Society for Chaos Theory in Psychology & Life Sciences

Dedicated to the development of nonlinear science worldwide since 1991

Abstracts to the 18th Annual International Conference, Richmond, VA

2008

2008 CONFERENCE
SOCIETY FOR CHAOS THEORY IN PSYCHOLOGY & LIFE SCIENCES

August 8-10
Virginia Commonwealth University,
Richmond, VA

PROGRAM ABSTRACTS[1]

Message from the SCTPLS President and Conference Chairs

Welcome to the 18th Annual International Chaos Conference. This conference has been organized by the Society for Chaos Theory in Psychology and Life Sciences with co-sponsorship of Virginia Commonwealth University's Center for the Study of Biological Complexity, thanks to Tarynn Witten, its director of research and development. The event attests to the ongoing scholarly commitment to the study of nonlinear dynamical systems processes and its applicability of a systems framework across a wide range of disciplines. We are pleased to offer you some of the best and most cutting edge work emanating from dynamical scholarship. Furthermore, as in previous years, scholars from many countries are represented here, creating rich opportunities for a productive cross-fertilization of ideas and insights.

Ivelisse Lazzarini, OTD, Ph.D
President , Conference Chair
Matthijs Koopmans, Ed. D.
Past President, Conference Co-Chair

Society for Chaos Theory in Psychology & Life Sciences
http://www.societyforchaostheory.org

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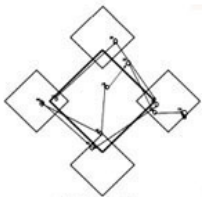
SUNSET SESSION KEYNOTE SPEAKER

Friday: 6:30 – 7:30 p.m.

Deborah J. Aks

Studying the Dynamics of Visual Search as a Window on Perceptual-Cognitive Behavior

The coordination of perception and cognition is intimately tied to people's interactions with their surrounding environment. This dynamic plays a crucial role in accounting for how incoming sensory information integrates with prior experience, and gives rise to efficient functioning in the real world. Critical to understanding such complex systems is the need to learn how behavioral patterns evolve over time, are time-dependent, and how they scale with surrounding context. Also essential is the need to determine the role that internal states and external conditions contribute to these behavioral patterns. Using visual search as a working example, I will discuss how dynamical systems theory and its tools can help us better understand the complex interplay between mental-behavioral-environmental systems. Specifically, I will describe how scan-paths can be used to assess patterns of correlation across a series of eye-movements. Results from various search tasks show scaling and long-range (1/f) trends across a diverse set of conditions. When display structure is altered, subtle but reliable shifts occur in search patterns: Extrinsic structure either attenuates or enhances intrinsic processes depending on which serves as the better guide to search. Despite these display-induced shifts, 1/f patterns were surprisingly pervasive across conditions suggesting a common, but highly variable, scanning strategy is used by most people across many different search settings. That this pattern occurs across the sequence of fixations is important since these are a hallmark of attention-based processes, and thus suggest a '1/f generating-mechanism' is involved in top-down cognitive processes. One significant and perhaps counterintuitive implication is that self-organizing processes may be essential to goal-driven behavior.



A visual scanning path

BANQUET SESSION KEYNOTE SPEAKER

Saturday: 7:00-9:30 p.m.

Mark Shelhamer

Timing is Everything - Statistics and Dynamics of Predictive and Reflexive Eye Movements

Ever since the pioneering work of David Robinson in the 1960s, rigorous mathematical approaches have been applied to the study of eye movements. These investigations, originally conducted by those with training in electrical engineering, continue to draw investigators from diverse fields, including physiology, psychology, neuroscience, and engineering. The work that I will describe brings to bear on oculomotor control another in a long and – mostly – successful line of mathematical approaches. After a brief review of the modern history of eye-movement research, I will move on to present my own more recent work on dynamical systems approaches to two types of eye movements: optokinetic nystagmus (OKN) and saccades.

OKN is a (mostly) reflexive eye movement that is driven by a large and homogeneous moving visual field. The resulting eye movements attempt to track the visual field in one direction with slow phases, and snap back occasionally with fast phases to foveate and track a new point. Some aspects of fast phases appear completely random while others have a correlated-noise structure. These correlations imply memory across fast phases, and I will discuss how this statistical structure can change when OKN is stimulated in different manners, which invoke different levels of reflexive and volitional control.

Saccades are rapid re-orienting eye movements that change the line of sight. Human subjects naturally generate predictive saccades when tracking periodically paced visual targets at a frequency above about 0.5 Hz, while tracking at lower frequencies produces reactive saccades. When target pacing monotonically increases or decreases, there is an abrupt transition between the two tracking modes (a phase transition), indicative of a bistable system. Several lines of evidence show that predictive saccade sequences are generated by an internal neural clock.

Reactive saccade latencies are uncorrelated and resemble white noise. Predictive saccade latencies are correlated, so that the performance of previous saccades is taken into account in the timing of subsequent saccades. These correlations are strongest over about two seconds; prediction is enabled when a sufficient number of previous saccades fall into this two-second window, so that their timing error can be monitored. This explains the transition between reactive and predictive tracking: only when target pacing is at a high enough frequency will a sufficient number of previous saccades fall into this window and allow an estimate of inter-stimulus intervals to be made.

Correlations between predictive saccades decay gradually, suggesting fractional Brownian motion (fBm), which is a hallmark of self-organizing systems and demonstrates variations on multiple time scales: trial-to-trial variations correct timing errors while slower variations reflect changing confidence in stimulus history. The longer a fixed stimulus continues, the more confidence there is in programming future behavior based on past performance. This is seen in the fact that correlations between predictive saccades increase as the pacing stimulus continues. (This also leads to hysteresis in the phase transition between reactive and predictive tracking.) I will discuss implications of these long-term correlations, and alternative explanations for their occurrence.

Another example of self-organization is the tradeoff between reliance on previous saccade performance and the current stimulus, and this weighting changes as stimulus variability increases. Thus, saccade sequences exhibit not only predictive behavior, but also the ability to modify predictive properties based on experience, another hallmark of self-organizing systems.

Abstracts to Workshops

Introduction to Fractals and Chaos
Facilitator: Larry S. Liebovitch
Florida Atlantic University

This workshop presents an introduction to fractals and chaos and their applications in a way that even those with a limited background in mathematics can understand. Topics covered will include : (1) Fractals: Introduction, Self-Similarity, Scaling, Dimension, Statistical Properties, (2) Chaos: Introduction, Phase Space, Sensitivity to Initial Conditions, Bifurcations, Analyzing Data, and Control of Chaos. The presentation will be based on the book, Fractals and Chaos Simplified for the Life Sciences, by L. S. Liebovitch, Oxford University Press, 1998 and the CD-ROM The Mathematics and Science of Fractals by L. S. Liebovitch and L. A. Shehadeh, Deco Bytes Education (www.decobytes.com).

Testing Hypotheses for Nonlinear Dynamics with Popular Statistical Software
Facilitator: Stephen J. Guastello
Marquette University, Milwaukee, WI

This workshop explains how hypotheses concerning catastrophe models, chaos, and related attractor dynamics can be tested statistically using SPSS or similar statistical software. The analytic techniques involve the polynomial extensions of the general linear model and nonlinear regression. Examples from published works on topics such as mental fatigue, leadership, population growth, personnel selection and performance, and economic inflation will be considered among other topics. This workshop is intended for participants who are familiar with the general linear statistical model and who are now ready to move forward.

