Society for Chaos Theory in Psychology & Life Sciences

NEWSLETTER

Vol. 21, No. 3
April, 2014

Society for Chaos Theory in Psychology & Life Sciences
24th Annual International Conference
31 July - 2 August 2014
Marquette University, Milwaukee, Wisconsin, USA

AN INVITATION TO OUR CONFERENCE

Stephen Dietz
2014 Conference Chair

The 24th Annual International SCTPLS Conference will be returning to Marquette University, Milwaukee, WI, July 31 to August 2, 2014. We have had a series of highly successful conferences and associated workshops over the past several years and are looking forward to continuing that this year in Marquette. The conference will once again kick off with a full day of workshops. The pre-conference workshop for this year is designed for the entry-level researcher who is sorting out relationships among the primary types of nonlinear dynamics and plans to use them to solve research problems.

In addition to our special invited guests, the 2014 conference will include single papers and symposia, 50-plus concurrent sessions and a poster session. Participants will include an international group of 60-70 psychologists, physicists, mathematicians, researchers and others who all share a common focus on the investigation and applications of nonlinear dynamics to psychology and the life sciences. Now is the time to begin your travel plans and to prepare your abstract for submission.

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

Some critical conference dates: Call for papers and symposia is open until **April 30**. **May 15**, all acceptances finalized by Program Chair. Everyone is looking forward to seeing you and catching up on your good work at the conference this summer.

July 1. Your lodging reservations at the Marquette facility need to be made by this date in order to ensure availability. Please see LODGING & HOTEL RESERVATIONS for further details. Lodging reservations require pre-payment, which can be done through the all-purpose conference registration form.

July 1. All speakers with papers accepted for presentation must register (with payment in full) by this date in order to remain on the program. The early registration rates are in effect until this date. Please note that lodging reservations and conference registration are two separate tasks, which you can do all at once or by sending two separate forms if desired.

July 5. If you are bringing an additional guest to the banquet Friday night who is not registered for the SCTPLS conference, please let us know so we can keep the headcounts straight with the caterers. You can use the conference registration form to make these arrangements and payments.

July 31. Preconference workshop on nonlinear methods. The day concludes with a reception for everyone at the conference.

August 1. Conference day with paper, colloquia, special formats, and featured speakers.

August 2. Conference day and SCTPLS Business Meeting.

CALL FOR PAPERS AND SYMPOSIA
24th Annual Conference of the Society for Chaos Theory in Psychology and Life Sciences
July 31 through August 2, 2014, Milwaukee, Wisconsin USA.

We invite interested scholars to present and discuss recent developments in nonlinear dynamical system theory, which includes chaos theory, fractals, complex systems and related topics. Over the years, the annual conferences of the Society for Chaos Theory in Psychology & Life Sciences have inspired and supported scholars from an array of disciplines to look at new ways to develop their theoretical and empirical work in an integrated approach to life sciences.

The Society for Chaos Theory in Psychology and Life Sciences is a multidisciplinary organization. The topics covered by the conference include applications of nonlinear dynamics theory and techniques to problems encountered in any area of the behavioral, social and life sciences including psychology, sociology, economics, econophysics, 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, dynamical diseases, or closely related constructs. The broad mixture of the disciplines represented here indicates that many bodies of knowledge share common principles.

The Annual Conference of the Society for Chaos Theory in Psychology and Life Sciences is the premier venue for training, networking, and sharing the latest empirical and applied developments in nonlinear dynamics across psychology, the life sciences and beyond. For 23 years (and counting), the Society and its conferences have been founded in the principles of interdisciplinary work, acknowledging the ubiquity of nonlinear dynamics across the behavioral, social, and life sciences. The conference is typically intimate in size. Attendance is typically broad geographically as well, with membership in SCTPLS representing each of the global continents.

The program will include workshops, invited addresses, symposia, panel discussions, a poster session, and sessions of individual papers. Advances in basic or applied research, developments in theory, reports of empirical results and methodological papers are all welcome. We continue to encourage all nonlinear scientists, including graduate students who might be finishing up a dynamical thesis or dissertation, to share their ideas through paper presentations, chairing a roundtable session, or by proposing other alternative presentation formats, such as posters, product demonstrations, short workshops, or debates around controversial topics.

