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Alphabetical List of Authors & Abstracts

Frederick David Abraham, Silliman University,
Stanley Krippner, Saybrook University
Ruth Richards, Saybrook University

A New View of Creative Bifurcations and the Edge of Chaos

Basic dynamical concepts relevant to human creativity include those of stability, instability, bifurcations, and self-organization. Here we present the view that most creative bifurcations are from chaotic to chaotic attractors, and that such bifurcation are macro-bifurcations comprised of a cascade of micro-bifurcations whether in continuous dynamical or network-style models. Examples are drawn from the Ueda Explosion (See Ralph Abraham & Shaw) for continuous systems, and the work by Langton; Packard; Mitchell, Crutchfield, & Hraber, and Kauffman with NK Boolean networks. These typically are thus smeared in time and state-space. We suggest that the misunderstood phrase edge of chaos could be used for such a liberalized concept. Self-organizational concepts are drawn from the concepts of Ralph and Fred Abraham and Kugler et al., wherein navigation in parameter space is a function of the state spaces, especially evident in intentional complex adaptive systems. We view these as consistent with those of Goldstein's views on emergence. Key words: creativity, stability, instability, bifurcations, self-organization, edge of chaos.

Lynn Adams, Woodbury School of Business, Utah Valley University, **Nathanael Adams**, Dept. of Business, Cardinal Stritch University

The Holistic Ethical Litmus of Leadership: A Practical Nonlinear Dynamics and Chaos Based Leadership Model

This paper presents a practical leadership matrix model based on nonlinear dynamics and chaos theory. Specifically, the authors searched for two or more leadership variables (characteristics) that would create a definite pattern. The researchers intuitively believed that some combination of variables would set up a pattern just as attractors (strange or otherwise) create patterns in data and show some of the characteristics of the system being studied. Over time a set of two main variables, loosely labeled as ethics and energy at first, were identified that created a leadership pattern for individuals. This paper describes the process that led to the identification of the two main variables and then to the matrix herein presented. Great leaders have fewer shared characteristics. So, the authors of this paper had a conversation over several years that led to the reduction of variables to two variables that immediately showed a clear pattern in individual leadership. This model, called The WELL by the authors, was created at first to explain political leadership, yet is showing applicability to all kinds of leadership. The WELL as presented is a theoretical construct, with only experiential and qualitative evidence at present to support the patterns inferred from the model. In addition to the extensive political experience of the authors the experience of public safety, mental health, military and academic professionals has been sought to validate the main conclusions shown in this paper and to improve the model.

KEYNOTE SPEAKER
Yaneer Bar-Yam, New England Complex Systems Institute

Complex Systems Science and Policy Challenges: The Global Economic and Food Crises -- Recent Events and Future Predictions

When an economic system is robust it can function under a variety of stresses, and when it is not robust even minor perturbations cause cascading failures and dislocation of its function. We have seen evidence of such dislocation in recent financial system failures, massive economic losses, and in the need for government rescue. Identifying the underlying reasons for economic instability and how they may be corrected motivates our work. Our studies show that government policy decisions, often in deregulation but also in regulation, have undermined market equilibrium and economic optimality. At least four areas of regulatory activity have played a major role in the global financial, economic and food crises: Banking deregulation, commodity futures deregulation, ethanol subsidies, and stock market deregulation. We trace their impacts to the massive economic losses and the starvation of millions and food riots due to non-equilibrium food prices. Trend following, panic, and other collective behaviors are known to destabilize market equilibrium, but we show for the first time their quantitative effect on market

prices, crashes and bubbles, validating against market data. Similar to other systems with emergent behaviors, effective economic activity depends on robustness to cascading failures. Science can provide both insight and analysis of the effect of regulations to increase reliability, reduce systemic risk and promote growth.

Jonathan Butner, University of Utah.

Integrating First and Second Order Modeling

This talk will focus on the integration and estimation of equation forms for first order and second order modeling, where velocity and acceleration are the outcome, respectively. Combining catastrophe models with methods for locally estimating derivatives one can capture first order relationships (where velocity is the outcome) with the inclusion of control parameters using equation forms specified by Guastello. When versions of these same equations are applied to second order models (where acceleration is the outcome), the catastrophe models create commonly studied oscillatory forms specified by Duffing, Rayleigh, and Van der Pol giving these a new interpretation in terms of catastrophe flows. This creates an inherent linkage between the first order and second order models where a series of commonly applied tools can be translated across levels. For example, each equation can be translated into functions for estimating set points and local Lypunovs. Furthermore, null clines can be used to combine multiple equations for identifying integrated topological behavior. On first order equations these have traditional interpretations of a vector-based approach. On second order equations, these take the form of complex numbers decomposing topology into its rational (set point behavior) and irrational (flow behavior) components. The first order equations can then be hierarchically nested within the second order equations, allowing one to identify the unique contribution (i.e., estimates of effect size) of each level. When combined with an assumption of ergodicity, this creates a general approach for theory testing and exploration using known tools in Dynamical Systems.

Xinguang Chen, Wayne State University
Bonita Stanton, Wayne State University
Xiaoming Li, Wayne State University
Din Chen, University of Rochester

Adolescent Intention to Use a Condom: Is it Rational or Quantum?

Adolescents are at particularly high risk to acquire HIV infection; increasing the likelihood of condom use is an effective measure to reduce the risk of such infections. Challenges in assessing actual condom use behavior among early adolescents render the precursor behavior, intention to use condom an appealing alternative. The concept of behavioral intention is a key component of a number of theories for purposeful behavior change, including the Protection Motivation Theory and the Theory of Reasoned Action and Planned Behavior. While analyzing data from a randomized control trial to evaluate a theory based intervention program to encourage condom use among early adolescents in The Bahamas, we observed a significant but limited effect with regard to condom-use intention when the linear analytical approach was used. In this study, we tested our hypothesis that intention, as a measure of the readiness to perform a behavior, may not always be rational, by analyzing the same data using cusp catastrophe method. Participants of the study were 1360 students participated in the trial and follow-up every 6 months up to 24 months with last follow-up in 36 months. In cusp modeling, intention to use a condom (5-point likert scale) at 36-month was used as the dependent variable. Condom skills (sum score) and condom-use self-efficacy, assessed at 24 and 36 months, were used as asymmetry and bifurcation variables respectively. Results from concurrent and longitudinal modeling analysis indicated a much better fit of the cusp model (R^2 >84%) than of the linear (R^2 <10%) or the logistic model (R^2<15%) for the intervention and control group. When the full sample was analyzed, receipt of the intervention was a significant predictor only if it was included as an asymmetry variable. We concluded that adolescent condom intention is more quantum than a rational in nature. Therefore, program effect will be limited if an intervention is devised following a rational hypothesis; and striving to achieve quantum change may present a new approach to encourage safer sex among adolescents.

Carlos Comperatore, US Coast Guard Office of Safety and Environmental Health
Antonio Carvalhais, US Coast Guard Office of Safety and Environmental Health

Monitoring Dynamic Changes in Operational Safety Capacity

Monitoring Dynamic Changes in Operational Safety Capacity Carlos Comperatore, Ph.D. and Antonio Carvalhais, Ph.D. U.S. Coast Guard Office of Safety and Environmental Health Washington, D.C. Disclaimer: The views presented here are those of the authors and do not reflect the official position of the U.S. Coast Guard, or the Department of Homeland Security. Search and rescue (SAR), medical evacuation, and fire rescue are few of the many on-demand operations where dynamically changing contextual variables contribute to the mission s hazard level. Mission characteristics (e.g., search and rescue, law enforcement, CBRNE response), weather conditions, crew operational proficiency and internal state (e.g., fitness, stress, and fatigue level) contribute to the hazard level of the mission. The interaction between crew fatigue and proficiency determines the crew s capability to conduct mission tasks safely and effectively from moment to moment. Challenges to the safety of the crew, however, emerge out of mission complexity elements (e.g., weather, rescue difficulty, etc.) affecting the magnitude of operational safety, moment to moment, from take-off time to recovery. In Coast Guard aviation SAR missions, however, crewmembers carry out rescue missions in dynamic operational environments with few risk

management tools to mitigate emerging hazards. In this work, we present a hazards assessment framework designed for Coast Guard aviation on-demand operations. The framework captures the momentary interaction among mission complexity elements contributing to the expansion and reduction of operational safety. In actual missions, this framework monitors hazards that may thrust crewmembers beyond the operational system s tolerance thresholds and result in unexpected outcomes.

