Society for Chaos Theory in Psychology & Life Sciences

NEWSLETTER

Vol. 21, No. 1
October, 2013

An Invitation to Participate

INSC 2014

6TH INTERNATIONAL NONLINEAR SCIENCE CONFERENCE

Radboud University
Nijmegen, the Netherlands, March 20-22, 2014

The principal aim of the **International Nonlinear Science Conference** is to provide a scholarly environment conducive to promoting exchanges between an array of disciplines to facilitate research and related academic activities in collaboration with colleagues worldwide.

The topics covered by the conference include applications of ***nonlinear dynamical systems theory*** and techniques to problems encountered in any area of the behavioral, social and life sciences including psychology, sociology, economics, management sciences, anthropology, aesthetics, education, biology, physiology, ecology, neuroscience and medicine. One or more of the following nonlinear concepts must be an explicit part of the presentation: *attractors*, *bifurcations*, *chaos*, *fractals, solitons, catastrophes, self-organizing processes, cellular automata, agent-based models, network analysis, genetic algorithms and related evolutionary processes, econophysics, dynamical diseases,* or closely related constructs. The broad mixture of the disciplines represented here indicates that many bodies of knowledge share common principles.

Contributions from other disciplines such as computer science, mathematics and engineering are also welcome provided the main focus of the paper is an application of nonlinear science in the behavioral, social or biological sciences.

Submit Abstracts for papers, posters, and symposia to the INSC2014 website:

www.societyforchaostheory.org/insc/2014

Deadline December 31, 2013

"Early Bird" submissions will begin to receive responses soon after Nov. 30.

Conference Committee

Anna Bosman, *Conference Chair, Radboud University;* **Jose Navarro,** *University of Barcelona;* **Dimitrios Stamovlasis**, *Aristotle University;* **Stephen Guastello,** *Marquette University;* **David Pincus,** *Chapman University*.

Sponsored by

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The Society for Chaos Theory in Psychology & Life Sciences

Loads of Good News from SCTPLS Members' Labs

By David Pincus, Past President, SCTPLS Associate Professor, Psychology, Chapman University

This issue we had a great *in-pouring* of news from our fellow members who are pushing the boundaries of *normal science*. At the most basic level, we each are connected to one another by our work. Yet unlike most professional organizations, we also share a number of deep scientific, phenomenological, and epistemological values. For example, we prefer a 'catch and release,' rather than a 'slice and dice' approach to scientific inquiry. In psychology, we may each draw this value back to the often overlooked teacher of the Gestaltists in psychology, Carl Stumpf. Further back, we may draw our lineage to Dionysian over Apollonian philosophies from Rome. Whatever our roots, this distinction in science and philosophy has always been present. In plainer terms, we as a group prefer to study nature as she naturally unfolds, rather than torturing her to submit to the agonies of some scientific preconceptions, such as: proportional cause-and-effect relationships, simple mean differences, or to the arbitrary statistical borders imposed by strait lines.

In addition to our shared appreciation for *real science* applications to *real nature* we share a number of frustrating experiences, which steel our resolve, build our unique professional identities, and bind us together as a society of scholars. How many of us have struggled as students to find a mentor who would guide us in the development of our interests in beauty of variance and natural curves? How many of us have run into colleagues that don't get it? How many of us have run into politics that reward conformity, justified by blind devotion to H-statistics, journal impact factors, and results that must be described in simple sound bites? How many of us have run into journal editors that insist on publishing only what their readers already know? How many times has each of us struggled in the boredom of *incremental* scientific discovery? The scientists whose work is listed below are doing work that is definitely non-incremental. They are field movers. I for one, am proud to share an organization with them, and grateful to have had the chance to hear what they are up to.

To each of you, please do send your latest lab news to me each quarter (send to pincus@chapman.edu). We would really like to keep this feature going strong. We are each of us nonlinear scientists, which makes us an interesting, yet quirky, bunch. If we don't read, appreciate, reflect upon, and cite each other's work, then I ask you - who will?

Tracking the Nonlinear Nature of Work Groups

Teresa Rebelo and Paulo Renato Lourenço, Faculty of Psychology and Education Sciences, University of Coimbra, Portugal; and Isabel Dimas, ESTGA – University of Aveiro, Portugal

In line with the sociotechnical approach, we regard groups as complex, dynamic and adaptive systems composed of two subsystems (task and socio-affective). In their lifetime groups transform and develop different ways to operate and adapt to their contexts. This process – group development - is far from linear. Therefore, a deeper understanding of how group behaviour changes and transforms over time require the adoption of perspectives and methods based on a nonlinear approach.

Our research is focused on the analysis of workgroup development through the Nonlinear Dynamical System (NDS) theory and methods. Specifically, this research has two main goals: i) to analyse how some group processes/emergent states (namely group culture, conflict and conflict management, team learning, leadership, communication, interdependency, cohesion, trust, team potency, team commitment, motivation and satisfaction with the group), and their interaction, influence the group's functioning over time; ii) to understand in more depth what the relationships are between those group processes/emergent states and how they influence different group evolutions.

To fulfil the aims proposed, we include in our research two longitudinal studies with Portuguese workgroups. The first study, already in progress, consists of about 30-35 project workgroups made up of college students of Engineering and Technology. We had the chance to analyse these work groups during their whole lifetime, from their foundation to its end, including the evaluation of their work. The data collection regarding the processes/emergent states abovementioned has been carried out through a self-report questionnaire and also in a meeting with the whole team, where members, together, answered a questionnaire by consensus. The second study will be focused on about 30 project teams in firms. The goal is to test and expand the results of the first study, with data collected in teams operating in companies. So, for this study, we intend to retain the variables and the models with the most promising results in the first study and test their behaviour and fit with these "real world" teams, which have some similar and some

different characteristics. In this second study we also want to collect data more often to increase its quality. Thus, we plan to inquire individually each team member about group processes using PDAs at least once a week, and to meet each team once a month where, collectively, group members will answer a questionnaire by reaching a consensus.

