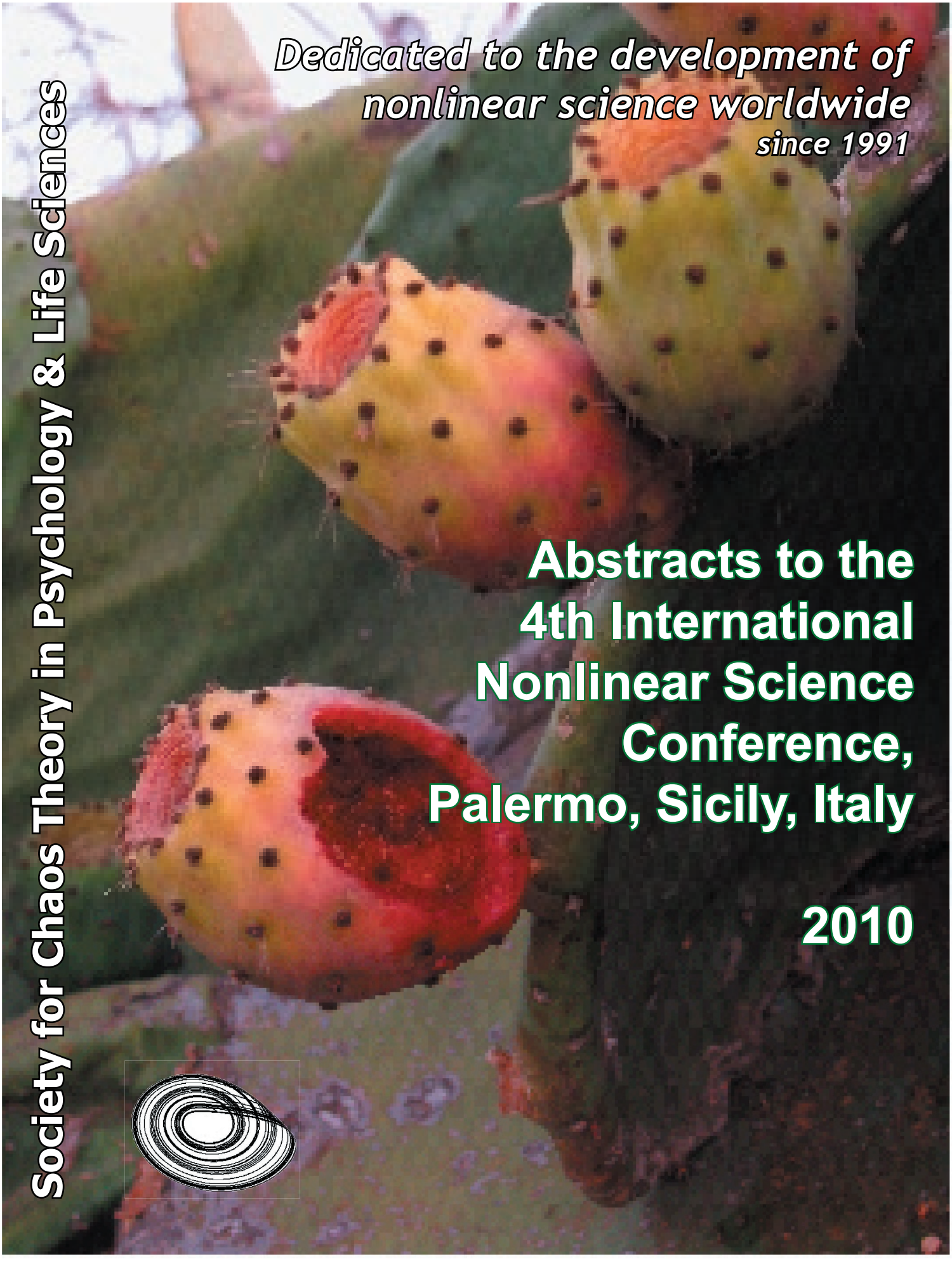

Society for Chaos Theory in Psychology & Life Sciences

Dedicated to the development of nonlinear science worldwide since 1991

Abstracts to the 4th International Nonlinear Science Conference, Palermo, Sicily, Italy

2010

*4th*INTERNATIONAL NONLINEAR SCIENCE CONFERENCE

March 15-17, 2010, Palermo, Sicily, Italy
Research & Applications in Behavioral, Social & Life Sciences
Conference Abstracts[1]

Welcome and Acknowledgment

On behalf of the 4th International Nonlinear Science Conference's scientific and conference committees, I would like to welcome you to the University of Palermo, a place that I hope will offer each one of you the same opportunity to share experiences and intellectual achievements in a synergic environment as in the other International Conferences. This year presentations have been selected in a broad range, from social and occupational Psychology to Economics and Econophysics. Nonlinear sciences paradigms are once more at the basis of all models and applications presented, which helps promoting scholarly exchanges in a true multidisciplinary environment. Incidentally, Sicily is, herself, a place where many diverse cultures merged peacefully in a unique blend of arts and sciences. A good match for the 4th INSC.

I am deeply indebted to the persons of the local committee who generously assisted me in organizing this Conference. They answered to my call with the same spirit as in James Hogg words: "Show what ought to be done, and here is the heart to dare, and the hand to execute." These persons are: *Marjorie Aiello, Paola Valenza, Francesco Piran*: Registration desk: *Marcello Mirabello, Michele Quartararo* – Technical assistance and security. Their help made it possible to aim at quality, efficiency, and comfort, which are goals of paramout importance for a Chairman. Had we succeded in that, most of the credit dutifully goes to them.

Gaetano L. Aiello, Ph.D. 4th INSC Chairman

Conference Committee:
Henry Dick Thompson, Ph.D., SCTPLS President, USA
Stephen J. Guastello, **Ph.D**., Marquette University, USA
Dimitrios Stamovlasis, **Ph.D**., Aristotle University, Greece

From the SCTPLS President

Welcome to the ***4th International Nonlinear Science Conference***. This conference has been organized by the Society for Chaos Theory in Psychology and Life in conjunction with University of Palermo. The event reflects a commitment on the part of our organizations to facilitate international collaboration and to encourage the cultivation of scientific partnerships across the globe. We are able to offer you a rich and varied program or presentations, covering a wide range of scholarly disciplines and including theoretical as well as applied approaches. It attests to the international character our scholarly community that we have presenters from many countries to share their work in nonlinear dynamics, including scholars from the U.S., Eastern and Western Europe as well as Asia. We hope that this conference will become part of a long-standing tradition of international scholarly exchange, which surely will strengthen our nonlinear dynamical systems community, and the impact of our work, in the long run.

Henry Dick Thompson, Ph.D., President,
The Society for Chaos Theory in Psychology & Life Sciences

 SCTPLS gratefully acknowledges the sponsorship of the University of Palermo, the DIFTA program, and Assemble Regionale Siciliana for their contributions to our collective efforts.

Featured Keynote Speakers:

Fortunato Tito Arecchi

"*Dynamics of consciousness: complexity and creativity*"

The cognitive problem is how a given sensorial input elicits a decision. Since neurons undergo deterministic chaos, information is lost in course of time. Control of chaos reduces such a loss rate by adding extra degrees of freedom. This addition is a *change of code;* such a re-encoding occurs on two time scales, namely, *A)* the *cognitive* one (lasting up to 3 sec), within which the brain reaches a collective state associated with a perception, and *B)*, the *linguistic* one (beyond 3 sec), whereby memory retrieves different *A)* units and compares them. In *A)* the neurons are mutually coupled in large networks; collective synchronization of neuron arrays elicit decisions. In *B)*, different *A)* slots are compared after retrieval from memory. This requires a subject conscious of him/herself as well as of the pieces of the stream to be correlated. While in *A)* the neuron synchronization is described in dynamical terms, in *B)* the slot comparison is formalized by an inverse Bayes rule. Distinction of *A)*, that we have in common with animals, from *B)* where we formulate attributions of truth, recovers the fundamental philosophical difference between *apprehension* and *judgment.*

Dr. **Fortunato Tito Arecchi** is a Professor emeritus of Physics, University of Firenze.

Paul van Geert

"*The human life span as a complex dynamic system*"

Human development across the life span is a prime example of a complex dynamic system. Development and aging are processes of change involving the intertwining of a myriad of components, involving the person and its properties and the social and cultural environment in which the person lives. Dynamics range from the short-term processes of human action and interaction to the long-term processes of life-span development and the macro-processes of intergenerational cultural change and biological evolution. These time scales interact in various ways. Part of the difficulty of understanding the life span as a complex dynamic system lies in the paradoxical combination of immediacy (one is the direct witness of one's own life) and the difficulty of scientific accessibility (the scientific study of the human life span is greatly hampered by the difficulty of collecting valid and reliable time-serial data). In this lecture I will present examples of theory building, empirical research and applied aspects of a complex dynamic systems view on human development.

