Society for Chaos Theory in Psychology & Life Sciences
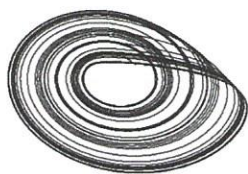
Abstracts to the 25th Annual International Conference, Gainesville, FL 2015

Dedicated to the development of nonlinear science worldwide

since 1991

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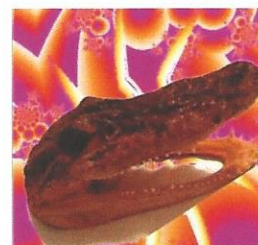
25th Annual International Conference
29-31 July, 2015
University of Florida, Gainesville, FL, USA

AN INVITATION TO OUR CONFERENCE

Sara Nora Ross
2015 Conference Chair

Celebrating 25 years!

Celebrating the 25th consecutive year of annual conferences, the 2015 Annual International SCTPLS Conference will be held in Gainesville, Florida, July 29-31, 2015, at the Harn Museum of Art and the Florida Museum of Natural History at the University of Florida

Our work has never been stronger or in higher demand. The Annual International SCTPLS Conference provides a one of a kind opportunity to showcase one's achievements, to keep up with advances in nonlinear science, and to network with international colleagues. Providing a small, focused conference with broad interdisciplinary and international scope, this summer is the time to share your interesting work among those who truly "get it."

Once again, the conference kicks off with a full day of workshops. The pre-conference workshop day for 2015 is under development - check back here for details and, if you're already a member, keep your eyes out for the announcements that come directly to your inbox!

In addition to our special invited guests, the 2015 conference will include single papers and symposia, 50-plus concurrent sessions and a poster session. Participants will include an international group of 60-70 psychologists, physicists, mathematicians, researchers and others who all share a common focus on the investigation and applications of nonlinear dynamics to psychology and the life sciences.

Florida Museum of Natural History
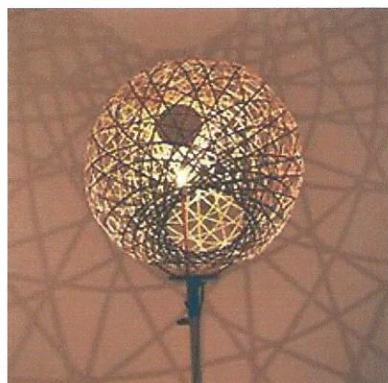
Five-Fold Sphere Projection Lap
by Eliasson (Harn Museum)
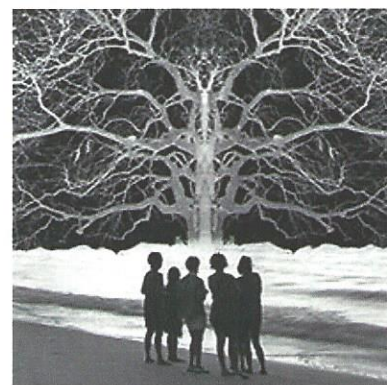
Apocalypse II, by Uelsmann
(Harn Museum)

From the Butterfly Rainforest, Florida Museum
of Natural History. (Photo by Krystyna Laycraft)

ABSTRACTS of SPECIAL CONFERENCE SPEAKERS

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**Dynamical Social Psychology:
Embracing (finally!) the Nonlinear Nature of Human Experience**

Robin Vallacher

July 30, 2015 Afternoon Keynote

For decades, the dominant paradigms in social psychology tried to impose tidy models of linear causality on the decidedly untidy and nonlinear dynamic processes of mind and action. True to the nature of nonlinear change, the traditional approach has become destabilized due to internal incoherence and is giving way to new paradigms that promise greater coherence, precision, and generalizability in capturing the nature of human experience. This phase transition is due in large part to the advent of sophisticated methods and tools (e.g., computer simulations, time series). I will highlight a tool developed in my lab that captures the internally generated ("intrinsic") patterns of psychological processes, and describe new insights into the dynamics of self-evaluation, social judgment, close relations, and intractable conflict revealed by this tool. I will conclude by proposing how the nonlinear dynamical systems approach may provide integration for the diverse subject matter of social psychology.

Night Thoughts of a Dynamicist

Scott Kelso

July 30, 2015 Banquet Keynote

Richard Feynman once said something like "We would not know where we are stupid until we stick our necks out." In this talk I'll discuss some of the key concepts and ideas behind coordination dynamics, the science of coordination, where they came from and why they matter. This will include some historical aspects including early conferences and interactions with certain prominent scientists. Then I'll stick my neck out and make

a linkage between consciousness and coordination. Rather than being a novel state of highly integrated information or matter, conscious agency will be seen to emerge as a disorder-order transition of a coordination dynamics defined in an appropriate space of relevant variables.