A. Steven Dietz, Texas State University
Keith Q. Owen, Somerset Consulting Group.

Rocks Breathe Slowly: Cultural Types and Organizational Change

This presentation is an exploration of some of the pertinent issues surrounding what culture is and how it functions to affect the performance of organizations; the attributes of high performing cultures; the observable features of such cultures; the role of leadership in bringing about cultural change; and strategies for organizational and cultural transformation. We present a data driven model for understanding/describing culture in organizations. The model demonstrates attributes that are most important in describing an organizations culture; how these attributes cluster; and how the results of that clustering can be described through three broad foci: unity, internal connectedness and shared meaning. We present five culture types that are defined by the data. Each culture type will be discussed in terms of the three foci. Application of this model to better facilitating organizational change will be discussed.

Teresa Duszlak, Multi-Systemic Therapist

A Dynamical Systems Model of Attention Deficit Hyperactivity Disorder

Researchers studying ADHD tend to investigate the disorder bit by bit, breaking the entirety of the disorder into manageable pieces. Thus, ADHD research is usually focused on one of, or some combination of, various phenomena relating to the disorder. Such research has greatly improved our understanding of the phenomena that make up the attention system, the specific mechanisms that influence the system s functioning, and the cognitive/behavioral issues that characterize a maladaptive attention system. Yet, there exists no coherent, overarching model to tie the piecemeal understanding together. Dynamic Systems Theory can provide us with such a model. The attention system can be modeled as a two stock system, feedback-loop structure in which one renewable stock, the level of focused attention, is constrained by another renewable stock, the attention resource stock. Additionally, the attention resource stock can be thought of as being the output of another dynamic system itself; It is the result of two competing balancing loops, the attention stock assembly loop and the attention resource expenditure loop. Finally, it is suggested that the ADHD-related deficits in sustained attention may be due, in part, to feedback delays located within the attention resource stock system.

Caroline Fielden, University of Sydney

The Dynamic Approach Withdrawal Survey (D.A.W.S.): Testing for Behavioural Indicators of Traits

Gray & McNaughton (2000) claim that personality traits have a causal relationship with individual differences in approach and withdrawal behaviors. Yet, more often than not, the Reinforcement Sensitivity Theory (RST) that they propose is tested using a psychometric approach that relies on self-report measures. This, however, ignores the questions of whether there are patterns of behavior indicative of underlying systematicity, and if so, whether these differ between individuals in a manner that is consistent with RST. The Dynamic Approach Withdrawal Survey (D.A.W.S) has therefore been developed to measure individual approach and withdrawal behaviors across time. This program draws on the work of Kim et al. (2010), assessing approach and withdrawal behaviors by allowing participants to lengthen or shorten the viewing time of visual stimuli. It is hoped that an examination of individual differences in both the distribution and general patterns of response will help clarify the relationship between traits and behavior. Early data examined using time-delay phase-space reconstruction, and recurrence quantification analyses indicate distinct patterns of response that differ between individuals. In this presentation, the D.A.W.S program will be demonstrated, and early data discussed.

KEYNOTE SPEAKER
Jeffrey Goldstein, Ph.D., Adelphi University

Honest Toil in Complexity Science

The address will provide a general sketch of how the sciences of complex systems have been, over the past several decades, radically revising our understanding of the dynamics of such systems. This unprecedented amplification of understanding has concomitantly been deepening of our capacities for making more effective interventions in complex systems. Not only have new mathematical and physical tools applicable for specific contexts emerged, but also novel problem-solving and critical-thinking approaches. The researcher, the theorist, the intervener now possess much greater insight into, e.g., cooperative structures, coordination dynamics, networked interactions, and how development can proceed. One of the keys for the advances made by complexity science has been vigilance on the part of theorists and researchers, against strong temptations not to, to follow this precept offered by Bertrand Russell: "The method of 'postulating' what we want has many advantages; they are the same as the advantages of theft over honest toil. Let us leave them to others and proceed with our honest toil." Topics to be highlighted

are meant to show how excursions into relatively lesser known regions of the world of complexity can offer suggestions as to how complexity science has remained true to "honest toil."

Joel Gordon, Social Policy Research, MDRC

Finding Structure in the Process Equation

Sabelli and his colleagues have argued for the biotic trajectory found in the process equation, x"=x+g*sin(x), as a touchstone for understanding creativity. This report expands on Sabelli s approach with a empirical investigation of the biotic region of the process equation (g>4.6) using the perspective of basins of attraction. Attractors have been found in bifurcation cascades beyond the onset of bios in columns similar to the periodic windows found inside chaos. They only occupy about 2-3% of the gain (g) parameter space, and, like periodic windows in chaos, seem to be found at arbitrarily small scales. Unlike periodic windows in chaos, those found inside areas of bios fragment into multiple distinct attractors, each of the same periodicity. Each attractor is broken into noncontiguous bifurcation cascades encapsulated in its own contiguous basin, islands of structure dispersed in a sea of bios. Any trajectory begun within the periodic windows outside of these basins is biotic, sensitive to initial conditions. When they eventually intersect one of the basins they become trapped in the fragmented structure. Sometimes it only takes a handful of iterations, but often it can take thousands of iterations for a trajectory to stabilize in a basin. One predictor found so far for how long it takes a biotic trajectory to stabilize is the width of the periodic window. The wider the window the quicker a randomly started trajectory will intersect a basin (r = -.98). Like chaotic windows, biotic attractors all show intermittency which, in combination with bios s inherent and unbounded diversification produces a model of a creative search process to locate structure.

Stephen Guastello, **Hillary Gorin**, **Samuel Huschen**, **Natalie E. Peters**, **Megan Fabisch**, **Kirsten Poston**, **Kelsey Weinberger.**
Marquette University

The Minimum Entropy Principle, Task Switching, and Entropy in Performance

In the course of a work day, interruptions and switching tasks can result in lower response time for the new task and reverting to the first one, or they could provide a relief from fatigue. According to the minimum entropy principle, efficient cognitive performance is produced with a neurocognitive strategy that involves a minimum of degrees of freedom. Although high performance is often regarded as consistent performance as well, some variability in performance still remains that allows the person to adapt to changing goal conditions or fatigue. The present study investigated the connection between performance, entropy in performance, and entropy levels associated with task-switching strategies. Fifty-four undergraduates performed 7 different computer-based cognitive tasks producing sets of 49 responses under instructional conditions requiring task quotas or no quotas. In the first part of the study, the participants ad lib task switching regimes were analyzed for underlying patterns using orbital decomposition. Four types of strategies were identified, which varied with respect to Shannon entropy, topological entropy and complexity of the pattern. Lower topological entropy associated with the switching regime was associated with better performance overall, although the relationship between entropy metrics and the number of switches used by the participants was more complicated. In the second part of the study, the participants time series of performance were discretized and analyzed for patterns using orbital decomposition. The performance patterns were relatively short in most cases, and lower Shannon entropy of performance was positively correlated with performance itself. Performance entropy did vary by task switching strategy. Overall the results supported the minimum entropy principle, although there seems to be a trade-off between minimizing entropy in the task pattern, entropy in the performance level, and fatigue or boredom effects.