Paul van Geert (1950) holds a doctoral degree from the University of Ghent (Belgium) and is a professor of developmental psychology at the University of Groningen in the Netherlands since 1985. He has had a pioneering role in the application of dynamic systems theory to a broad range of developmental areas, including early language development and second language acquisition; cognitive development in the context of learning-teaching processes; and social development including social interaction and identity. His main aim is to better understand the general nature of developmental dynamics, i.e. nature of the mechanism(s) that drive and shape a developmental process in an individual, as the individual, given his or her biological properties and potentialities interacts with his or her actively explored environment.

As an artist, Paul van Geert has had a life-long interest in the representation of people and close personal relationships. His current work consists of life-size representations of people, in the form of free-standing and moveable constructions.

René Lefever

"*Deeply gapped vegetation patterns and desertification: A topical Ostwald ripening process*"

Natural vegetation covers exhibiting landscape-scale regular spatial patterns have been reported for arid and semi-arid areas world-wide. Recent observations and theories show that such patterns are bound to low-productivity environments can arise in the absence of environmental anisotropy and can originate by self-organization processes strictly intrinsic to the vegetation dynamics. The conditions of deeply gapped pattern formation and the conditions under which desertification takes place will be investigated more specifically. It will be shown that desertification may occur either as a local desertification process that does not affect pattern morphology in the course of its unfolding or as a gaps coarsening process after the emergence of a transitory, deeply gapped pattern regime. Ecological implications will be discussed. The results amend the commonly held interpretation associating vegetation patterns with a Turing reaction-diffusion type of instability. They provide a more unified understanding of vegetation self-organization within the broad context of matter order-disorder transitions.

Prof. Lefever is member of the Department of Chemical Physics and Theoretical Biology, Faculty of Sciences, Universitéibre de Bruxelles.

Rosario Nunzio Mantegna

"*Empirical investigations of economic and social complex systems*"

Rosario Nunzio Mantegna is Applied Physics Professor and Head of the Observatory of Complex Systems at the University of Palermo, Italy. Mantegna is one of the founders of Econophysics, the application of Statistical Physics to the study of Economics. He is the author (together with Gene Stanley) of Introduction to Econophysics: Correlations and Complexity in Finance.

According to their book, statistical physics concepts such as stochastic dynamics, short- and long-range correlations, self- similarity and scaling, correlation-based networks can be used to model the global behavior of economic systems. Mantegna's current research is focused on the analysis and modeling of financial markets; econophysics, social systems, biomedical and biological complex systems.

He is one of the initiators of the Jerusalem Declaration on Data Access, Use and Dissemination for Scientific Research, launched at the 5th European Conference on Complex Systems held in September 2008 in Jerusalem, Israel.

Rolf Pfeifer

"Self-organization, embodiment, and biologically inspired robotics"

Robotics researchers increasingly agree that ideas from biology and self-organization can strongly benefit the design of autonomous robots. Biological organisms have evolved to perform and survive in a world characterized by rapid changes, high uncertainty, indefinite richness, and limited availability of information. Industrial robots, in contrast, operate in highly controlled environments with no or very little uncertainty. Although many challenges remain, concepts from biologically inspired (bio-inspired) robotics will eventually enable researchers to engineer machines for the real world that possess at least some of the desirable properties of biological organisms, such as adaptivity, robustness, versatility, and agility.

In this talk, I will introduce the concept of embodiment and follow up on its far-reaching implications, in particular how the physical dynamics of an agent's interaction with its environment is coupled with the information processing of the brain (or the brain dynamics). It is also argued that this coupling is fundamental for learning and for the development of cognition in general. All points will be illustrated with many examples from robotics, biology, and psychology.

Prof. Pfeifer is the director of the Artificial Intelligence Laboratory, Department of Informatics, University of Zurich. His recent book Josh Bongard, is entitled, how the body shapes the way we think.

Attractors for Communication?

Marie Moström Åberg, *School of technology and business studies, Work Sciences, University of Dalarna;* **Mattias Ateg**, *School of technology and business studies, Work Sciences University of Dalarna*; **Tomas Backström**, *School of Innovation, Design and Engineering Mälardalen University.*

From a complexity perspective, interaction in workgroups is interesting because people create relations when interacting, and these relations create social systems, which are emergent, complex and sensitive to initial conditions. This paper focuses communication in workgroups and the application of a previously developed model for observing and analysing the performance of business teams made by Losada & Heaphy (2004). The aim with this paper is to bring further understanding of how and if this model can be used to understand verbal communication in teams. The model (ibid) stresses that three bipolar dimensions, advocacy /inquiry, self /other, and most important, positive /negative statements in communication, can be seen as attractors for communication, showing effectiveness in teams. Communication in 28 workgroup meetings in 13 different organisations have been filmed, observed and analysed. The method and analysis was inspired by the model (ibid). The results show that there were small differences between the teams regarding the dimensions of advocacy /inquiry and self /other, but larger differences concerning positive /negative statements. The results raise some problems and questions. The characterisation of statements is problematic using the definitions given (ibid). The kind of meeting observed and the behaviour of the leader seem to affect the results. The predicted proportion between the different dimensions in the model (ibid), isn't reflected in the results. How could these results be understood? Are the identified attractors really the ones predicting effectiveness? Is communication perhaps more complex than predicted by the model?

Shared Vision as an Order Parameter

Tomas Backström, **Anette Strömberg**, **Carina Sjödin**, *School of Innovation, Design and Engineering, Mälardalen University, Sweden.*

The interactions between members of a group working with a problem have to be complex, otherwise the group will not be able to scout the phase space for new solutions. Permanent work teams may have problem with too much order. Temporary groups, on the other hand, may need an order parameter to avoid chaos. An understanding of the future increases the chance of success for an innovation process. Humans are holders of individual images of the future. Methods to make them shared are sometimes used early in an innovation project. One method uses pictures and a story-line, like in a movie. Changing description language from words to pictures makes it easier for people to improvise and think new, which is needed, otherwise people will hinder each other in the process. In this method the shared vision of future is allowed to emerge in interactions between group members. It may control the interaction of the group in a not too rigid manner for the creativity of the group. This could be a type of order parameter temporary groups need for creative tasks. A shared vision of future as an order parameter will be tested in the creativity lab of Mälardalen University. In the lab the group interaction may be captured in a detailed manner in order to analyze if and when it is in a complex phase. This may hypothetically be determined by analyzing different frequency distributions of the interaction to see if they follow the power law.

Free Will is the Illusionary By-product of Self-perception

Enrico Bignetti, University of Parma

Unconscious neural events appear to anticipate voluntary actions by hundreds of msecs (Libet, 1999, 2004; Soon *et al*., 2008). The impact of such timing on Self-perception and Free Will (FW) is discussed. Libet's model accounts for a delayed conscious action in order to allow a possible voluntary veto. Although, no one veto was recorded, the role of FW still stands unchallenged in Libet's perspective. Up to us, the paradox is that even the veto should account for a neural event! Our feeling is that, in the West, the idea that FW was donated by God as a tool of self-control is a paradox. If we go East, with few exceptions, we can experience an opposite perspective. By meditating, our holy essence is realized as well as our FW illusion is disclosed. In Samkhya metaphor, all is moved by Prakriti (unconscious nature), however, Purusha (conscious mind) steals the role of and pretends to decide instead of Prakriti. According to this perspective, Bignetti's model (Bignetti 2001, 2003, 2004) is proposing that our unconscious mind first reacts against a stimulus by choosing some chaotic ideas within the memory store. Then, the events in their due course, draw the attention of our conscious mind, thus causing the arousal of Self-perception. Since we become aware of what's happening only when Self-perception is lightened, we miss the unconscious events occurred few msecs before. That's why we always deceive ourselves about FW existence. Consciousness can learn from the outcome of an action but cannot decide it.

Asset Pricing Model with Heterogeneous Agents: Wealth Dynamics

Serena Brianzoni, **Cristiana Mammana**, & **Elisabetta Michetti**, University of Macerata

We consider an asset pricing model with wealth dynamics in a market populated by heterogeneous agents. Differently from previous works, we assume that all agents belonging to the same group agree to share their wealth whenever an agent gets in the group (or leaves it), hence we develop an adaptive model which characterizes the evolution of the distribution of wealth when agents switch between different trading strategies. As a consequence, the average wealth of agents belonging to each group has to be updated at any time. The most important fact is that the wealth of the new group takes into account the wealth realized in the group of origin, whenever agents switch between different trading strategies. Two groups with heterogeneous beliefs are considered: rational agents and chartists. Another novel ingredient is given by the fact that the model is developed in a Walrasian scenario and a growing dividend process is introduced. The final nonlinear three-dimensional dynamical system is piecewise and it is studied in order to investigate complicated dynamics and to explain the wealth distribution among agents in the long run. Analytical and numerical results show coexistence of attractors, sensitive dependence on initial conditions and complicated dynamics. Complexity is mainly due to border collision bifurcations which are involved by the wealth dynamics.

