents Contribute to the Sustainability of Complex Socio-technical Systems
James Hazy, Adelphi University

Organizations as complex socio-technical systems face the challenge of continuing operations as well as surviving in a constantly changing environment. That is, organizations seek continuing access to the resources they require; they seek sustainability. An organization‘s members, as autonomous agents, choose to participate in a collective enterprise because each benefits in some way from membership and this agent-level benefit derives in part from the sustainability of system-level organization. Presumably each member's participation provides it predictable access to the resources it requires to sustain itself as well. But how do the micro-activities and interactions among agents relate to the system level organization s presumed purpose of sustainability? This study explores this relationship. It posits a mechanism whereby cooperative interactions among autonomous agents enhance sustainability of system-level organization. By implication, system sustainability iteratively supports member-agent sustainability as rewards are distributed as a benefit of participation. Thus, the analysis looks at the system-level organization of autonomous agents as a complex adaptive socio-technical system interacting and co-evolving with a changing environment. It considers autonomous agents as choosing to act as coordinated, cooperative members of the system that is organized for system level benefit by an emergent signaling system. This emergent signaling system is represented symbolically, as signal cues received by each agent. It is varied, selected and retained in an evolutionary process of gathering and distributing resources and adapting to change at the system level.

Power Law Scaling for Structural and Functional Complexity in Human Movement and Posture
Lee Hong, Kinesiology, The Pennsylvania State University; James Bodfish, Psychiatry, University of North Carolina at Chapel Hill; Karl Newell, Kinesiology, The Pennsylvania State University

A loss of physiological complexity has generally been equated to an increased isolation of system components (Pincus, 1994). Here we compare the dynamics of body rocking and sitting still across adults with stereotyped movement disorder (SMD) and mental retardation (profound and severe) against age-, height-, and weight-matched controls from the perspective of structural and functional complexity. We investigated the center of pressure (COP) motion on the mediolateral (side-to-side) and anteroposterior (fore-aft) dimensions and the information entropy of the relative phase between the 2 dimensions of motion during quiet sitting and body rocking. Approximate Entropy (ApEn) of the COP motions of each axis served as a measure of functional complexity, while information entropy of the relative phase time-series served as a measure of structural complexity. In the controls, the higher functional complexity was found on each dimension of motion during quiet sitting. However, there was no difference in ApEn between the intentional body rocking of the controls and the stereotypic rocking of the SMD group. Similarly, the controls exhibited greater structural complexity during quiet sitting, but were similar to the SMD group during body rocking. Information entropy of the relative phase between the two dimensions of COP motion and complexity of their respective motions fitted a power-law function, revealing a relationship between macroscopic entropy and microscopic complexity across both groups and behaviors. This power law provides support for the idea that movement and posture are organized along a scale-invariant, fractal process.

Butterfly Catastrophe Model: Sexual Orientation, Intimate Relationships, and Religious Beliefs
Gary Horlacher, University of Southern California

Catastrophe theory (Thom, 1975; Zeeman, 1976) provides a method of modeling situations that involve building tension to a point of discontinuous change. It contrasts with traditional modeling methods which use linear or threshold analysis. Two catastrophe models are of special interest to social applications: the cusp model and the butterfly model, the former being a special case of the latter. Although several empirical studies have tested a cusp model, fewer have employed the butterfly model. This paper reviews three studies in which the butterfly model is used. The first involves a study of the conflict encountered by 165 currently or formerly highly religious Mormons (members of The Church of Jesus Christ of Latter-day Saints or LDS church) with a homosexual sexual orientation, the second involves the level of stability in the relationships of 9,839 intimate couples (RELATE), and the third involves change in religious beliefs for over 1,200 individuals across 35 years and three generations of the same families (LSOG). This paper will point out general insights into the butterfly model dynamics drawn from these three studies: (1) Typology: five qualitatively different regions of the outcome variables. (2) General guidelines for identifying control variables in social applications. (3) Correlation patterns across control factors. (4) Testing the different dynamics involved in the two catastrophes. (5) Predicting the control variables: Mediation. (6) Patterns in common trajectories of change.

Particle Swarms: Simulating the Social Adaptation of Cognition
James Kennedy, US Bureau of Labor Statistics

Particle swarm optimization is a computational intelligence paradigm based on the insight that social interaction comprises a powerful problem-solving algorithm. A population of individuals, starting from random positions in a search space, interacts by approximating the self-presented successes of their neighbors, as communicated through a social network. Through iterative parallel search a small (typically N=20) population refines problem solutions, first identifying promising regions of a problem space that may be nonlinear, multimodal, high-dimensional, etc., and then finding optimal points within those regions. The method has been the topic of hundreds of papers, including books, chapters, special issues of journals, and conference proceedings; doctorates have been awarded for research in this field in universities in more than a dozen countries. Though the author (an originator of the paradigm) is a social psychologist, and social-psychological metaphors underlie the paradigm, SCTPLS program committee members may not be aware of this research because most of it has been presented in the fields of Computer Science and Engineering. Festinger's original cognitive dissonance manuscript began with "Hypothesis I: There are two major sources of cognition, namely own experience and communication from others" (Harmon-Jones, 1999, p. 355), but the published version isolated the individual s cognitive dynamics from the social field, and consequent discussion tended to treat the two separately. Particle swarms offer a theoretical framework for understanding how complex cognitive systems can become organized through the integration of one's own experience with experiences observed in the social context, and indicate that the effect of human social behavior on cognition is highly adaptive.