Stephen J. Guastello, **Matthew Malon**, **Paul Timm**, **Kelsey Weinberger**, **Hillary Gorin**, **Megan Fabisch**, **Kirsten Poston,** Marquette University

Cusp Catastrophe Models for Cognitive Workload and Fatigue in a Vigilance Task

The performance effects of cognitive workload and cognitive fatigue has been notoriously difficult to separate historically. Some significant headway has been achieved recently through the use of two cusp catastrophe models one for workload and one for fatigue and experimental designs that permit testing of both models simultaneously. The present study involves a vigilance task with dual-task methodology in which subjects watch a virtual security camera and ring a bell when they see intruders while working on a jig-saw puzzle. Subjects worked alone or in pairs. Workload was manipulated by varying the speed of camera scenes that were used as stimuli. Other hypothetical control variables were personality traits anxiety and conscientiousness, work ethic, emotional intelligence, frustration, and the amount of work done on the puzzle. Results for the workload cusp (R^2 = .33) showed that increasing speed corresponded to the asymmetry parameter and frustration corresponded to the bifurcation parameter; the cusp model was more accurate than the two competing linear alternative models (R^2 = .22 and .29), in which emotional intelligence and conscientiousness replaced frustration as significant variables. The cusp model for fatigue (R^2 = .43) showed that changes in performance were affected by whether the fast or slow condition was presented first (asymmetry) and how much work was done on the puzzle (bifurcation). Again the cusp was more accurate than the linear alternatives (R^2 = .05 and .17).

Joshua Haworth, **Nathaniel Hunt**, **Yawen Yu**, **Nicholas Stergiou,** NBCF, University of Nebraska, Omaha, NE

Gaze and Postural Coupling to Visual Stimulus Oscillations of Complex Motion Organization

We are interested in visual and postural system coupling in adults, particularly in the sensitivity of coupling to the statistical complexity of the motion of a point-light stimulus. Work in biomechanics has revealed that the kinematics resultant from biological sources of motion can be characterized by nonlinear measures of temporal structure of the movement variability (Stergiou, et al., 2003). The health of a biological system is related to an optimal state of this variability; characterized by the presence of mathematical chaos examined in movement over time. We sought to evaluate the perception (eye tracking) and motor replication (posturography) of the motion of a visual stimulus, which was driven by chaotic and non-chaotic signals. Participants were presented with four separate conditions, each consisting of a different point-light stimulus defined to follow one of four signal structures; sine, chaos, surrogate, and brown noise. Each signal was comprised of 15,000 data points at 50 Hz, providing five minutes of continuous point motion. Gaze and posture were measures at 50 Hz. Correlation Dimension (representative of the number of active degrees of freedom) and Approximate Entropy (characterizes the structure of variability/regularity) properties were calculated to determine the responsive changes of visual and postural behavior. Results show sensitive responses of gaze and posture to the complexity structure of stimulus motion. This work suggests that entrainment of these systems is possible, even over complex input signals.

James K Hazy, **Thomas Shinick,** Adelphi University.

Parameterizing Innovation When Using a Cusp Catastrophe Model for the Potential Function

This paper explores the process of innovation in organizations by using the cusp catastrophe as the potential function reflecting the changing performance potential enabled by innovation processes. The model assumes that the internal variable of interest is adaptive performance which refers to the ability of the organization to reinvent itself to improve its survival potential as the environment changes. This paper will explore the question of parameterizing this process for purposes of dynamical system modeling. The assumption is that conditions in the environment reflect regularities at the coarse-grained level and this creates conditions that result in a "rate that something occurs at the fine-grained level in a manner analogous to reproduction rates or infection rates in classic dynamical systems models. For example, in the predator/prey case, regularities in safety and feeding conditions in the environment interact with the rabbits to imply a reproduction rate within the population. Drawing on prior work, two possible parameters will be explored. First, conditions of Opportunity Tension (OT) will be shown to imply a "rate of experimentation" (like an infection rate) that operates as the bifurcation parameter within organizations. Experimentation is the rate that the system gathers information about the environment by trying things and finding out what happens. Separately, conditions of Informational Differences (ID) across a heterogeneous population (presumably from different local experiments) imply a "rate of recombination" which selects successful experiments and uses relevant information for further experimentation. This is the asymmetry parameter. Challenges and measurement issues will be discussed.

Sean Hill, Lewis & Clark Community College

Considerations of Chaos and Complexity on Race

Over the past few decades, nonlinear dynamics have been increasingly utilized to gain a deeper and more nuanced understanding of psychological phenomena. Although there has been research applying chaos and complexity to numerous aspects and perspectives within psychology, there has been very little application to racially-associated phenomena. Race, chaos, and complexity are diverse concepts yet what they share is a dynamic nature and properties that seem to be self-contradictory. It is these shared characteristics that allow them to make somewhat interesting allies. This presentation will describe how concepts of chaos and complexity can be applied to understanding the dynamic and socially constructed nature of race and various racially related concepts, such as socialization, stereotypes, stigmatization, and discrimination. The presentation concludes with a visual unified model of racial identity development using the principles and properties of chaos and complexity that builds on and acknowledges existing models while addressing many of the criticisms directed toward them.

Bob Hodge, Institute for Culture and society, UWS

Nonlinear Linguistics: an Interdisciplinary Proposal

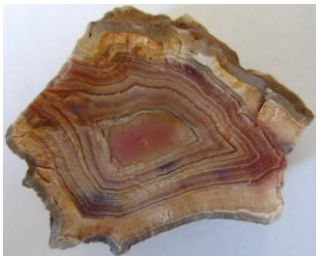
This paper argues that language in use is a site of many nonlinear phenomena. It re-examines assumptions of mainstream linguistics, to show that key qualities of language have already been understood, by at least some linguists, as having nonlinear properties, or can be reframed to reveal unexpected nonlinear characteristics. Many linguists see language as an autonomous coherent system, to be studied by an autonomous linguistics, leaving out the study of systems of society and meaning. Others criticise this model because it cannot explain social effects of meaning that are what make language of interest to the rest of the social sciences. A conception of language as part of a Poincar擁-body system provides non-deterministic models of the relationships between these 3 sub-systems. Linguists commonly see given languages at different scales as

systems, implicitly complex. The idea of language as complex adaptive systems is powerfully explanatory for linguistics. The role of language in social causality is subject to dispute in Linguistics. It needs nonlinear cybernetic models with positive feedback loops, producing catastrophes, and negative loops maintaining complex adaptie systems at the edge of chaos. Linguistic semantics sees meaning as a set of crisp, linear hierarchally-organised categories. It is better seen as a dynamic field of networks, displaying power-law characteristics, needing fuzzy logic descriptions. Language as a complex dynamic system is full of fractals. These have already been found in phonological codes, but not recognised as such by linguists. Fractal analysis is a powerful new tool for all areas of linguistics.

Aini-Kristiina J@ppinen, Adjunct Professor, Academy Research Fellow.

Studying Emergence of Collaborative Leadership as a Complex System Through Eight Co-dynamics

The paper examines collaborative leadership as a complex nonlinear system. This system is supposed to be composed of interactive and intertwined inner attributes of a professional learning community. A movement or change in any of them has an [unexpected] effect on the entire system and, thus, on the leadership that is emerging inside the community. In the paper, the attributes are described with a tested and experimented model called TenKeys®. The model was created by the author on the grounds of (1) a comprehensive amount of organizational and educational leadership theories and studies where collaboration or complexity was the core element and (2) three large-scale Finnish studies (2006-) revealing successful collaborative elements, actions, and practices, in exploiting thus a progressive theory and data-based concept analysis. Within this framework, the paper presents an empirical study of the emergence of collaborative pedagogical leadership in a large Finnish educational organization s leadership-team and reveals certain co-dynamics as those invisible strong powers that make the attributes to move and change. In a long-term development process, particularly eight co-dynamics were found to impact the complex system of collaborative leadership of which the paper presents diverse examples of the attributes movements as to their reciprocal relationships. Emergence is here defined by seven conditions: connectivity, diversity, rate of information flow, lack of inhibitors, good boundaries, intentionality, and watchful anticipation. In the paper, also these conditions of emergence are treated.