The workshop is organized into six themes: (1) The statistical properties of measurements in a nonlinear process. (2) The properties of exponential distributions, power law distributions, and the interpretation thereof. (3) Catastrophe models for discontinuous change processes, which are extensions of the general linear model. (4) The properties of nonlinear regression and how it can be used to specify and test any nonlinear hypothesis, including how to find a Lyapunov exponent and a fractal dimension. (5) The exponential series for continuous change processes, such as attractor dynamics, oscillations, and the presence of chaos. (6) As time permits, the foregoing principles will be extended to cover static representations of dynamical processes and linkage (or slaving effects) in self-organizing systems. The goal in each module is to provide participants with a step by step procedure for accomplishing their analytic objectives.

CHAOS, Inc.™ Learning Laboratory
Facilitators: **John Winthrop Link and Jo Lee Loveland Link**
VOLVOX, Inc., Middleton, VA

CHAOS, Inc.™ is an original improvisational game that applies chaos and complexity insights to real-world social/ organizational systems. Together with participants, we co-create and enter an environment of collaborative learning and exploration. Workshop participants enter a well-defined simulated "company," and begin work. The "company" then is subjected to events and pressures typical in contemporary organizations – i.e., never the same twice. Participants face multiple dilemmas. Mid-way in the exercise, "company" members have an opportunity for organizational redesign. All are challenged and invited to reinvent their organization. Then, in a "work restart," participants can test their new strategies, assets, approaches, and learning that may be leveraged "back home."

Unlike most workshops or training, CHAOS, Inc.™ is a true experiential laboratory, designed for everyone from beginners through those with more advanced understanding. Again, just as in real life, we learn from one another. People from different levels of knowledge and experience create dynamic creative friction – and we are all made richer by the mix. CHAOS Inc.™ produces every time outcomes and insights that are intriguing, diverse, and mirror emerging dynamics.

Abstracts to Presentations, Alphabetical by First Author

The Capabilities of Chaos and Complexity
David L. Abel
The Gene Emergence Project

This lecture will examine to what degree chaos and complexity might be able to generate a Peptide World of crude protometabolism having no genetic control, a heritable linear digital symbol system that could instruct, organize, regulate, and maintain a potometabolism. A system of self-replication or self-reproduction First, chaos and complexity must not only be defined, but their cause-and-effect mechanisms and relationships delineated. Is there any formal (non physical; algorithmic) component to either, or are they both entirely physicodynamic (physical; mass/energy interaction alone)? Might there be some yet-to-be-discovered new law of biology that will elucidate the derivation of prescriptive information and control? Chaos and complexity can produce some fascinating phenomena. But can chaos and complexity steer events toward pragmatic benefit? select function over non function? optimize algorithms? integrate circuits? produce computational halting? organize processes and bona fide systems? control and regulate existing systems more efficiently? What exactly is a system? Are weather “systems" really systems? How do self-ordering phenomena differ from formal organization? What can spontaneous chaos and complexity *do* of pragmatic value?

A General Model of Human Consciousness (Global Cultural Evolution)
Marcus Abundis
Stanford Graduate School of Business (GFTP)

A model of human consciousness based on Earths geologic history of mass-extinction & recovery (evolutionary dynamics). Five Earthly dynamics trigger within humanitys adaptive psychology an adverse relationship with environment - a Paradox that sparks human consciousness with intellectual and spiritual questions of unity vs. diversity (Earth/Mother vs. humanity). Humanity adaptively mirrors Earths five evolutionary dynamics with five gender-based archetypes (bio-cultural dynamic) that unfold in a mythologizing of natural adversity as foundation for all human knowledge. The intellectual lineage used to develop this model includes: - Evolutionary biology and Earth systems science to establish an overarching context for this study, an answer to Chalmers’ “hard question,” - Paleoanthropology defines the circumstance of humanity’s emergence from Gaia, - Psychology then monitors humanity’s shift from animal-self to modern creative-self, using work of Hegel, Freud, Jung, Joseph Campbell, Arnold & Amy Mindell to define a new structural psychology, - Fractal geometry then offers a holographic/mathematical design for modeling consciousness, - Memetics, Finally, a tool for measuring humanity’s conscious traits is presented, with a variation of the Hall-Tonna values inventory. This work is presented as a *general hypothesizing model* for human consciousness, in attempting a science of consciousness.

Play's Role in Promoting Wholistic, Fluid Connections: Script Theory, Theory of Mind, Brain Development, and Transdisciplinary Trading Zones
Doris Fromberg
Hofstra University
Doris Bergen
Miami University
Karen Vanderven
Pittsburgh State University

This seminar will discuss recent theoretical and research perspectives that stress the role of human play as a vehicle for promoting wholistic, fluid connections among script theory, theory of mind, brain research, and transdisciplinary trading zones. As a non-linear dynamic activity, play creates meaning and learning. Each presenter will give a perspective on ways that chaos/complexity theory explains children's play and its connections to meaning, learning processes, and transdisciplinary thinking. An interactive discussion among the presenters will be followed by a dialogue with the audience on implications of these perspectives for educational and psychological fields. Recent research in cognitive science and neuropsychology suggests that there are major reconceptualizations of mind and brain being identified, which have implications for human development and education. Because this information requires a revised way of thinking about play, mind, brain, and chaotic/complex systems, it has not been readily accessible to many professionals. Thus, this seminar will engage them in gaining understanding and discussing how these wholistic, fluid connections can inform their work. The first presenter (Fromberg) will outline the three non-linear theories (script theory, theory of mind, chaos/complexity) and explain how children's play, especially sociodramatic play, can be understood as a non-linear system that utilizes the concepts of these theoretical perspectives. She will address how technological skills and non-linear media communication forms, in which children are presently immersed as recipients and as actors, affect their play experiences, and how the power of play as a non-linear system has been obscured in an age of assessment accountability. She will draw implications for human development, practice, and policy. The second presenter (Bergen) will review recent research on early brain development, especially as it illustrates the wholistic, fluid connections that are characteristics of non-linear dynamical systems. She will examine the self-organizing and plasticity aspects of brain development that are fostered in playful activity, and address how technology-enhanced toys may create changes in human play patterns, and thus influence children's brain configurations in regard to script development, theory of mind, and adaptation to chaos and complexity. She will draw implications for human development, practice, and policy. The third presenter (Vanderven) will discuss the trading zones premise of the physicist Peter Galison, that advancement of scientific knowledge comes when members of established disciplines exchange ideas with others and create new disciplines. She will discuss the relationship between childhood play and scientific interdisciplinary inquiry, examining how the non-linear dynamical characteristics of play (a complex adaptive system) fosters the ability to move beyond conventional ways of thinking and promte trandisciplinarity, or trading zones that transform bounded disciplines into new ones. She will illustrate how play's relationship to hierarchical complexity, which leads to ever more complex ways of thinking, culminates in synthesizing, cross-paradigmatic abilities relevant to effective work in trading zones. She will draw implications for human development, practice, and policy.