Engaging the Natural Tendency of Self-Organization
Richard Knowles, Ph.D., The Center for Self-Organizing Leadership(TM)

There is a natural, pervasive tendency for living systems to self-organize. This is seen throughout nature at all levels of scale from tiny bacteria to large eco-systems. People experience this phenomenon in gathering to talk, work and play. This tendency is so pervasive and subtle that it is often not noticed. Yet it is happening all the time. As we engage in leadership activities, we have a simple, initial choice to make. Do we engage this tendency in a purposeful way and learn to flow with the energy and creativity within the system, or do we try to impose our will upon the system struggling to make what we want to happen actually happen? From this very simple, initial decision huge differences in the behavior and performance of organizations are experienced. While the initial choice for leaders is simple, the follow through is more complex. This paper will explore these ideas, providing insights, based on the author s many years of practical, hands-on experience and study about how these decisions play out. Suggestions will be shared about ways we can purposefully engage with this natural tendency of self-organization and the benefits of learning to work this way.

Issues Created by Applying Complexity Science to Public Policy
Gus Koehler, Time Structures & USC Sacramento

Recent articles in the New Yorker and the New York Times discussing the application of power-laws and network analysis raise serious privacy and welfare policy questions. For example, what are the implications that power laws have for delivering social services such as welfare or for dealing with Aids? Do data mining and network analysis inevitably create privacy problems and generate false positives when search for terrorists? A panel of complexity scientists with public policy experience will discuss these questions.

Analysis of High-frequency Financial Data by Folding Dimension
Yoshiaki Kumagai, Education and Integrated Arts and Sciences, Waseda University, Japan

The fractal structure of high-frequency financial data has been analyzed by the folding dimension, which has no relation with time scale. The transactions in the market do not occur in equal time intervals. In general, the time which evolves the price process, cannot be determined uniquely. There are at least four candidates for the proper time scale to use for analyzing market data: physical time, trading time, the number of trade, and cumulated trading volume. The folding dimension is defined using the extreme values determined with price scale. The fractal structure of non-equidistant data is measured by folding dimension without choosing time scale. This analysis with price scale is a reformulation of non-time series charts of the technical analysis. High-frequency financial data of the Dollar/Yen exchange rate and prices of the crude oil futures are used. The results show that the folding dimension can describe time evolution of fractal structure with price scale.

Biotic Patterns in Music
Allan Levy, Society for the Advancement of Clinical Philosophy; David Alden, Coauthor; Caleb Levy, Collaborator

Since Pythagoras discovered how the ratio of the length of the strings in musical instruments corresponds to octaves and chords, musicians and scientists have struggled to connect the beauty of music to an underlying physics and mathematics. Bios is a theory of natural processes that when applied to music may help to quantify many of its attributes. These include: sensitivity to initial conditions (the first four notes of Beethoven's fifth limit the nature of what may follow); novelty--for a musical piece to be interesting new patterns must continue to emerge; complexity within structure; and time limited patterns--like the movements in a piece of music. The fundamental input for biotic quantification is a time series. This corresponds naturally to the twelve-tone sequences of notes common in Western music. In a musical composition each tone has, among other characteristics, a pitch, duration, amplitude and sequence in time. Conveniently, the Musical Instrument Digital Interface (MIDI) data format provides these values in a readily accessible manner. Our biotic quantification of two musical pieces by Johann Bach, Prelude One in C major (from the well tempered Clavier), and Minuet in G major, and one by Claude Debussy, Dr. Gratus ad Parnassum, demonstrate that these pieces show strong biotic patterns, both in the writing of the composer and the performance by the artist.

Analysis of Biological Networks by Artificial Neural Networks
Larry Liebovitch, Florida Atlantic University; Nicholas Tsinoremas, The Scripps Research Institute; Abhijit Pandya, Florida Atlantic University

There are many networks of interacting molecules in living cells. We have developed an approach to analyze experimental data to determine which pathways in these networks interact and to design combinations of drugs that take advantage of those interactions to maximize a desired effect. To find the relationship between a set of input

drugs (d) and the expression of a set of genes (g) we construct an artificial neural network. We train the network on inputs of drugs presented one-at-time and pairs-at-a-time. We optimized the performance by using only 1 output, softening the transfer function between the input and hidden layer, using four times as many units in the hidden layer as the input, and taking the logarithm of the output values. For linear and nonlinear test models of a given g=f(d) the network can then accurately compute the value of g for combinations of drugs d. With 15 d inputs that are either , the network accurately computed the output from all 2^15=32,768 possible input patterns with 99% of the outputs having errors of less than 10%. These test results suggest that this approach may be of value in the analysis of interference RNA experiments to determine which genes interact with each other and which combinations of iRNA could be used to maximize therapeutic effects.