Tomorrow's Science: Fractional Calculus View of Complexity

Bruce J. West

July 31, 2015 Morning Plenary Session

A number of attempts have been made to develop new ways of doing science, which are respectful of the complexity of the phenomena being studied. Examples of such efforts that come to mind include Cybernetics, Systems Theory, Catastrophe Theory, Complexity Theory, Nonlinear Dynamics and their subsequent generalizations. The common element of these and other such efforts is the recognition that complex phenomena, whether natural or artificially constructed, ought to be treated as a whole and not selectively dissected and once understood, stitched back together. This talk does not seek to accomplish this Herculean task, but has the more modest goal of juxtaposing a few of the disparate contributions, made by a number of gifted scientists, into a single strategy for gaining understanding and acquiring a new kind of knowledge; one in which the qualitative can be, and often is, as important as the quantitative. This strategy is an application of da Vinci's approach to understanding and it forms the basis of *Tomorrow's Science* (a new book by the speaker), which in reality is five centuries old.

Just as Newton's calculus replaced the geometric description of mechanical phenomena, a more general calculus is necessary to replace the fractal geometry of complex phenomena and this requires a new way of thinking. The fractal trajectories of complex dynamics are non-differentiable, and averages over ensembles of such trajectories are described by fractional derivatives of probability densities, in space, in time, or both. The solution to the fractional phase space equation is an inverse power-law probability density function, which describes all the phenomena mentioned earlier and many more. However, rather than focusing on mathematical formalism, this talk addresses the meaning of the mathematics and attempts to answer the question: *Why is the fractional calculus entailed by complexity?*

ABSTRACTS

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In alphabetical order by presenter

Random-Walk Model Accounts for how Axons of Newborn Neurons Reach their Partners in Early Networks

Gaetano L. Aiello, Dipartimento di Fisica e Chimica, Universita' di Palermo

In approaching a target-neuron the axon of the newborn neuron actively probes its surroundings in search of guidance cues. The latter are special "guidepost" molecules which are embedded in the substrate and distributed according to a genetic blueprint, still largely unknown. In a *percolation model* of axon guidance, guidepost molecules are implemented as scattering points randomly distributed in a 2D lattice. At all points a set of probabilities determine the next move. Upward moves are negated. The axonal trajectory is thus described by a symbolic sequence of Right-Left-Down moves, which – after filtering out all Down symbols – leads to a one-dimensional *Random Walk*. The probability of an axon reaching a given target cell - and thus the early network connectivity - would then be ruled by a *binomial law*. This states the equivalence between percolation models and current random walk approaches to cytoskeleton dynamics.

The Relational Synapse: Mirror Neurons, Attachment, and Intersubjectivity in Psychological Development

Jessica Boyatt, Infant Parent Training Institute

"Humanity…is to be found neither in one of the two partners, nor in both together, but only in the dialogue itself, in the between which they live together" (Martin Buber, 1958). The term in-between is somewhat pedestrian; what happens in the space between one thing and another is often neglected, the assumption being that there is nothing there, that it is empty. However, as mirror neuron research suggests and the psychological concepts of attachment and intersubjectivity flesh out clinically, when this gap fills with the communicative actions of each participant, empty space becomes experience. A core theoretical construct that has emerged from thinking about the dialogic origin of mind and brain is what I call the relational synapse. Using a complex systems framework, I think of the relational synapse as the location of emergent, co-created relational phenomena that are recursively folded in to each individual's internal and interpersonal experience. What is created in the relational synapse becomes both internalized paradigms of self, other and relationship *and* in-vivo relational expectancies. I conceptualize the space in-between two people

as a potential source of power that can spiral towards psychopathology or psychological health on both a neuronal and relational level. Under good enough conditions in both development and psychotherapy our minds, brains and relational experience, and all the variations of in-between space within and among them, will move towards greater flexibility, complexity and coherence, engendering experiences of psychological health.

Using Catastrophe Theory to Examine the Impact of State Expenditures on Mental Health
Barbara Bruhns Frey, Potential Connections, Inc.

This is an early stage investigation examining variation in mental health indicators as a function of the cusp catastrophe in community-based expenditures over years. Several measures related to mental health are examined (e.g., self-reported alcohol consumption, criminal justice referral for treatment). The data from multiple US State Mental Health Agencies (SMHA) related to SMHA controlled mental health expenditures, specifically, for community-based programs are clustered and examined using catastrophe theory. States are clustered into three groups using changes in annual expenditures from 2004 to 2010: (1) minimal change in annual expenditures (no change), (2) increase in annual expenditures (increase) and (3) decrease in annual expenditures (decrease). Data grouped by children/adolescent and adult populations will be presented along with transition points related to the clusters and the 2008-2009 recession. The implications for state and national policy will be discussed.