A Nonlinear System Model of Retirement Behaviour in Italy

Francesco Ceresia, *University of Palermo.*

Studies of retirement behaviour have mainly followed two substantially different approaches: a) identity-based theories, emphasize on the individual's coping and adjusting behaviour; b) multidimensional theories, consider systemically the social, organizational and political factors as well as individual factor. Systemic theories have developed numerous models, yet the limits reported are such that only parts of the models are applied in the study of retirement. This paper tries to underline that a specific methodology called System Dynamics allows the building of a nonlinear system dynamics model in which psychological, economic, social, legal and organizational variables converge to describe the retirement behaviour and its main unintended consequences on retirees' quality of life. A total of 916 retired individuals (men = 62%; women = 38%) living in Italy participated in this study. The participants worked and lived in the North (n = 398), Centre (n = 264) and South (n = 254) part of Italy, and they were fully retired and receiving a retirement pension. The data collection procedure has been supported by a Retirees Association of a Labour Union (FNP-CISL). To develop the System Dynamic Model, a causal loop diagram has been provided to show the nonlinear causal relationship between the main variables of the considered system. Then a stock and flow structure was built to explore the behaviour of the system dynamics model. Finally, alternative scenarios and results from simulation runs have been provided.

Homo Psychologicus: Modeling Behavioral Aspects of Rational Epidemics

Alhaji Cherif, *School of Human Evolution and Social Change, Arizona State University*

In recent decades, interdisciplinary scholars and public health officials have turned to epidemic modeling as a tool in dealing with epidemiological events ranging from Malaria, SARS, HIV/AIDS, H1N1 Swine and H5N1 Avian Influenza. As a result, we have seen an increase in the use of theoretical models to reveal the subtleties of contact processes (e.g., meta-population, assortive mixing, networks, spatial and individual-based models) underlying the transmission mechanisms and the biological constraints of host-pathogen interactions. However, individual objective and subjective vulnerabilities to disease and their behavioral outcomes have been ignored. In this talk, we formulate a model of pathogen-avoidance mechanism and its interaction with the spread of disease, and investigate its impact on behavioral defense (e.g., risk aversion measures, social distancing or exclusion) and epidemic outcomes. We propose a new formalism of hybrid cryptodeterministic differential equations, where we investigate aversive behavioral response to epidemiological events, and develop concepts of behavioral cue enhancement factor and differential behavioral responsive barriers to model individual responses.

The Birth of Global E-Citizenship: Does the Flapping of a Butterfly' s Wing in Tehran Set off a Tornado in Washington, D.C.?

Alexander Dawoody, Marywood University, USA

In , Edward Lorenz suggested that small variations of the initial condition of a dynamic system can produce large variations in the long term behavior of the system. This became known as the ' Butterfly Effect.' Globalization and the electronic information networks, such as the World Wide Web, Facebook, Twitter, YouTube, blogs, electronic journals and newspapers, cable, satellite networking and cell phone text-messaging and video recording are fusing through economic, social and political barriers. This dynamic is forcing the emergence of a new, vibrant, active, and

interconnected e-citizenship. We witnessed the emergence of such e-citizen after the June, Iranian presidential elections, bridging it with the world through an interconnected network that is forcing an illustration of universal consciousness and the mantra of the oneness of humanity. Can the e-citizen force the collapse of outdated structures and utilize the butterfly effect in causing small variations that will produce larger variations in the longer trajectory? To build on Philip Merilees' question does the flap of a butterfly' s wings in Brazil set off a tornado in Texas,' does the twittering of a cell phone in Tehran sets off a political change in Washington, D.C. or elsewhere around the world? This paper will examine the morphing of e-citizenship in Iran and the changes of the initial conditions that is leading toward a new dynamic. This dynamic may transcend outdated structures and bring forth through random and unpredictable, yet deterministic chaotic restructuring the emergence of new political dynamic that is better capable in dealing with changes in today's interconnected global environment.

Stability and Bifurcation Analysis of an SIS Epidemic Model with Treatment Presented by Fractional Derivative.

G. Hossian Erjaei, & **Modi Alnasr**, *University of Qatar, Doha, Qatar.*

We consider an SIS epidemic model with a limited resource for treatment in the form of fractional differential equations. The non-local property of SIS epidemic model presented by fractional order differential equation makes the model to be more realistic compare to the analogues integer order, which lacks this property. We discuss the stability and bifurcation analysis of this model regarding the different equilibrium points which is produced by changes of the parameters within the model.

Towards a Functional Understanding of Consciousness: Dynamical Interplay of Engagement Involving and not Involving Conscious Awareness

Martin Gardiner, *Center for the Study of Human Development, Brown University, U.S.A*

Though its functional role in human behavior was widely ignored during much of the 20th century, conscious awareness is central to human experience. Even today, Le Doux and many other scientists assert that processes that shape human behavior operate largely outside of conscious awareness. To the contrary, building on our own and other evidence, this paper argues that what we experience as conscious awareness has a critical and specific role in the creation of most of our behavioral trajectories. I propose that the brain uses two interacting types of engagement in developing behavioral trajectories dynamically. One type of dynamical engagement involves conscious awareness, the other does not. Engagement not involving conscious awareness is employed for situations fully anticipated or which are sufficiently similar to ones already experienced that engagement procedures prepared previously can be used. Engagement involving conscious awareness is reserved for situations presenting aspects that are new and to which behavior must be developed creatively. Whereas engagement not involving conscious awareness proceeds smoothly, engagement involving conscious awareness proceeds iteratively, with reference and adjustment to feedback from representation we experience as conscious awareness. The distinction between these forms of engagement will be clarified by comparing approaches to solving differential equations when solutions are known or must instead be approximated iteratively, as in Euler's method. Typically both forms of engagement creating behavioral trajectories work together, as most situations are neither entirely familiar nor entirely novel. Learning is intimately involved in longer-term development and integration of both types of engagement.

Psychological Well-Being in Adolescence: An Approach from Fuzzy Sets Theory

Monica Gonzalez, *University of Girona, Spain*
Ferran Casas, *University of Girona, Spain*

Psychological well-being, as a component of quality of life, has been a field of important developments lately. However, there are limitations which impede better understanding of both the construct and its structure. The consensus around a definition of psychological well-being and of its related components is not high, and the majority of results obtained up to now explain with difficulties the relationships among different related variables. In our opinion, both limitations have to do to with the fact that, historically, researchers have approached psychological well-being as it were not a complex construct, the way complexity theories understand it. Our position states that psychological well-being is far from being a simple construct as it reflects a complex phenomenon with, therefore, fuzzy, nonlinear and chaotic aspects (Allegrini *et al.*, 2004). The objective of this communication is to explore the opinions and evaluations of adolescents (12 to 16) on their psychological well-being (definitions and related variables), from a qualitative approach, which departs from the information obtained through semi-structured group interviews. In contrast to the common procedure of content analysis based on dichotomous belonging to a particular category, categories are here, and according to fuzzy theory, constructed so to allow belonging to multiple categories

simultaneously. Results show that there is some agreement on the core elements conforming psychological well-being and more disagreements for the more peripheral aspects. The fact of considering the degree of belonging to different categories allows a deeper understanding of this phenomenon from the point of view of adolescents themselves.

Clubs, TI-GERS, & Nonlinear Social Dynamics - Oh My!

Robert Gratz, *Superintendent of Schools*,
Bruce Smith, *President, Board of Education*
Diane Pittenger, *Assistant Superintendent for C & I*

Context: Intervention - TI-GERS Talent Identification Growth & Enrichment through Resource Sharing, a complex, adaptive, social networking approach to student educational improvement. The TI-GERS initiative is based upon the complexity theory model of asset identification. TI-GERS seeks to identify and develop the talent that exists in each of our schools and community by creating and maintaining social networking. Through engaging our population in after school activities and extending our school day, we enrich our school environment by creating nonlinear group dynamics and evolving new opportunities. This theory was initially put into practice during the - school year. Including our at-risk students, the targeted population, over students are involved in a variety of clubs and activities in our elementary and middle schools. The poster title is a turn of the phrase from the movie classic The Wizard of Oz. Our students, analogous to the movie characters traveling to see the wizard, possess talents which are untapped and undeveloped (mind, heart, and courage). The movie characters' journey to the wizard and battle with the wicked witch helped them realize the assets they were seeking were already hidden within. The goal of our TI-GERS initiative is the same. By identifying and nurturing 'hidden' assets, students become more confident, capable learners. Additionally, our school becomes a richer, more engaging place for students to learn.