David Katerndahl, **Sandra Burge**, **Robert Ferrer**, **Johanna Becho**, **Robert Wood**, Family & Community Medicine, University of Texas Health Science Center, San Antonio, TX

Effects of Violence Nonlinearity upon Outcomes in Violent Relationships

Prior research suggests that intimate partner violence is a complex, nonlinear phenomenon. In addition to the violence trajectory itself, decision-making, help-seeking and leaving are nonlinear processes as well. The purpose of this study was to determine whether nonlinearity of violence contributed to outcomes in violent relationships. This 3-month time series study was conducted among 200 adult women in violent relationships. Women completed daily telephone assessments of household environment and marital relationship using Interactive Verbal Response; missing husband-to-wife violence data was imputed using TISEAN software to maintain its nonlinear characteristics. LZ complexity, approximate entropy (ApEn), and largest Lyapunov exponents were used as measures of nonlinearity. Factor-analyzed outcomes included coping and appraisals, hope and support, symptomatology, functional status, readiness-for-action, and medical utilization. Stepped multiple linear regression and cusp catastrophe modeling were used to explain outcomes. Results showed that nonlinearly predicted negative coping, positive appraisals, and hope/support in regression analyses. However, when nonlinearity of violence was used as a bifurcation variable in cusp catastrophe modeling, nonlinearity helped explain positive and negative coping as well as readiness-for-help. Thus, knowledge of the nonlinearity of violence can help explain coping, appraisal, hope/support and readiness-for-action in violent relationships. In conclusion, measures of nonlinearity of violence contributed to the variance of several outcomes in linear or catastrophe modeling. This suggests that knowledge of nonlinearity of violence may have applications when working with violent couples.

Adam Kiefer, Cognitive, Linguistic & Psychological Sciences, Brown University, Providence, RI

A Behavioral Dynamics Approach to Perceptual-Motor Dysfunction

Dynamical disease has proven beneficial as a theoretical framework to understand how the healthy dynamics of physiological control systems change due to constraints imposed by certain pathologies. A signature of this class of pathologies is that the affected system departs away from adaptable, healthy functioning and toward either overly rigid or overly flexible dynamics as the physiological system s behavior unfolds over time (Van Orden, 2007; West, 2006). Unfortunately, this approach does not lend itself well to a clinical examination of more overt, low-frequency behavior because it relies on fractal times series methods and predictions that require extremely large data sets. Thus, an alternative solution is needed. The framework of behavioral dynamics, first

introduced by Warren (2006), provides such a solution. Behavioral dynamics stipulates that human-environment interactions give rise to emergent dynamics of behavior, and accounts for stable behavioral solutions (in terms of attractors) and transitions between stable solutions (in terms of bifurcations) as the human -environment system evolves over time. This approach has demonstrated utility with regard to perceptual-motor dysfunction in the context of human coordination dynamics. Expert and pathological postural coordination, as indexed by cross-recurrence quantification analysis (CRQA), exhibits specific dynamic signatures of stable behavioral states in the context of a perceptual tracking task. The result is a set of findings that provide insight into the influence of training and pathology on coordination across the spectrum of health, with important translational implications for clinical assessment and rehabilitation.

John Kolm, Team Results USA, CEO.

Extinction at the Corporate K-T Boundary

A history and analysis is presented of a nonlinear descent into chaos at a large manufacturing plant for which the drivers were purely behavioral and initially minor. A trivial causative effect grew into a self-organizing, recursively-generated emergent behavior that closed a plant of 1500 people within 15 minutes, at a cost of $2.5M per day. The effect of nonlinear, evolutionary, survival-based models on both routine and catastrophic events in industry is discussed using this and other case studies from work done by the author, and a new corporate leadership model is proposed using these models that is based on a redefinition of feedback in evolutionary and self-organizing terms. The practical application of this model to the original case study, and the results obtained, are also discussed. The aim of the work done in all cases was to investigate and if possible improve the productivity and survival benefit conferred on work teams. Measurement was through achievement of simulated and real-world group tasks in actual work teams, and also by quantitative analysis. Results indicate that strong productivity benefit can be obtained through practical application of ideas in nonlinear dynamics, especially when these are operationalized. John Kolm is the CEO of Team Results USA, a company specializing in the application of nonlinear models to team and organizational dynamics in wide range of clients including Toyota, IBM, Pfizer, Stanley, Hitachi and some 35 Federal agencies including NIH, the Office of Personnel Management, the FDA and the State Department.

Mauricio Lask, California School of Professional Psychology, San Francisco, CA & Gouverneur Healthcare Services, New York, NY

Chaos in the Session: An NDS-Informed Therapy for Depression

Nonlinear Dynamic Systems (NDS) has been used to model features of psychopathology. However, there have been few attempts to apply these concepts to individual therapy. This presentation will present a verbal NDS-based model of the tr$_e$atment of depression. People are conceptualized as complex adaptive systems that exist in a psychological state space, which encompasses all dimensions of psychological functioning, including emotion, motivation, motor behavior, and cognition. Depression is a self-organized strange attractor characterized by extremes along dimensions such that interaction with the environment is restricted. The basin of attraction and stability of the attractor is mediated by control parameters such as prior learning and genetic factors. The goal of therapy is to facilitate the move from a depressed attractor to one of higher functioning. This change requires increasing the internal energy of the system and modifying the control parameters in order to decrease the attractor s stability. The NDS-based treatment of depression is grounded on ongoing assessment of the system dynamics, leading to an idiographic formulation of the episode of depression. This conceptualization and treatment is unique in that it provides a framework to guide the recovery process without prescribing specific interventions. It attends to the interactions between different aspects of an individual and how they relate to the world around them, allowing for a holistic and individualized approach that can be applied regardless of a clinician s theoretical background. The proposed therapeutic framework provides a rationale for treatment and suggests a novel way to approach the process of recovery.

Laurie McCabe, Regent University

The Human Values of Entrepreneurship: Empirical Analysis of the Human Values of Social and Traditional Entrepreneurs

There is yet no empirical evidence supporting emergent theoretical definitions of social entrepreneurship. Given that individual human values are the limiting factors that guide decisions regarding behavior, this research provides the lacking empiricism with analysis of the human values of social entrepreneurs in comparison with otherwise traditional entrepreneurs. In a quantitative method to collect and analyze data, 89 participants completed the Rokeach Value Survey, and provided a rank order listing of their 18 in-strumental values and 18 terminal human values. Among the most influential values for all participants and both types of entrepreneurs are (a) a sense of accomplishment, (b) health, (c) family security, (d) wisdom, (e) courageous, (f) honest, (g) imaginative, (h) helpful, and (i) broad-minded. Among the values with a different influence by entrepreneur type were (a) equality, (b) freedom, (c) salvation, and (d) a world at peace. Theoretical implications of the research are that human values are a reliable source to describe and predict behavior; and the influence of these values will contribute to the emerging definitions of social entrepreneurship. Practical implications will likely be training or funding for social entrepreneurs done according to these values. Research recommendations include further analysis of correlations among subsets of values; validations of the aforementioned differences; and interpretations of how these values affect entrepreneurial behavior.