Mother-Infant Verbal/Nonverbal Interaction as Predictor of Attachment: Non-Linear Dynamic Analyses
M. Ángeles Cerezo, Gemma Pons, and Rosa Trenado, University of Valencia

In assessing the history of mother infant interaction sequential real time coding provides the necessary perspective of interactive processes to predict in/secure attachment. The Nonlinear Dynamic Systems (NDS) approach offers a new perspective to the classical construct of maternal sensitivity. The present study is a further development of a previous one published in NDPLS that showed higher flexibility through several NDS indices derived from the State Spaces Grid (SSG) in infants at 6 months in B dyads (secure attachment). That study pointed to the benefit of a subsequent study including verbal behavior in the analysis of the interaction. Method: Differences between in/securely attached children were analyzed with NDS. Participants: fifteen mother-infant dyads, in 3 groups: A, B and C types of attachment assessed at 15 months using the Strange Situation Test. The mother-child interaction, free-play situations, at 6 and 12 months, sequentially coded, provided the information that was analyzed with the SSG. Results: Analyses are ongoing. However, preliminary analyses are indicating that indices of flexibility emerge differently for verbal than non-verbal behavior adding clear value to the previous findings. There were more differences at 6 than at 12 months. The verbal behavior functions as attractor showing differences among A, B & C groups. The proportion of time spent in the verbal states over the total time showed that B group is medium, while the A were more verbal and the C was more silent. This study provides a new perspective on maternal sensitivity and early markers of insecure/secure attachment.

Identify Partially-Observed Markov-Systems for Studying the Dynamics of Adolescent Marijuana Use with Cross-Sectional Data
Xinguang "Jim" Chen, University of Florida, Ding-Geng Chen University of Rochester, and Guanghui Lan, University of Florida

Better understanding the dynamics of marijuana use is essential to protect US adolescents, but longitudinal data are needed to investigate the dynamics. Capitalizing on previous research on probabilistic discrete system (PDES) for tobacco use research, we developed a Markov Chain-based 3-stage and 7-transion marijuana use PDES model. One fundamental challenge to solve the model is that this model is not identifiable with data collected through most survey studies, the National Survey of Drug Use and Health (NSDUH), one of the most relevant surveys for drug use research. In this study, we reported our work on solving this issue using the 2012 NSDUH data (N=55229, aged 12-17) and two different analytical methods the convex optimization and Moore-Penrose generalized inverse matrix system that are devised for solving non-identifiable equation systems. Probabilities for the seven steps of transitions by age groups were successfully estimated with the data and the methods. Furthermore, the results from the two different methods were close to each other; and lastly, the results are scientifically reasonable. In conclusion, the non-identifiable PDES marijuana use system may be solvable using an appropriate method. The approach we used in this study may also be used to investigate the dynamics of many health risk behaviors with cross-sectional survey data that are widely available for research.

Self-Organization of Team Communication under Varying Task Constraints
Terri Dunbar and Jamie Gorman, Texas Tech University

Team coordination, or the organization of different elements that work together, may be impacted by numerous factors, such as the type of task the team is performing. In this study, we examined a specific type of team coordination team communication and how team communication dynamically structures itself according to the type of task the team per-formed. We used type of task to manipulate team task constraints, or environmental factors that alter the team s opportunity for communi-cation acts. From our perspective, constraints impact self-organized criticality, controlling the way team communication self-organizes. We measured self-organized criticality in team communication through fractal patterns of coded team communication. Based on this approach, we hypothesized that the way team communication self-organizes can be controlled through task constraints. We further hypothe-sized that fractal team communication is less susceptible to perturbations. To test our hypotheses, dyads participated in one of two types of tasks that required verbally coordinated problem solving. During the experiment, the experimenter periodically interrupted team communication to determine how unexpected perturbations impact self-organization of team communication. As hypothesized, we were able to control fractal patterns in team communi-cation using team task constraints. Our perturbation results indicated that non-fractal communication structures were negatively impacted by perturbations; however, there was no evidence that perturbations impact team communication structure differently depending on the type of task. Our results demonstrate that different

fractal team communication structures self-organized as a function of task type. This suggests that team communication is dynamically structured in different ways depending on the team task constraints.

Physiological Synchronization in a Vigilance Dual Task
Stephen J. Guastello, Marquette University

The synchronization of autonomic arousal levels and other physiological responses between people is a potentially important component of work team performance, client-therapist relationships, and other types of human interaction. This study addressed two problems: What statistical models are viable for identifying synchronization for loosely coupled human systems? How is the level of synchronization, as determined by nonlinear time series analyses, related to psychosocial variables such as empathy, subjective ratings of workload, and actual performance? Participants were 70 undergraduates who worked in pairs on a vigilance dual task in which they watched a virtual reality security camera, rang a bell when they saw the target intruder, and completed a jig-saw puzzle. Event rates either increased or decreased during the 90 min work period. The average R2 values for each person were .66, .66, .62, and .53 for the linear autoregressive model, linear autoregressive model with a synchronization component, the nonlinear autoregressive model, and the nonlinear autoregressive model with a synchronization component, respectively. All models were more accurate at a lag of 20 sec compared to 50 sec or customized lag lengths. Although the linear models were more accurate overall, the non-linear synchronization parameters were more often related to psychological variables, such as empathy, and performance. In particular, greater synchronization was observed

with the nonlinear model when the target event rate increased, compared to when it decreased, which was expected from the general theory of synchronization. Nonlinear models were also more effective for uncovering inhibitory or dampening relationships between the co-workers as well as mutually excitatory relationships. Future research should explore the comparative model results for tasks that induce higher levels of synchronization and involve different types of internal group coordination.