VENUE

Our meetings will be held at the modern gothic campus of **Marquette University, Milwaukee WI**, in the heart of the region of the country informally known as Ecotopia. We will be using the futuristic yet cozy facilities of the **Raynor Library Conference Center** for our conference meetings. On-campus lodging will be available through the Society registration process also. Additional information about these facilities and local attractions will be posted to the lodging page or the local logistics page of this conference web site.

INSTRUCTIONS FOR ABSTRACTS

Abstracts should be between 150-250 words for posters, individual papers, short workshops and other alternative formats. The connection to nonlinear dynamics, chaos, complexity, fractals or related concepts should be clear to the reader. Include organizational affiliation and contact information on each speaker or author.

Abstracts may be up to 500 words for symposia or panel discussion. For symposia, abstracts should reflect the content of EACH speaker's contribution. The format for a symposium is for all speakers to give presentations, followed by or interspersed with discussion. Symposia should present current research within a coherent theme defined by the title and abstract.

For experimental work, the background, aims and framework, methods and samples, results, conclusions and Implications should be clear to the reader. For theoretical work, the background, aims and framework, mode of inquiry, outcomes, conclusions and implications should be clear to the reader.

Abstracts for panel discussions should provide a brief overview of the topic, and indicate the relevant background of the panelist and sample questions they will address. The format for a panel discussion is an introduction to the topic and the speakers, after which the panelists address as series of questions or issues (rather than just giving a series of presentations).

Abstracts for workshops should present state-of-the-art information on techniques useful for conducting research or applications of nonlinear science in the behavioral, social and life sciences. They should be pedagogical in nature. Where applicable, the abstract should emphasize skills that attendees can expect to acquire.

For all abstracts: The connection to nonlinear dynamics, chaos, complexity, fractals or related concepts should be clear to the reader. Please stress what is the overall value added to the field (e.g. new method, new information, new perspective or issue, valuable confirmation of the present knowledge, adds clarity to present understanding). Also, please indicate on the submission form which of the following categories is representative of your submission:

Check all that apply: 1) Empirical (e.g., presentation of empirical results of a study), 2) Theoretical (e.g., empirically testable theoretical development), 3) Applied (e.g., organizational, business, product development or marketing, or involving clinical interventions), 4) Quantitative (e.g., computational or statistical modeling); 5) Qualitative (e.g., non-quantitative analysis of empirical data); 6) Philosophical or artistic (e.g., epistemology, philosophy of science, aesthetics, or audio-visual demonstrations)." Each person submitting is limited to a maximum of two presentations as first author. It is acceptable to be a co-author on additional work submitted by others.

****Trouble submitting?**** If your submission is recieved successfully you will be taken to a confirmation page, with a link to follow for any future edits. If you have repeated trouble making your submission, as a back-up option please feel free to send all of the relevant submission information directly to Steven Dietz: scarver103@gmail.com , the conference chair, who can make sure that your submission is successfully loaded into the system.

The deadline for submissions is **April 30, 2014**.

Early birds will receive acceptances after March 23rd

Abstract should be submitted electronically by visiting:

http://www.societyforchaostheory.org/conf/2014

PUBLICATION OPPORTUNITY

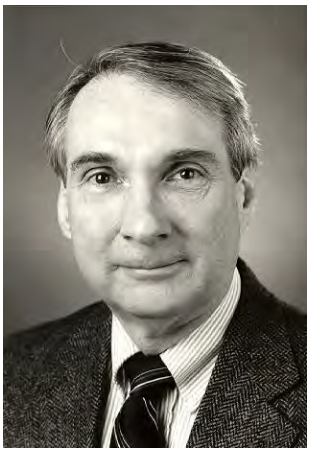
All presenting conferees are further invited to prepare their papers for review and possible publication in the Society's research journal *Nonlinear Dynamics, Psychology, and Life Sciences*. *NDPLS* is peer-reviewed and abstracted in *PsycInfo* (*Psychological Abstracts*), *Medline* (*Index Medicus*), *JEL/Econlit, MathSciNet,* and other important databases. *NDPLS* uses American Psychological Association (APA) style. Click JOURNAL on the SCTPLS web site to access Instructions for Authors. All SCTPLS members receive NDPLS and the *SCTPLS Newsletter* as a benefit of membership. *NDPLS* accepts manuscripts all through the year, but please use October 1, 2014 as the target date for submitting conference-related papers; the journal would like to have as many articles based on conference presentations as possible ready for the same issue.