The Functionality of Complex Brain Networks

Dominic E. Nathan, BioElectronics Research Lab, Marquette University; Stephen J. Guastello, Dept. Psychology, Marquette University; Robert W. Prost, Dept. Radiology, Medical College of Wisconsin; Dean C. Jeutter, BioElectronics Research Lab, Marquette University

Complex network analysis based on graph theory is a multidisciplinary approach that has been translated to the study of brain network organization [1]. Through the use of complex network analysis measures, the dynamics of functional brain networks and how they change can be quantified. This critical feature enables the parsing of meaningful associations relating to functional connectivity in the brain that have neurobiological implications. Furthermore, the ability to quantify brain networks creates a platform for the development of potential functional imaging biomarkers to assess the extent of injury or disorder, the effects of treatment and subsequent recovery. Such features are of particular relevance to upper extremity rehabilitation, and could add benefit to understanding recovery, cortical reorganization and transfer of skill, especially in individuals suffering from chronic physical dysfunction such as stroke, spinal cord or traumatic brain injury. Complex network analysis may provide answers to the following key questions: (a) How is motor skill as dictated by handedness represented in the brain? (b) What are the convergent and divergent, if present, neural correlates of movement imagery and movement execution? (c) To what extent does each brain region contribute toward the planning and execution of voluntary movements? (d) How are the within region network dynamics influenced by the type of task. Our preliminary work with complex network analysis revealed the ability to quantitatively describe several networks that encompass the cerebellum, parietal cortex, thalamus, prefrontal cortex and SMA [2]. Our results also indicate that network topology of task planning and motor skill are indicative of task specific interactions between regions [2] that alter their connections during movement execution, presumably to accommodate the shift in the motor paradigm. Some of these findings compliment our prior research on motor control strategy using orbital decomposition [3], and we will be working on expanding these two analysis techniques to further understand between region interactions using tools such as entropy and mutual information. While promising however, more work needs to be done to determine how robust these motor control networks really are in a larger subject population and in particular with regards to injury. Furthermore, we will also be exploring within region interactions to ascertain how strategy and the medication of movement influences local networks. For more information please contact Dominic Nathan at dominic.nathan@mu.edu

1. M. Rubinov and O. Sporns, "Complex network measures of brain connectivity: uses and interpretations", Neuroimage, pp. 1059-69, vol.52, no.3, 2010.
2. DE. Nathan, SJ. Guastello, RW. Prost and DC. Jeutter, "Exploring Functional Networks of the Brain Relating to Upper Extremity Motor Skill Using Graph Theory", Society of Chaos Theory In Psychology and the Life Sciences 2012 Conference Presentation, 2012, Baltimore, MD.
3. DE. Nathan, SJ. Guastello, RW. Prost and DC. Jeutter, "Understanding neuromotor strategy during functional upper extremity tasks using symbolic dynamics", Nonlinear Dynamics Psychology Life Sciences. Pp. 37 – 59, vol. 16, no. 1, 2012.

All Things Topological

Jonathan Butner, Department of Psychology, University of Utah

We are currently writing up an application of the cusp catastrophe model to a portion of the NASA budget as a way to understand uncertainty and budget overruns. What is particularly interesting from a statistical view is that the control parameters are unknown and thus we utilize random effects in a multilevel model as a stand in with great success. This is leading us to request a funded extension of our grant with NASA where we hope to integrate human factors and dynamical systems modelling techniques for management.

We are also experimenting with mixture modelling and structural equation modelling as an exploratory way to estimate topological features from complex time series that are not conducive to time delay reconstruction. We have applied this to understanding physiological differences in the two hours leading up to sleep (as a function of pre-sleep arousal) and adolescent-mother interactions in managing type 1 diabetes. Our hope is to provide a complete exploratory approach to topology that can even be used to identify potential control parameters as opposed to other variables that move with the system.

Clinical Application of Nonlinear Dynamics: Improving Patient Outcomes using Variability

By Sara Myers, PhD and Jennifer Yentes, PhD

As trained biomechanists, our research building has all the common tools of biomechanics – force platforms, high speed cameras, electromyography and many others for recording information on human movement. However, we differ from other scientists in that all of our research is patient-oriented and contains a common thread of questions centered on human movement variability. The clinical focus stems from our desire to use our expertise to help others and the practical fact that most federal funding is directed to improve public health and function in some way. Our theoretical approach in the study of human movement variability heavily employs Chaos Theory. We operate under the idea that variability is intrinsic in all biological systems and is representative of a healthy state. In Stergiou et al. 1, we proposed a new theoretical perspective to explain movement variability as it relates to motor learning and health. This theory contends that healthy states are associated with an optimal state of movement variability. This variability has a distinct form and is chaotic in nature. Chaos provides with the ability to be adaptable. Less than optimal movement variability characterizes biological systems that are overly rigid and unchanging, whereas greater than optimal variability characterizes systems that are less adaptable to perturbations, both of which can be associated with unhealthy states (i.e. chronic disease).

Under this new theoretical perspective, we have investigated movement variability of older individuals and those with movement related disease and disabilities using common tools from nonlinear dynamics. Here we will present a sample of our work and how our research is moving from the research setting towards improving clinical practice.

Peripheral arterial disease (PAD) is a consequence of atherosclerotic blockages in the lower extremity arteries that results in gait dysfunction and muscle pain known as claudication. Claudicating patients experience reduced mobility and increased risk for falls. PAD is an under-recognized disease, the leading cause of amputation worldwide, and associated with the greatest impairment in physical function and occurrence of cardiovascular events as compared with other cardiovascular diseases. Treatment of patients with PAD attempts to restore lower extremity function and prevent disease progression. Current therapeutic options include pharmacotherapy, exercise therapy, and revascularization, accompanied by lifestyle changes and risk-factor management. Current guidelines for management of PAD are limited by inadequate tools for assessing patient functional status (i.e., questionnaires, visual observation of walking). This limitation fuels a debate regarding the best functional outcome measures with which to assess treatment success and by the need for comprehensive evaluation of treatment strategies. Thus, work in our lab sought to evaluate lower extremity function in patients with PAD with tools from nonlinear dynamics.

In the first study, we collected joint flexion and extension kinematics while nineteen symptomatic patients with PAD (age: 63.6 ± 9.8 years; body mass: 82.1 ± 18.5 kg; height: 1.71 ± 0.06 m) and 17 healthy matched controls (age: 65.2 ± 12.5 years; body mass: 82.0 ± 25.9 kg; height: 17.3 ± 0.08 m) walked on a treadmill 2. Patients were walking prior to the onset of claudication pain. Relative joint angles were calculated for the ankle, knee, and hip flexion and extension time series and stride-to-stride variability (i.e. gait variability) was calculated from at least 30 consecutive footfalls. Variability was expressed using the Lyapunov exponent, standard deviation, and coefficient of variation. Independent t-tests were used to compare gait variability between the groups. Results demonstrated that patients with PAD had significantly greater Lyapunov exponent values and coefficient of variation values for all joints, and higher standard deviation values at the ankle and the hip (Figure 1; $p<0.05$). These results suggest that even prior to the onset of claudication pain, patients with PAD experience significant deterioration in gait variability and lower extremity function.