A Roundtable Dialogue between Divergent Perspectives of Academy & Praxis on Applying Chaos & Complexity to Organizations
John Link, Organizational/social science practitioner, VA ; Jo Lee Loveland Link, Organizational/social science practitioner, VA

Rationale for this Proposal: As some of the SCTPLS leaders and members know, John and Jo Lee have been engaged with concepts derived from the fields of chaos and complexity since 1991, and are inventors of the experiential simulation, Chaos, Inc., which provides an open-ended laboratory on complex systems dynamics in reality-based organizational life. We have been enriched by sharing in conferences, presentations, articles, and informal discussions together with a number of other practitioners (especially Glenda Eoyang), as well as academicians and researchers (including Jeff Goldstein, Steve Guastello, Kevin Dooley) and have found these exchanges have added vitality to our own practitioner-based efforts with government and business. For the past three years, we have been virtually sequestered inside what are perhaps the most future-oriented efforts in the Department of Defense, where transformation has grown to embrace complex systems dynamics on several levels: militarily, where computational researchers are investigating swarm theory and other concepts relevant to today's battlespace; technologically, where the term Net-Centricity refers to often globally- distributed self-organizing Communities of Interest that communicate and collaborate in web-enabled open systems; and organizationally, where traditional stovepipes become fractal boundaries between military Services, other federal agencies, and even foreign allies in ways that preserve information security while enabling information-sharing. This conjoining with complexity-in-action (Argyris & Schon s theory in use) has led us full circle: we are finding ourselves in need of revitalization from the academy (espoused theory et al.!). Yet, like many fields (especially new and more diffuse ones like conflict resolution and organizational/behavioral science), we see that complexity as an aggregate set of related disciplines is caught in tension between the domains of theory and practice. Boundaries and roles in these two great nations are at best fractal and at worst remote, in conflict, and unengaged in joint dialogue. . We propose a roundtable/panel to forge a dialogue that would enliven and enrich both worlds. An optimum outcome would be to identify potential opportunities to strengthen the theory-practice synergy, with the possibility of specific areas on which to focus. Proposed Session Format: John and Jo Lee will introduce, convene, and facilitate the session. The roundtable will consist of 2-3 academically-oriented panelists and 2-3 practitioner-oriented panelists (to be identified prior to the conference in consultation with SCTPLS colleagues). In advance of the session, panel chairs would select up to 5 key issues each group sees as important in organizations right now. Panelists will then present a more in-depth discussion of the issues, identifying the theory-practice nexus and differences. The audience will be able to add on the lists and identify related issues. Facilitators will use difference questioning to tease out sub-issues and new possibilities. Finally, the full group will identify what potential synergies and future steps make sense in the context of findings from the session. If desired, the session will be written up for publication in SCTPLS Journal.

Gregory Bateson: His Epistemology, Logic and Legacy
Thomas E. Malloy, University of Utah; Matthijs Koopmans, Research & Consulting; Jeffrey Goldstein, Adelphi University

Gregory Bateson s work in the nineteen-forties and early nineteen-fifties was situated at the cusp of several significant developments. At the same time, with the onset of cybernetics and a variety of general systems models, this period was a critical one in dynamical systems thinking. In psychology, meanwhile, the search for paradigms that would overcome the limitations of the predominance of behaviorism and psychoanalysis was beginning to produce results, and in anthropology, there was a growing interest in a more systematic cross-cultural analysis of social and family structures as well as of the use of language as a means to create, classify and reinforce those structures. It attests to the breadth of Bateson s scholarship that he was able to contribute in each of these areas in a manner that was often brilliant and thought provoking, but also often elusive and abstract almost to a fault. The three presentations that constitute this symposium respond to the resulting and ongoing need to make sense out of Bateson, his logic and the nature and significance of his contributions to science and scholarship. An outline of each of the three individual presentations follows: *Prerequisites to Batesonian Epistemology* Thomas E. Malloy (Department of Psychology University of Utah): I shall summarize a series of fundamental issues which frame Gregory Bateson’s epistemology. These include the map/territory distinction, the universe is a web of relations, the

pattern which connects all living beings, the idea that knowledge is news of difference and that only some differences make a difference, the structure of thought and evolution as best describable as stories (which are patterns changing over time), and the distinction between conscious logic and unconscious logic. These ideas, all deep, will necessarily be more like enticements than full expositions given the short time for a presentation; my intention is to paint a panoramic vista and leave the audience to fill in details later through their own explorations if they should wish.

Double Bind Theory Then and Now: From a Brilliant Insight to a Troubled Legacy Matthijs Koopmans: My presentation will briefly discuss Double Bind theory, which argues that major psychotic disorders such as schizophrenia are associated with internally contradictory social interactions among significant others. It was once considered a very important theory, but was ultimately discarded, because of its lack of specificity, and no one, including Bateson, was capable of fully overseeing its ramifications. In this presentation, I will discuss what were some of the problematic issues regarding double bind, what resolutions are to this day available to us to salvage some of its core ideas, and which pitfalls to shy away from.

Paradox, Logic, and Dialectics in Bateson, and Complexity Jeffrey Goldstein (Adelphi University): First, I will present the way Bateson applied theories of logic and paradox in his idea of the double-bind and related constructs. I will then compare his approaches with cognate uses of logic and paradox in complexity theory, particularly, with the phenomenon of emergence in complex systems.