A cybernetic analysis of obesity in an island population.

Graeme Martin, *University of Birmingham.*

Over a fifty-year period the rate of obesity on the Micronesian island of Kosrae has increased from a negligible level to a high of nearly 60% of the adult population. The history of the island since colonial occupation is well documented, good data on economic, social and political change exists and importantly epidemiological data of the whole adult population was obtained through a clinical evaluation in 2000, including BMI, which allows for cybernetic modeling of this dynamic condition. Using Kaufman's second order definition of cybernetics an analysis is given to show the influences that have led to this increase in obesity and additionally then, the model extends into psychological and physiological levels, showing pernicious upward and downward loops. The population of Kosrae is young and while ongoing medical research is looking for potential interventions, it may be helpful to identify in this complex model some of the wider social parameters open to change.

Algorithmic Complexity of Electronic Negotiations: A Comparison of Different Communication Modes

Michele Griessmair, *Vienna University;*
Guido Strunk, *Vienna University of Economics and Business*; **Patrick Hippmann**, Vienna University

It is generally acknowledged that the medium influences the way we communicate (Daft & Lengel, 1986; 1988) and negotiation research directs considerable attention to the impact of different electronic communication modes on the negotiation process and outcomes (e.g. Sheffield, 1995; Rockmann & Northcraft, 2008). In the present work we compare the complexity of the negotiation communication process among synchronous and asynchronous electronic negotiations as well as an electronic negotiation support system including a decision support system (DSS). For this purpose, 145 negotiation transcripts have been subdivided into sense units and coded according to the "Bargaining Process Analysis II"-category scheme (Walcott et al. 1978). The so generated timelines were analyzed employing the Shannon Entropy H (Shannon 1948) and the Grammar Complexity C_G (Jiménez-Montaño, 1984). H is a measure "of information, choice and uncertainty" (Shannon 1948, p.19), depending on the taken perspective (Brissaud, 2005). In the present context H would be at maximum when all negotiation utterances (e.g., accommodate/agree, tactical behavior) are used equally distributed and would decrease accordingly if the negotiators focus on specific negotiation communication. However, H does not consider the temporal sequence. On the contrary, measures of algorithmic complexity (Kolmogorov 1965; Chaitin, 1974) such as C_G "complement an examination of the symbol distribution by identifying sequence-sensitive patterns" (Rapp et al., 2001). Our results show that negotiating asynchronically as well as including a DSS significantly reduces the entropy and complexity of the communication process. Furthermore, a reduction of complexity increases the probability of reaching an agreement.

Catastrophe Model of the Accident Process, Safety Climate, and Anxiety

Stephen J. Guastello, *Marquette University*
Mark Lynn, *Marquette University*

In spite of its intuitive appeal, the safety climate construct has an inconsistent relationship to occupational accidents. The present study addresses the problem by expanding the range of constructs that contribute to safety climate and incorporating a cusp catastrophe model to explain dynamics of the accident process. Participants were 1262 production employees of two steel manufacturing facilities who completed the Occupational Hazards Survey, which measured safety management, anxiety, subjective danger, dysregulation, physical stressors and hazards. Nonlinear regression analyses showed, for this industry, that the accident process could be explained by four variables within the cusp structure (R2 = .72): safety climate, anxiety, environmental hazards, and age and experience.

Combining Constructive and Realistic Simulations: Development of "SIGVerse" as an Integrative Simulator for Sociointelligenesis

Takashi Hashimoto, *Japan Advanced Institute of Science and Technology;* **Tetsunari Inamura**, *National Institute of Informatics/The Graduate University for Advanced Studies*; **Tomohiro Shibata,** *Nara Advanced Institute of Science and Technology*; **Hideaki Sena**, *Writer.*

Sociointelligenesis is a new challenge of nonlinear science to study the origin, evolution, and development of social intelligence. This paper discusses the roles of two types of simulations, constructive and realistic, and their integration in sociointelligenesis. The purpose of sociointelligenesis is to understand social intelligence of humans from the viewpoint of its genesis. For this purpose, constructive study, in which objective systems are investigated by constructing and operating abstracted systems using robots and computer simulations, is an important approach. The development of computing technologies enables us to realistically simulate various physical and biological objects. These two are different types of simulations, constructive and realistic. Representative examples are a simulation by Lorenz in finding chaos and the earth simulator, respectively. While these two share the same starting point, the Navier-Stokes equation, the approaches and the achieved successes are different. Nevertheless, combining knowledge from both types advances our understanding of the dynamics of meteorological phenomena. In order to further sociointelligenesis, where modeling and simulation of cognition and interactions of more than one human are critical, it must be effective to integrate these two types of simulations. For performing such integrated simulations, we have been developing a simulator environment for sociointelligenesis, called "SIGVerse". In SIGVerse, such different levels as bodily and environmental dynamics, perceptions, and communications are modeled and simulated in an integrative manner. Since the dynamics, perception, and communication are nonlinear dynamic phenomena, understanding of dynamical systems and multi-agent systems are not only applied, but also must be progressed through the integration.

Diffusion Models for Innovation

Joseph Jacobsen, *Milwaukee Area Technical College*
Stephen Guastello, *Marquette University*

This presentation is an overview of diffusion. It begins with an S-curve for innovation diffusion and gradually progresses to models of propagation, differential proposals and multivariate nonlinear models of diffusion. The presentation is designed for individuals who are interested in modeling the diffusion phenomena within the context of business and social networks. It will also be useful to researchers in other areas of science who are interested in the spread of various phenomena. The presentation will close with the diffusion of sustainable innovations.

Synergy and Synergetics in the Context of Emergence and Complexity

Klaus Jaffe, *Universidad Simon Bolívar*

Synergetics refers to synergy, which relates to the concept of the output of a system not foreseen by the simple sum of the output of each system's part. Synergy is also used as a reference to negative entropy. In the world of many components or constituent parts, complex interactions are not always arithmetically conserved. That is, two forces my add up to less that what the sum of each one would yield when measured separately, because they dissipate energy when joined; they might conserve their energy perfectly and sum up arithmetically their energies; or they might interact synergistically releasing more energy that what they both represent when measured separately. These different ways of interactions we might call the synergy constant of interactions or Φ. Thus defined interactions where Φ > are synergistic. Systematic studies of synergetics have bee undertaken in geometry and architecture (Richard Buckminster Fuller) and in far from equilibrium thermodynamics (Hermann Haken), but a comprehensive and general understanding of synergy is still not available. Synergistic interactions are not easy to quantify. Here I present cases taken from ant, termite and human societies where Φ might be quantified and show results of computer simulations which show the importance of Φ in

stabilizing social cooperation. The final aim of this exercise is to arrive at a fundamental quantitative definition of Φ.

Logistic Map in Economics

Aleksander Jakimowicz, *Economics, Warmian-Masurian, University of Olsztyn, Poland*

The logistic map constitutes one of the most well-known maps in science. It has peculiar characteristics, it is able to generate topological chaos and ergodic chaos, and it reveals various routes to chaos. The transition to chaos is made by way of the period-doubling bifurcations, the type-I intermittency appears, too. The logistic map is a perfect generalization of numerous classical economic models covering economic growth, monopoly rule, inflation, or the theory of consumer choice. Consequently, it can be regarded as a kind of a portal which the chaos and complexity theories have been introduced to economics. This eventually leads to the creation of a new trend - the complexity economics which has been successfully competing with the mainstream economics.

Market Institution as a Place of Knowledge Processing through Interaction

Shigeto Kobayashi & **Takashi Hashimoto**, *Japana Advanced Institute of Science and Technology, Japan.*

Market institutions can be thought of as a place where new knowledge for market participants is created through interactions between the institutions and the participants, while they are usually understood as to maintain a market system by restricting behavior of market participants. In this study, we try to illustrate what kind of knowledge processing mechanism produces new knowledge for each individual, organization and society from market institution, and how the market system is build based on the newly created knowledge. In order to see the change of market institutions, we have to consider not only physical reality but social reality which people are continuously creating. Social reality is different in each society. Social institution is a certain belief which is shared and justified by most people in a society. After the financial crisis in 2008, however, a gap between people's belief and social reality has caused a significant change in market institutions. Although many institutions maintain effectiveness by ensuring certain consistency between social reality and physical reality, market institutions often lost the consistency. We show, through an analysis of the transition of trading halt system in stock markets, that path dependency and people's consciousness on value contribute to the formation of market institution and thus these factors are significant for institutional design in market. We also claim that institutions should be understood as existing in between micro and macro levels, therefore we call the level of institutions as meso level, and that the micro-meso-macro interactions change market structure continuously.