Symmetric Specified Complex Information is Conserved
Don Booker
School of CSIS, Pace University, NYC

Specified complex information is conserved, but under a 'no free lunch' theorem, the effectiveness of evolutionary (or genetic) algorithms to generate specified complex information is severely constrained. However, the applicability of this theorem has been questioned. I propose an alternate formulation of specified complex information which emphasizes its symmetry and derives an alternative basis for the conservation of information which allows the extension and application of the 'no free lunch' theorem.

Holding the Tension: How System Resilience Emerges From the Search for Fit Meaning and How Jung, Kristeva, and Arendt Suggest This Search Proceed
Joan Conger
Fielding University

Health in human systems (relational, familial, organizational, societal) is not a delineated end product so much as an ongoing process of interactions between individuals that contribute to, detract from, or miss completely an adaptive solution-finding resilience. Thus, the entities that self-organize in the search for systemic health are not the interacting individuals themselves but the quality of the narrative and propositional processes. In their search for fit meaning agents use these processes to refine their understandings of the current challenge and distribute their learning from attempted solutions (Cilliers, ; Stacey,). As much as each agent would like to reserve sovereignty, adaptive solutions within a system require that agents engage the process of change and remain open to the influence of the search for meaning within and around them. Taking new action creates the resiliency of survival, and it also introduces the enormous and almost assured risk of uncertain and irreversible consequence. Survival and consequence create the classic Hegelian negativity from within which all things new emerge. Psychology, social sciences, and organizational sciences traditionally seek equilibrium in the resolution of tension. This paper will explore the revolutionary idea that health involves not the resolution but the maintenance of tension (the welcoming of confusion, sitting with paradox, holding of opposites). A thriving complex adaptive system must exist within a processual holding structure that needs to be in a state of tension not resolution to allow its participants to navigate anxiety and search for fulfillment. How best to search for fit meaning surfaces from within readings of Jung's conjuntio/complexio oppositorum, the Freudian Kristeva's revolt and subject-in-process, and Arendts via activa of uncertainty/irreversibility and promise/forgiveness.

Nonlinear Detrended Fluctuation Analysis of Sitting Center-of-Pressure Data as an Early Measure of Motor Development Pathology in Infants
Joan E. Deffeyes
Department of Psychology, University of Nebraska at Omaha
Naomi Kochi
HPER Biomechanics Laboratory, University of Nebraska at Omaha
Regina T. Harbourne
Munroe-Meyer Institute, University of Nebraska Medical Center
Anastatia Kyvelidou
HPER Biomechanics Laboratory, University of Nebraska at Omaha
Wayne A. Stuberg
Munroe-Meyer Institute, University of Nebraska Medical Center
Nicholas Stergiou
HPER Biomechanics Laboratory, University of Nebraska at Omaha

Early identification of infants with motor development delay, such as infants with cerebral palsy, allows for earlier therapeutic intervention, which is thought to produce better outcomes due to greater neural plasticity in younger infants. Upright sitting is one of the first motor skills an infant learns. Thus, evaluation of sitting postural control by quantifying sway provides an early window into the infant's motor development. Applying mathematical algorithms from chaos theory (e.g. largest Lyapunov exponent) to physiologic time series data may be problematic because stationarity of the data is typically assumed in the derivation of the algorithm. Often physiologic time series data is mathematically non-stationary. Detrended Fluctuation Analysis (DFA) is useful to characterize the fractal nature of time series data, because it is does not assume stationarity of the data being analyzed. In standard DFA analysis, linear detrending is performed, but higher order detrending has also been reported on heart rate data. In this study we found that higher order detrending improves the ability of the DFA algorithm to distinguish infant sitting posture time series data from brown noise (random walk). In addition, first and second order detrending improves the ability of the DFA algorithm to distinguish between infants with motor delay from infants with typical development. Thus the power of the DFA algorithm to distinguish between time series data from different populations can be enhanced by suitable selection of the order of the detrending function.

Full Dimension Analysis: Developing a Global Research Focus
Albert Dietz
Texas State University
Keith Owen
Somerset CG

This presentation will propose a process for identifying, understanding, and examining global research issues associated with organizational change. Most often the process of identifying, understanding, and examining research concepts is treated as linear and unique to specific researchers or small groups of researchers. The process presented here moves our understanding of research need outside of the traditional, limiting process of moving theory forward (review of the literature-research question-methodology-analysis-publication-back to review of the literature) to a dialogical process that invests a population of researchers in uncovering the universe of research needs. The process presented is called Full Dimension Analysis (FDA) (Owen and Dietz, in press) and is based on current concepts and theories related to organization change and dynamics, and complexity science.

Dynamics of Workforce Integration in an Organizational Merger
Terrill L. Frantz
Carnegie Mellon University
Kathleen M. Carley
Carnegie Mellon University

We report on a theory-grounded, virtual experiment that simulated the socio-technical network dynamics during the integration phase of an organizational merger. Using the information-processing paradigm of the Construct model of interaction, we discover the range of the dynamics and the

performance impact of merging two previously independent organizations into a single goal-seeking organization. Outcome variables such as binary task performance, knowledge diffusion, et cetera, are reported.

Social Entrepreneurship and Complexity: Findings from a Conference
Jeffrey Goldstein
Adelphi University

On April 2008, my university, Adelphi University of Garden City, NY, hosted The First International Conference on Social Entrepreneurship, Systems Thinking, and Complexity. We had presenters from six continents and countries. One of the reasons for the conference was the perceived lack of a good theoretical underpinning among the many very inspiring stories of social entrepreneurial ventures throughout the world. Mostly, these stories take the form of a kind of hero's journey where the personal charisma and influence skills of the founders are understood as the key to the success of the social entrepreneurial projects. But just as in the study of leadership in general, I thought that the study of complex systems could remedy both the lack of theory and the focus on hero worship. In particular, the conference explored how such constructs and methods as network/graph theory, nonlineary dynamic systems, and emergence could help spur social entrepreneurship into its next phase. In this presentation, I will present highlights from the conference, particularly in regard to how the study of complex systems can aid practitioners of social entrepreneurship.

Prototypes of Chaos and Conflict
Stephen J. Guastello
Marquette University

The interest in the link between chaos and conflict has come into resurgence recently, although some of the ideas expressed in the psychological and political science literature are more closely connected to formal principles of chaos than others. This paper presents some prototypes of conflict situations that follow from different pathways to chaos and that can be extracted from empirical investigations. A distinction is also made between conflicts that are centered in chaos and those that are more similar to the hysteresis feature of catastrophe models.

Formalizing Rare Complex Dynamical Systems Linked to Anomalous Cognition in SFT's Framework
Christine Hardy
Terra Futura

Semantic Fields Theory (SFT, Hardy, 1998) poses that semantic fields—consciousnesses—are complex dynamical systems instantiating semantic or *syg-energy* and organized by semantic parameters and variables. It postulates that syg-energy springs forth from a layer of deep mind-matter interconnection and is non-dependent on the constraints of Newtonian physics, thus explaining rare phenomena undecipherable by current cognitive models. This paper analyzes 3 types of such phenomena: (a) Cognitive acts (intention, meditative state) triggering the emergence of complex dynamical energy-structures—e.g. torus rotating between four meditators, syg-rods connecting two deeply harmonized minds—generating powerful cognitive insights and instantly affecting a larger group; (b) Beyond a given threshold of harmonization between minds (praying, improvising music) a collective consciousness field—or *Telhar field*—is created, presenting specific cognitive traits and physical/energetic properties, e.g. spatial extension, precise boundary; (c) Two cases of exceptional Telhar field instantiating a disruption of - or annulling - Newtonian space. 1) Concentric embedment of two normally distant spaces—the outer ring unfolding the anomalous information. 2) A syg-rod linking two fusioned minds (nodes 1 & 2) appears, creating a large Telhar field. Then a syg-funnel appears—its small end at the rod's midpoint—instantly annulling distance between the first space and a semantically proximate, yet geographically distant, space. In these instances of space disruption, the control variable is *semantic proximity* – the main parameter posed by SFT as triggering spontaneous linkages and inter-influences between semantic fields independently of Newtonian distance.