Alan McDonnell, Criminologist UK Public Sector

A Physical Hypothesis for Emotional Contagion in Group Cohesion and Public Order

This work is a literature review of physical phenomena believed to influence group decision making through data transmission between crowd participants in Public order situations. Crowds were observed to share communalities of behaviour with birds, animals, fish and insects in flocking or swarming events. These behaviours also appeared to reflect phase transition events , initiating increased simultaneous group cohesion and changes in cognition . This mechanism may be an ancient trait operating through neuronal networks at a basic evolutionary level due to the wide divergence of physiologies in species sharing these behaviours. It is hypothesised that the body contains a detection mechanism through anisotropic paramagnetic proteins and organic iron compounds present in blood which may be capable of detecting unconsciously these emotions in others. Certain configurations of the waveform of the electromagnetic component of light emitted from the body may correspond to metabolic signatures of particular emotional states such as anger. Every photon emitted from metabolic activity is accompanied by an electromagnetic wave, perception of information carried by magnetic resonations in intense emotional states may initiate phase transition from conscious individuality and logical thought to emergency subconscious routines and collective reactions . It is hypothesised perception of signals consistent with the presence of danger initiate rapid activation of fight or flight responses favouring survival in riot situations. Activation of this physiological collective communication is hypothesised to only be initiated in emotionally charged situations due to a greater metabolic cost detection incurs. Evolutionary advantage can be inferred in those with sensitivity to perceiving them. Emotional emissions are argued to be amplified or damped to a greater or lesser degree by the interaction of ambient magnetic fields from the earth, individual physiological differences and the variable impact of solar wind fluctuations on the magnetosphere and atmospheric Schumann resonation field.

Barbara Meeker, Sociology, University of Maryland.

Nonlinear Dynamics of Group Dynamics: Models from Mathematical Sociology

I present a summary of a research program in which assumptions from the classic Lotka-Volterra model of species competition are adapted to apply to the development of inequalities in amount of contribution to a group discussion. This kind of mathematical system is well known to be very sensitive to the initial values of the parameters, with parameters in one range producing output of two actors that converges while when parameters are in another range one actor"s output falls to zero and the other reaches a stable positive result. To adapt this model to human interaction, I take into account that human beings monitor and adjust their behavioral output throughout an interaction. This requires an additional assumption, that the parameters vary depending on how unequal the rates of contribution have become. Since this introduces a feedback loop that prevents direct solution of equations, I use a computer simulation to develop predictions. Different values of initial parameters produce some results that stabilize at equality, others that stabilize at unequal rates of output, and still others that seem chaotic. Of most interest to sociologists are the ones that stabilize at unequal (but not zero) rates of participation. These results are expanded to apply to groups of three, four, or more members and compared with data from actual discussion groups.

Dominic Nathan, Department of Biomedical Engineering, Marquette University
Stephen Guastello, Department of Psychology, Marquette University
Robert Prost, Department of Radiology, Medical College of Wisconsin
Dean Jeutter, Department of Biomedical Engineering, Marquette University

Exploring Functional Networks of the Brain Relating to Upper Extremity Motor Skill Using Graph Theory

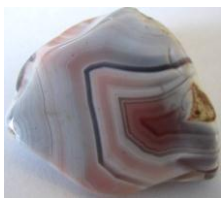
Connectivity analysis of the brain provides a method of identifying networks that relate to functional and anatomical pathways. The ability to quantify functional brain networks has been critical for the detection of various neurocognitive disorders such as ADHD, Alzheimer s disease and schizophrenia. However the majority of research has been conducted on resting state data sets which are absent of explicit stimuli. The examination of network connectivity relating to specific tasks such as hand use could add benefit to understanding recovery, cortical reorganization and transfer of skill, especially in individuals suffering from chronic physical dysfunction such as stroke, spinal cord or traumatic brain injury. The efficiency of information flow, network structure, integrity and the interaction among anatomical regions of the brain that are specific to the performance of voluntary upper extremity motor tasks were investigated. In this paper, we examine functional connectivity of the brain using complex network analysis tools of graph theory. More specifically, we examine functional networks and their characteristics relating to motor skill during the performance of tasks using the dominant and non-dominant hand. Analysis was performed using data from a custom developed time resolved fMRI paradigm involving human subjects (N=5). A total of 5 measurements were calculate including the cluster coefficient, efficiency, density, characteristic path length and degrees for inter region and within region networks. The networks analyzed were weighted and undirected. The results provide quantitative information regarding the interactions of brain regions that are involved with the functional motor tasks. Furthermore the results provide insight regarding local, within-region organization of networks which have implications of neural correlates relating to motor skill. Information from this study has potential for the

development of quantitative neuro markers which may provide further insight regarding plasticity and cortical reorganization from injury and treatment.

David Pincus, **Kiersten Eberle**, **Christin S. Walder**, Crean School of Health and Life Sciences, Chapman University
Curt A. Sandman, **Aaron S. Kemp**, **Christopher Mabini**, Department of Psychiatry and Human Behavior University of California, Irvine School of Medicine

Intentional Self-harm and Behavioral Resilience

There is no commonly accepted explanation or intervention for severe and persistent self-injurious behavior (SIB). This study utilized orbital decomposition to examine the impacts of SIB on the dynamics of behavior-environmental interactions over time. Methods: Data consisted of categorical time-series of sequential behaviors gathered from individuals within a residential treatment setting for adults with developmental disabilities along with severe and persistent SIB. Several 2.5 hour series were collected for each participant, some with SIB (N = 134) and some without (Non-SIB; N = 96). Results: (1) Series were characteristic of self-organizing systems (mean Lyapunov Dimension = 1.2; range: 1 3.64 with 98% of values lower than 2.0). (2) SIB series had more coded behaviors (SIB mean = 173, Non-SIB mean = 136; $t = 3.66$, $p < .001$); contained longer patterns (SIB mean = 12.55, Non-SIB mean = 8.80; $t = 2.487$, $p = .014$); and were higher in Shannon entropy (SIB mean = 4.329, Non-SIB mean = 3.939; $t = 4.329$, $p < .001$). (3) Regression analyses revealed significant negative correlations between the number of SIB occurrences in each series and: topological entropy ($r = -.258$, $p < .01$), Lyapunov Dimension ($r = -.223$, $p < .05$), fractal dimension ($r = -.255$, $p < .01$), structural integrity ($r = -.463$, $p < .001$), and Shannon Entropy (controlling for number of behaviors in time series; partial-$r = -.391$, $p < .001$). (4) An analysis of stationarity was conducted for 26 series with discrete SIB episodes occurring toward the middle of the observation session. Twelve series showed linear changes after SIB (mean $R2 = .123$); ten showed quadratic change (mean $R2 = .05$); and four were stationary across the SIB events. Negative and positive regressions were equally evident with SIB occurring just before or just after periods of high patterning. Conclusions: SIB is generally associated with higher levels of organization and flexibility, and can shift dynamics toward order or complexity, depending upon initial conditions. However, too much SIB degrades fractal structure and creates systemic rigidity. These results may lead to novel interventions for individuals with intractable SIB based on providing them with healthier means to alter their levels of behavioral complexity.