Utilizing Fractal Time
Terry Marks-Tarlow

With the invention of the clock came a linear conception of time. Although initially useful to coordinate people and activities, a linear model can be oppressive in contemporary culture. Epidemic levels of stress include pervasive feelings of never enough time. Despite our minds, our bodies already use fractal time in the form of 1/f dynamics. To help free up our everyday experience, this paper presents a nonlinear alternative. A fractal conception of time injects the infinite into the finite, with open-ended possibilities for nested temporal cycles. From a fractal point of view we can pack an infinite number of activities into the same period of time and still leave room for more.

Dynamics of Interpersonal Synchrony and Cooperation
Kerry L. Marsh, University of Connecticut; Michael J. Richardson, CESPA, University of Connecticut;
R. C. Schmidt, College of Holy Cross; Reuben M. Baron, University of Connecticut

Dynamical systems approaches to understanding the movement of individuals interacting is an area of relative neglect. We discuss results from two areas of research that redress this. In one area, we use a methodology developed to examine unintentional behavioral coordination between individuals (Schmidt & O'Brien, 1997). In recent studies, we find that the patterns of local rhythmic movement (swinging of handheld pendulums) and global movement (rocking in rocking chairs) of pairs of individuals are described by a coupled oscillator dynamic (Richardson et al., 2005). We find that dyads are coupled by an informational linkage, where vision (or language) leads pairs to unintentionally synchronize their movements. The patterns we find, however, indicate relative coordination rather than phase-locking. In a second area of research (Richardson et al., 2006), we demonstrate that cooperative action can be understood as a self-organized process. In their shifts between action modes (e.g., solo and cooperative action), pairs engaged in a simple physical task (moving planks of wood) display characteristic features of dynamical systems such as hysteresis. We discuss this research from our synergistic approach to the emergence of social units, a perspective that combines ecological perception and dynamical systems approaches with an emphasis on embodied processes of meaning (Marsh et al., 2006).

Dynamics in Nonlinear Heterogeneous Duopolists with Product Differentiation
Akio Matsumoto, Economics, Chuo University

Continuous dynamic mixed duopolists will be examined with product differentiation and isoelastic price functions. Mixed duopolists means that one takes the quantity strategy and the other takes the price strategy. We will first prove that under realistic conditions the equilibrium is always locally asymptotically stable. The stability can however be lost if the duopolists use delayed information in forming their best responses. Stability conditions are derived in special cases, and simulation results illustrate the complexity of the dynamics of the systems.

City Adopts Complexity Indicators
Kenneth A. Meter, Crossroads Resource Center

City governments face complexity daily, yet few measuring tools allow civic leaders to assess nonlinear or transforming systems. In 2005-2006, the city of Minneapolis became one of the first in the U.S. to connect complexity measures to its comprehensive plan. Specific targets have now been set for sustainability indicators that are closely linked to city budget processes. A vital public process, involving 85 residents and professionals, defined 30 such indicators at the city's request, setting out a 50-year vision for a changed city. This workshop, presented by the coordinator of that public process, outlines the theoretical framework and methods used including key assumptions, technical and political constraints, and where this effort falls in a tradition of systemic evaluation approaches. Then it offers a glimpse into the realpolitik of installing such an evaluation process in a major urban center, including a review of how separate agencies are learning to work together to address cross-cutting issues over the long term.

Linear and Nonlinear Measures of Heart Rate Variability in Psychiatric Conditions
Susan Mirow, PhD, MD, Dept. of Psychiatry, University of Utah School of Medicine; Olinto Linares, PhD candidate, Dept. of Bioengineering, University of Utah School of Medicine

Nonlinear measures of physiological time series may provide a way to study psychiatric conditions with their unique patterns of transitions. We first review the details of heart rate variability with the production of the tachogram and its derivation from the electrocardiogram. Next we describe classical linear measures used to characterize heart rate variability data, i.e., segmented statistic, trend analysis, histogram, mean and standard deviation. Frequency measures are next reviewed, such as LF/HF and frequency spectrum and autoregressive frequency as they have been applied to descriptions of psychiatric conditions. A review of Poincare plots follow, characterizing normal sleep as well as several sleep disorders, i.e., parasomnias. Lastly, we present our work using nonlinear measures of heart rate variability to describe healthy people and to distinguish them from those with psychiatric illness. Using examples and case studies, we hypothesize the usefulness of these measures for diagnosis and treatment of psychiatric disorders.

Complexity Theory and Positive Psychology: An Overview
Frank Mosca, Life Coach, Private Practice

There has been a growing connection between the Positive Psychology movement originating with Marty Seligman at U. Penn among others, and complexity theory. The primary idea has been the question of whether alterations in human behavior in the direction of positive affect, perception and outlook might not be boosted by an underlying reality relating to the ration of positive to negative events, behaviors, thoughts etc. The article by Frederickson and Losada, Fredrickson B. L. & Losada M. F. (2005). Positive affect and the complex dynamics of human flourishing. American Psychologist, 60, 678-686. abstract pdf detail this conjunction. My presentation will broaden the view and offer some personal speculations about how different models may profit from a complexity theory understanding of the positive dimensions of human experience.