We look forward to seeing as many of you there as possible!

Warmest regards,

A. Steven Dietz, SCTPLS President & Conference Chair, Texas State University; **David Pincus, Ph.D., Past-President,** Chapman University, SCTPLS President; **Stephen J. Guastello, Ph.D**., Marquette University, SCTPLS Conference Committee; **Sara Nora Ross, Ph.D.,** Antioch University, SCTPLS Secretary.

FEATURED SPEAKERS



J. C. Sprott.
"Lessons Learned from 19 Years of Chaos and Complexity."

Barkley Rosser, Jr.
"Complexity in Behavioral Economics"

David Schuldberg
"Developing a "Feel" for Nonlinear Systems: How to Work with Impossible Problems."

Pre-Conference Workshop

The **pre-conference workshop (July 31, 2014, Milwaukee)** on Nonlinear Methods and Concepts is a great first step to integrating nonlinear science into your research agenda. The pre-conference workshop for this year is designed for researchers at any career stage who are ready to break into this fascinating area and expand their research agendas in the life and social sciences. The program is also ideal for graduate students who want to do new research with impact on their respective topic areas! Of further interest, a version of this program was very popular in the past with professors who were exploring the best means for importing nonlinear dynamics to their substantive theory or methods courses. Participants may register for either or both the AM and PM sessions.

AM SESSION

Segment 1: Basic premises of nonlinear systems: attractors, bifurcations chaos, fractals, self-organization, catastrophes, agent-based strategies. Presented by Stephen Guastello, Ph.D., Marquette University.

Segment 2: Chaos, fractals, and power laws, up close and personal. Presented by J. C. Sprott, University of Wisconsin, Madison

PM SESSION

Segment 3: Entropy, state space grids, and pattern extraction with symbolic dynamics. Presented by David Pincus, Chapman University, Orange, CA.

Segment 4: Formulating hypotheses with nonlinear dynamics. Presented by Keith Owen, Principle, Somerset Consulting Group, Austin TX, and A. Steven Dietz, Texas State University, San Marcos.

RECEPTION AND DISCUSSION

The day will conclude with a reception and open discussion on theory building concerns, methods questions, and research strategies. *All conferees* are invited to join us for this final session of the day.

News from SCTPLS Labs

News from Members' Labs

by
David Pincus, Chapman University

Just when I think we've heard from nearly everyone in the society, another excellent outpouring of news from our fellow members about their work. We aren't the biggest professional organization, but it is clear to me at this point that we are doing the best work. The march of nonlinear science and applications goes on – right into April. And as always – please read, network (join our LinkedIn group too), and cite one another's work…

Because if *we* don't know what We are doing, who will?

Glenda Eoyang
Human Systems Dynamics Institute, Minnesota

I'm Glenda Eoyang, founding executive director of the Human Systems Dynamics Institute. We draw lessons from nonlinear dynamics and use them to help people work and play more effectively in all kinds of situations. Lately, we have been growing our international connections and work with education.

International. Working on research in resilience in Finland. Teaching for NGOs and the oil and gas industry in India. Offering certification courses in UK. Consulting with international NGO in UK. Providing leadership training for federal government in Canada. Working with self-organizing systems in healthcare policy, practice, processes, and organizational structures. Centre for HSD in Israel. Our network of 450 HSD Associates is global and engaged in wide range of personal and professional applications of human systems dynamics theory and practice.

Education. Using Adaptive Action (What? So what? Now what?) to motivate and implement school reform. Whole system transformation. Early literacy instructional strategies. Writing instruction in partnership with the North Star National Writing Project. Systemic change with boards of education, administrative teams, and classroom teachers. We have redesigned our Human Systems Dynamics Professional Certification training to be four months of online practice and engagement kicked off with three days of face-to-face Patterns and Possibilities. Leading seminar at AERA about Adaptive Action and research methods this spring.