Further studies have been conducted to determine the diagnostic value of gait variability parameters by examining the specificity and sensitivity in identifying individuals with PAD 3. Gait variability of 30 healthy older controls (age: 60.1 ± 8.0 years; body mass: 86.6 ± 16.1 kg; height: 1.76 ± 0.08 m) and 30 patients with PAD (age: 63.8 ± 9.10 years; body mass: 81.1 ± 14.7 kg; height: 1.72 ± 0.05 m) was assessed using the same procedures as the above study 2. A receiver operating characteristics curve analysis was performed to determine the specificity and sensitivity of gait variability parameters and to determine optimal cut-off values for separating individuals with PAD from healthy individuals. Several gait variability measures were able to classify patients and healthy controls into their correct group, including the Lyapunov exponent of the ankle, knee, and hip flexion/extension time series. This data show that gait variability parameters have potential diagnostic value, with some having up to 90.0% probability of identifying patients with PAD.

Our laboratory is now investigating the most beneficial ways gait variability could be implemented in clinical practice. One of those ways could be to predict which patients benefit most from invasive surgical intervention. Pilot data in three patients has been promising. Specifically, post-surgery improvements in the Lyapunov exponent (patients moved towards the level of healthy controls) are consistent with the improvements in the clinical domains of blood flow, quality of life, and functional walking distances. Based on our work thus far, gait variability is a realistic tool

that could be an indicator of multiple domains of patient status and be used to predict functional improvements to expect post treatment. This is a shift in the current clinical paradigm from using blood flow and symptom report to evaluate treatment success to an outcome arguably most important to the patient – functional status. We are continuing this work so that practical and meaningful ways to assess gait variability in a clinical setting can be found.

This approach of evaluating functional status is not limit to patients with peripheral arterial disease. Other work in our laboratory is moving through the same process to investigate functional mobility in patients with chronic obstructive pulmonary disease (COPD) 4. Preliminary work evaluated amount (standard deviation and coefficient of variation) and temporal structure (sample entropy) of variability from 238 steps of walking at five different speeds in patients with COPD and healthy age-matched controls. Subjects were tested at their self-selected walking speed on a treadmill, along with ±10% and ± 20% of that speed. Step length, step time and step width time series were then generated for all steps. Results demonstrated that patients with COPD demonstrated more regularity at all speeds in their step width as compared to the healthy control group. This means that patients with COPD display a more wide and periodic pattern that lacks flexibility as compared with their healthy counterparts. Thus, the overall functional mobility of patients with COPD is limited in the medio-lateral plane – the direction that is implicated as a predecessor to falling. Further work in this area will investigate whether these gait variability changes explain why patients with COPD have a higher incidence of falls compared with individuals without COPD.

In conclusion, our laboratory is investigating human movement variability though nonlinear dynamics to understand unhealthy behavior that results from a clinical condition. Furthermore, Chaos Theory is in the foundation of our approach that leads in the development of improved functional outcomes in various patient populations.

1. Stergiou N, Harbourne R, Cavanaugh J. Optimal movement variability: A new theoretical perspective for neurologic physical therapy. J Neurol Phys Ther. 2006 Sep;30(3):120-9.
2. Myers SA, Johanning JM, Stergiou N, Celis RI, Robinson L, Pipinos II. Gait variability is altered in patients with peripheral arterial disease. J Vasc Surg. 2009 Apr;49(4):924,931.e1.
3. Myers, SA, Pipinos, II, Johanning, JM, Stergiou, N. Age, vascular occlusion, and peripheral arterial disease differentially affect variability of gait patterns. 2011.
4. Yentes, J. Rennard, S., Pipinos, I., and Stergiou, N. Functional outcomes associated with gait in patients with chronic obstructure pulmonary disease. [dissertation]. 2013.

Psychological Dynamics Lab at the University of Montana

David Schuldberg

These are exciting times in our lab in Missoula, Montana. Members of the research team are at work on diverse projects that have a unifying theme of dealing with change over time. For myself, I am learning and accumulating more and more techniques for dealing with such data where time is a variable.

Very interesting work is being done by the three graduate students currently in my lab. Ms. Lia Harrington is putting together an M.A. project investigating creativity in children with features of autism spectrum or schizotypal disorders. She is interested in convergent thinking processes and their relationship to creativity and is developing an assessment methodology using a computerized Tower of Hanoi task and concurrent measurements of affect. She is exploring data analytic techniques using State Space Grids as a way of examining the temporal properties of affect and creative problem-solving.

Daniel Dewey is beginning data-gathering on a project using Ecological Momentary Assessment methodology to examine fluctuations in affect and PTSD symptoms in young adults who have recently experienced a traumatic event. It is been interesting thinking about data analytic strategies to use in this particular situation. The primary hypotheses in his work can be addressed using traditional spectral analysis techniques, as well as hierarchical linear modeling. We are also looking into ways to employ nonlinear data analysis techniques.

Ecological Momentary Assessment represents an excellent way to gather fairly intensive longitudinal data in psychology. A thorny methodological problem for those of us interested in nonlinear techniques involves the fact that data points are not evenly spaced in time. In general, these techniques utilize random prompts which are also limited to specific times during the day. While a variety of interpolation techniques are available, this is a problem we are still working on.

Jenny Wills has been evaluating the effects of on-the-job traumatic events in the trajectories of self-reported personality characteristics of police officers, using a longitudinal methodology. Her participants were assessed in pre-employment interviews, and they later responded to a personality inventory again as part of her study. Her M.A. paper examines the possible effects of trauma and stressful event exposure on changes in levels of these traits; even with two time points, the data analyses are very interesting. She has come up with important results regarding self-rated personality change with time and the potential roles of life-events.

For myself, I am continuing to work with Dr. Richard Field on further explorations of Oregonator-like models of stress and social support processes, and this is proving to be very educational for me. I am also sitting

in on a course given jointly by our Math Department and School of Business on "Streams" methodology. This term refers to intensive real-time data analytics using "big data." I want to alert colleagues in SCTPLS that the area of real-time data analytics represents a tremendous opportunity for those of us interested in time as a variable, in psychological measurement, in nonlinear modeling, and in prediction methodologies where new data are taken into account as they arrive.

I am delighted to be working with a crew of excellent students and colleagues across a number of departments and programs. An overarching concern is continued development of both linear and nonlinear data-analytic techniques, as well as testable nonlinear models, all involving nonlinear dynamical systems concepts and methodologies. It is an exciting time to be doing this work.

Nonlinear Dynamics Help Health Researchers Understand Intimate Partner Violence

David Katerndahl

The research team (David Katerndahl, Sandra Burge, Robert Ferrer, Robert Wood, Johanna Becho) in the Department of Family & Community Medicine at the University of Texas Health Science Center-San Antonio studying intimate partner violence (IPV) just received 2 grants to further their work on the application of complexity science to better understand IPV. The first was obtained from the National Science Foundation and looks at nonlinearity in women's daily decision-making concerning taking action (leaving, seeking help, seeking legal action) in violent relationships. The second was obtained from the National Institute for Alcohol Abuse and Alcoholism and will use state space grids to investigate the relationships among husband- and wife-perpetrated daily violence and alcohol use.