Comparative Dynamics for Climate Policy Choice
Yasuo Nonaka, Department of Economics, Kanto Gakuin University

This paper investigates long-run effects of climate policy choices. A policymaker introduces global carbon taxes in order to reduce atmospheric CO2 (carbon dioxide) accumulation. The policymaker adjusts the tax rate for observation of CO2 emission. This paper considers the interaction between a policy adjustment and the dynamics of carbon uptake by terrestrial biosphere. It numerically demonstrates that given the nonlinear carbon sink, the atmospheric CO2 accumulation will show complex behavior.

When Government Asks All the Questions What About the Other Things that Matter? Feedback and Adaptation in Complex Policy Systems
Denise O'Connor, U of T (only until 6.30.06)

The notion that governments respond to feedback is a basic element of how we think of the policy cycle. However, complex policy systems provide a particular challenge to this conceptualization. Complex policy systems are composed of independent yet interdependent actors and affected by a myriad of exogenous factors. Outcomes are not easily measured or measurable yet governments continue to rely on traditional methods of performance evaluation. Research into home care delivery in Ontario and England identifies the way in which problems that get in the way of the smooth running of a delivery system are left unresolved when governments define what constitutes appropriate feedback and the concerns of service providers are relegated to the channels of political advocacy and treated as self interested claims. In both jurisdictions home care is organized into an internal market and the relation-

ship between government contractors and providers is one of principal-agent. The contract between them becomes a fixed feature of the system, whether it works or not, and those issues covered in the contract are removed from the feedback loop. With the trend of centralized control of system design coupled with decentralized implementation the fixed features of such systems can result in suboptimal outcomes produced by maladapted systems.

Leader Project
Mario Pigazzini

Leader Project Lecco-Adelaide Evaluation Research Project Following the Sierpinski's gasket model I elaborated a grid, called Shaping Mind, of three interacting series of three variables which represent the basic organization of the most significant aspects of the psychodynamic psychotherapy s session. These nine variables are divided into a three-phase space psychotic, neurotic and natural adult personality and each of them has ten parameters, from worse to best. At the end of every session the psychotherapist fills in the grid selecting the most representative item of the nine variables of the session. Using Access and others software like Mathlab, many diagrams are plotted, and this gives us the opportunity to evaluate the psychotherapy process. From this model I developed another software, called Changing boundaries in psychotic state, which intend to measure the evolution of psychotic patients inside the residential care unit. One relates to the experiences of the weekly rehabilitation activities and the other to the nurse s daily observations. Diagrams give us the opportunity to evaluate the real behavioral changes, comparing them with clinical observations.

Orbital Decomposition in Conversation Analysis: A Demonstration with Contiguous Family Therapy Sessions
David Pincus, Chapman University, Orange CA; Katherine Perez, Chapman University, Orange CA

The analysis of sequential patterns in small group discussions holds great promise in advancing the scientific foundations of theory relating to interpersonal process (i.e., various forms of psychotherapy, small group process theories, and developmental psychopathology). Orbital decomposition (OD) is a relatively new approach that has shown some strong initial utility in this regard. OD allows a researcher to break a long string of categorical data (i.e., a lengthy conversation) into smaller strings, or patterns. The global dynamics of those patterns may then be analyzed to yield measures of chaos and complexity including information entropy, fractal dimension, and topological entropy. The current presentation will use an example analysis of five contiguous sessions of family therapy to demonstrate how one may derive these measures using standard statistical software packages (i.e., SPSS), as well as how one may carry out inferential tests with respect to changes in entropy, both within and across sessions.

A Chaos Theory Perspective on Mortality Salience and Resultant Terror Management: A Novel Approach to the Dilemma of Sentiency
Scott Richards, Psychology, Walden University

Terror Management Theory (TMT) presents an inclusive construct addressing the dilemma of sentiency: the nature of human existential angst and the terror management techniques deployed and employed when confronted by mortality salience. However, TMT remains too confined to explain the serpentine course of human existence as a response to existential angst. Viewing TMT within a Chaos Theory (CT) construct, with mortality salience resembling a strange attractor resulting in a terror management response, permits a wide-angle view on human anxiety, the origination of various traits and states to protect the individual from that anxiety, and the inevitable path of human suffering as exhibited and reinforced by existential angst. Exploring this novel integration permits researchers and practitioners to obtain an improved and tangible view of anxiety development, prompting new insight and potential existential psychotherapeutic tools. As background, the intricacies of a psychological science application of chaos theory, the tenets of terror management theory, and motivational constructs regarding the development and response to anxiety, including attachment theory and sociometry theory, are discussed. Lastly, a call for a research project involving the incorporation of Buddhism s The Four Noble Truths in existential psychotherapy is presented as a response to integrating this new construct within an expanded psychotherapeutic vision.

Complexity, Information and Robustness: The Role of Information 'Barriers' in Complex Networks
Kurt Richardson, ISCE Research

In this supposed information age a great premium is put on the widespread availability of information. Access to as much information as possible is often cited as key to the making of effective decisions. Whilst it would be foolish to deny the central role that information and its flow has in effective decision making, this paper explores the equally important role of barriers to information flows in the robustness of complex systems. The analysis demonstrates

that (for simple Boolean networks at least) a complex system s ability to filter out, i.e., block, certain information flows is essential if it is not to be beholden to every external signal. The reduction of information is as important as the availability of information.

Chaos and Migraine
Lawrence Robbins, M.D., Rush Medical College; Cameron Leith, PhD.