David Rail, Neurologist, Private Practice, Sydney Australia

Steps Towards Developing a Formula Integrating Meaning and Time

The temporal structure of cognition and the activity of its neural substrate is the key to understanding both perception and information processing (Fingelkurts). We contend that the brain has evolved to satisfy the conflicting demands of meaning construction and time. We survive and thrive through developing maximal meaning in minimal time. This understanding is the basis for a formula relating the two entities. Part 1: The solution to minimising TIME stems from: parallel processing, interhemispheric connectivity, massive reentry mechanisms, and function at criticality (metastability). At criticality the nervous system is fully connected (embodied). This state is characterised by fractal relations and reduced dimensionality. The brain functions in Fractal Time (Tf) where the nested structure of the Now explains how we can perceive a tune or any other time series as a meaningful entity (Vrobel) i.e. Tf underpins meaning. Part 2: The MEANING aspect of the formula is derived from a background of: Microgenesis (Rosenthal); Image schemas (Rohrer); Frame and construction semantics (Fillmore), especially lexical polysemy (Evans); Ideal cognitive models (Lakoff); Mimetic schemas (Zlatev); Neurobiological theory of Neural Darwinism (Edelman) and Imagination (Kaag). We reduce meaning generation to the interaction of three parameters: Imagination (T*), through metaphor where T* is an analog of tropological function; Gestalt formation (G); and an isomorphism connecting sensorimotor (SM) and language (L) functions (SM <-- > L). We propose that when the brain self-organises to criticality phenomenal perception is optomised and the following formula integrating meaning construction and time pertains: [T* (G (SM <--> L))] = Tf. We discuss the implications of the formula.

John Barkley Rosser, James Madison University.

Complexities of Natural Selection Dynamics

This paper considers complex patterns of natural selection dynamics. One important issue is that of gene-level versus multi-level selection, an ongoing discussion within evolutionary theory. Origins and history of this debate as well as recent insights that link to the social sciences will be considered. Another major issue is the balance between pure natural selection and self-organizing complex dynamics. This latter will be seen to take various forms, but will always remain constrained by the broader natural selection process of Darwin.

Mark Shelhamer, Johns Hopkins Medical School,
Steve Lowen, McLean Hospital,
Aaron Wong, **David Lasker.** Johns Hopkins.

Of What Value are Fractal Correlations in Sensorimotor Systems?

Fractal correlations occur in many physiological systems, and are associated with healthy function. However, the mechanism by which fractal structure leads to enhanced function (the specific physiologic advantages that it confers) have been elusive. I present recent results in two different sensorimotor systems, which can help bridge the gap between description and explanation in fractal physiology. First, in the vestibular (balance) system, we find fractal scaling in mouse afferent neurons. Scaling is only present on time scales of a second or more, which suggests that it does not come into play during a single head movement. Instead, the underlying long-term correlations may have a role in activities that occur on longer time scales, such as maintaining balance from the afferents on each side of the head (imbalance leads to vertigo). The extensive knowledge base on vestibular processing, including a number of useful mathematical models, make it feasible to test hypotheses about the role of fractal scaling in this system. Parallel work on implantable vestibular prostheses to recover lost function make it possible to apply signals with various fractal properties to the afferents, to test these hypotheses. The second system discussed is oculomotor: saccadic eye movements. Saccades have remarkable predictive and adaptive capabilities. Amplitude is readily modified with a double-step paradigm. Consecutive predictive saccades exhibit an intriguing fractal structure: a power-law form of temporal correlations and power spectrum. This fractal structure is correlated with adaptive capability, providing one of the first clear examples of a performance benefit accruing from fractality.

Rob Steiner, University of Louisville SPHIS HMSS

Examining Traditional Cultural Health Care Systems from the Perspectives of Complexity and Systems Sciences: An Emerging Approach for Improving Global Health

Scientific inquiry is a complex human activity, characterized by multiple diverse interactions between scientists, concepts and their theories, all in relationships to form measurable phenomena. Complexity may be a tool to re-frame worldviews, thus engendering meaningful links between humanism and science. Traditional cultural health care systems (TCHCS) pose different worldviews about the nature of reality. Understanding TCHCS may provide enriching perspectives for hypothesis generation and scientific inquiries. For example, traditional Chinese Medicine is based upon restoring harmonies of yin/yang, while Ayurveda balances Tridosha through lifestyle and yoga. Tibetan philosophies of the Mind-Only School (Cittamatra) describes relative world as projections of mind magical displays that lack any self-existing, inherent nature; while the Middle Way School (Madhyamaka) poses that Ultimate Mind is valid albeit beyond concepts, free from all dualities yet Such can be realized directly through practices of meditation, as per oral traditions. Novel approaches for western scientific inquiries may emerge when native perspectives enmesh with complexity. TCHCS, when informed by complexity, may open an awareness of unexamined, implicit cultural assumptions. From these etic perspectives, Western scientific methods may appear to be culturally bound limited by habitual patterns of dualistic thinking. Such notions may impede the development of novel insights about modern worldviews among western scientists. Complexity perspectives like emergence and self-organization offer potentials to engage unexpected premises from culturally different traditions, and so bring them into new, meaningful contexts. Applying complexity perspectives to TCHCS carries the potential for novel humanistic interactions to benefit societies.

Ron Stevens, IMMEX/UCLA, Learning Chameleon, Inc.
Jamie Gorman, Texas Tech University
Polemnia Amazeen, Arizona State University
Trysha Galloway, Learning Chameleon, Inc.

Modeling the Neurodynamic Organization of Teams

Teams, like many complex systems, operate at a level of self-organized criticality between random and highly organized states. This state, also called the edge of chaos, allows teams to adapt to both momentary disruptions, such as environmental perturbations, and more permanent alterations, such as changes in task requirements. We have asked the questions: Do teams self-organize at a neurodynamic level? How can this organization be visualized and measured? What induces these self-organized dynamics, and what do they signify? We apply ideas from complexity theory to neurophysiologic models of ship navigation, high school problem solving, and other teamwork activities to analyze how teams reorganize in response to changes in the task or environment. Our approach is to identify and characterize interesting or important periods of team organization using the information contained in symbolic data streams of neurophysiologic measures. The neurophysiologic measures include EEG-derived levels of engagement or workload modeled into collective team variables called Neurophysiologic Synchronies (NS) that represent the engagement or workload of each team member and the team as a whole. We show that NS data streams are structured and contain information about the status of the team which can be identified by local fluctuations in the Shannon entropy of these data. These fluctuations occur as natural products of teamwork and reflect periods of increased team organization, especially around periods of stress or confusion. Experienced teams had the highest levels of NS entropy suggesting a lower neurodynamic organizational state may be favorable for better performance.

Michael Susko, Roots and Branches School

Big History: The Four Types of Time

Big History and the Four Types of Time This workshop will offer reflections on four types of time that are unfolding in the universe: 1) Cosmic Time of the Physical Universe 2) The Logarithmic Nature of Evolutionary Time 3)The Generational Nature of Historical Time; and 4) The Emerging Sense of Global Time. The presenter will mostly focus on the middle two types of time which characterize biological evolution and historical process. Evolutionary time shows a pattern of repeated punctuation at logarithmic intervals at Major Nodes in time, as well as a logarithmic patterning of evidence which exhibits increasing certitude that grade level change is occurring around such nodes. With regards to history, patterning is based on generations of 15 years and is most clearly evidenced by empire states. Their history follows a developmental like regularity, and can grant us a current perspective of our own country s movement in history in terms larger 75, 150, and 225 year intervals. The presenter will also offer more general reflections on a sense of cosmic time in the physical universe, as well as the new emerging sense of global time. Lastly, reflections will be given on the interweaving of the various types of time

Ken Ware, Private Practice, Department of Neurotricional Sciences, Generations Healthy Life Centre, Emerald, Queensland, Australia

Core Strength/Stability versus Complexity

The fitness and rehabilitation industry long ago adopted a notion that the muscular skeletal system below the neck is stabilized by a core group of muscles, primarily focused in the viscera s abdominal wall. Sympathetically, these industries encourage millions of people daily to do an abundance of exercises to strengthen their so-called core. It has been said that one can never have a core that is too strong, suggesting that the stronger the core, the more stable and reliable the function and structure of the muscular skeletal system will be for the person. Whether it be a bad back, knee, hip or any other misery beneath the neck, the therapist will be prone to test the person s core strength as the first and most likely reason the person has a muscular skeletal disorder. An alternate approach to health and wellness is to treat the body as a complex system that is comprised of many interconnected and interacting parts. No one part of that system is privileged over any other; rather, the system functions as an integrated, whole unit. This perspective informs a radically different approach to therapy: Instead of building up strength in one area, the core, it is essential to treat the system as a whole and to encourage flow or information transfer across all parts of the system. As a rehabilitation therapist, I have created a program of therapy that treats the body and the person as an integrated, complex system. The result is a rapid and sustainable result for patients who experience a broad spectrum of physical and mental health issues.