A Cusp Catastrophe Model of Psychological Contract Obligation Perceptions
Richard Hermida
George Mason University

The employment relationship between an individual and his/her organization can be conceptualized as a psychological contract which is comprised of perceived mutual obligations. Psychological contract breach occurs when an employee feels the organization has not lived up to its responsibilities in terms of what is owed to the employee. Most obligations that comprise the contract are considered to be dynamic and changing over time. However, some obligations are infrequent and discrete. Instrumental approaches suggest that employees perceive their own obligations to decrease over time. A cusp catastrophe model for changes in employees' perceptions of personal obligations given different levels of fulfillment of specific and infrequent discrete obligations is proposed. It is proposed that when infrequent and discrete obligations are not met by the organization, perceptions of obligations owed by the employee can become unstable, especially when the owed obligations in question are quite ambiguous, extracurricular, and non-definitive. In turn, this could lead to sudden, drastic shifts in the state of the perceived obligations of the employee. This hypothesis and analytic strategy emphasizes an analytical strategy that directly follows the dynamic nature of employees' perceived obligations. Additionally, understanding of psychological contracts over time will be better understood at a more precise level regarding obligations in the employment relationship and their antecedents and consequences.

A Cusp Catastrophe Model of Work-Family Conflict, Interruptions, and Withdrawal Cognitions
Richard Hermida
George Mason University

Work-Family conflict is a form of interrole conflict in which the role pressures from the work and family domains are mutually incompatible in some respect. Withdrawal cognitions are considered to be cognitions that relate to the employee reducing the amount of work it gives to the organization. Specific cognitions are thinking of quitting, intent to search for another job, probability of finding an acceptable job elsewhere, and intent to leave the organization. Workplace interruptions cost the American economy hundreds of billions of dollars each year in lost productivity. A cusp catastrophe model for changes in employees' levels of withdrawal cognitions given different rates of work-family related workplace interruptions is proposed. It is suggested that when work-family interruptions occur, rates of withdrawal cognitions by the employee can become unstable, in particular during the time period where the interruption is being dealt with by the employee. In turn, this

could lead to sudden, drastic shifts in the state of the withdrawal cognitions of the employee. It is hypothesized that the unstable state will see a dramatic shift upwards of withdrawal cognitions. This strategy reconsiders a part of how withdrawal cognitions can develop in employees by considering a major source of interrole conflict in work-family conflict, and proposing a nonlinear dynamical system about workplace work-family interruptions and withdrawal cognitions.

Numerical Explorations of R. M. Goodwin's Business Cycle Model
Aleksander Jakimowicz
Nicolaus Copernicus University, Poland

Goodwin's model still attracts economists' attention. The first numerical explorations of the model were conducted in the early fifties of the twentieth century by Strotz, McAnulty and Naines. They discovered coexistence of attractors and, nowadays well known, two properties of chaotic systems: the sensitive dependence on the initial conditions and the sensitive dependence on parameters. The occurrence of periodic and chaotic attractors is dependent on the value of parameters in a system. In case of certain parametric values there occur fractal basin boundaries which results in enormous system sensitivity to external noise. If periodic attractors are placed in the neighborhood of the fractal basin boundaries, then even a low external noise can move the trajectory into the region in which the basins structure is tangled. This leads to a kind of movement that resembles a chaotic movement on a strange attractor. In the Goodwin's model, apart from typical chaotic behaviors, there exists yet another kind of complex movements transient chaotic behaviour which is caused by the occurrence of invariant chaotic sets that are not attracting. The examples of such sets are chaotic saddles and basin boundaries. Some of the latest observation methods of trajectories lying on invariant chaotic sets that are not attracting are straddle methods. The article provides the examples of the basin boundary straddle trajectory and the saddle straddle trajectory. Moreover, their Lyapunov's exponents, box dimension and correlation dimension have been calculated.

Dynamics of Conflict: Mathematical Model of the Interactions Between Two Actors
Larry Liebovitch
Complex Systems, Florida Atlantic University
Vincent Naudot
Mathematical Sciences, Florida Atlantic University

We developed a nonlinear model of the interactions between two actors in a conflict which could represent two people, two groups, or two nations. The state of each actor depends on its own state in isolation, its previous state in time, its inertia to change, and the feedback from the other actor. We determined the dynamics of this system both analytically and numerically. When the feedback is small, less than the inertia, then both actors evolve to a neutral state, as if there was no feedback between them. When the feedback exceeds this threshold, then their behavior changes dramatically. For positive-positive feedback, both evolve towards either a positive or a negative state. For negative-negative feedback, one evolves to a positive state and the other to a negative state. For positive-negative feedback, the states of both actors oscillate but ultimately reach a neutral state. There are no limit cycles in this system. Judicious switches of feedback, of one of actor alone, can change the outcome of a conflict. If the loser in a negative-negative feedback conflict temporarily switches to positive feedback, the state of both actors will oscillate. If that actor then switches back to negative feedback at a time when that actor is more positive and the other actor more negative, the roles of loser and winner will be reversed. The model predicts that for this strategy to work the duration of the switch should be inversely proportional to feedback and we are now testing this prediction in laboratory experiments.

Empirical Markov Chains as Models of Dynamic Processes
Stephen Merrill
Marquette University

Markov chains are time series in discrete time whose changes of state can be described in terms of one-step transition probabilities. The use of Markov chains whose transition matrices are constructed from time series is described. Applications from heart rate variability, movement of the heart in cardiac registration, and ARMA processes are used to illustrate the range of applications. These models can be used to describe long term behavior of a time series, bifurcations, nonstationarity, and provide a framework to describe chaotic dynamics that are not purely deterministic or that are not deterministic + noise in nature. In general, the deterministic nature of a process can also be revealed through this process. Markov chains are in some sense well understood, yet the dynamic behavior of their sample paths is more varied than one-dimensional dynamics. They provide a powerful method to describe the nature of the dynamics of a time series.

From Simplicity to Complexity: Attachment and Attunement
Susan Mirow
Dept. of Psychiatry, University of Utah School of Medicine
Terry Marks-Tarlow
Faculty, Santa Barbara Graduate Institute; Research Associate, Institute for Fractal Research

Self-regulation theory provides a useful paradigm for understanding and predicting normal, as well as at-risk emotional development in infants. Our paper places the interpersonal neurobiology of the human attachment system within the context of a complexity model. Historically, important links have been forged between an evolutionary perspective and neuropsychobiological regulation of the immature brain through study of parent/infant attunement. To date, however, specific links from attachment and attunement processes to dynamical systems theory have not been elaborated in detail. Emotional self-regulation is currently understood as resulting from the ongoing interaction between primary caregiver and infant along with his/her developing modes of auto-regulation. Referencing the literature as well as our clinical work, we identify broad-based principles illustrating the nonlinear self-organizing nature of experience-dependent brain maturation in the context of iterated processes of attachment and attune-ment. We discuss several nonlinear principles at work during these processes such as synchronous, temporally organized, interactions of a parent/infant dyad and the global system dynamics revealed during transitional states of these dyads. The development of brain, mind and body, with its fractal patterning and allometric control, highlights evolutionary organization from simplicity to complexity. We conclude with a discussion of the developmental interplay between flexibility and stability, along with exploration of multi-scale, multi-system interconnected feedback in the production of emergent complexity.