Towards the Development of Quantitative Descriptions of the Neurodynamic Rhythms and Organizations of Teams

Ron Stevens and Trysha Galloway, UCLA School of Medicine / The Learning Chameleon, Inc.

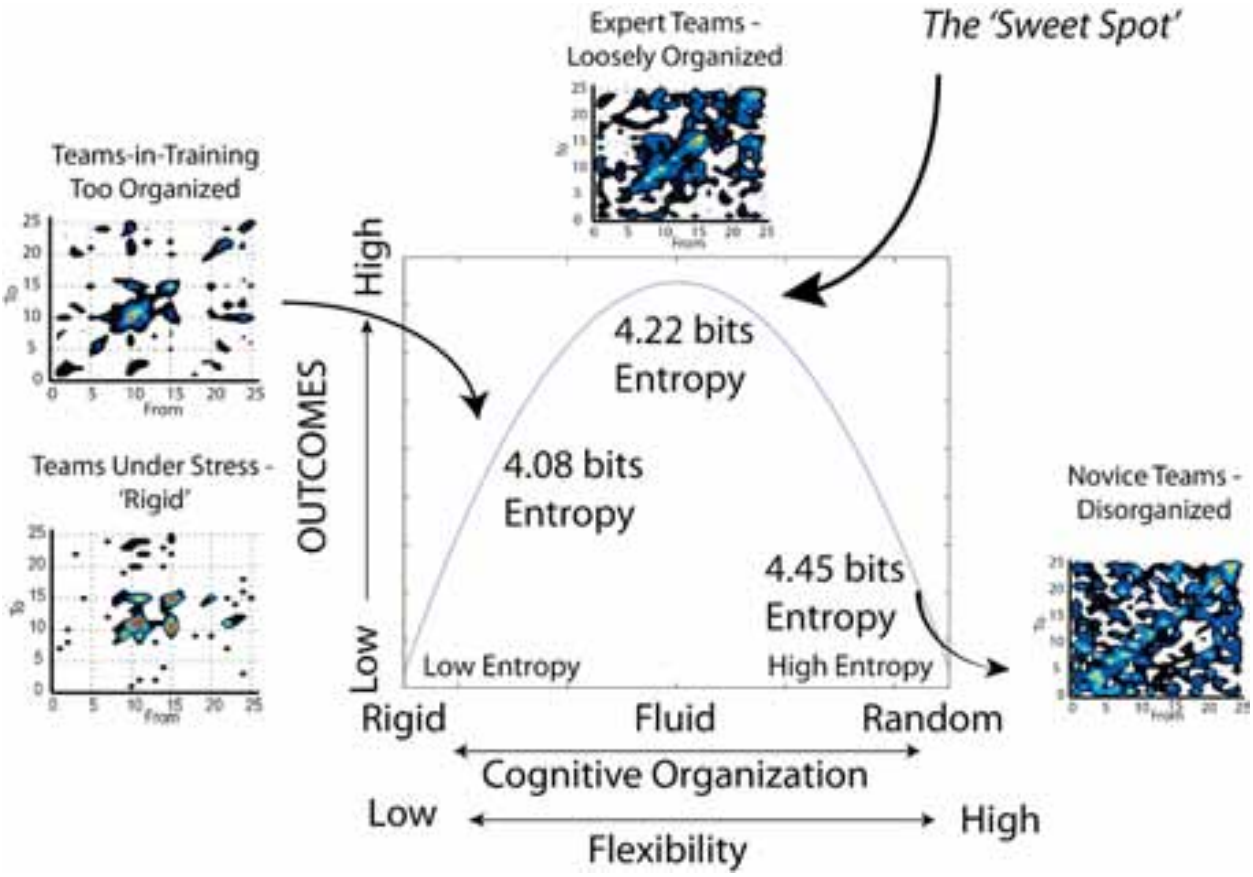
The ubiquity of teamwork in the workplace makes its optimization imperative, from the initial selection and training of teams to the on-the-job formative guidance and feedback. However, unlike the performance evaluations of individuals where estimates of ability are common, there are few measures and models for rapidly and quantitatively comparing across teams to help direct this guidance and feedback. Without the objectivity such measures could provide it is difficult to approach deeper contextual understandings of team concepts like robustness and resilience, and even seemingly simple questions like 'How is this team doing?' can become difficult to answer.

At the 2013 meeting of the Human Factors and Ergonomics Society annual meeting in San Diego the authors presented *Towards the Development of Quantitative Descriptions of the Neurodynamic Rhythms and Organizations of Teams* that described an information and organization-centric approach for developing quantitative systems to evaluate team processes.

The framework is information centric in the sense that raw EEG measures are converted into Neurodynamic Symbols (NS) that each second shows the cognitive levels for each team member and the team as a whole. The NS data streams generated during teamwork have structure and within that structure statistical regularities exist which identify 'interesting periods' relevant to the team and teamwork. This framework is quantitative in that the level of proficiency of a team can be specified in terms of bits of information (see Figure below). This model was easily able to distinguish novice teams which had near random neurodynamics organizations from the more expert-teams which were more flexibly organized from a cognitive perspective.

The models developed are reliable, sensitive and valid indicators of the changing neurodynamics of teams around which standardized quantitative models can begin to be developed. The technology is intended for documenting how rapidly / well teams are progressing towards proficiency and expertise and for understanding why some teams function better than others.

These studies raise the very interesting question of how second-by-second neurodynamic fluctuations of individuals in teams are coupled over larger scales such that they can become reflections of a team's performance.



The Neurodynamic Organization of Teams. The x-axis plots low / high levels of neurodynamic entropy and relates them to the cognitive organization of the team ranging from rigid to random. These scales parallel team flexibility with randomly organized teams being more (too) flexible than rigid teams. The y-axis represents the team performance / outcomes. The transition matrices surrounding the curve plots the NS expressed at time *t* against time *t + 1* and provides an alternative perspective of the cognitive organization of the teams. Ideally teams want to be in the 'sweet spot' of cognitive organization having sufficient organization to efficiently complete the task, but also having the flexibility to respond to unforeseen problems.

Finding Patterns in the Electrical Storms of the Brain

Sifis Micheloyannis

Sifis Micheloyannis (PR, MD) has organized a Research Clinical Neurophysiological center in the University of Crete. He is working especially with children performing neuropsychological studies and EEG signal analysis. The signal analyses were in the beginning spectral. Then nonlinear analyses and graph theoretical tools are used. This laboratory has collaborations with other universities in Greece and in other countries to analyze MEG signals. 10 selected papers:

Klados MA, Kanatsouli K, Antoniou I, Babiloni F, Tsirka V, Bamidis PD, Micheloyannis S. A Graph Theoretical Approach to Study the Organization of the Cortical Networks during Different Mathematical Tasks. *PLoS One*. 2013 Aug 19;8(8):e71800. doi: 10.1371/journal.pone.0071800.