Many aspects of migraine pathophysiology are best explained by chaotic control mechanisms. The relation of fractals, dimension, and the mathematics of chaos to migraine will be discussed. At the heart of migraine are 3 mechanisms: 1. brainstem dynamics, 2. cortical spreading depression(CSD), and 3. central sensitization(CS). In migraine, the brainstem's modulatory system of inhibition/excitation is skewed toward hyperexcitability. Chaotic mechanisms most likely are at work on the descending periaqueductal gray and dorsal raphe nucleus inhibitory 'off-cell' pathways. Linear or random dynamics would not explain the ion-channel events that govern brainstem actions. The loss of low-dimensional chaos may occur in those with chronic migraine(CM). CSD drives neuroinflammation in the periphery, as well as increasing excitation in the brainstem. A tiny change in K+, Ca+, or Na+ ions results in NMDA receptor activation, and then CSD. Small initial changes resulting in bifurcations and major events downstream is one hallmark of chaos. CSD triggers major brainstem and peripheral inflammatory changes; only the flexibility of a nonlinear chaotic system could govern this process. CS starts with wind-up and summation at the dorsal horn, control of which is most likely chaotic. Tiny inputs result in a brainstem cascade of events, leading to genetic changes. Several neural networks, each probably under low-dimensional chaotic governance, interrelate at this level. Thalamic perturbations, leading to allodynia, are most likely under chaotic control. Control of chaotic mechanisms may lead to improved therapies. Working with compounds that alter ion channels through chaotic mechanisms, with tiny initial inputs, may prove beneficial.

Bios Theory of Cosmological and Biological Evolution
Hector Sabelli, Chicago Center for Creative Development; Gerald Thomas, Milwaukee School of Engineering; Louis Kauffman, University of Illinois at Chicago; Lazar Kovacevic, Chicago Center for Creative Development

We here explore the hypothesis that evolution embodies logically necessary relations, rather than being the product of chance and selection. Sabelli (Union of Opposites, 1989) proposed that three fundamental mathematical structures, lattice order, group symmetry, and topological form are the primary processes that guide physical and biological evolution. These mathematical structures are fundamental components of all others (Bourbaki), and are equivalent to the primary psychological structures in human development (Piaget). These three primary processes together constitute a biotic generator, i.e. a process that creates steady states, periods, chaos and bios, as exemplified by the process equation $A(t+1) = A(t) + k * t * \sin(A(t))$ (Kauffman and Sabelli, Cybernetics and Systems 1998). Bios is a fractal pattern, sensitive to initial conditions, with features of novelty and diversification absent in standard forms of chaos (Sabelli, 2005). We have found biotic patterns in the temporal distribution of galaxies, and in Schrödinger equation (Sabelli and Kovacevic, Complexity, 2006). The equation generates bios at time and distance scales obtaining shortly after the big bang, raising the possibility that biotic processes may account for early expansive and creative cosmological processes. (Thomas et al, NECSI 2006). We have now found that bios is NOT generated if there is no conservation of mass. Biological evolution also requires conservation (genes). We also found bios in the population numbers of five (lynx, muskrat, beaver, salmon, fox) of six animal species. Biological evolution may result from the generation of novelty and diversity by bipolar, synergistic and antagonistic interactions.

Bios Method of Psychotherapeutic and Sociotherapeutic Action
Hector Sabelli, Chicago Center for Creative Development

Bios theory provides a method of thinking based on natural science and on psychotherapeutic practice. Logically necessary mathematical structures are embodied in all natural and human processes as lattice of action (energy * time), a group of communication, and a topology of material structures. Action, bipolar opposition, and triadic form are universal forms of order that together create periodicity, chaos and bios, as illustrated by recursions such as $A(t+1) = \sin(A(t) * k * t) + A(t)$. Recursion (action), bipolar opposition (trigonometric function) and conservation (+A(t) term) are necessary to produce diverse, novel and complex life-like (biotic) patterns. Order creates complexity: organization out of order rather than order out of chaos. Recognizing action, bipolar opposition, and connection as the three components of creation in natural processes provides tools for creation in human affairs. Regarding action as the sole constituent of nature places biological, social, psychological and ideological interventions on an equal footing; it also implies the need to take the initiative. Bipolarity means cooperation and struggle, and need for opposition --not one party or bipartisan consensus. Topological connections conserve processes as structures: lattice asymmetry is conserved as hierarchy, and group circulation as feedback. Upward causation is primarily energetic (priority) and unipolar, and downward causation is primarily informational (supremacy) and bipolar. This applies to hierarchical levels of generations, sexes, and classes, and to biological, economic, and ideological processes. Health care,

peace, and a healthy environment are social priorities but building a majority requires attending to cultural and emotional processes.