Compatibility of Language Changes and Sharing Vocabulary: The role of Priority of Generalization and Preventing Production of Homonyms

Takeshi Konno & **Takashi Hashimoto**, *Complex System Analysis, School of Knowledge Science, Japan Advanced Institute of Science and Technology.*

Humans communicate with others using common vocabularies. And the human language has an important property of compositionality whereby an expression's meaning is a function of the meanings of parts of that expression and the way they are put together. But in the evolutionary process of the compositional language, expressions of the vocabularies should change dynamically. If the language evolved in response to the need to communicate using the common vocabularies, the acquisition of the different expressions impedes advantages of the communication. How the language changes and the common vocabularies can be compatible? We study the mechanisms of compatibility using a computational model for the evolution of compositionality by Kirby (2002) with slight extension. The model is capable of generating the compositional language through linguistic transmission from one generation (parent) to the next (child). We tested two mechanisms: to persist parent's expression rather than to generalize, and to prevent the production of homonyms. By introducing these two mechanisms, we counted the average ratio of common vocabulary to successive two generations. We found that the former mechanism decreased the ratio and that the latter promoted the ratio dramatically. These results suggest that at least two abilities have an important role for sharing vocabulary in learning compositional language. One is to give priority to generalization over the persistence of parent's expressions, and the other is to prevent the production of homonyms.

Linguistics and Chaos Theory: An Overview

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As Ferdinand de Saussure said, the language is a system où tous se tiens. All the schools of the twentieth-century linguistics agree to this axiom. Structuralism and generativism consider the languages as closed systems. The different forms of functionalist linguistics consider the context of production and the languages as complex systems. The chaos theory and the complexity theory describe the features of dynamic and

complex systems. There is no doubt that the language is one of the more complex systems. Do linguists use the chaos theory for their analysis of languages? Aim of this paper is to inspect the linguistic literature of the last thirty years in order to value the penetration of the chaos theory in linguistics.

Towards a Functional Understanding of Consciousness: Dynamical Interplay of Engagement Involving and not Involving Conscious Awareness

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Though its functional role in human behavior was widely ignored during much of the 20th century, conscious awareness is central to human experience. Even today, Le Doux and many other scientists assert that processes that shape human behavior operate largely outside of conscious awareness. To the contrary, building on our own and other evidence, this paper argues that what we experience as conscious awareness has a critical and specific role in the creation of most of our behavioral trajectories. I propose that the brain uses two interacting types of engagement in developing behavioral trajectories dynamically. One type of dynamical engagement involves conscious awareness, the other does not. Engagement not involving conscious awareness is employed for situations fully anticipated or which are sufficiently similar to ones already experienced that engagement procedures prepared previously can be used. Engagement involving conscious awareness is reserved for situations presenting aspects that are new and to which behavior must be developed creatively. Whereas engagement not involving conscious awareness proceeds smoothly, engagement involving conscious awareness proceeds iteratively, with reference and adjustment to feedback from representation we experience as conscious awareness. The distinction between these forms of engagement will be clarified by comparing approaches to solving differential equations when solutions are known or must instead be approximated iteratively, as in Euler's method. Typically both forms of engagement creating behavioral trajectories work together, as most situations are neither entirely familiar nor entirely novel. Learning is intimately involved in longer term development and integration of both types of engagement.

States of Consciousness and Languages as Group Functions of a Multi-layer Psychic Reality

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The group psychic reality shows itself as a *Complex Multi-layer*, that is a global configuration similar to a space-time portion in which we can single out beings, forces, relationships, multisensory points of view, and where physical, biological and psychological phenomena take place. It is not external, but internal to the mental space of the human beings. A group, collocated within it, expresses itself using, as functions, different states of consciousness and languages; they belong to the individualities that form the group and are related to the specific, topological and dynamic, collocation of the formers within the multi-layer psychic space-time. At this level, the language is primarily an individualizing, asymmetric, conscious, cognitive tool of relation, and helps to build a kind of group called from Bion work group. This network of relations sets up another group level singling out a sovra-systemic entity. Within this entity states of consciousness and languages, proper of the single components, flow together in a new plural state of consciousness (Nos, opposite to Ego), and in a new language belonging to the contest (atmosphere) that is continuous, symmetric, unconscious, emotional. Both help to generate, as an emerging function, a kind of group called from Bion group in basic assumption. In this research we try to describe these events in metaphoric terms: also internal psychic reality seems so to be ruled topologically by a fractal configuration and dynamically by strange attractors.

Group and institutional setting: basin of attraction, topology

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The psychoanalytical setting is a recursive space-time organization used to give sense to the emotional flow between patient and analyst. The increasing of point of views, in the group and/or institutional situations, makes it more complex modifying its topology. That because: 1) number of participants; 2) simultaneous involvement of multi-level entities (groups, institutions); 3) high variety of many

concentric multilevel fields analyzed at the same time; 4) confusion of roles: observing subject, observed object and investigation tool are the same complex object in the multi-layer setting; and especially the one that gives sense to the emotional flow between the group, its participants and itself as a whole. Either the topology of the concentric fields and the multilevel entities or their complex interlacements will be described. A new trans-personal object will emerge from a catastrophic change when the dual analytical entity makes itself plural involving the context. In the multi-layer setting the emotional movements of contextual entities can be observed as a continuity (for example Bion basic assumption); they express themselves in a symmetrical, oneiric dimension typical of unconscious language, permeating all the levels. On the contrary the individual entities establish discontinous, asymmetric relationships typical of the conscious language. The group atmosphere contains, in scale symmetry within the setting, many different emotional fields ranging from the social to the individual ones. The emotional flows, crossing the basins of attraction and putting in phase each possible entity and relation of the setting, take a complex form similar to a strange attractor .

Price and Quantity Competition in Dynamic Differentiated Oligopoly Games

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This study reconsiders the nature of competition in Bertrand and Cournot markets. It has been questioned which competition is more profitable. Using the duopoly framework, Singh and Vivies (1984) show, among others, that Cournot competition always yields higher price compared to Bertrand competition whereas Cournot competition is more profitable if the goods are substitutes and so is Bertrand competition if the goods are complements. Using a n-firm oligopoly model, Häckner (2000) finds that these clear-cut results are sensitive to the duopoly assumptions. On the other hand, it has been known that a Cournot equilibrium becomes unstable if the number of firms is more than three. However, stability is not considered for Häckner's model. This study complements Häckner's results by examining the stability/instability conditions of the Bertrand and Cournot equilibria in the n-firm model and demonstrate the following results: (1) it determines the parametric configurations under which the results developed by Häckner are preserved; (2) in the case of local instability, discrete dynamic evolution can exhibit chaotic oscillations if the firms behave cautiously regardless of which competition is assumed; (3) the long-run average profit taken along chaotic trajectories can be larger than a stationary Cournot profit obtained at a Cournot equilibrium when the goods are substitutes and the Cournot equilibrium is unstable; (4) the long-run average profit taken along chaotic trajectories can be larger than a stationary Bertrand profit obtained at a Bertrand equilibrium when the goods are complements and the Bertrand equilibrium is unstable. The last two results imply that the unstable cases are very important from economic point of view. [Singh, N. and X. Vivies, Price and quantity competition in a differentiated duopoly, *Rand Journal of Economics*, 15 (1984), 546-554. Hackner, J. A., A note on price and quantity competition in differentiated oligopolies, *Journal of Economic Theory*, 93 (2000), 233-239].

Dysfunctional Dynamics in Supervised Work Groups

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From the psychological literature (Spector, 2003), it is well known that inequity can affect employees' motivation. In particular, according to Adams (1965), individuals exerting different aggregate effort and receiving the same reward may experience inequity. In a dynamical setting, being exposed to inequity may degenerate into situations resembling the proverbial straw that broke the camel's back. (Cosier and Dalton, 1983). In this paper we provide a mathematical formalization of a supervised work group dynamics and in particular, we consider the effort allocation dynamics when the total production is the result of two non-additive tasks. The differences each coworker finds when comparing his effort with the colleague's can induce him to alter the effort allocation to resolve the tension caused by the inequity. This effort allocation dynamics is modeled as a nonlinear system which is thoroughly analyzed. The results prove the coexistence of different dynamics varying in terms of efficiency. Chaotic dynamics when the agents have different capacity has already been studied in a previous work. Here we prove that the exposition to injustice can trigger complex dynamics even in the case of same capacity. When both subordinates are intolerant to injustice several cycles may coexist even with retaliation. Finally, for sufficiently large levels of intolerance, chaotic cycles and full conflict with no production occur. The formal model we provide clarifies how inequity can disrupt the work group production and may provide a better understanding of the implications in terms of conflict prevention strategy.