Dimitriadis SI, Laskaris NA, Simos PG, Micheloyannis S, Fletcher JM, Rezaie R, Papanicolaou AC. Altered temporal correlations in resting-state connectivity fluctuations in children with reading difficulties detected via MEG. *Neuroimage.* 2013 Jun 15;83C:307-317. doi: 10.1016/j.neuroimage.2013.06.036.

Smit DJ, Boersma M, Schnack HG, Micheloyannis S, Boomsma DI, Hulshoff Pol HE, Stam CJ, de Geus EJ. The brain matures with stronger functional connectivity and decreased randomness of its network. *PLoS One*. 2012;7(5):e36896. doi: 10.1371/journal.pone.0036896. Epub 2012 May 15. PMID: 22615837

Dimitriadis SI, Laskaris NA, Tsirka V, Erimaki S, Vourkas M, Micheloyannis S, Fotopoulos S. A novel

symbolization scheme for multichannel recordings with emphasis on phase information and its application to differentiate EEG activity from different mental tasks. *Cogn Neurodyn*. 2012 Feb;6(1):107-13. doi: 10.1007/s11571-011-9186-5. Epub 2011 Dec 6. PMID: 23372623

Dimitriadis SI, Kanatsouli K, Laskaris NA, Tsirka V, Vourkas M, Micheloyannis S. Surface EEG shows that functional segregation via phase coupling contributes to the neural substrate of mental calculations. *Brain Cogn.* 2012 Oct;80(1):45-52. doi: 10.1016/j.bandc.2012.04.001. Epub 2012 May 23. PMID: 22626921

Tsirka V, Simos P, Vakis A, Vourkas M, Arzoglou V, Syrmos N, Stavropoulos S, Micheloyannis S. Material-specific difficulties in episodic memory tasks in mild traumatic brain injury. *Int J Neurosci*. 2010 Mar;120(3):184-91. doi: 10.3109/00207450903585308. PMID: 20374085

Rubinov M, Knock SA, Stam CJ, Micheloyannis S, Harris AW, Williams LM, Breakspear M. Small-world properties of nonlinear brain activity in schizophrenia. *Hum Brain Mapp*. 2009 Feb;30(2):403-16. PMID: 18072237.

Micheloyannis S, Vourkas M, Tsirka V, Karakonstantaki E, Kanatsouli K, Stam CJ. The influence of ageing on complex brain networks: a graph theoretical analysis. *Hum Brain Mapp*. 2009 Jan;30(1):200-8. PMID: 17990300

Micheloyannis S, Pachou E, Stam CJ, Breakspear M, Bitsios P, Vourkas M, Erimaki S, Zervakis M. Small-world networks and disturbed functional connectivity in schizophrenia. Schizophr Res. 2006 Oct;87(1-3):60-6. Epub 2006 Jul 27. PMID: 16875801

Micheloyannis S, Pachou E, Stam CJ, Vourkas M, Erimaki S, Tsirka V. Using graph theoretical analysis of multi channel EEG to evaluate the neural efficiency hypothesis. *Neurosci Lett*. 2006 Jul 24;402(3):273-7. Epub 2006 May 5. PMID: 16678344

Minutes of the SCTPLS Business Meeting 8:00 am, July 27, 2013
Submitted by: Sara Nora Ross, Secretary

The meeting participation quorum requirements were met.

New year, new Society President takes the helm

Outgoing President Dave Pincus handed the figurative "leadership gavel" over to new President Steven Dietz to chair the business meeting.

Constructive review of conference thus far

With the business meeting situated at the beginning of the second full day of the conference, review of the conference as a whole with fulsome attention to lessons learned and suggestions for the future was not possible. The group did, however, exchange perspectives on the facilities at Portland State University's University Place Hotel and Conference
Center. Positives were hotel staff performance, menu and food service, and the convenience of having our lodging in the conference center. Feedback was positive toward the all-day pre-conference methods workshop approach used again this year.

Approval of committee reports

Stephen Guastello presented the verbal versions of the publication committee report and the Treasurer's report. Each report was unanimously accepted. Both reports are reproduced in this Newsletter.

Discussion of 2014 conference location options

Ideas for next year's conference location were discussed, including consideration of the pros and cons of airport convenience. The annual conference geographic region-picks typically cycle around locations in the east, in the west, and in the middle. 2014 is due for a mid-US location. It was concluded from discussing President Steven Dietz's ideas and connections with Trinity University that San Antonio was the number one pick for 2014 to pursue post-conference.

Nominations for 2014-2015 term of president

Jeff Goldstein continues to head the nominating committee. The floor was opened for nominations for the next president. A. Steven Dietz and Constance (Connie) Porter were nominated and their names will appear on the fall 2013 ballot.

Membership committee

The membership committee, an ad hoc committee, was re-approved by the members at the Business Meeting. Current committee members are Caroline Fielden, Adam Kiefer, and David Pincus. Caroline is doing local group Facebook in Australia. We also decided to put a "detour sign" in main fb site to web and to LinkedIn to increase traffic to the site. Adam is managing the Linked-in discussion group. David will be assisting in general membership development strategy.

Treasurer's Report
23rd Annual International Conference of the Society for Chaos Theory in Psychology & Life Sciences
July 27, 2013

This report summarizes the financial results for the Society for the fiscal year 2012 ending 31 March, 2013. The net returns for this year were $13,325 before applying encumbrances and $9,025 after applying allocations for the next year. SCTPLS has been running at a modest surplus consistently since June 1994.

The three main areas of operation were the annual conference in Baltimore, MD (Line A, Table 1), the International Nonlinear Science Conference (INSC: Line C) and the membership-journal activities (Line D). We did not hold an INSC this year; a positive net was recorded for the other two areas. The total attendance at the 2012 annual conference in Baltimore was 50. The attendance for the 2013 conference in Portland was 64. SCTPLS does not fund travel expenses for the Executive Committee members to the annual conference. Plans for the 6th INSC in Nijmegen, Netherlands are now underway.

Table 1. Financial results for FY 2012.

Project	**Net Income**
A. 2012 Conference in Baltimore	$ 541
B. Deposit on 2013 Conference in Portland OR	0
C. INSC conference	0
D. Membership fees, institutional subscriptions, book sales, minus production costs and expenses.	6045
E. Donations to special funds	1700
F. Advertising	(362)
G. Royalties, permissions, special sales	697
H. Interest on accounts and investments	6704
I. General finance and accounting office	(2000)
Net before encumbrances	**$13,325**
J. Donations to special funds (same as E)	(1700)
K. Membership fees for 2013-14 and later years received before 4-1-12	(3840)
L. 2012 Conf revenue received before 4-1-12	(0)
M. Encumbrance for advertising and 2014 conference deposits	(2500)
Final net	**$9,025**

Line D contains receipts from membership fees, institutional subscriptions to *NDPLS*, individual book sales, minus expenses to produce the journal and *Newsletter*, produce the annual art poster, purchase books that are resold at the annual conference, and related membership operations. Our membership stands at 213 active members as of July 20, 2013.