Physiological Synchronization in Emergency Response Teams: Workload and Fatigue, Drivers and Empaths
Stephen Guastello, David Marra, Clair Perna, Julian Castro, and Maribeth Gomez, Marquette University

Behavioral and physiological synchronization has important implications for work teams with regard to workload management, coordinated behavior, and overall functioning. This study extended previous work on the nonlinear statistical structure of GSR series in dyads to larger teams. The experiment also varied work-load in the form of time pressure. Eleven teams of 3 or 4 people played a series of six emergency response (ER) games against a single opponent. Six of the groups worked under a time pressure instruction at the beginning of the first game. The other five groups were not given that instruction until the beginning of the fourth game. The optimal lag length for the teams, which appeared to be phase-locked, was substantially shorter than that obtained previously for loosely-coupled dyads. There was a complex nonlinear effect from the time pressure manipulation on the autocorrelation over time that reflected workload dynamics operating. The R2 values for linear and nonlinear statistical models differed by less than .01. ER team members were

classified as drivers and empaths, based on the autocorrelations and transfer influences to and from other players in the GSR time series. Empaths were rated by their peers as making more types of positive contributions to the problem solving discussions than others, and drivers received the lowest ratings. Their time series were plausibly non-stationary because of events transpiring across different time scales. The origins of these non-stationary influences are a topic of future research. Correlations between individuals Lyapunov exponents and other parameters from statistical models with ratings of subjective workload are now under investigation.

Three-people Dormitory Model
HAIRI, School of Aerospace, Tsinghua University

I present the dynamics of 3 people relationship in accordance with Strogatz¡'s romantic model, where he established a dyadic romantic relationship model. Similarly, the model I propose is a 3 people relationship dynamical model, where the emotional feelings are towards the crew of all 3 people. The idea came into being because the author is living in a 3 people capacity dorm, so the reason is natural to study the dynamics of the group of 3 people as Strogatz did in his model. The process of establishing the model is from a linear one to a nonlinear one, where plausible assumptions are added. Different types of personality to the dorm can be represented in the model. Interesting results can occur even in the linear model. Gradually, I modify the model into a nonlinear one, which may be more realistic compared with the linear one. There are many ways to introduce the nonlinearity to the model; I used the logistic equation where repair nonlinearity was introduced into this kind of model by Sprott. Richer dynamics appear. These useful results can be

good recommendations for the schools or other organizations to arrange proper combinations of personalities into a dorm, which, I think, can prevent severe harms that are caused by a bad roommate relationship.

Understanding the Source of Nonlinearity of Partner Violence
David Katerndahl, Sandra Burge, Robert Ferrer, Johanna Becho, and Robert Wood, Family & Community Medicine, University of Texas Health Science Center at San Antonio

Partner violence generally follows a nonlinear trajectory. Although predictors of such violence is known to include husband, wife and relational characteristics, we know little about the triggering of abusive events and why the trajectory is nonlinear. The objective of this study was to identify predictors of violent events and determine whether features conducive to nonlinearity (multiple interdependent factors, circular causality, feedforward dynamics) were present. 200 adult women who experienced partner violence in the prior month were recruited from 6 primary care clinics and asked to report daily via telephone for 12 weeks on their household environment, marital relationship and violence. The degree of violence nonlinearity was assessed using LZ complexity, Lyapunov's exponent and approximate entropy. Prior-day and prior-week factors associated with violent events were sought using vector autoregression (VAR). All 3 measures of nonlinearity suggested that violence generally followed nonlinear trajectories. We found that violence depended upon prior-day husband-perpetrated violence, hassles, emotional upset, marital distance and lack of husband's alcohol intake; wife-perpetrated violence depended upon her prior-day violence and alcohol intake. Feedforward dynamics were present for both

husband- and wife-perpetrated violence, and circular causality was observed. This study found that partner violence is associated with multiple interdependent factors, feedforward dynamics and circular causality as expected in complex systems, presumably leading to nonlinear violence dynamics. Such dynamics implies that, while simple interventions may have little chance of success, understanding couple-specific patterns may allow women to recognize high-risk prior-day profiles and take preventative action.

The Complexity Leadership Process: Exploiting the Nonlinearity of the Process Enneagram
Richard N. Knowles, Richard N Knowles & Associates, Inc.

The Complexity Leadership Process works, having been successfully used in a variety of organizations around the world. Using the nonlinear, dynamical Process Enneagram© (not to be confused with the enneagram of personality) helps people solve complex problems (high levels of ambiguity, and low levels of certainty). Engaging a cross-section of the organization's people in dialogue about an important problem, and approaching it from the 9 different, but interrelated Process Enneagram perspectives, a dynamical, strategic plan emerges. Sharing this with others, posting it in meeting rooms, discussing it for understanding, upgrading and modifying as conditions change, new insights develop. Information flows freely and recursively, new insights emerge, excitement and trust build. With so many contributions the people have co-created their solution. An attractor called the BOWL develops,providing the order and focus for the organization and the freedom, within it, for the people to be creative in solving the problems they encounter. The

nonlinear, dynamical, recursive features of this Process help organizations achieve excellence whereas linear processes like John Kotter's "Leading Change" only achieve compliance. Actual case studies and new insights will be shared.