Using the Logistic Equation Model for Studying Emotional Dynamics

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Logistic iteration equation X(n+1)=Lambda*X(n)*(1-X(n)) which describes the state the system X in the moment n+1 as function from the state this system in the moment n was used

for analyzing emotional states. It is known that the type of final set is determined by Lambda. It can be one point attractor, attractor with several (finite numbers of points) or chaotic. The data were 28 emotional evaluations which 40 subjects did every day as diary. Three different emotions (happiness, listlessness, helplessness) were measured for all subjects in implicit and explicit way. For each series of experimental data logistic equation was built and lambdas were calculated. Also data for different personality tests (temperament, emotion sphere, psychosomatic symptoms, motivation, self regulatory process and dispositions, personality styles) for each participant were collected. The goals of the study were 1) to realize the psychological scene of lambdas as index of system relations and integration between different level of components of personality regulation; 2) to reveal differences between lambda (reflecting complex hierarchical system organization) and variances in emotional states from day to day (as index of stochastic process). Mediator analysis helped to explain the important relations between lambdas and psychological variables through mediators. Lambdas for each type of emotions separately were used as independent variables (we interpreted its as more deep personality indices) and personality traits as dependents. Structural equations modeling were used with this goal to compare models with experimental data.

Mind, Embodiment, and Second-Person Perspective

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One of the central themes in cognitive sciences is how to explicate subjective experiences. Mental contents which can only be accessed introspectively are supposed to be unobservable from the outside. Despite the fact that observable brain states and subjective mental states are intimately correlated, some argue that there remains an explanatory gap between them. Descriptions of brain states using scientific terms are radically different from the language used by subjects when making first and second person reports. And yet an interpretation of the data concerning brain states necessarily depends, in an obvious way, upon those subjective and inter-subjective reports. The problem here is how we should integrate those first and second person reports into scientific methodologies which are apparently incompatible with subjectivism. In this context, second person reports are descriptions of other's concrete bodily motion through which we may know, in a distinctive way, the inner state of other's mind. The concrete bodily motion is observable, but it should properly be distinguished from objectively observable, third person data. In the present paper, we provide a schematic framework within which to incorporate first person descriptions by introspection and second person descriptions about bodily motion into the scientific study of mind. For such an incorporation to be successful, those descriptions need to be elaborated and to be regimented properly. We argue that phenomenological methods, particularly those afforded by the studies of the body, can be very helpful to this task. Then we show that our framework can give a useful suggestion for those working on the field of robotics who try to implement the robot equipped with some kind of intention or agency.

Healthy Variability: Chaos in Productive Organizational Behaviour

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Research in organizational behaviour has stressed the stability and linearity of phenomena. For this reason, techniques derived from the general linear model (GLM) have been imposed on the scientific activity in the area. However, since the 90s, there has been a sea of evidence showing, that stability and linearity, seem to be the exception and not the rule in organizational behaviour. In this paper, we present three studies that we have recently conducted using different methodological techniques based on the complexity sciences (recurrence analysis, Lyapunov exponents and surrogate data); with different samples of employees (N = 48 and N = 60) and professional basketball players (N = 94). Our findings reveal strong evidence of nonlinear and chaotic behaviour in work motivation, flow and individual and team effectiveness. Specifically, over 80% of the cases examined, showed a chaotic dynamic pattern. What has been most interesting is the finding that chaotic dynamic behaviour is associated with high levels of these variables. That is, workers exhibiting high levels of motivation and flow as well as high-performance athletes are precisely those that show chaotic dynamics. These findings are in line with the 'healthy chaos' thesis developed in the biological and physiological fields, and should help us to understand that the chaotic within-individual fluctuations found in work motivation, flow and individual and team effectiveness, are not anomalous functioning that should be avoided. Instead, it should be regarded as a dynamic, positive, and healthy behaviour. Moreover, our findings put forward the benefits of using nonlinear analyses as opposed to the techniques derived from the GLM.

How can Increased Transparency Contribute to Business Creation?

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Lack of transparency tends to cause firms as well as entirely society' s loss in the economy. This paper will highlight the phenomenon of transparency from an innovation and complexity perspective. Can increased transparency through self organizing network processes contribute to higher efficiency and business creation? The paper will present a number of examples where transparency has played an important role for the development in a positive or negative direction. The development of value networks will be discussed as well as how a business intelligence process can be shaped that capture an organizations sensibility for latent signals in the environment. A network analysis has been made on a group of firms where the employees are connected with a great number of extern relationships. The analysis indicates the importance of strange attractors for scattering transparency into the organization. A sketch for a foresight model that includes the concept of weak ties ' strong ties will be presented as a complement to existing business intelligence analysis models. A hypothesis is that firms or organizations can improve their foresight by developing a transparent system together with competitors where employees are encouraged to take part in a wider range of interest than normal. That might lead to new insights at the intersection of ideas.

Dynamic Systems Theory (DST) Applied to the Evolution of Language

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Dynamic systems theory (DST) applied to the evolution of language years after Darwin' s credo for self-organization the evolutionary market is well stocked with dynamical approaches which help to explain how from starting small we went through recurrent growth cycles of various complexities. Current research on the emergence of language is a joint-venture of varied disciplines. We shall view the pertinent trajectory paths along the arrow of time and propose the application of dynamic systems theory (DST) to language evolution under different conditions and across multiple time scales: macro-, phylo- and ontogenetic. The simulation of language growth involves evolutionary clusters and potential landscapes making much of sound shifts, syntactic changes and self-organizing semantic networks. The operating words are determinism and indeterminism, meaning that some processes are triggered by (supposedly) universal laws serving as a stronghold in data selection and processing and ' by contrast ' are dependent on specific order parameters guiding the organization of systems. A dynamic approach featuring multistability might explain why systems, due to their particular dynamics are stabilized and channeled by epigenetic factors (environmental as well as maturational). To have proven that it is in fact possible to match the genetic clock of language against the motors of change and to derive more complex structures from less complex ones without recourse to innate knowledge, is one of the greatest achievements of DST.

How Trope Metastability Characterizes the Structure of Gnosis

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Cognitive semantics proposes that gnosis (knowledge gained from experience) stems from conceptual structures shaped by perception and embodiment. The major tropes (metaphor, metonymy, synecdoche and irony) mediate the formation of these structures. The tropes are not just figures of speech; they are ontological concepts essential for our interpretation of reality. Whilst the tropes have been extensively studied individually their coordination (CT) has received far less attention. CT is not only the basis of concept formation it also represents cognitive development across a broad spectrum of time scales: phylogeny, ontogeny and the evolution of mind. We propose that these facts indicate that CT has universal features which epitomize gnosis. This presentation develops the proposal by showing that time is the pivotal aspect of CT dynamics, i.e. the narrativity of the tropes. We develop the proposal that the character of time changes when the tropes become fully coordinated. CT self organizes to criticality and becomes metastable. The system is then governed by 1/f behaviour and fractal time. This leads to an isomorphism linking CT and perception. The isomorphism leads to the universal structure of gnosis. We discuss the basis of universality and important cognitive implications stemming from this structure.

Sexual Affordance Invariance Extraction and Intentional Nonlinear Dynamics: Deviant and Non-deviant Patterns

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This paper presents results about the use of penile plethysmography, gaze behaviour nonlinear dynamics and virtual immersion to characterize deviant sexual preferences. Pedophile patients and non-deviant subjects were immersed with virtual characters depicting relevant sexual features

(N=42). Gaze behaviour dynamics as indexed from correlation dimensions (D2) appears to be fractal in nature and significantly different from coloured noise (surrogate data tests and recurrence plot analyses were performed). This perceptual-motor fractal dynamics parallels sexual arousal and differs from pedophile to non-deviant subjects when critical sexual information is extracted in 3D perspective. Results are interpreted in terms of sexual affordance invariance extraction and intentional nonlinear dynamics. Fundamental and clinical issues are discussed.

Do the Numbers Tell the Tale? Principle of Reduction Versus the Principle of Complexity

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Do the numbers tell the tale? Principle of reduction versus the principle of complexity. Objective: How to tackle the measurability problem of demand-driven primary mental health care. Health insurances increasingly demand using outcome indicators as a valuable measurement to define the success of a treatment. However, can a few individual indicators be indicative of the complexity that is involved in a demand-driven primary mental health care? Method: To provide a global insight into the tense relationship between demand-driven primary mental health care, evidence-based professional standards and the national health organization's objectives. Furthermore, this tense relationship will be related to the meaning of outcome indicators. Results: From a (scientific) reduction perspective, one can state that individual parts of a treatment can predict the success of such a treatment as a whole. But argued from a complexity perspective, the whole is more than the sum of its individual parts. Outcome indicators tend to measure the result of the treatment relative to its aim whereby is assumed that both aims and results are clear. Conclusion: Demand-driven primary mental health care is far from clear-cut, but is in effect complex; there is always a tension between the demands of the client, the evidence-based professional standards and the national health organization's objectives. By increasing our understanding of the complexity of the whole, we could improve our assessment of the measurability of demand-driven primary mental health care.