We write about our work on:

- Adaptiveaction.org
- *Adaptive Action: Leveraging Uncertainty in Your Organization* (Stanford University Press, 2013) by Glenda Eoyang and Royce Holladay
- *Radical Rules for Schools: Adaptive Action for Complex Change* (HSD Institute, 2013) Leslie Patterson, Royce Holladay, Glenda Eoyang
- Am doing a TEDx talk on March 29 entitled *Get Unstuck: 3 Simple Questions*

Michael J. Gerson, Ph.D.
California Lutheran University,Thousand Oaks, CA

I am an Associate Professor in Graduate Psychology at California Lutheran University. Most of my professional career has been in private practice (since 1981) as a clinical psychologist and psychoanalyst. I moved into full-time academia 6 years ago. My most recent publication is *Reconsidering Self and Identity through a Dialogue between Neuroscience and Psychoanalytic Theory*. It will be appearing in the next issue of Psychoanalytic Dialogues. The paper promotes the use of a complexity theory epistemology for bridging the gap between the two disciplines.

Gholamhossian Erjaee
Shiraz University, Shiraz, Iran

Right now, I am teaching dynamical systems theory in graduate level and doing the research in the same subject in Mathematics Department, Shiraz University. I am supervisor of 4 MS and 2 Ph.D. students and these take most of my time. In research, I am leading principle of one project including three teams from Iran, Qatar and France. I am also principle investigator in another active project running by three teams from Iran, Qatar and Sweden. The funds for these two projects are provided by Qatar National Research Fund. The subjects of these research activities are: Chaos and Synchronization, Fractional Differential Equations and their applications into the mathematical modeling of health, HIV, cancer and economy as well. I am also chief editor of mathematics section of Iranian Journal of Sciences and Technology, Tran. A., which is rank it as an ISI journal.

Russ Gonnering
The Medical College of Wisconsin, Milwaukee

My interest is bringing an awareness of non-linear dynamics and the tools of complexity and organizational science to healthcare. My current interest involves two complementary branches: (1) the use of agent-based modeling to explore the elements of organizational performance; (2) investigation into the structural complexity of language and how language influences both sensemaking and, in turn, performance. While these have profound implications for healthcare reform, they are basic to other areas as well. It is imperative that we in healthcare expand our horizon to understand the complex as well as the complicated.

John M. Gottman, Ph.D
Relationship Research Institute & The Gottman Institute, Deer Harbor, WA

I am still working on our nonlinear differential equations for couples' interaction (and physiology). Just finished a book called PRINCIPIA AMORIS: THE NATURAL PRINCIPLES OF LOVE. This book was written for couples' therapists, who tend to be very leery of math. With Paul Peluso we've extended our modeling to the psychotherapy situation, modeling therapy with different "influence functions." Now we are collecting data in Paul's lab. Again math and psychotherapy don't seem compatible to psychologists, but the work is gaining acceptance and getting published. Paul is working with mathematician Larry Lebovitch.

I have worked with James Murray, mathematical biologist. We published a book called THE MATHEMATICS OF MARRIAGE (MIT PRESS) in 2002.

Alan McDonnell
Emergent Dynamic Technologies Ltd, UK

I am a criminologist currently continuing work around emotional contagion and its effects on group based cognitive processes. There has been some interesting research published around the effect of different colored light on mood; I suspect there is a role of the limbic system in light based transfer of emotionally significant information between people. I have been kicking some of these ideas around, and have had a research review accepted for publication in the Journal of Brain and Behaviour. I will be giving some thought as to possible experimental methodologies over the summer, (with hopefully some assistance and

enhancement of creative cognition from a cocktail based diet in a beach environment) and see whether the results suggest the hypothesis holds up.

Charles Nelson
Kean University, Union, NJ

My research focuses on how second language speakers learn to write in another language in the classroom.