First Order Change and the Policy Churn in Public Education in the US
Matthijs Koopmans, School of Education, Mercy College

Educational organizations, public schools in particular, are seen as being notoriously inert and resistant to change, and yet, the socio-economic determinants of educational achievement show remarkable persistence over time: the achievement gap endures, graduation rates remain too low, failing schools most likely are the ones serving students from poor families, and a plethora of schools reform efforts, curricular innovations and policy initiatives has done very little to alter any of these realities. At the same time, urban school systems are also likely to have high teacher turnover, as well as a significant turnover of school principalships and district superintendencies in response to the volatile demands of local constituencies. This state of affairs has been called the policy churn (Hess, 1999) indicating a high degree of turbulence in the system, while at the same time, nothing really changes in the long run, i.e., first order change. This presentation seeks to obtain a deeper understanding of the apparent contradiction implied by the policy churn metaphor by reviewing two disparate literatures that have important yet disparate insights to offer into this subject: the school reform literature, which describes the public school system in highly dynamical terms without the benefits of the nonlinear dynamical systems (NDS) framework, and the dynamical literature

on change in organizations, which is richly informed by this framework, without being focused on the plight of public education in the US. The field would benefit from a productive synthesis of these complementary insights into stability and change in educational organizations.

The Role of Competing Variants in the Emergence of Nonlinear Profiles in the Complex System of Speech
William A. Kretzschmar, Jr., Universities of Georgia, Glasgow, and Oulu, and Ilkka Juuso, University of Oulu

Computer simulation is the only practical way to model linguistic diffusion and change over time in speech. We have successfully simulated diffusion with a cellular automaton. Throughout hundreds of generations that correspond to the daily interaction of speakers across time, we can watch regional distributional patterns emerge as a consequence of these simple update rules. We have also successfully demonstrated the use of social criteria as a factor that influences diffusion, and we have determined how the inclusion of a random factor in the evaluations affects overall distributions. In this paper, we wish to show how variants for one feature, drawn from the data of the Linguistic Atlas of the Middle and South Atlantic States (LAMSAS), compete with one another as they all diffuse at the same time. We know that a feature, once established, can spread across an area. However, we now consider how variants compete with one another to create the nonlinear frequency profiles (evidence of operation of a complex system) that we always see in real LAMSAS data. We find that the persistence of different variants in clusters, and the maintenance of arrays of variants at every location, creates the emergence of nonlinear profiles in "active" use of variants

(related to cognitive chunking), as opposed to preservation of variants in "passive" understanding of speech. Operation of the complex system preserves variants across wide areas in passive understanding of language, but active use of language involves common use of a smaller number of variants per speaker with a nonlinear preservation of variants across the whole population. The simulation thus addresses individual human cognitive capacity and explains how we understand all of the variants that we do not normally use. This finding has strong implications for models of human cognitive language development, in that it does not support the existence of an array of physical symbols or linguistic representations (as commonly asserted in cognitive linguistics), and instead suggests the likelihood of the dynamical systems model (important in neuroscience) in which frequency and habituation influence the maintenance of a continuous system for linguistic information.

Creativity of Young People
Krystyna Laycraft, The Center for Chaos Studies, Calgary

The study of creativity of young people and its role as a component of their psychological development is presented. For this qualitative research, hermeneutic phenomenology/ontology linked with the narrative/biography methodology was chosen. As a process of interpretation of the data, we create conceptual models called pattern models of the developmental dynamisms of young people by applying the concepts of complexity science, especially self-organization with the Dabrowski theory of positive disintegration and the Plutchik theory of emotions. The theory of positive disintegration is especially useful for understanding the tumultuous psychological development of

gifted and creative adolescents. Dabrowski stresses the importance of emotional turbulence in the process of human growth, which corresponds to Prigogine's idea that non-equilibrium is a source of order. In general, creativity of young people could be modeled as a self-organizing process that originates spontaneously in far-from-equilibrium created and maintained by the complex emotions/dynamisms like enthusiasm, curiosity, delight, resourcefulness, subject-object in oneself, and third factor. These emotions are the driving forces generating order and complexity not only in their creativity but above all in their psychological development that is characterized by lesser tension, and greater ability to integrate their experiences, to take the development into their own hands, and to find direction for their future.

The T-Pattern as a Candidate Principle for Behavioral and Natural Organization: With Detection Software Theme
Magnus Magnusson, Human Behavior Laboratory, University of Iceland

The T-pattern, defined and discussed in a number of my papers over 30 years, was theoretically and empirically inspired by ethology, radical behaviorism, and linguistics. It was initially developed and used for research on children and adult's nonverbal interactions using ethological and some verbal act categories. Inspired also by multivariate computational methods such as Markov chains, Cluster Analysis and Time Series Analysis, I first presented the T-Pattern with corresponding detection algorithms and software THEME (www.patternvision.com). T-Pattern Detection & Analysis (TPA) has since been applied extensively to the analysis of behavior and interactions of organisms from neurons to humans, including robot-human

interactions and olfactory neurons. The T-pattern is a repetitive hierarchical and recursive tree structure of a particular statistical (critical interval) relationship between point series defined and detected on the basis of approximate translation symmetry and evolution methods. The T-pattern thus has the self-similar recursive structure of a particular kind of repeated statistical pseudo-fractal object type. The widespread presence of T-patterns suggests a fundamental aspect of biological dynamics, but possibly also of static DNA structure exemplified by genes, among others (Magnusson, 2004, 2005) and when generalized to two and three dimensions this also seems true for cities and possibly cosmic fractal structures (Baryshev Y & P Teerikorpi, 2002).