Nonlinear Analysis of Heart-Rate Variability and Movement in Attention Deficit Hyperactivity Disorder
Susan Mirow
Dept. of Psychiatry, University of Utah School of Medicine

Twenty patients who fit the DSM-IV criteria for Attention Deficit Hyperactivity Disorder, as well as twenty age and sex matched controls were studied using heart-rate variability and movement variability monitored over a twenty-four hour period, both before and after treatment. Those with Attention Deficit Hyperactivity Disorder showed a specific pattern of heart-rate variability and movement variability, easily seen at night during sleep. This characteristic pattern was normalized after treatment.

Attractor and Lyapunov Models for Reach and Grasp Movements with Application to Robot-assisted Therapy
Dominic E. Nathan
Marquette University
Stephen J. Guastello
Marquette University
Michelle J. Johnson
Marquette University and Medical College of Wisconsin

Reaching-to-grasp is one of the most desired motor skills post stroke. Individuals who lack this ability suffer disruptions in activities of daily living, employment and social interaction. Robotic aided rehabilitation is at the fore front of stroke therapy. However, there are areas that need significant improvement especially in mapping natural human prehension movements to the robot through robotic trajectory models. We have developed a reaching-to-grasp model for use in a robotic upper extremity stroke therapy system that was predicated on the principles of attractors and Lyapunov exponents. Previously known models for these movements, namely the fifth order minimum jerk and the advanced seventh order polynomial, have not been able to account for the change in grasp aperture of the hand or model real-world tasks efficiently. The Lyapunov model was tested with reaching-to-grasp movements performed by five neurologically healthy subjects. The goodness of fit was assessed using R2 coefficients computed through nonlinear regression. The Lyapunov model produced an average R2 = .97 over 15 replications for 41 different task events, reflecting a notable advantage over the fifth order (average R2 = .58) and seventh order (average R2 = .67) models. A similar level of success was obtained for the Lyapunov model that was specific to grasp aperture. The results indicated that intentional movements can be accurately characterized as attractor trajectories, and as functions of position along two Cartesian coordinates rather than as functions of time. Because the Lyapunov exponent model required fewer parameters, it provides an efficient platform for real-time implementation in that it reduces computing time and increases system performance overall.

Teaching Complexity: Confessions, Emergence and Challenges
Connie Porter
St. Edward's University
Ryan Schoenbeck
St. Edward's University
Albert Dietz
Texas State University

This presentation focuses on the challenges associated with teaching complex adaptive human system concepts to graduate students in a Human Services program. The MAHS program at St. Edwards University requires their students to take a course titled, Systemic Intervention which is designed to assist students in learning/understanding the basic premises of complex adaptive systems and apply those concepts to an organization (focusing on identifying leverage points for change within those organizations). The development and orchestration of this course has had interesting consequences most of which were unintended. We will briefly outline the course and then identify those things we think resonate well with students and their understanding of complexity in organizations, those processes that seem to work well in identifying distinct patterns, and those activities that do and donot work in the classroom and the organization. We will also share some final student projects that seem to exemplify a practical understanding of complexity concepts.

The Origin and Maintenance of Human Life is Based on Complexity Science
Eddie Price
eMedilab

This paper presents the hypothesis that any living organism is continuously in three states: solid, fluid and most-importantly second order phase transition state (sofid) with interconnections with the environment. The strange attractor movement pattern of the sofid state enables structural coupling with the environment generating information and the solid and fluid neighbouring states facilitating information processing. This, it is proposed, is the missing mechanism in Morowitz's origin of cellular life in the protocell. This mechanism is continuing constantly at the microscales in the human body, and is the basis of cognition. It also extracts energy (negentropy) from the environment and is the pulse of life. This is consistent with the Santiago Theory of Cognition. The above bifurcation enabled information processing to dominate over external forces in determining the organism's future behaviour. Further complexity mechanisms/bifurcations led to the evolution of primary consciousness (emotions and perceptions) and further to reflective consciousness (meaning and neocortex development), as their being the pre-potent determinants of future human behaviour, as well as body physicality. Finally, the previous structural coupling that occurred for the information generation, created rigidities (static forms) which, it is proposed, contribute to illness and restrict healing. Techniques to loosen these rigidities present new possibilities for science-based health improvement therapies.

Tropes - The Dynamic Kernels of Thought
David Rail

Thought is one of the most dynamic of dynamic systems. The tropes (metaphor, metonymy, synecdoche, irony) have recently come to be recognized as more than just figures of speech. They underlie our conceptual system and consciousness. They are basic for thought. But what sort of dynamic underlies the system of tropes? In order to try to answer this question we need to re-conceptualise the system of tropes in terms of three dynamic theories.

Reducing the Mystery of Complex Emergence: Nonlinearity in the Model of Hierarchical Complexity
Sara Ross
ARINA, Inc.

This workshop introduces how a general theory, the nonlinear Model of Hierarchical Complexity, offers explanations and measurement of a number of dynamic systems concepts and

behaviors. After 30 years of development and refinement, the Model was formalized as a general theory that applies to all information-organizing tasks. In 2008, a triple special issue dedicated to it comes out in World Futures: The Journal of General Evolution, co-edited by Ross with Michael Commons, originator of the Model. The Model accounts for universal patterns in behaviors as they develop increased complexity. These tasks are developmental: they account for evolutionary and developmental processes studied in psychology and life sciences. Ross discovered and continues to develop the fractal version of the Model. Orders of hierarchical complexity and their ubiquitous transition step dynamics evidence self similar scaling properties and dependence. Learning objectives are for participants to: 1) experience how this kind of hierarchy is nonlinear, 2) interpret common dynamic systems concepts through the lens of hierarchical complexity dynamics, and 3) relate hierarchical complexity to issues in several disciplines and areas of practice. Workshop materials include graphic and text handouts. Methods include presentation, experiential exercises to apply and internalize the nonlinearity of hierarchical complexity, and discussion to relate its concepts to dynamic systems behaviors and practical applications of the Model in modeling, social science, and practice.

Further Demystifying Emergence: Theory and Research that Responds to Goldstein's Call and "Self-Transcending Constructions"
Sara Nora Ross
ARINA, Inc.

Jeffrey Goldstein's new model for emergence proposes self-transcending constructions as the next step in understanding what does and does not happen in dynamics of emergence and self-organization. This paper reflects two approaches to build upon the model's "two fundamental requirements for emergence: building blocks and a simultaneous transcendence of the same building blocks." In the first, it responds to Goldstein's description of the unfilled gaps that a generalization of Cantor's construction would need to fill. It does this by showing how the axioms of the nonlinear Model of Hierarchical Complexity account for innovative operations. Following that theoretical response, models and findings from Ross's research are overviewed. These are selected on the basis of those that already begin to respond to Goldstein's call for leadership research that investigates a) the role of "containers" and changing containers in predicting the type of order that will show up in emergent processes, b) ways for leaders to achieve "non-consensus coherence" and how to develop temporary structures, and c) what exactly is involved in the active role of building up novel structures with novel properties. Suggestions for furthering a research agenda that exploits Goldstein's, Ross's, and others' models are proposed.