Ken Ware

The Influences a Persons Posture has on Non Linear Metabolic Activity, Emotions and the Perception of the Environment

I examine how and why variations to the posture of individuals, influence an increase or decrease in metabolic activity, the emergence of variable emotions and their intensities and the individuals sensory interpretation and cognitive assessment of the external environment. I also examine the variable effects, the qualities of an individual thoughts and feelings have on them and the apparent correlations there are to their postural variations, along with the maintenance of their physical skills. Our centre has for many years, focused on the restoration of postural structure and tone in individuals to enhance the general physical and emotional health and wellbeing of our clients. This has proven to be very physically and emotionally rewarding for clients, especially those with critical needs. Our sensitive dependence on posture for our physical and emotional stability is not a new concept. Past Generations were intuitively aware of this and by all means enforced it, especially at education facilities. Positive alterations to the posture of a person suffering from depression always coincide with a shift in their attention away from their depression to a more positive mental state. It appears that a person is only maintaining their depressed state whilst they maintain a relevant posture. I will be explaining why this would be the case In this presentation I will be sharing what our exciting, relative observations have been over the past 25 or so years - involving tens of thousands of our clients, from a Complex Adaptive System perspective, along with the unique methods that we use to encourage desired alterations to the clients system, by targeting their systems most vulnerable regions. The presentation will include relevant video footage of these special events.

Rita Weinberg, National-Louis University

Chaos Theory, Neurology, and Processing of Metaphors

In this paper we will explore the question of how we can process, use, and understand the indirect language of metaphors looking at the lens of neurology and Chaos Theory. We use metaphors commonly; one in every three sentences. The dictionary defines metaphors as something which stands for something else. As indirect language, metaphors also must be decoded to understand their meaning. Our neurology enables us to

process metaphors and Chaos Theory facilitates our understanding of the process. Bifurcation, a sudden change in organization, helps us comprehend this process as it is similar to what occurs to process metaphors. When we hear a metaphor, we de-stabilize the existing interpretation; our system disorganizes to search memory for the "hidden meaning". As an attractor draws us in, we move to re-organizing with a different view or perspective of what this metaphor is about. Metaphors are also sensitive to initial conditions. One small change in perspective can lead to a completely different understanding of the underlying metaphor. Things are the same as before, yet different. It is not the surface content but the underlying message which is now comprehended. Dynamic systems are interactive, create networks and wholes out of parts. Previously separate things become coupled in larger wholes. They are spontaneous self assemblies, and single parameters may determine one organization or another. Interdependence produces patterns, coherence self-organization, networks and synchronization. Metaphors are a good example of the butterfly effect, with change being an emerging new perspective. Neurologically, metaphor narratives and stories, frequently expand working memory and imagination. Visual imagery, verbal and nonverbal expression of emotion activates circuitry of both left and right hemispheres, cortical and sub-cortical networks, various regions of frontal lobes,, hippocampus and the amygdala.. Therefore, many sectors of the brain are actively involved. The role of language in neural integration, memory formation, and self-identity makes metaphors a powerful tool in the creation and maintenance of the self. How we process metaphors can facilitate understanding ourselves and others.

Bruce West, Chief Scientist Mathematics, Army Research Office

Consensus, Control and Minority Opinion

A few years ago I helped initiate a program to understand networked decision making and which reestablishes connections that had been severed by the boundaries separating the physical and human sciences. A particularly significant outcome of this research has been the Decision Making Model (DMM) for complex networks that undergoes a phase transition at a critical value of the coupling parameter. The DMM has provided insight into the information exchange between complex networks and why inflexible minorities can dominate the behavior of complex social networks; possible mechanisms to explain the Arab Spring and the Occupy Wall Street movement. In general DMM dynamics self-organize linked elements on a simple two-dimensional lattice through a phase transition to generate a scale-free interdependent topological structure with the inverse power-law exponent of 1.0 and an inverse power law distribution of consensus times with index 1.5. The DMM dynamics are sensitive to internally committed minorities and to internal minorities that are externally controlled. These minorities are unresponsive to the host network and are shown to either stabilize or induce social crisis.

Justin Williams, **A. Steven Dietz**, Texas State University - San Marcos

Boundary Setting in Human Systems: Excuse Me? But Why are You Peeing on My Leg?

This presentation will examine current literature as it applies to boundary setting in human systems. Initially we will review literature associated with living non-human groups (i.e. fish, reptiles, and mammals). Then we will review literature associated with legitimate and illegitimate human systems such as governments, gangs, ethnic groups, kin networks, school districts and businesses (i.e. fishing industry; telecommunications; etc.). The literature provides some commonalities between different human groups as well as between non-human and human groups. The literature also provides some ideas about how and when boundary rules are generated and maintained. We will present these results as they fit within a complexity paradigm model that will help delineate boundary setting in complex adaptive human systems.

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Back cover image – Keyword cloud to the 5th INSC, Barcelona, by José Navarro and Shana Narayan, University of Barcelona. *Fractalicious rock photos* by Ken Ware, Emerald, QLD. *Cover fractal* by J. C. Sprott.

Nonlinear Dynamical Bookshelf

Conte, E. (2012). ***Advances in Application of Quantum Mechanics in Neuroscience and Psychology: A Clifford Algebraic Approach.*** **Hauppauge NY: Nova Science.** ISBN: 978-1-61470-325-9. The first psychological studies and physics were once both considered together in the realm of psychology. Today, neuroscience, psychology and physics are seen together very infrequently. When physics is seen linked to mathematics as it is in the case of the present book, both these disciplines are considered so abstract and distant from neurologists and psychologists that reading the matter creates difficulties, some prejudice, and considered unable have some advantages. One of the interesting results of this book is that quantum mechanics relates directly to cognitive entities. Consequently, there is evidence that, in order to recover such a gap, an adequate role of quantum physics must be acknowledged and appropriate explanation offered. Contents: Preface; I. An Investigation on the Basic Conceptual Foundations of Quantum Mechanics by Using the Clifford Algebra; II. On the Possibility That we Think in a Quantum-Probabilistic Manner; III. A Possible Clifford Algebraic Quantum Mechanical Structure of the Self; IV. The Theory of Concepts According to Quantum Mechanic; V. Experimental Analysis of Quantum Interference; Index.

Frame, M. (Ed.). (2012). ***Benoit Mandelbrot: A Life in Many Dimensions.*** **Singapore: World Scientific.** ISBN 978-981-4366-06-9. This is a collection of articles, many written by people who worked with Mandelbrot, memorializing the remarkable breadth and depth of his work in science and the arts. Contributors include mathematicians, physicists, biologists, economists, and engineers, as expected; and also artists, musicians, teachers, an historian, an architect, a filmmaker, and a comic. Some articles are quite technical, others entirely descriptive. All include stories about Benoit. While he is known most widely for his work in mathematics and in finance, Benoit influenced almost every field of modern intellectual activity. No other book captures the breadth of all of Benoit's accomplishments.