Heleen Pennings
Utrecht University, The Netherlands

I am a graduate student at department of Educational Sciences at Utrecht University in The Netherlands. I study nonlinear dynamics in real-time teacher-student (class) interactions and try to relate this to the interpersonal relationship they have together. I use interpersonal theory to conceptualize both teacher and student behavior in interaction. I use the Questionnaire on Teacher Interaction (QTI) to study the teacher-student relationship with student perceptions and Sadlers' computer joystick method to study real-time interactions. This method allows me to observe and code interpersonal teacher behavior and interpersonal student behavior every half second as a blend of Agency and Communion, resulting in time-series. Up until now I have used State Space Grid Analysis to combine these time-series and visualize the interaction trajectories. I have related selected attractors, visit entropy and dispersion to the teacher-student relationship (as perceived by the students).

In March, I visited the 6th International Nonlinear Science Conference in Nijmegen, because in my department I am the only one using nonlinear methods, I wanted to get to know people in and outside The Netherlands using nonlinear methods. Also, I hoped to learn about possible nonlinear analyses I could use for my research. I really enjoyed this conference, everyone was so nice, and I could talk to other researchers about my research without being looked at like I am saying something incomprehensible (this often happened to me at other conferences). It sort of felt like I was "at home" at this conference. Although some of the information was too difficult for me at the moment (I guess it was my turn to look puzzled), I really learned a lot and got some very good suggestions to improve my research. I am now looking into Hidden Markov models and Recurrence Quantification Analysis for my next analyses.

If you are interested in my research I would like to refer you to two of my papers, both are published in January 2014 one in NDPLS and one Teaching and Teacher Education (http://dx.doi.org/10.1016/j.tate.2013.07.016). And of course any suggestions are welcome!

Rob Robson
Elora, Ontario, Canada

Rob Robson is a specialist emergency physician from Canada who developed an enduring interest in complexity science and chaos theory after doing a Master's in Human Factors and System Safety at Lund University in Sweden. I have developed a two day workshop to train system safety practitioners in systemic nonlinear methods of analyzing healthcare events. It is called SPHERE (Shifting the Paradigm in Healthcare Event Review and Evaluation) and has been presented on five occasions in the past year. At the request of colleagues in the mining and resource extraction sectors, I am preparing a more generic (not limited to healthcare) condensed (one-day) version of the workshop (acronym not yet developed!). I wrote a chapter in the book Resilient Health Care (published in 2013 by Ashgate) describing some of the principles behind such a workshop and will contribute another chapter to a follow-up book called Resilience in Everyday Clinical Work dealing with the concept of healthcare as a CAS.

Dr. Janice Ryan
East Tennessee Community College Alliance

I have been applying nonlinear, neurodynamical science to occupational therapy practice, practitioner education and the coaching of mindfulness, self-organizing performance, and generative life engagement since 2004. Most recently, I completed some of (or possibly) the first textbook chapters designed to set the conditions for students to learn how to become more mindful practitioners in psychosocial occupational therapy. In these chapters, I introduced a therapeutic model to treat clients with psychosocial challenges related to the emotional dysregulation that emerges from feelings of social isolation, exclusion or other triggers for ongoing, negative influences of the ought-avoidance bifurcation factor. Student practitioners are coached in the applications of my Adult Play Therapy Model as a way to improve performance of clients with dementia, depression or anxiety by avoiding these triggers and promoting ought-approach behaviors through the positive coping system. For the first time, in my chapters, the common occupational therapy terms of "grounding" and "centering" are clarified through similarity and difference analysis. In addition, a wide spectrum of therapeutic activities is introduced to teach future clinicians how to promote integration of emotion and cognitive control. In addition to being a supportive member of Society for Chaos Theory in Psychology and Life Sciences, I am an active member of Human Systems Dynamics Institute where I am continually teaching and learning new ways to facilitate non-scientists' understandings of how they can apply nonlinear, neurodynamical science in a wide variety of practice contexts.