Dyadic Flexibility During the Still Face Paradigm: Analysis of Infant-caregiver Interactions Within the Dynamic Systems Framework Using the State Space Grid Technique

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Little research has been done on the organization and effects of perturbations on infant-adult face-to-face interactions from a dynamic systems framework. This study examined the change in dyadic flexibility of a normal interaction compared to an interaction following a perturbation of the interaction; the adult holding a ' still-face' and not responding to the infant. Dyadic flexibility was defined as the ability of the dyad to adapt to changes in the environment, such as the still-face perturbation. Using the State Space Grid (SSG) technique dyadic flexibility of the interactions of three month old infants and their caregivers was characterized using dynamic systems constructs such as range, fluctuation, dispersion, perseveration and entropy in order capture the attractor repeller landscape of the dyad. Our initial hypotheses were that greater dyadic flexibility in the first normal interaction would correspond to lower levels of stress in the infant when faced with the perturbation, and lead to a better quality of stress resolution when the normal dyadic interaction was resumed. Contrary to our expectation, we found that there is a significant increase in the dyadic flexibility post-perturbation, and infants in dyads with high initial dyadic flexibility showed higher levels of stress when faced with the perturbation. Also, these dyads had greater difficulty regaining their normal level of dyadic organization. These findings suggest that greater dyadic resilience after a perturbation is associated with lower levels of flexibility, a finding that questions several models of the organization of infant-adult interactions.

Explaining Students' Failure: The Dynamics of Problem Solving and Catastrophe Theory Hypotheses

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Research has shown that students' achievement in science education and particularly in problem solving is associated with some psychometric /cognitive variables, such as the information processing capacity. The information processing capacity however, interferes with other variables, such as field dependence-independence and/or logical thinking, which could act as inhibitory processes when the mental task requires it. This could lead to working memory overload and to student's failure. The present work adds to the previous research by providing further empirical evidence for discontinuities in students' performance. Data were taken from high school students' achievement in non-algorithmic problems of varying demand. The depended variable was the change in achievement $\Delta Y(i\text{-}j)$ from the problem of demand =i to the problem of demand =j. Data analysis for various (i,j) were carried out by implementing dynamic difference equations and statistical regression techniques. The model implements two cognitive variables as controls: Baddeley's working-memory capacity as asymmetry factor and logical thinking and/or field dependence-independence as bifurcation

variables. The cusp model proved to be superior to the linear counterparts and demonstrated nonlinear interactions between students' mental resources and mental tasks. The phenomenology of hysteresis effects and bifurcations supports the dynamical nature of problem solving process where nonlinearity is expected. Moreover, it provides empirical evidences for nonlinear processes in education research, and it could build bridges between NDS-theory concepts, psychological or/and pedagogical theories.

The Scale-free Property in Emotion: Associated Word Networks

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Some researchers have proposed the use of network models for investigating the concept of emotion in psychology. Bower (1981), for example, demonstrated that emotional episodes formed a certain pattern of networks and that emotion was crucial in activating these networks. However, no studies have clarified the topology of networks concerning the concept of emotion. Thus, the purpose of our study was to investigate the topology of networks relating to emotion by examining words associated with emotion. We specified words, such as "success," "funeral," and "death," with respect to basic prototype emotions (happiness, sadness, anger, fear, disgust, and surprise). Second, using a Likert-type scale, participants rated the similarity between all possible word pairs formed on the basis of the six prototypes (i.e., pairs). We then, applied "Pajek," a very popular software in network analysis, to the ratings in order to visualize the emotion-associated word networks. As a result, a scale-free property emerged from the topology of the networks, which had some hub nodes with many links and many nodes with only a few links. Moreover, the average separation between all nodes was 3.98, indicating that most emotion-associated words appear within four links regardless of whether the words are positive or negative. It is clear that the scale-free property has a major impact on research focusing on emotion and reveals a new research method on networks in psychology.

Hidden Markov Models for the Identification of Hidden Orders in a Financial Market

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Many empirical signals describing natural or social phenomena are typically non-stationary. A class of non-stationary models are those of regime-witching in which the process is assumed to be subject to shifts in regimes, i.e. the statistical properties change abruptly from time to time. Typically the boundary between different regimes must be inferred from the data. Among the various regime-switching models, one notable class is represented by the models with the switching is controlled by an unobserved state variable. When the latent state variable controlling the regime shifts follows a Markov-chain we obtain the Markov-switching model. Here we present the application of a Markov regime-switching model, the Hidden Markov Model, to the time series of transactions of the members of a financial market. These time series are clearly non-stationary and the aim of this analysis is to apply a segmentation method able to find the boundaries between different regimes in which the probability to buy, for example, changes abruptly. In this way the regime in which the probability to buy is very high is interpreted as a result of a splitting strategy of an ' hidden' big order to buy. We detected a huge number of hidden orders and found a fat tail distribution of their size. Moreover we found that long hidden orders are characterized by a high fraction of market orders and low participation rate and the contrary is true for the shorter ones. We found also a buy-sell asymmetry of hidden orders depending on the market trend.

Control of Chaos to Enhance Creativity And Physical/ Emotional Performance And Stability Through Super Slow Resistance Exercises

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Based on over 20 years of experience and devotion to refined rehabilitation techniques and elite human performance, physically and emotionally. The paper introduces an exciting technique to disinhibit the nervous system to induce creative flow that to date has proven to be 100% effective for thousands of participants. It is obvious that neural inhibition which increases through stress, anxiety, lack of confidence etc. which manifests physically or emotionally shifts the nervous system to higher states of protection, minimizing growth, reproduction and creative potential. Precise neurobiological descriptions that detail the inhibitory processes which include the associated areas of the brain, the role the sympathetic nervous system plays (positive and negative feedback loops); The body's representation in the brain and associated behavior as 'attractors' are given. Video play of clients performing the exercises that are performed on resistance equipment, which have been proven to produce the best result will be presented. Real time examples of the clients nervous systems 'sensitivity to initial conditions' are demonstrated, observing a person, healthy or otherwise, exhibit uncontrollably chaotic (spastic,

random, sometimes violent) shaking that becomes more and more chaotic as they are encouraged to become more relaxed. This is seen 100% of the time in ALL clients and would appear in every reader of this paper under these conditions. However over a few days of stimulation that is still very minimal, you are able (as is the client) to witness how the nervous system disinhibits and self organizes through intrinsic mechanisms separate to characteristics, beliefs and perceptions of the client, without any contribution from the client, except that they initiate the movement in the required posture, stay super relaxed and just let the 'system self organize'. The synergy between the mental state of the client and the behavior of the nervous system is then recalibrated. It is demonstrated that the chaos seen at very low levels of stimulus is manifested to higher degrees at all functioning levels of the system and is indicative of how all sensory input is being metabolized. The paper introduces a very special technique, which stabilizes the response to the initial conditions. Positive corrections of all disorders are influenced as the client fully appreciates they now have flow and control at all levels. The client stays with the program enjoying periods of time when they express high levels of creativity, structure and physical / emotional rewards, i.e. a change in the 'attractor landscape'. The reliability of the technique to visually show the chaos that inhibits a person's nervous system and interferes with its functional capacity, as well as being able to visually witness the 'self organizing' which stabilizes the responses to stress/load experiences for the person, hopes to inspire a much more detailed description of the phenomena from researchers who are much better positioned and equipped e.g. functional MRI and other sensory feedback apparatus to elaborate on the findings, than the author who spends his day in practice with clients. The technique has not only produced world champions (including Guiness Book of World Records title holders in very demanding fields of sport) but has been responsible for the physical and emotional rehabilitation of thousands of people over the last years.

Reading Fluency is in the Dynamics: A Self-Organization Perspective on Cognition

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Long-range correlations constitute a general signature in repeated human performances. Across behavioral domains, a consensus is arising that this fractal patterning emerges more clearly in more coordinated actions. Taking this claim seriously, we examined word recognition dynamics in dyslexic children, age-matched controls, and college-level readers. Fractal dimensions were closer to random white noise for dyslexic children, distinct from age-matched and college-level readers. Another complexity metric (sample entropy) was also reliably higher for dyslexic children compared to age-matched children (and lowest in college-level readers). In a second experiment, a reduction in fractal dimension and entropy was observed when college-level readers repeatedly read the same list of words, a paradigm known as word repetition. These data support the contemporary view that more coordinated actions reveal clearer examples of 1/f scaling in their dynamics. We interpret these results as a strong indication for the self-organizing capacities of the cognitive system. Although different interpretations exist, such perspectives fail to predict consistent changes in the relative presence of 1/f scaling (between experimental groups and conditions) a priori, and do not provide adequate post-hoc explanations. These results further confirm the need for a theoretical framework, which is comfortable with, rather than surprised by, complexity measures serving as a metric for the effectiveness of human performance.