Hoover, W. G. & **Hoover, C. G. (2011).** ***Time reversibility, computer simulations, algorithms, chaos*** **(2nd ed.). Singapore: World Scientific.** 978-981-4383-16-5. A small army of physicists, chemists, mathematicians, and engineers has joined forces to attack a classic problem, the "reversibility paradox", with modern tools. This book describes their work from the perspective of computer simulation, emphasizing the authors' approach to the problem of understanding the compatibility, and even inevitability, of the irreversible second law of thermodynamics with an underlying time-reversible mechanics. Computer simulation has made it possible to probe reversibility from a variety of directions and "chaos theory" or "nonlinear dynamics" has supplied a useful vocabulary and a set of concepts, which allow a fuller explanation of irreversibility than that available to Boltzmann or to Green, Kubo and Onsager. Clear illustration of concepts is emphasized throughout, and reinforced with a glossary of technical terms from the specialized fields which have been combined here to focus on a common theme. The book begins with a discussion, contrasting the idealized reversibility of basic physics against the pragmatic irreversibility of real life. Computer models, and simulation, are next discussed and illustrated. Simulations provide the means to assimilate concepts through worked-out examples. State-of-the-art analyses, from the point of view of dynamical systems, are applied to many-body examples from non-equilibrium molecular dynamics and to chaotic irreversible flows from finite-difference, finite-element, and particle-based continuum simulations. Two necessary concepts from dynamical-systems theory — fractals and Lyapunov instability — are fundamental to the approach.

Lasserre, J. B. (2012). ***Moments, positive polynomials, and their applications*****. Singapore: World Scientific.** ISBN: 978-1-84816-445-1."This book makes a dynamic entrance into the literature of optimization. It is a self-contained textbook devoted to a modern, rapidly developing area of applied mathematics, characterized by a profuse use of optimization techniques combined with important results of real algebraic geometry, and supporting applications in many other domains. It is undoubtedly a nice piece of work and potentially a valuable reference for future developments." - *Mathematical Reviews*. Many important applications in global optimization, algebra, probability and statistics, applied mathematics, control theory, financial mathematics, inverse problems, etc. can be modeled as a particular instance of the Generalized Moment Problem (GMP). This book introduces a new general methodology to solve the GMP when its data are polynomials and basic semi-algebraic sets. This methodology combines semidefinite programming with recent results from real algebraic geometry to provide a

hierarchy of semidefinite relaxations converging to the desired optimal value. Applied on appropriate cones, standard duality in convex optimization nicely expresses the duality between moments and positive polynomials. In the second part, the methodology is particularized and described in detail for various applications, including global optimization, probability, optimal control, mathematical finance, multivariate integration, etc., and examples are provided for each particular application. *Contents*: Moments and Positive Polynomials: The Generalized Moment Problem, Positive Polynomials, Moments, Algorithms for Moment Problems. *Applications:* Global Optimization over Polynomials, Systems of Polynomial Equations, Applications in Probability, Markov Chains Applications, Application in Mathematical Finance, Application in Control, Convex Envelope and Representation of Convex Sets, Multivariate Integration, Min-Max Problems and Nash Equilibria, Bounds on Linear PDE.

Marks-Tarlow, T. (2012). *Clinical Intuition in Psychotherapy: The Neurobiology of Embodied Response*. New York: Norton. Author draws from 30 years of clinical experience to explore the central—yet neglected—topic of intuition in psychotherapy. "This book is a *superb synopsis of psychotherapeutic experiences, and a delight to read*. With a flowing and sensitive narrative, spiced with selections from modern affective and cognitive neurosciences, Marks-Tarlow's clinical skills and insights offer new ways to envision how disturbed minds can be guided toward positive self-realizations, through the transformative power of social joy." *—Jaak Panksepp, PhD. Baily Endowed Professor of Animal Well-Being Science, College of Veterinary Medicine, Washington State University.* "This is a topic near and dear to my heart; the pages just flew out of me during the writing. I amazes me that despite our minute to minute use of clinical intuition within psycho-therapy, there is only one other book on this topic. Mine contains chapters on empathy, play, humor, imagination, and wisdom. In efforts to fully engage the reader, the book is story based, and includes animal tales, clinical vignettes, plus personal stories. I also managed to illustrate the whole thing amply." – TMT.

Verspoor, M.H., de Bot, K. & Lowie, W. (2012). *A dynamic approach to second language development: methods and techniques*. Amsterdam, Philadelphia: John Benjamins. This book contains an introduction to variability analysis of time series using descriptive techniques, visualization techniques, an introduction to coding and extracting (language-) data, and an introduction to modelling developmental data. The focus of the book is on second language development, but most techniques can also be applied to other fields. The book is intended as an introductory methods textbook for students and scholars who are new in this field and want to use variability analyses for time series. It contains a set of illustrated How-To sections and comes with an accompanying website for further tools and information.

Z**eraoulia, H., & Sprott, J. C. (2012). *Robust chaos and its applications*. Singapore: World Scientific.** 472pp. ISBN 978-981-4374-07-1. Robust chaos is defined by the absence of periodic windows and coexisting attractors in some neighborhoods in the parameter space of a dynamical system. This unique book explores the definition, sources, and roles of robust chaos. The book is written in a reasonably self-contained manner and aims to provide students and researchers with the necessary understanding of the subject. Most of the known results, experiments, and conjectures about chaos in general and about robust chaos in particular are collected here in a pedagogical form. Many examples of dynamical systems, ranging from purely mathematical to natural and social processes displaying robust chaos, are discussed in detail. At the end of each chapter is a set of exercises and open problems (more than 260 in the whole book) intended to reinforce the ideas and provide additional experiences for both readers and researchers in nonlinear science in general, and chaos theory in particular.

Zhang, W-J. (2012). *Computational ecology: Graphs, networks and agent-based modeling.* Singapore: World Scientific. ISBN: 978-981-4343-61-9. Graphs, networks and agent-based modeling are the most thriving and attracting sciences used in ecology and environmental sciences. As such, this book is the first comprehensive treatment of the subject in the areas of ecology and environmental sciences. From this integ-rated and self-contained book, researchers, university teachers and students will be provided with an in-depth and complete insight on knowledge, methodology and recent advances of graphs, networks and agent-based-modeling in ecology and environmental sciences. Java codes and a standalone software package will be presented in the book for easy use for those not familiar with the mathematical details.

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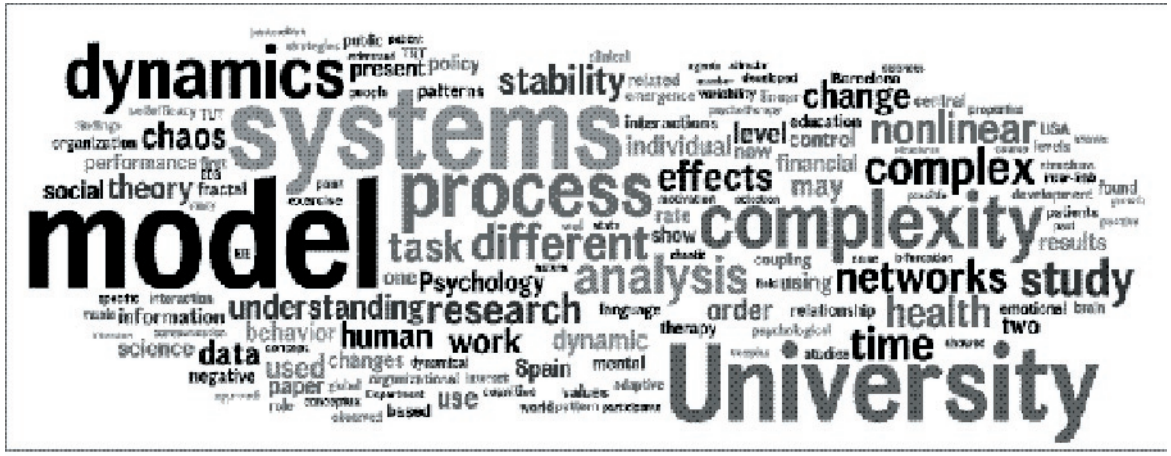

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