Econophysics and Economic Complexity
J. Barkley Rosser, Jr.,
James Madison University

This paper will focus upon the confluence of two strands of debate, their interaction and mutual implications. One involves the nature of economic complexity and the best way of thinking about it theoretically and empirically. The other is the nature and relevance for economics of the recently developed sub-discipline of econophysics. We shall proceed first by considering the concept of complexity and its concommitant idea that only computationally based definitions of complexity are sufficiently rigorous to be useful in any science, including economics and physics' peculiar recent offspring, econophysics. This premise has involved criticism of more dynamically based definitions of complexity that have tended to be used more widely and frequently in economics over recent decades. Although the arguments of the advocates of the computational approach have some merit, it is argued that their criticisms of the dynamic approach are overdone. Next, we address the separate strand of debate that involves the nature and relevance to economics of the recently developed sub-discipline of econophysics. While econophysicists have made strong claims about the superiority of their approaches, even going so far as to argue that econophysics should replace standard economics as such, the critics have argued that there have been some serious flaws in much econophysics work, including ignorance of relevant work in economics, inappropriate use of statistics, excessive and unwarranted assertions of finding universal laws, and a failure to provide adequate theory for the models used. Again, points made by both sides have some reasonableness to them.

EEG Nonlinear Dynamics in Patients With Disorders of Consciousness
Marco Sara
S. Raffaele-Cassino
Francesca Pistoia
S. Raffaele-Cassino
Paolo Onorati
S. Raffaele-Cassino

Objective: we evaluated the hypothesis that neural networks derangement in patients with disorders of consciousness (DOC) may cause an alteration of electroencephalographic (EEG) activity nonlinear dynamics. Materials and Methods: thirty-eight brain-injured patients with a diagnosis of vegetative state (VS) at admission and matched healthy control subjects were included in the study. One week after admission, all patients were assessed by means of the Extended Glasgow Outcomes Coma Scale (E-GOS) and the Coma Recovery Scale Revised (CRS-R). At the same time an EEG recording with a -channel common reference montage was performed in all patients and controls. A -minuts continuous electroen-cephalographic artefact-free recording was selected from each electrode and for each subject and used for the time series analysis. Approximate Entropy (ApEn), a nonlinear parameter quantifying the irregularity of a time series, was calculated from the average values. Discussion: Neural networks may be regarded as complex systems. Our findings support the hypothesis that derangement of neural networks may cause a reduction of EEG signal nonlinear behaviour. A decrease in ApEn, reflecting a greater signal regularity, may correspond to a decreased neural networks complexity and inter-connectivity resulting in functional isolation. Conclusions: Investigating the dynamic correlates of consciousness seems to be extremely advantageous in order to explore neural networks and their complexity. Approximate entropy may be regarded as a useful tool to assess the post-critical residual derangement in neural networks and to predict recovery in patients with disorders of consciousness.

Synchronized Chaos in Competitive Logistic Networks with Adaptation
Claudio Tebaldi
Department of Mathematics, Politecnico di Torino

A general N-node network is considered for which, in absence of interactions, each node is governed by a logistic equation. Interactions among the nodes take place in the form of competition, which also includes adaptive abilities through a

(short term) memory effect. As a consequence the dynamics of the network is governed by a system of NxN nonlinear ordinary differential equations depending on the strength of competition, the adaptation characteristic time and the size of the network. Reduced models of four equations, where N appears as a parameter, are proven to account for existence and stability of the equilibria and are effective also in describing the transitions to time-dependent regimes. Such regimes exhibit remarkable properties of synchronization both in the case of periodic oscillations and chaotic behavior, related to the existence of attractive invariant subspaces. The loss of synchronization happens when, increasing the adaptation time, the invariant subspaces loose attractiveness.

How Leaders Think: Discontinuous Levels of Consciousness
Dick Thompson
High Performing Systems, Inc.

As the “war for talent” escalates, what we need is not more fads; its not more people talking about leaders with vision, but rather an understanding that each Level of the organization requires leaders who think with different Levels of consciousness. Each Level of consciousness provides a necessary talent required for at a particular Level of organizational complexity. The knowledge of how leaders think and how to assess their Innate thinking processes will pave the path to winning the war for talent. At its simplest level, leadership is: the emergent property of the art and science of getting people to willingly perform work toward organizational goals across time scales in a structured system nested in a fractal environment (Thompson,). This session explores how leaders at the four organizational complexity Levels (Tactical, Operational, Strategic and Visionary) deploy the four hierarchical Levels of Thinking (consciousness) and the relationship of thinking to work complexity and time scales. Kirkpatrick and Locke state that, “It is unequivocally clear that leaders are not like other people. Leaders do not have to be great men or women by being intellectual geniuses or omniscient prophets to succeed, but they do need to have the right stuff and this stuff is not equally present in all people.” Case studies showing the development of the Levels of Consciousness as a discontinuous function will be explored. When hiring or promoting leaders, an organization must be able to accurately match a leader’s Level of Thinking with the level of complexity required by the leader Role Level. Placing an under- or overqualified person in a leadership Role results in predictable negative outcomes for the leader, his/her direct reports and the organization

A New Definition of Health Derived from Chaos and Complex Systems
Stefan Topolski
University of Massachusetts, School of Medicine

Millions of health care professionals work to preserve and maintain health, yet what is health? Health is an extremely complex concept which has always proven difficult to define, measure and improve. The health profession's efforts are hindered by a poor understanding of the core principle of health itself. Chaos and complexity theories can enlighten us with clear and robust qualitative-quantitative methods. General measures of individual growth and population health are examined through fractal concepts and log-normal distribution curves. Various basic physics principles and more advanced entropy/complexity curves provide a three dimensional surface for an individual's health potential. Health then becomes the trajectory across a three dimensional potential space. We posit that the fractal character of the surface changes over a lifetime. The new definition of health advances the biopsychosocial metaphor. It better describes behaviors of health at different stages of life. It provides new insights and suggests new predictions which one can make about human health and more specifically how it changes over a lifetime. Chaos and complexity theory are fundamental to this revolutionary new understanding of health to advance the quality of health care.

The Friendship System and Chaos Theory
Rita M. Weinberg
National Louis University

Friendship is a primary relationship between two (or more) people. This appears to be a simple system of people who trust one another and who want to spend time together. In Chaos theory, it is a self organized system which is usually open, involving exchange of energy, material and information between members. Primary requirements of close friendships are the openness and closeness between participants. Self-similarity exists as well as shared ideas and perceptions. What serves as attractors of friendship formation and its maintenance? The main attractors appear to be the friend(s) themselves as well as the relationship between them. Individuals are drawn into each other’s attractor basin and into self organizing a new system. We explore initial conditions leading to a friendship, such as shared experiences, propinquity, or the challenge of making a friend. At some point, bifurcation changes a relationship from a casual acquaintance into a close personal friend. What are the roles of drivers-personal experiences, personality characteristics, or the self system in friendship relations? What is the impetus to self organize into a close friendship? Adolescents especially are drawn to be close, to spend more time with their friends. Friendships can lead to convergence, coupling or entrainment. Does the self-organized system account for gradations between ‘a’ friend, ‘good’ friend, ‘close’ friend, ‘best’ friend, ‘false’ friend? What stabilizes or de-stabilizes the friendship relationship system; where are the boundaries, the limitations?