Defining Adaptation in Terms of Biological System Source Code Geometry
F. Matthew Mihelic, Graduate School of Medicine, University of Tennessee

Adaptation has not been well defined to date as it relates to complex systems, and it is often confused with a system's compensatory responses. The difference between the adaptive and compensatory mechanisms of a system can be illustrated through the example of cardiac physiology and the Frank-Starling curve which represents how the heart compensates for increased filling with increased output on a beat-to-beat basis. Compensatory responses deal with rapidly changing perturbations within fixed limits of fluctuation, but adaptive changes of the heart occur when the geometry of the heart muscle changes over time in response to a long-term change in filling pressure, and this is represented by a shifting of the Frank-Starling curve. This physiologic difference between adaptation and compensation is theorized to have its origin in the DNA source code of the

cardiac biological system, in which the rapid changes necessary for cardiac compensation can be efficiently represented in two dimensions, but the adaptive changes in cardiac geometry are most efficiently represented in three dimensions. Certain Euclidian distances in the DNA source code s geometric configuration can be envisioned to correlate with certain phenotypic expressions, and so changes in DNA geometric configuration would be necessary for the most efficient representation of the adaptive changes in cardiac muscle geometry. Therefore biological compensatory mechanisms would be considered as Markovian, and biological adaptive mechanisms would be considered as non-Markovian because information would be retained in the geometric reconfiguration of the DNA source code. When viewed in this way, certain repetitive sequences of so-called junk DNA might be theorized to represent ratchet points of geometric reconfiguration that can correlate with changes in phenotypic geometry. The paradigm of compensation vs. adaptation as a function of source code geometry can be generalized to improve understanding of higher-order biologically-based complex adaptive systems and their dysfunctions.

Self-Organization of Marital and Family Therapy: Complexity-Based Mental Health Treatment
Michael K. O'Hearn, College of Medicine, Dept. of Psychiatry and Behavioral Neuroscience, University of Cincinnati

Self-organizing systems, including mental health systems, develop requisite component and interactive properties to evolve. The mental health system's component-only history is naturally informed by component-only feedback loops on everything from evidenced based practices to budget formulas. This kind of

dilemma is stochastically fractal to other cultural institutions, and the human race. Our advanced capacity for symbolic consciousness contributed to our unprecedented evolutionary efficiency. However, accelerating human complexity particularly in the socio-cultural component of human evolution is a sustainability threat. A complexity-based clinical model with component and interaction feedback is proposed for mental health clinicians, administrators, and particularly marital and family therapists. The model synthesizes Self-Organized Criticality (SOC), Game Theory, and Odum's pulsing paradigm; the protocol emulates Gottman's trust metric. Recurring states of criticality and phase transitions are linked with specific mental states and behaviors. These observation codes along with perception ratings in matrix format, quantify the impact of complexity on individuals, couple's, and families. The quantified feedback is used to assess the impact of clinical efficacy on family ecosystems. A complexity-based model is necessary because curative factors of effective treatment are concentrated in the myriad of treatment process dynamics. Some typical arenas of substantial interaction-dominant dynamics of treatment include: the evolving therapeutic alliance, understanding and resolving transference, and understanding and resolving personal resistance to change. Time series correlations may be an effective method to quantify stochastic fractal clinical dynamics, revealed by interactive methods.

Experiential Balancing Therapy: An Integrative Psychotherapy Theory and Approach Grounded in Complex Adaptive Systems Theory

David Pincus, Chapman University

This presentation introduces a treatment manual for a new integrative approach to psychotherapy, Experiential Balancing Therapy (EBT), which is based on principles from complex adaptive systems (CAS) theory. The approach combines theoretical constructs and techniques from the broad variety of empirically validated approaches including: cognitive-behavioral (particularly third wave behavior therapies, emotion-focused and related humanist-experiential therapies, and the vast array of empirically supported psychodynamic approaches (including interpersonal therapies. The basis for integrating these seemingly disparate approaches rests in the understanding that all psychotherapies share a common focus on (a) expanding people s experiential range and intentionality while (b) maintaining or improving the systemic integrity of people s consciousness, particularly the sense of self. EBT aims directly at this common goal: increasing people s broadband experiential flexibility and sense of freedom without pushing the experiential system beyond its structural limits. This manual is intended to be used as a guide for clinicians interested in bridging some of the most common theories, approaches, strategies and techniques in psychotherapy to fit a contemporary systems science perspective. The talk will describe the theoretical grounding for the approach, as well as the key concepts that are used in case formulation.