The Adaptive Range of Fractal Force Production
Jacob Sosnoff, Kinesiology and Community Health, University of Illinois at Urbana-Champaign;
Andrew Vallantine, Department of Kinesiology, Pennsylvania State University; Karl Newell, Department of Kinesiology, Pennsylvania State University

The output of a number of physiological and psychological processes is fractal in nature. However, this complex output is often in response to non-fractal task demands. The purpose of this investigation was to examine whether human subjects can scale their motor output to fractal demands. Subjects produced isometric force output to 6 visually presented targets of distinct fractal dimensions (dimension 0 constant force, dimension 1 sinusoidal force, black, brown, pink and white noise). The frequency content of the fractal waveform was varied from 0-4 Hz, 0-8 Hz and 0-12 Hz in independent conditions. Complexity of the force output scaled in general to that of the target, but task performance was found to decrease as a function of target complexity. The most complex output was found in the constant task and the least complex in the sinusoidal force target. Subjects increased the complexity of the force output in the white and pink noise targets with increases in frequency content. In contrast, there was a decrease in force complexity as a function of frequency content in the brown and black noise targets. The findings reveal that subjects: 1) are capable of adaptively scaling motor output to fractal task demands; 2) can utilize high frequency content in modulating force production; and 3) can increase complexity with feedforward processes. There is an adaptive fractal range to the variability of isometric force production due to exploiting the multiple control processes operating over unique time scales.

Complexity and the Transformation of Education: Creating and Growing Curricular Forms
Darren Stanley, University of Windsor; Jack Yantis, Antioch University (Seattle)

The modern paradigm of education and the project of schooling continues to suggest that we live in a closed system where knowledge is to be discovered, but not created. This kind of uncovering of a pre-existent world is a limited and limiting way for framing, understanding and structuring learning in the classroom. Such a view of schooling as the already-formed or -produced suggests a taking-in or a consumption orientation to learning. Creating and growing a curriculum, on the other hand, places a focus on the producer rather than the produced. If education, as its etymological roots suggest, is not only a kind of leading, but a notion strongly related to growing, then what might the project of schooling look like that embraces the emergent and self-organizing nature and quality of life? In this paper, we consider what learning might look like as a transformative process akin to a creating and growing of complex curricular forms.

Emergence on the Game of Life
William Sulis, McMaster University

Conway's Game of Life provides a classic example of emergence in a formal model of a complex system. In this emergent situation certain configurations of Life patterns can be arranged so as to simulate the flow of bits through a configuration of logic gates. Archetypal dynamics, a formal framework for understanding emergence through a study of information flows in complex systems, is applied to this particular emergent situation. Archetypal dynamics describes a complex system as a tapestry (observations) evolving via a two player combinatorial game (dynamics) whose players, Proposer and Disposer, extend the tapestry using constructor tapestries (actions) subject to constraints provided a by a formal tapestry (context/rule space/symmetries). Complete reality games are exhibited for the Game of Life and for systems of logic gates. These are shown to be mutually irreducible. Two complete tapestries are exhibited for the emergent situation and it is shown that these tapestries evolve in a manner consistent either with Life or the logic gate game. This emergent situation in Life arises through the presence of an ambiguous subsystem, one that admits two complete descriptions that evolve under mutually irreducible games.

The Fragility of Evolution and the Logarithmic Nature of Evolutionary Time
Michael Susko, STATE OF MARYLAND/CIRCARE

This presentation will first review a previous publication, The Fragility of Evolution, a re-envisioning of biology around the metaphor of protection of fragile periods of change and fragile populations, rather than elimination of the less fit. Areas of consideration range from genetics, developmental biology to ecology. After considering the basic mechanisms of evolution, this essay will explore a work in progress, The Logarithmic Nature of Evolutionary Time. Here, the dynamics of time and how mega-evolutionary change clusters around distinct logarithmic intervals will be explored. This presentation is a synthesis includes data from data from morphological evolution to more recent cultural evolution on the threshold of historical time.

Paradigm Shifts and Patterns in Psychological Thought
Rita Weinberg, Ph.D., National-Louis University

A paradigm is a prevailing point of view or way of thinking about an issue that exemplifies an entire scientific culture. Science changes as our perceptions and patterns change. Psychology is still an evolving science so paradigms shift often. Change comes about through technology, such as the invention of the computer or the microscope; or through a new theory such as Chaos theory which provide new ways of seeing how things work and finding patterns in what appears to be confusing or disorganized. In this paper we delineate some of the paradigm shifts which we have read about or observed in psychological theory and practice over its history. We include Chaos theory as leading psychologists to a major shift in perception of people and how they operate. It also taught us to look for pattern where none appeared to exist. Some shifts include widespread use of psychoanalytic principles to explain behavior. Another shift was behaviorism. Its approach was radically different, more mechanistic explanation of how our behaviors were externally controlled and shaped by rewards and punishment. A radical shift in the field of psychology was a turn from a focus on pathology and the problems of the mentally ill. Psychologists began to explore more positive emotional states such as joy and pleasure and look at individual's positive internal resources. Research about resiliency of children and adults began to appear. Learned pessimism gave way to learned optimism. Chaos theory was a factor in another shift in psychology. People were perceived as whole cybernetic systems, following rules of nonlinear theory leading to new perceptions and understandings of behavior and human functioning. We provide examples of the shifts, changes of perception and pattern differences.