Connection Between Daily Stock Market Dynamics and Brokers’ Blood Pressure: New facts and Old Questions
Anatoly Zhirkov
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Harmony and life Association
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Harmony and life Association and Research Institute for EMC
Earlier this year,we presented data about interconnection of stock market and brokers blood pressure complex parameters (INSC,Tokyo). The aim of this work was to research some mechanisms of this connection. We examined dynamics of stock markets (SM) as Dow (DJI), S&P (US) and RTS (RUS) indices daily moving and blood pressure (BP) of male brokers of different age in Saint-Petersburg during RTS and NY stock sessions. We have shown correlation between stock market dynamics and BP. Parameters of correlation were non linear. The higher correlation of parameters was revealed for quick movement of SM. They depended on brokers’ age, week day,

emotional parameters of psychological tests and BP level. It was suggested that psychological factors may determine professional decisions and the same mechanisms are well known in BP regulation. Recently data about influence of sex and stress hormones levels of traders decisions was published. Our psychological research match this point of view.

More investigations are nessesary to explore this so-called Zhirkovs phenomenon. Latest publications about common mathematical laws of finance and biology systems functions may be used for this purpose. The first results had shown that researching connection between of brokers' hypertension and stock markets should be an important part of the investigation.

About our Cover Artist...

Understanding the Lights of Taverna

by Gian Paolo Prandstraller
Professor of Sociology, University of Bologna

To interpret Attilio Taverna, I would like to choose an epistemic approach, that is to locate this artist within the effort of "getting to know reality," an effort that inevitably interests all of us. I do not believe that a strictly aesthetic glance can explain the work that he has undertaken or allow the understanding of what he is trying to achieve.

It is a common notion that art has been for almost all its life a modality of representation. It has diligently conceived its object reproducing nature as the eye sees it, even if through several subjective modifications. The nature, from which art has borrowed, is the one that for centuries has integrated the perceptive reality, the land, the landscapes, the figures of human or other kinds, the sky, the sea, the clouds and so on.

"Probability of a Pulse Between the Kosmos and Chaos"

An identity only recently denied has been produced/happened between the "object" of the art and "nature." A nature of which artists have come to discover, with time, new and unknown aspects, even if they did not abandon the idea that these aspects were a part of the body located under the control of the senses. Even under a social point of view, art has undertaken the job of reproducing the natural existence, and through the proof of that, it has performed several functions like illustrating actions of important people, facts of religious history, features of persons, and similar functions. Functions that if we want are secondary to the human activities dedicated to survival but that, through the notion of "form," were fully within the field of "knowledge." Art has been an investigation concerning the form, the outline of natural identities, the recipients within which are collected the various parts of reality.

For a very long time, art with its specific means has tried to find an answer to the question "what constitutes reality?" a basic question in the cultural experience of humans. The answer has been: the visible forms of reality are these and those, this is one aspect this is another one. This approach, which we could call representative, was in large part abandoned by artists at the beginning of this century; and the most syntomatic mode of the abandonment has been giving up on the idea of "form." Art has destroyed form in several ways, all known by its recent history: destroying the figure and messing up the parts that comprise it, forcing within abstract lines the outlines of the object, emphasizing phenomena that do not obey to any rule, underling the randomness of the possible events, having colors preempt the line, using uncontrollable automatisms, etc. The decision of art to abandon form has appeared during the century, to be substantially incontestable.

It did away with nature in the way we perceive it with the senses and as a consequence has assigned to the artist enormous discretion. By eliminating the form I will call naturalistic, the artist has become a true and proper arbitrator of the intrinsic essence of reality. Reality has been transformed into something completely subjective, created exclusively by the artist. At this point it is no wonder that the "act" of the artist has become the true experiential field of art; being no more a representation of reality but rather an outpouring of the internal vitality, of the turmoil inside the artist. From here derives the tendency and the impulse to transform artistic action into pure simple "performance," intrinsically identical to any other action of life that humans have to undertake to remain on earth. From here, derives the identification of art with everyday life that arises in the second part of the century; for this reason accomplishing an action in art, being present as identifiable subjects on the canvas or in the sculpture, being photographed as living statues, leaving weak remnants of ourselves, accomplishing some actions of importance, all of this is art.

At this level the old concept of "death of art " dissolves into the new concept that art is nothing else than life, with the thin distinction of that "sense" that characterizes the conscious expression of life, left naturally to the artist. After arriving to such a conclusion, it becomes logical to give artistic value to any object, as many artists learn to do - from the ironic lesson of Duchamp - taking for their own the formae mentis of the antique animists that assigned a soul to the forest, to the river, to the volcano, to the tree trunk, elevating, for example, this last one in a totem pole, to an object loaded with value and supernatural peculiarities. Thinking this way, the question "what constitutes reality?" remains as we would say hanging, given that reality that counts is no longer the natural one, but rather the one that the artist - animist - is able to impose upon an object of which what matters is no longer the true form but the sacred charisma imposed by the same artist.

Let us now return to this crucial question, and ask ourselves if the contemporaneous science has added any new possible answers when compared to the times in which reality was offering itself in its macroscopic aspect. In my opinion, the answer is positive. It is natural to identify in “quantum mechanics,” the physics of the elementary parts introduced by Plank at the beginning of the century, added to the “relativity theory“ by Einstein, a vehicle of a new way to see the structure of reality.

Being a way of discovering an infinitesimal reality and of establishing the characters, this derivation of the physics represents an entrance to the “intrinsic form” of what exists. And this form is all to be explored, an open field of investigation, very attractive, even seductive. Well, this is the place to which Attilio Taverna addresses himself - I am finally talking of him - whose research, for this reason, must be interpreted as a tentative to visually penetrate the “quantum reality “ that you cannot see with the naked eye even if it forms the-in-depth tissue of every identity. Taverna proposes to observe it through the expressions of painting, and it is here the radical risk of this tentative, given that now that are well known means for that purpose, the technological means with the contemporary person is provided, like the machinery used by the physicians, the computers and so on.
The challenge of Taverna is here: to utilize painting as an instrument of investigation of the “quantum world,” even knowing how limited the instruments of painting are.
Such an undertaking of risk is nonetheless motivated by Taverna in the idea that painting can “aesthetically see” better than science the “quantum space possible, “the geometric declinations of that context, the infinite modulations of the element that makes it visible: the light!

Science investigates this space through its equations, through a mathematical approach that emphasizes its formal relations, without offering its vision. The equations in fact are not visions. The particle accelerators show trajectories, networks of signs that indicate the existence of the particles, but once again they do not offer an open view of the reality constituted by the particles. The painting instead can have access – says Taverna – to the concealed world of the new forms, to the complexity of that invisible that has now become visible. And if art does not take advantage of this supreme opportunity to become a transit toward the mysterious reality of “quantum,” it has fewer paths in front of itself. In fact, the other road, to be a performance and life, cannot maintain its charm for a long time. It can even become the indefinite fall of a time full of falls in which everything is homologated to the vital flow and in that way risks to drown in it.