Line E: The Society established two special funds in April 2004. The Student Scholarship Fund provides for waivers of conference registration fees for student members who have a technical presentation accepted for the annual conference. The International Hardship Fund provides for reductions in conference registration fees for members who have a technical presentation accepted for the annual conference and who have made a reasonable claim for hardship; travel from a currency-impaired country is the primary example of hardship addressed by the fund program. Other than the qualifications described above, applicants are given awards on a first-come first-served basis to the extent that resources allow. The funds will be expended at the end of the 2013 conference; new donations are needed to continue the program.

Line G: Royalties, permissions, and special sales were down this year. Special sales consist of single issues and articles in PDF form to individual requestors.

Line H: Interest on accounts and investments consists of bank interest on certificates of deposit, and proceeds from a conservative investment account that was opened in August 2011.

SCTPLS has no outstanding debts in the form of bank or other loans, bonds, or accounts payable in excess of 60 days.

Submitted by:
Stephen Guastello, Ph.D.
Treasurer and CFO for SCTPLS

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No-recording policy for SCTPLS conferences

In light of the occasional questions that arise, SCTPLS' standing provision regarding audio and video recording at its conferences is reproduced here:

To balance the desires of presenters with the rights of attendees, presenters (excluding invited addresses) may choose to record their presentations so long as it does not include the voice or likeness of any other person in attendance.

The foregoing policy has stood well for many years to protect the social atmosphere of the conferences as a medium for open exchange of ideas.

Non-endorsement policy

SCTPLS does not provide endorsements for the work products of its individual members. To do so would undermine the role of SCTPLS as a forum for the open exchange of scientific and professional ideas. SCTPLS the organization does, however, endorse its own products for which it collects fees, notably the annual conference, its pre-conference workshops, and NDPLS as media for quality scientific communication, and a small number of books for which it collects royalties.

Adamatsky, A., & Chen, G. (2013). (Eds.). Chaos, CNN, memristors and beyond: A festschrift for Leon Chua. This invaluable book is a unique collection of tributes to outstanding discoveries pioneered by Leon Chua in nonlinear circuits, cellular neural networks, and chaos. It is comprised of three parts. The first — cellular nonlinear networks, nonlinear circuits and cellular automata — deals with Chua's Lagrangian circuits, cellular wave computers, bio-inspired robotics and neuro-morphic architectures, toroidal chaos, synaptic cellular automata, history of Chua's circuits, cardiac arrhythmias, local activity principle, symmetry breaking and complexity, bifurcation trees, and Chua's views on nonlinear dynamics of cellular automata. Dynamical systems and chaos is the scope of the second part of the book, where we find genius accounts on theory and application of Julia set, stability of dynamical networks, chaotic neural networks and neocortical dynamics, dynamics of piecewise linear systems, chaotic mathematical circuitry, synchronization of oscillators, models of catastrophic events, control of chaotic systems, symbolic dynamics, and solitons. First hand

accounts on the discovery of memristors in HP Labs, historical excursions into 'ancient memristors', analytical analysis of memristors, and hardware memristor emulators are presented in the third and final part of the book. The book is quintessence of ideas on future and emergent hardware, analytic theories of complex dynamical systems and interdisciplinary physics. It is a true Renaissance volume where bright ideas of electronics, mathematics and physics enlighten facets of modern science. The unique DVD covers the artistic aspects of chaos, such as several stunningly melodious musical compositions using chaotic atttractors, a virtual gallery of hundreds of colorful attractors, and even a cartoon-like play on the genesis of Chua's circuit that was based on a widely acclaimed performance in Rome and other venues in Italy. In short, it is a veritable kaleiscope of never-before-published historical, pedagogical, and futuristic technical visions on three timely topics of intense interest for both lay readers and experts alike.

Allen, P. M., Richardson, K. A., & Goldstein, J. A. (2013). *Emergence, Complexity & Organization: E:CO Annual Volume 12.* Litchfield Park, AZ: Emergent Publications. ISBN 9781938158056 (642 pages + index).

Argyros, I. K., & Hilout, S. (2013). *Computational methods in nonlinear analysis*. Singapore: World Scientific. The field of computational sciences has seen a considerable development in mathematics, engineering sciences, and economic equilibrium theory. Researchers in this field are faced with the problem of solving a variety of equations or variational inequalities. We note that in computational sciences, the practice of numerical analysis for finding such solutions is essentially connected to variants of Newton's method. The efficient computational methods for finding the solutions of fixed point problems, nonlinear equations and variational inclusions are the first goal of the present book. The second goal is the applications of these methods in nonlinear problems and the connection with fixed point theory. This book is intended for researchers in computational sciences, and as a reference book for an advanced computational methods in nonlinear analysis. We collect the recent results on the convergence analysis of numerical algorithms in both finite-dimensional and infinite-dimensional spaces, and present several applications and connections with fixed point theory. The book contains abundant and updated bibliography, and provides comparison between various investigations made in recent years in the field of computational nonlinear analysis. *Contents:* Newton's Methods, Special Conditions for Newton's Method, Newton's Method on Special Spaces, Secant Method, Gauss–Newton Method, Halley's Method, Chebyshev's Method, Broyden's Method, Newton-like Methods, Newton–Tikhonov Method for Ill-posed Problems.

Byrne, D., & Callaghan, G. (2013). *Complexity Theory and the Social Sciences: The state of the art.* New York: Routledge. For the past two decades, 'complexity' has informed a range of work across the social sciences. There are diverse schools of complexity thinking, and authors have used these ideas in a multiplicity of ways, from health inequalities to the organization of large scale firms. Some understand complexity as emergence from the rule-based interactions of simple agents and explore it through agent-based modelling. Others argue against such 'restricted complexity' and for the development of case-based narratives deploying a much wider set of approaches and techniques. Major social theorists have been reinterpreted through a complexity lens and the whole methodological programme of the social sciences has been recast in complexity terms. In four parts, this book seeks to establish 'the state of the art' of complexity-informed social science as it stands now, examining: the key issues in complexity theory, the implications of complexity theory for social theory, the methodology and methods of complexity theory, complexity within disciplines and fields. It also points ways forward towards a complexity-informed social science for the twenty-first century, investigating the argument for a post-disciplinary, 'open' social science. Byrne and Callaghan consider how this might be developed as a programme of teaching and research within social science. This book will be particularly relevant for, and interesting to, students and scholars of social research methods, social theory, business and organization studies, health, education, urban studies and development studies.