Speed-Accuracy Trade-Off and Noise Correlates: Limited Capacity or Constraints across Timescales?

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Fitts' law is one of the strongest arguments of information processing theories of human cognition. Accurate pointing, reaching, or grasping movements become slower when target size or the distance to the target (Index of Difficulty, ID) increases. The robust finding is that movement time can be predicted as a function of ID plus some degree of random noise. Fitts' law is thought of as an indication of the limited capacity of the cognitive system, as revealed by the trade-off of movement speed against accuracy. Also principles of saving and releasing kinematic and potential energy, which occur at a timescale faster than the individual movement, are sensitive to speed-accuracy manipulations, as revealed by the harmonicity of the end-effector oscillation. To these levels of analysis we add dynamical principles that occur over slower timescales than the individual movements; 1/f scaling in both spatial and temporal task dimensions. The task instruction was to move back-and-forth between two targets, as fast and as accurately as possible, until lines were drawn. In a difficult task condition, the kinematic, aggregate, and dynamical levels of analysis were highly correlated. The spatial and temporal task dimensions were negatively correlated, also revealing a trade-off phenomenon in the extent of 1/f. In an easy task

condition, the levels of analysis were rather independent, and surprisingly, at the dynamical level, the spatial and temporal task dimensions were positively correlated, revealing a win-win situation rather than a trade-off. It is unclear how information processing theories could corroborate this finding.

Guanxi Marketing in View of Complex Adaptive System - an Empirical Study in Insurance Industry

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Guanxi Marketing in View of Complex Adaptive System -- an Empirical Study in Insurance Industry Abstract In China, guanxi is the basis on which Chinese exchange a lifetime of favors, resources, and business leverage. Guanxi is considered as a unique construct and a product of Confucian values and the contemporary political and socio-economic systems in Chinese society. While it is emphasized in Western on ' what you know', refers to technological expertise, including the price and quality of tendered product or service, it is emphasized in Confucian societies on 'who you know', which refers to personal connections with the appropriate authorities or individuals. These connections are known in Chinese as guanxi, and functions as the Complex Adaptive System in Chinese social network. Taking service quality as the research object, we address and conduct a survey to examine guanxi effect on marketing. Results of the study suggest that guanxi is not just the base in constructing and maintaining interpersonal relationship; it also acts as the buffer accommodating the conceptual gap of the service quality between service receivers and providers. Keywords: Confucianism, guanxi marketing, Complex Adaptive System, service quality

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Adding Resilience to Financial Markets: Toward a Volatility-based, Power-Law Indicated, Resilience Initiation Point

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Mathematical descriptions of financial markets with respect to the efficient market hypothesis and fractal finance are now equally robust but EMH still dominates. EMH and other current paradigms are extended to accommodate situations having higher information complexity and interactions coupled with positive feedback. The 'herding behavior' literature in finance marks a significant recognition that interdependent trader behavior may result in deviation from normal distribution of returns, as does 'chartist' trading. Further legitimization of the separate-but-equal status of EMH and Fractal Finance is pursued. Research on the nonlinear models giving theoretical underpinning to equations representing mirror markets as complex dynamical systems is encouraged. Why some herding- and chartist-behaviors scale up and then die off whereas others result in significant crashes is explained. The build-up to the liquidity crisis offers an example of nonlinear scale-free dynamics. Concepts from complexity science, econophysics, and scale-free theory are used to offer further explanation to physicists' mathematical treatments. Ideally one would like to create financial markets that are robust against meltdowns. Failing this, one would like promulgate resilience as early acting as possible. To accomplish this, we propose several elements from econophysics (West & Deering, 1995; Mantegna & Stanley, 2002). Starting with Hyman Minsky's positive-feedback based theories about market bubbles and crashes (1982, 1986), we suggest several additional 'scale-free' causes of skew distributions, that when combined lead to the extreme outcomes of long-tailed Pareto distributions, as signified by power laws (Newman, 2005). We then draw on Per Bak's 'self-organized criticality' theory to set up increasing power-law distributions of price volatilities in market trading as a general indicator of an impending crash, as traders move away from an efficient-market's 'Triple Point' and toward the 'Critical Point' of a market crash (Yalamova & McKelvey, 2009). We then assemble a variety of recent studies in support of the creation of a power-law-based indicator suggesting when the volatility spikes in increasingly correlated trading behaviours could be approaching the Critical Point. We then suggest a variety of actions such as reducing leverage limits, stopping short sales, or limiting securitization re-packaging, and other ways of either reducing correlated trading or softening the impact of volatility extremes. We begin with a short review of key elements seen as essential ingredients of resilient systems in general, as presented in several chapters in Hollnagel et al.'s book, *Resilience Engineering* (2008). Next, we describe financial trading phenomena due largely, and recently, to financial engineering. This includes a review of how markets build from efficient-market 'Triple Point' dynamics up to the 'Critical Point' at which they exhibit significant crashes (Yalamova & McKelvey, 2009); a sequencing of the growth in financial engineering starting with derivatives circa; a review of common elements found in older crashes by Hyman Minsky and more recent ones by ourselves, which are based on applying a complexity-science perspective; and a direct linking of various segments of the build-up to the liquidity crisis and subsequent worldwide Recession to several scale-free theories, which explain shifts from Gaussian- to Pareto-distributed outcomes. Following this, we illustrate the change in power laws in the volatility autocorrelation function as the build-up proceeds from Triple to Critical Point. We then define the period of increased information complexity when rationality recedes, imitation and herding cause bursts of volatility to trigger the instigation of a range of suggested resilience-inducing behaviours that

could be set off automatically or by regulators' actions. A conclusion follows.

The Fractal Structure of Small World Networks Generates Landscapes with more Homogeneous Behavior than the Landscapes Generated by Non-fractal Random Graphs.

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In a network individual nodes can have differing numbers of links. Barabási (2003), among others, proposes that self-organizing networks in nature are scale-free, yielding many nodes with few connections and few nodes with many connections; the (log-log) frequency of connections per node should follow a power law. In contrast, random graphs should produce non-power-law connections-per-node distributions. Our NK Boolean simulation program, E42, generated networks whose nodes came into existence Simultaneously or in a developmental Order. In Simultaneous networks, all N nodes simultaneously connect their K links randomly among all nodes; in Ordered networks each node receives links only from nodes that are created after it; thus nodes that exist earlier have more opportunity to get links from later nodes. The .95 confidence interval for mean log-log regression slopes for 1000 Simultaneous networks was -1.0868 +/- 0.2485 and -1.4865 +/- 0.2485 for 1000 Ordered networks. Thus Ordered networks do have a scale-free, fractal structure whereas Simultaneous networks do not. Static network structure is one thing; the dynamics of what flows across a network is another. Our research focus is on finding the relationship between static network structure and the dynamics of the flow across the networks. We frame dynamic flow in terms of the landscape theory. In samples of 50 networks per type we found that Ordered networks produce landscapes that are more rugged but are more homogeneous and more susceptible to taxonomic classification. We discuss implications of these findings.

Sudden death and Natural death: DFA and Poincare Map of Heartbeat in Animal Models.

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The aim of our study was to distinguish the heart by EKG traces recorded at natural-death and sudden-death. We analyzed EKG data of animal models, by DFA (detrended fluctuation analysis) and Poincare Map (delay time embeddment). EKGs were recorded by conventional electro-physiology methods. Model animals, crabs (Birgus latro and Scylla serrate), lobster (Panulirus japonicus) and other crustaceans were used. At healthy condition, the scaling exponents (DFA) were maintained at about 1.0. At natural death, scaling exponents gradually went down, approaching to 0.5. At unpredictable death, i.e., sudden death, scaling exponents were maintained at high values, 1.3 ~ 1.5. Poincare Map of EKG traces showed distinctive difference between natural-death and sudden-death. At natural death, Map trajectory distorted step by step when dying. At sudden death, Map trajectory kept steady until very end of life. Map represents configuration of action potential of cardiac muscle cells of corresponding heart beat. Therefore, we can diagnose from the Map that blood condition of natural death animal is deteriorating gradually but blood condition of sudden death animal is maintained until very end. Lower scaling exponent and distorted Map trajectory indicate that the subjects are gradually getting sick. In contrast, higher scaling exponent and normal Map trajectory indicate that unpredictable death (sudden cardiac cessation) could attack the subjects. The DFA and Map provide analytical strategies, focused on patterns of variation in sickness and in health, if models and human beings live on all functions under the same set of physical laws.