Modeling and Simulation of the Movements of Social Groups over Regions with Dynamically Changing Welfare Opportunities

Stanislaw Raczynski, Universidad Panamericana

The aim of the model is to simulate migrations of social groups over certain geographical regions, in search of better work opportunities and welfare. We use the object- and agent-oriented approach instead of a Systems Dynamics modeling frequently used in similar problems. The main model components are regions and individuals belonging to certain social groups. A region is characterized by more than 30 parameters, such as geographical data, actual population statistics, education facilities and work opportunities, among others. For the social groups the parameters include the demographics and educational statistics. The simulated individuals attempt to optimize their welfare by moving over the model map. The region parameters change due to the number and the parameters of incoming individuals, which provides a dynamic and nonlinear feedback. The qualitative results show that the model never reaches a steady state and that the social groups remain in periodical movement.

A Case Study: Mixed Methods Analysis of a Highly Sensitive Person Performing in a Temperament-Appropriate Career

Janice Ryan, University of Tennessee in Chattanooga

Current advances in understanding the nonlinear nature of self-referential systems during ongoing cycles of autopoiesis or self-creation will contribute to a better understanding of which careers are temperament-appropriate for highly sensitive persons and why this personality trait often draws us to careers in which we can repeatedly co-evolve with another person as half

of a creative pair (Montuori, 2015). Research at the California Institute of Integral Studies is currently describing personality traits and exploring the strengths of highly sensitive people such as this presenter. Sometimes referred to as The Integral Being, this personality trait is recognized to describe approximately 20% of people distributed equally across racial and gender lines. I propose that mindful therapists are part of this group and that we use a transpersonal form of consciousness that supports a higher state of intersubjective awareness between client and therapist. I will provide a phenomenological analysis and Orbital Decomposition data analysis of a treatment session during which I propose core evolutionary neurobiological knowledge is transferred through two-way exchanges between client and therapist. As a therapist who couples mindfulness and treatment within personally preferred multi-sensory environments (Messbauer, 2015), I explain how emerging scientific theory in the areas of evolutionary neurobiology and the neuroscience of positive affect as well as the difference between these and game/drama theories are expanding on mental and cognitive health practice models. I propose that cognitive and mental health treatment models previously focused too narrowly on obvious action cycles with little attention to the action-perception cycles that promote neuroplasticity in treatment and provide opportunities for lifelong habit change. I describe the therapeutic use of a co-evolutionary approach to treatment that I call Improvisational Dynamics and explain how treating within a multi-sensory environment contributed to my own development of triple-loop learning or enhanced mindfulness. Implications of this data analysis include the value of recruiting and promoting the success of highly sensitive people as therapists and natural

holistic healers with the potential to be more mindful and empathic than is the tendency of the other 80% of the population. Another implication is the value of using multi-sensory environments to enhance the potential of this co-evolutionary therapeutic process through autopoiesis by recognizing the importance of the environment in the self-creation of self-organizing systems.

Scaling Laws in Emotion-Associated Words and Their Network Topology
Takuma Takehara, Doshisha University

Words relating to emotion are used frequently in interpersonal communications. While many studies have used scaling laws to describe general words or corpora, no prior studies have focused on the use of scaling laws to describe the appearance-frequency distribution of emotion-associated words. We investigated whether scaling laws were present in the appearance-frequency distribution of emotion-associated words and determined whether the network constructed from those words had small-world or scale-free properties. Over 1,400 participants were asked to write down the first single noun that came to mind in response to nine emotional cue words, resulting in a total of 12,556 responses. We identified Zipf"s law in the distribution of the data, as the slopes of the regression lines reached approximately -1.0 in the appearance frequencies for each emotional cue word. This suggested that the emotion-associated words had a clear regularity, were not randomly generated, were scale-invariant, and were influenced by unification/diversification forces. We also found that the 1-mode network of emotion-associated words clearly had small-world properties in terms of the network topologies of clustering, average distance, and small-worldness value, indicating that all nodes

(words) were highly interconnected with each other and were only a few short steps apart. Furthermore, the data suggested the possibility of a scale-free property. Interestingly, we were able to identify hub words with neutral emotional content, such as "dog", "woman", and "face", indicating that these neutral words might be an intermediary between words with conflicting emotional valence. These findings provide better understanding of the organization of emotion-associated words, and the role of emotion-associated words in effective and rich emotional communication.

Using Complex Adaptive Systems Theory to Guide a State-Wide Post-secondary System
John Usher and Syed Hammad Ali, University of Lethbridge

Beginning in October, 2013, an Outcomes & Indicators Advisory Group was convened by the Province of Alberta, Canada to 'tame' the operationalization of a Results Based Budgeting (RBB) exercise to be imposed upon Campus Alberta. Campus Alberta is the governmental institution that encompasses and provides oversight of the entire publically-funded post-secondary sector in Alberta (26 institutions) ensuring transferability of programming, collaboration of research and allocation of budgets. The individual colleges, universities and polytechnics of Campus Alberta are grouped into six sectors based largely on research and teaching mandates similar to the more elaborated Carnegie classification system: Comprehensive Academic and Research Institutions (CARI), Baccalaureate and Applied Institutions (BAI), Polytechnical Institutions (PI), Comprehensive Community Institutions (CCI), Independent Academic Institutions (IAI), and Specialized Arts and Culture Institutions (SACI).