Chaitin, G. J. (2013). *Thinking about Godel and Turing: Essay on complexity 1970-2007*. Singapore: World Scientific. Dr Gregory Chaitin, one of the world's leading mathematicians, is best known for his discovery of the remarkable Ω number, a concrete example of irreducible complexity in pure mathematics which shows that mathematics is infinitely complex. In this volume, Chaitin discusses the evolution of these ideas, tracing them back to Leibniz and Borel as well as Gödel and Turing. This book contains 23 non-technical papers by Chaitin, his favorite tutorial and survey papers, including Chaitin's three *Scientific American* articles. These essays summarize a lifetime effort to use the notion of program-size complexity or algorithmic information content in order to shed further light on the fundamental work of Gödel and Turing on the limits of mathematical methods, both in logic and in computation. Chaitin argues here that his information-theoretic approach to metamathematics suggests a quasi-empirical view of mathematics that emphasizes

the similarities rather than the differences between mathematics and physics. He also develops his own brand of digital philosophy, which views the entire universe as a giant computation, and speculates that perhaps everything is discrete software, everything is 0's and 1's. Chaitin's fundamental mathematical work will be of interest to philosophers concerned with the limits of knowledge and to physicists interested in the nature of complexity.

Chua, L. O. (2013). *A Nonlinear Dynamics Perspective of Wolfram's New Kind of Science* (Volume VI). Singapore: World Scientific. This invaluable volume ends the quest to uncover the secret recipes for predicting the long-term evolution of a ring of identical elementary cells where the binary state of each cell during each generation of an attractor (i.e. after the transients had disappeared) is determined uniquely by the state of its left and right neighbors in the previous generation, as decreed by one of 256 truth tables. As befitting the contents aimed at school children, it was found pedagogically appealing to code each truth table by coloring each of the 8 vertices of a *cubical graph* in red (for binary state 1), or blue (for binary state 0), forming a toy universe of 256 *Boolean cubes*, each bearing a different vertex color combination.

Cutler, R. M. (2013). *How Soviet Foreign Policy Failed: What Complexity Science Tells Us That Nothing Else Can.* Litchfield Park, AZ: Emergent Publications. ISBN 9781938158117 (112 pages).

Hoover, W. G., & Hoover, C. G. (2013). *Time reversibility, computer simulation, algorithms, chaos* (2nd edition). Singapore: World Scientific. A small army of physicists, chemists, mathematicians, and engineers has joined forces to attack a classic problem, the "reversibility paradox", with modern tools. This book describes their work from the perspective of computer simulation, emphasizing the authors' approach to the problem of understanding the compatibility, and even inevitability, of the irreversible second law of thermodynamics with an underlying time-reversible mechanics. Computer simulation has made it possible to probe reversibility from a variety of directions and "chaos theory" or "nonlinear dynamics" has supplied a useful vocabulary and a set of concepts, which allow a fuller explanation of irreversibility than that available to Boltzmann or to Green, Kubo and Onsager. *–Publisher*. "The second edition with over 100 pages of new material, gives an up-to-date and distinctive treatment of physical issues, emphasizing the need for a holistic view incorporating theory, simulation and experiment... It provides rich inspiration and insight for graduate students and more experienced researchers alike. This work challenges philosophers and mathematicians to engage with the latest numerical and experimental findings, and practitioners of quantum chaos and nanotechnology to incorporate and extend the underpinning classical irreversibility." *--Dr Carl Dettmann, University of Bristol.*

Knowles, R. B. (2013). *The Process Enneagram: Essays on theory and practice.* Litchfield Park, AZ: Emergent Publications. ISBN 9781938158100 (178 pages).

Letellier, C. (2013). *Chaos in nature.* Singapore: World Scientific. Chaos theory deals with the description of motion (in a general sense) which cannot be predicted in the long term although produced by deterministic system, as well exemplified by meteorological phenomena. It directly comes from the Lunar theory — a three-body problem — and the difficulty encountered by astronomers to accurately predict the long-term evolution of the Moon using "Newtonian" mechanics. Henri Poincaré's deep intuitions were at the origin of chaos theory. They also led the meteorologist Edward Lorenz to draw the first chaotic attractor ever published. But the main idea consists of plotting a curve representative of the system evolution rather than finding an analytical solution as commonly done in classical mechanics. Such a novel approach allows the description of population interactions and the solar activity as well. Using the original sources, the book draws on the history of the concepts underlying chaos theory from the 17th century to the last decade, and by various examples, show how general is this theory in a wide range of applications: meteorology, chemistry, populations, astrophysics, biomedicine, etc.

Mainzer, K., & Chua, L. (2013). *Local activity principle: The cause of complexity and symmetry breaking*. Singapore: World Scientific. The principle of local activity explains the emergence of complex patterns in a homogeneous medium. At first defined in the theory of nonlinear electronic circuits in a mathematically rigorous way, it can be generalized and proven at least for the class of nonlinear reaction–diffusion systems in physics, chemistry, biology, and brain research. Recently, it was realized by memristors for nanoelectronic device applications. In general, the emergence of complex patterns and structures is explained by symmetry breaking in homogeneous media, which is caused by local activity.

't Hooft, G., & Vandoren, S. (2013). *Time in powers of ten*. Singapore: World Scientific. Zooming in and out in time to eternity, the authors weave a magnificent tale throughout, showcasing the incredible diversity of natural phenomena taking place at different time scales, in powers of ten. At each time scale, extraordinary phenomena from all disciplines occur, from the decay time of elementary particles and

atoms to the time-span of plate tectonic movements, to even the rotation speed of pulsars. Presented in the popular style of the bestselling Powers of Ten documentaries, this vividly illustrated book reveals the dazzling array of natural phenomena through time. Nobel Laureate Gerard 't Hooft was awarded the 1999 Nobel Prize in Physics for his proof that Yang-Mill theories are renormalizable. Other notable prizes the Nobel Laureate has won include the prestigious Wolf Prize (1981), the Lorentz Medal (1986) and the Franklin Medal (1995). Assoc. Prof. Stefan Vandoren currently teaches Theoretical Physics at Utrecht University. Winner of the 2008 Descartes-Huygens Prize, his current research focuses on superstring theory, supergravity and supersymmetric field theory.

Li, C., Wu, Y., & Ye, R. (Eds.). (2013). Recent advances in applied nonlinear dynamics with numerical analysis. Singapore: World Scientific. Nonlinear dynamics is still a hot and challenging topic. In this edited book, we focus on fractional dynamics, infinite dimensional dynamics defined by the partial differential equation, network dynamics, fractal dynamics, and their numerical analysis and simulation.