For this reason, the intention of Taverna is not a gamble, but a conclusion of a reflection on art, developed in a moment in which, in front of an art transformed in life philosophy, it is necessary to open to the idea of art as penetration and knowledge of what has not been yet represented. It is at this level - affirms Taverna – that art plays its role, its reason for being.

It seems understandable that, moving along this line, Taverna does not feel with the normal sufferance the problem of originality as the “invention” (a problem that nowadays influences more than anything else artists that derive from invention both their personal identity and differences with other artists). Something else torments him: an urge to discover, given that he has in front of him an unknown reality, noticed and penetrated only in this century from the science of the elementary particles.

A similar reality is the object of cognitive acquisitions that were not possible before and that have now become readily accessible. But to “discover,” we need to take into account what the others have discovered before us. As everybody knows, science has until now proceeded, according to principles called natural laws; their listing has been nothing more than an ordering criteria on the basis of which it was possible to forecast the phenomena. In an absolute and eternal way, it was affirming the classical physics - from Newton to Laplace. Nowadays the natural laws are considered probabilistic, but that does not mean that the principles have ceased to be important. They still are important, and the “searcher,“ Taverna, knows it quite well. And, in fact, in his effort to know reality, he relies on principles set forth by scientists of this century. Before naming them it is necessary to say that they are the support to a conviction that, once again, legitimizes Taverna’s effort.

The conviction: in our century, Physics eclipses - if we can say so - the substance to become an eidetic experience; and it is the “way of going” or vectorial direction of the light that is beyond this change. Richard Feynman, as our artist remembers, gets awarded a Nobel prize in the sixties because he has found a way of representing the interactions between the elementary particles and the “way light moves.” He has created the “Quantum Electrodynamics Theory“ that predicts the interaction of light with substance, how the photons get converted into electrons and vice versa. Here is then, from Taverna’s point of view, the intersection between the science of the elementary particles and light tout-court. It is light, he claims, that is the primary element that the artist has to analyze; in the ways indicated by recent “quantum theory.”
So the antique conception of Plotino, that was transcending the platonic theory of Beauty through the postulate “you cannot give a theory of Beauty without involving light,” is elevated by Taverna (through an excursion that we could call a brief history of light from antiquity to our times) to an investigation of light as the revealing element of the quantum nature of reality. An investigation that has a precise goal: make live spatial eidetics that were not there before, reveal spaces the existence of which we did not suspect the possibility of before. In other words: the goal is to point to the discovery of the unknown spaces, whose vibrations filled with breakage, broken rhythms, strange contortions, asymmetries that are ready to be investigated.

The confrontation of Taverna with geometry, “the measure of entities,“ but in a new sense, happens in this terrain. Investigating reality means now understanding geometric essence that takes into consideration the hidden reality. This cannot be done without considering certain principles described by quantum physics, and keeping in mind the impossibility of predicting the trajectories of particles with certainty. The principles by which Taverna becomes the visual applicator are: (a) “the principle of indetermination,” of Heisenberg, according to which throwing a quantum of light over a particle in order to identify its position, you alter the state of the particle, with the consequence that it becomes impossible to establish its direction and future positions with certainty; (b) “the exclusion principle of Wolfgang Pauli,“ according to which in the same quantum place you cannot have two particles with identical quantum characteristics; (c) “the principle of overlapping of phases in space of Hilbert,” that identifies the place - not place - where the particles appear.

Such factors already give the measure of how difficult is the result of their movements. But if we add to them the concept of “Chaos“ (the idea that the evolution of trajectories is not exactly predictable), we have a more adequate measure of the uncertainty that the researcher must face if he wants to represent the profound reality in the frame of the vectorial dimension of light.

And this in fact, by what I can understand, the drama in which Taverna finds himself; he must manage himself between physical principles and chaotic movements. It is possible to notice in him the effort to overcome the contradiction between the concept of unpredictability and one of Form: if, in fact, it is not possible to predict the road that the particles will take with certainty, how is possible to set the form deriving from their trajectories? It is understandable that Taverna is looking for a way to get out of that antimony. On the theoretic level, it seems to me that the most solid argument to which he can anchor his approach is the concept of "negative entropy, " that is, that in physical existence there is a trend that opposes or fights the total chaos, creating a new, unknown order, after the preceding order has reached its end. It is like saying that in every phase structure of a new kind—we imagine them more complex than the preceding—are possible and consequently created new forms. This concept seems to represent to Taverna an escape road to defeat the impossibility of predicting, and so of representing the quantum dynamism of reality.

On the pictorial level, instead, he faces the above mentioned difficulty through operative means whose aim it is to interpret the ambiguity and the never-ending complexity of all that exists. Without thinking of representing them all, I will mention the following: “the symmetry breakage, the squareness, the perceptive transparency, the use of color to assert differences.” These lines sustain both his concrete realizations and his differences as an artist from the other artists. The symmetry breakage is conscious antinomy with respect to that system of order and relation that is present in the majority of the traditional painting. Symmetry means that to each form corresponds to the hypothesis that the elementary particles describe, in their rotation, overlapping, vibration, a germinal form that gives a minimum of structure to what would be otherwise completely without a form.

As to the perceptive transparency, it is a psychological concept of perception for which we are allowed to catch several dimensions of the space, several orders of level, through a glance addressed only to the superficial (Taverna declares in this point his debt toward Metelli, a psychology professor of the University of Padua, who gave important contributions on this subject). As for the color, there is nothing better than looking at the paintings of our artist to understand how he uses it to exalt the distinctions that light emphasizes; I believe that in Taverna the color is a profound maker of ontological differences, a never-ending revealer of complexity. Without the color, the entire pictorial operationalization of the person who tries to perform such a task becomes impossible. And this is, luckily, a typical attribute of painting.

All the theories from which his art finds a justification, for this reason, cannot substitute the direct vision of a painting. It is in what we call “phenomenology” the final explanation of his artistic thought; giving a definite form to what appears and that is seen thanks to the light; the base of all appearances and all differences.

Not certainly an indication of original truth of what appeared, but a significant mixture of sensible elements, of forms. Through it, it is possible to discuss the differences of Taverna from the all the other artists that before him have pointed their sight toward the new reality, perceiving rationality, or just with the instinct its appearance on the art scene: men like Malevitch, Mondrian, Max Bill, Dorazio, Vasarely, that Taverna calls “my uncles, my relatives,” and to whom he recognizes his intellectual debt even if affirming his originality in the effort to understand the complicated and ambiguous perspective that contemporary science has put in front of us.

Naturally, all of this would be pure abstraction if in the level of the sensorial realization an imaginative component would not intervene; it does not leave but instead reinforces intensively the cognitive intent. Such a component (nowadays admitted and recognized also in the sophisticated world of science) gives for natural vocation the best of itself in art.

Nonetheless the characteristics of Taverna‘ s imagination is that it is based on ideas, it is built on principles, and for this reason is never purely arbitrarily, free, and irresponsible. And this is what makes more significant the intervention of the Artist in a field still so distant from the common sense, a field that he not only indicates but also cultivates laboriously because he has seen clearly the fundamental point: there is in front of us a “new reality,“ all to be explored, all to be appreciated.

“Sliding Door”