Each sector has a mandate that is legislated in the province's Post-Secondary Learning Act. The authors use Burgelman's work (1983) on intra-organizational evolution to model both induced – directed by targeted funding - and emergent – wholly autonomous – collaborative behaviors within the system. Such behaviours are instances of cooperation between and among institutions that may or may not be in the larger system's interest. We seek to identify and incorporate in the larger set of RBB measures the general indicators needed to ensure that the system health of Campus Alberta is sustainable, adaptable, diverse and resilient. By building in these indicators, Campus Alberta will be able to understand the strategic importance of the autonomous strategic behaviours it monitors, and evaluate, then possibly select, those instances of emergent order which are outside the induced strategic loop/process yet show promise for significant adaptive change, not simply superfluous self-organization that drains resources from the system.

By focusing on the six sectors as the central actors in the health of the overall system, we hope to guard the system against actions by individual institutions that would move it beyond R2 (possibly through synchronization of agents) or allow it to slide back into complacency below R1. We employ McKelvey's (2002) thinking about coevolutionary damping mechanisms such as loss of agent diversity, strength of weak ties, network failure at the nodes, and separation from adaptive tension to begin to specify the multi-level forces at play. We admit to significant hand-waving at this stage, but think we have some useful entre into the belly of the beast, policy-wise, and would welcome any help from SCTPLS colleagues in terms of theory and method to put some flesh on these bones.

Chaos and Information Theories Applied to Preschool Years of Growth

Rita Mohr Weinberg, Professor Emeritus National Louis University

This paper deals with theories about growth processes during preschool years, a period of rapid physical and psychological growth. Chaos theory deals with systems and change. Change is general but divided by sudden shifts in equilibrium. Information theory informs us about our DNA, energy and the role of experiences (environment) related to growth and expression of genes. These theories give depth to our understanding of how human growth changes and how systems co-effect one another. Chaos and information theories lead to applications in psychology to facilitate optimal environments and to remediation of abnormal development.

Intrinsic Dynamics of Self-Evaluation: The Role of Self-Concept Clarity

Alexander Wong, Florida Atlantic University

Change in self-esteem is commonly viewed as random variation or a response to external influence. The present research investigated whether changes in self-evaluation are produced instead by the structure of the self-system and thus reflect intrinsic as opposed to extrinsic dynamics. In this view, temporal variability in self-evaluation reflects the landscape of attractors and repellors in a person's self-concept. Using a computer mouse procedure (Vallacher, Van Geert, & Nowak, 2015), we recorded the time series of participants' self-evaluation over a 3-min period, and examined whether the resultant temporal patterns tended to stabilize on particular evaluative states (attractors) or converge on but quickly move away from such states (repellors). We hypothesized and found that participants with high self-concept clarity (signaling a well-integrated system) demonstrated attractor dynamics, whereas those with lower clarity demonstrated weaker attractor tendencies but stronger repellor dynamics. Discussion centers on the implications for stability and change in self-evaluation and the utility of dynamical tools for assessing the structure of self-concept.

Attractor Dynamics during the Menopausal Transition and Early Post-Menopause

Alexander Wong, Florida Atlantic University; Jonathan Butner, University of Utah; Lisa Taylor-Swanson, University of Washington; Mary Koithan, University of Arizona; David Pincus, Chapman University; Lisa Conboy, Harvard University; and Nancy Woods, University of Washington.

The Seattle Midlife Women s Health Study is a naturalistic, prospective, repeated measures longitudinal design (23 years) examining patterns of menopausal biopsychosocial factors. We limited this secondary analysis (n=55) to monthly reports of daily stress, fatigue and relationship interference although initial data included monthly and annual symptom and biopsychosocial measures. Our analytic approach capitalized on a combination of visual tools to observe changes in dynamics across stages (observed vector plots & kernel density plots), exploratory topographic analogs to these visual tools (mixture modeling of discrete change models within menopausal phases), and analyses of topologic equations that parallel the earlier results while allowing for stage differences. This last technique involved a multivariate multilevel model of the discrete changes for stress and fatigue and explored changing attractor and coupling dynamics as a function of menopausal stages. All three analytic approaches consistently showed different

patterns across menopausal stages, suggesting that a second, higher stress and fatigue attractor characterizes early menopause transition stage and a continual weakening of attractor stability and changes in stress-fatigue coupling as menopause continues. Fatigue and interference with relationships exhibited fixed point attractor dynamics throughout the menopausal experience. This study helps inform our understanding of stress and fatigue during the menopausal transition. Furthermore, it provides initial data of how coupling of stress and fatigue is dependent on menopausal transition phase. During late transition and early post-menopause, when symptoms reported across the literature tend to be most severe, we see a breakdown in coupling. This destabilization of the system merits further study.

Above: Shark Exhibit at the Florida Museum of Natural History. Photo by Stanislaw Raczynski. Below: Woolly mammoth serves dessert at the SCTPLS banquet. Photo by Mike O'Hearn.