V Dolotin (*ITEP, Russia*) By (author): **A Morozov** . **Introduction to Non-Linear Algebra (2007). Singapore: World Scientific.** This unique text presents the new domain of consistent non-linear counterparts for all basic objects and tools of linear algebra, and develops an adequate calculus for solving non-linear algebraic and differential equations. It reveals the non-linear algebraic activity as an essentially wider and diverse field with its own original methods, of which the linear one is a special restricted case. This volume contains a detailed and comprehensive description of basic objects and fundamental techniques arising from the theory of non-linear equations, which constitute the scope of what should be called **non-linear algebra**. The objects of non-linear algebra are presented in parallel with the corresponding linear ones, followed by an exposition of specific non-linear properties treated with the use of classical (such as the Koszul complex) and original new tools. This volume extensively uses a new diagram technique and is enriched with a variety of illustrations throughout the text. Thus, most of the material is new and is clearly exposed, starting from the elementary level. With the scope of its perspective applications spreading from general algebra to mathematical physics, it will interest a broad audience of physicists; mathematicians, as well as advanced undergraduate and graduate students.

Weaver, N. (2013*). Measure theory and functional analysis.* Singapore: World Scientific. This book provides an introduction to measure theory and functional analysis suitable for a beginning graduate course, and is based on notes the author had developed over several years of teaching such a course. It is unique in placing special emphasis on the separable setting, which allows for a simultaneously more detailed and more elementary exposition, and for its rapid progression into advanced topics in the spectral theory of families of self-adjoint operators. The author's notion of measurable Hilbert bundles is used to give the spectral theorem a particularly elegant formulation not to be found in other textbooks on the subject.

Manuscripts Accepted for Publication in NDPLS

The following manuscripts have been accepted for publication in NDPLS and will be appearing in 2014.

Downing, R., & Taylor, R. P. The fractal clock: Using chaos to bridge the art-science divide.

Guastello, S. J., & Lynn, M. Catastrophe model of the accident process, safety climate, and anxiety.

Guastello, S. J., Reiter, K., Shircel, A., Timm, P., Malon, M., & Fabisch, M. The performance-variability paradox, financial decision making, and the curious case of negative Hurst exponents.

Guevara, P., Lopez, L., Posch, A., & Zuniga, R. A dynamic nonlinear model for educational systems: A simulation study for primary education.

Heinzel, S., Tominschek, I., & Schiepek, G. Dynamic patterns in psychotherapy: Discontinuous changes and critical instabilities during the treatment of obsessive compulsive disorder.

Koopmans, M. Nonlinear change and the black box problem in educational research.

Nicolis, H., & Delvenne, V. Nonlinear dynamics of runaways among children and adolescents: Disruptive disorder or step toward suicide?

Pennings, H. J. M., Brekelmans, M., Wubbels, T., van der Want, A., Claessens, L. C. A., & van Tartwijk, J. A nonlinear dynamic systems approach to real-time teacher behavior: Differences between teachers.

Pincus, D., Eberle, K., Walder, C. S., Kemp, A. S., Lenjavi, M., & Sandman, C. A. The role of self-injury in behavioral flexibility and resilience.

Rinaldi, S., Della Rossa, F., & Landi, P. A mathematical model of "Pride and Prejudice."

Ruiz, M., Faura, U., Lafuente, M., & Dore, M. H. I. Nonparametric tests for serial dependence based on runs.

Stamovlasis, D., & Sideridis, G. D. Ought-approach versus ought-avoidance: Nonlinear effects of arousal under achievement situations.

Tani, G., Correa, U. C., Basso, L., Benda, R. N., Ugrinowitsch, H., & Choshi, K. An adaptive process model of motor learning: Insights for the teaching of motor skills.

About The Society

The Society is an international forum that brings together researchers, theoreticians, and practitioners interested in applying dynamical systems theory, self-organization, neural nets, fractals, cellular automata, agent-based modeling, and related forms of chaos, catastrophes, bifurcations, nonlinear dynamics, and complexity theories to psychology and the life sciences.

Our members hail from numerous specialties within psychology, other social sciences, and biology, physiology, neuroscience, mathematics, philosophy, physics, computer science, economics, education, management, political science, engineering, and the world of art. Our membership spans more than 30 countries.

SCTPLS Annual Conference

The SCTPLS Annual International Conference offers a unique intellectual and social atmosphere that stimulates dialogue with symposia, roundtables, single papers, workshops, the business meeting, and prominent guests. Operating since 1991, it is the longest-running conference of its type. Presentations may be theoretical, applied, empirical, or methodological in content. *Program* tracks include: Biomedical sciences, Cognitive Psychology and Ergonomics, Clinical Psychology, Mathematics, Ecology, Sociology, Economics, Communication, Group Dynamics and Organizational Behavior, and Philosophy of Science. SCTPLS also sponsors the International Nonlinear Science Conferences.

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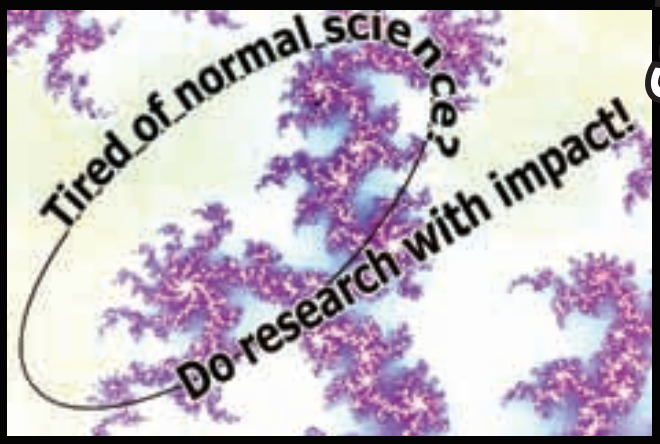

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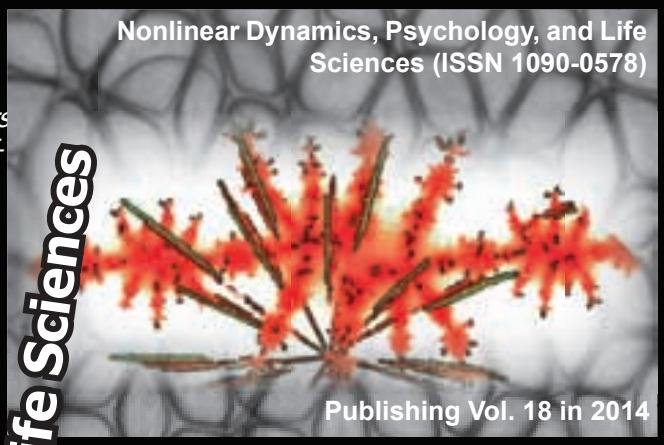

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Back cover photo: Professors Downtown Nijmegen. Photo by VOX.

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