Determination of Optimal Blood Pressure Determination in Human Beings: From Theory of Complex Systems to Simple Decision
Anatoly Zhirkov, RIEMC; Victor Kostenko, RIEMC; Alexander Subbota, Association Harmony and Life; Grigory Shatov, Association Harmony and life

In establishing of optimal correlation between systolic and diastolic BP theoretical model of vascular wall and intravascular blood stream oscillation had been used. (Ph-)/(-Ph) ratio of systolic (SBP) and diastolic (DBP) blood pressure allows to provide intravascular blood flow with minimal energetic outlay. Data obtained last time confirmed an opportunity of application of described ratio in clinical practice. On the other hand, there was a lot of factors influenced on BP described in medical publications. Aim of our trial was to study an opportunities of using of complex systems theory in developing formulas of optimal BP calculation in clinical practice. We examined more than patients treated in-hospital in -. Primarily we have analyzed more than factors influenced on BP described in medical publications worldwide, than selected of them with maximum rating according scientific sources. Some significant values were excluded because of being too expensive or not applicable in clinical practice. We evaluated mainly such factors as age, height, weight, cholesterol level, blood glucose level, smoking, alcohol consumption, family history of hypertension. It was revealed the difference in factors correlation separately for SBP and DBP. We established that two clusters of correlative links for studied factors formed for SBP and DBP. One kind of factors were closely connected with BP, other one with age. Finally it was revealed that equation BP=a+ñ*A (a and c are constants, A age in years) provides % value. After analysis of the data we proposed formulas for SBP and SBP: SBP= as + (Ô-)*A, DBP= ad+ (-Ô)*A. Data obtained can be considered (in terms of complex systems theory) as a way from complexity to simple models more suitable for clinical practice. Our results suggest that Phidias number can play important role in description of some points described in complex systems theory.

KEYNOTE SPEAKERS

Information Flow and Symmetry Breaking in Interpersonal Coordination

Steven M. Boker
University of Notre Dame

Abstract: The semantic content of conversation is accompanied by coordinated prosody, head movement, eye movements, eyebrow movement, smiles, and other facial changes. Coordination between conversants' movements and/or facial expressions can be observed when an action generated by one individual is predictive of a symmetric movement by another. Both spatial and spatiotemporal symmetry is commonly observed in conversation and may be linked to mirror neuron systems that organize embodied coordination into a perception—action loop. Overt expressions of symmetry thus are likely to be indicative of mutually shared inner states. But the greater the symmetry between two individuals, the greater the redundancy in their embodied states. The greater the redundancy, the less information is transferred in a nonverbal communications channel. Therefore, symmetry breaking must also be a component of coordination in dyadic coordination have been observed in a recent set of motion tracking experiments. Current methods for estimation of nonstationarity in the association between variables are discussed and the results of application of these methods to motion tracked dyadic conversations are presented. These results suggest that the ongoing mutual estimation of affect that occurs during human interaction may be framed as a dynamical systems model, and that this step may help us better understand emotion regulation.

Steven M. Boker is associate professor of Quantitative Psychology at the University of Notre Dame. His research interests include the application of dynamical systems analytic techniques to psychological and physiological data. His contributions include methods for examining change in multivariate mixed cross-sectional and longitudinal data include Statistical Vector Fields, Windowed Cross- Correlation with Peak Picking, Differential Structural Equation Modeling, and the Latent Differential Equations method for fitting differential equations models to multivariate multiple occasion data. Dr. Boker's lab uses motion capture technology for experiments in interpersonal coordination and perception-action coupling during conversation, dance, and imitation learning.

Finding Order in the Flow of Human Experience: The Re-Emergence of Dynamical Social Psychology

Robin R. Vallacher,
Florida Atlantic University

Abstract: Human experience qualifies as a complex system, in that any aspect of intrapersonal or interpersonal functioning can be analyzed with respect to myriad factors. Because these factors rarely operate as main effects but rather interact with one another over time to promote an ever-changing trajectory of experience, personal and interpersonal processes are open to investigation as nonlinear dynamical systems. The earliest formulations of social psychology were remarkably prescient in this regard. Such pioneers as William James, C. H. Cooley, George Herbert Mead, Kurt Lewin, and Solomon Asch all emphasized the multiplicity of interacting forces operating in individual minds and in social groups, the potential for sustained patterns of change resulting from such complexity, and the tendency for individuals and groups to strive for mental and interpersonal coherence. Despite this explicit focus on dynamics at the field's inception, social psychology for much of the 20th century typically employed paradigms better suited to capture the static aspects of experience. This state of affairs has changed in recent years with novel adaptations of nonlinear dynamical systems to a host of personal and social processes at different levels of social reality. Though still in its infancy, dynamical social psychology shows signs of emerging as a major paradigm, with the promise of establishing coherence for a field that is currently highly fragmented.

Robin Vallacher is a professor of Psychology, Florida Atlantic University, and a research affiliate at the Center for Complex Systems, Warsaw University. He has been a visiting scholar at University of Bern, Switzerland, and Max-Planck-Institute for Psychological Research in Munich. Dr. Vallacher has investigated a wide variety of topics, from principles of social cognition, action identification, and self-concept, to issues in social justice, social change, and international conflict. His current work employs a dynamical systems framework to identify the invariant properties underlying these phenomena. Using experimentation and computer simulations, he and his colleagues are investigating the dynamic underpinnings of self-regulation, social judgment, close relations, inter-group conflict, and the emergence of personality from social interaction. Dr. Vallacher has published five books, including two with Andrzej Nowak that develop the implications of dynamical systems for social psychology.