Mark Shelhamer
Johns Hopkins University School of Medicine, Baltimore, MD

As of June 2013, I have taken a leave of absence from my academic position at Johns Hopkins, to serve as Chief Scientist of the NASA Human Research Program at Johnson Space Center. This temporary move allows me to pursue in depth my other research passion (besides nonlinear and fractal systems): human adaptation to space flight. But there is an irony in this situation, which is why I thought it might be of interest to readers of the

newsletter. I had thought that I would have to put aside my research interests in NLD and fractals during my time with NASA, since I will not have time to pursue my own research on this new job. However, one thing that we lack in our understanding of humans in space is an overarching conceptual framework. Most every physiological system in the body is affected (bone, muscle, cardiovascular, immune, sensorimotor, even psychological), but we study these systems largely one at a time, as in "conventional science." A conceptual framework is needed that will enable us to explore adaptation of the organism as a whole: integrative physiology. In order to achieve this, a significant modeling effort, informed by NLD principles, will be crucial. To this end, I have been building support for an effort in our program to investigate ideas such as self-organization, which might help us better understand what happens to the human body in space, help us develop integrated countermeasures to the major physiological changes, and at the same time advance the overall field of nonlinear dynamics and complexity. Thus my new position turns out to be an ideal venue to pursue my NLD interests. I welcome thoughts from SCTPLS members on this topic.

Patrick C. Trettenbrein
University of Graz, Graz, Austria

As I recently gave a presentation on my (preliminary) work at the conference in Nijmegen, I figured that now would be the time to comply with the request for updates in order to briefly introduce my work and myself. I am a graduate student of linguistics (master's) specializing in neuro- and psycholinguistics at the Department of Linguistics at the University of Graz, Austria. Additionally, I am working as a teaching assistant with Prof Annemarie Peltzer-Karpf, head of the Language Development & Cognitive Science Unit at the same university, who is also my thesis supervisor. My thesis project deals with language attrition, the linguistic term used to denote the non-pathological, time-dependent, and gradual loss of language-related information in an individual. Whereas studying language acquisition and learning has been on the agenda of linguists for quite some time, language attrition research has only become a distinct field of study in the last three decades, leaving us with an emerging research area that is still longing for new and/or comprehensive theoretical approaches to major issues. Roughly speaking, my work is supposed to show that (nonlinear) dynamics are an important factor in understanding lifespan development of an individual's language abilities, as well as part of the *modus operandi* of the faculty of language in regard to production and processing. My major goal thus is to develop a descriptive model of language attrition in the context of nonlinear dynamic systems, partly building on work done by my supervisor who has been developing a similar approach in regard to language acquisition and language learning in the last decades. The basic idea thus is, given that taking a nonlinear perspective has enhanced our understanding of language acquisition and learning, the same will hold true for the inverse process(es), which is language attrition.

Wayne Wakeland, PhD
Portland State University, Portland, OR

My colleagues and I are focused on three major projects right now: 1) completing an NIH-funded project to create a policy-oriented system dynamics model of the diversion and abuse of prescription pain medicine, 2) a new DOD-funded project to create a dynamic model to help explain the different trajectories for patient recovery from concussion, and 3) writing a textbook and creating an on-line course about modeling social-ecological systems.

Shane Wurdeman, PhD
University of Nebraska at Omaha, Omaha NE

I'm working towards improved patient outcomes through nonlinear dynamics analysis. At the Biomechanics Research Building, located on the campus of the University of Nebraska at Omaha, we are focused on improving patient outcomes through analyses of variability. Our theoretical approach in the study of human movement variability heavily employs Chaos Theory, operating under the pretense that variability is intrinsic in all biological systems and is representative of a healthy state. This variability is highly organized and complex, characteristic of mathematical chaos. The loss of complexity coincides with a decrease in adaptability common to aging and pathological conditions.[1]

Individuals with lower limb amputation must walk with an artificial device, trying to incorporate the movement of the prosthesis into the person's own natural movement rhythms. Using the largest Lyapunov exponent, in a group of 14 individuals with below-knee amputations, we reported that walking with a prosthesis leads to increased attractor divergence.[2] In another study with 13 individuals wearing a below-knee prosthesis, we had the individuals wear two different prosthesis setups. We measured the change in attractor divergence with the largest Lyapunov exponent as well as using a continuous visual analog scale to measure prosthesis preference. We found that prosthesis preference and the largest Lyapunov exponent were strongly correlated, with the individual having greater preference for the prosthesis that afforded decreased attractor divergence.[3]

In more recent work, following up on these initial studies, we had 28 individuals with below-knee amputations participate in a 6 week randomized, crossover study. Individuals spent 3 weeks in a "more appropriate" and a "less appropriate" prosthesis, appropriateness dictated by matching and mismatching individuals with the prosthesis based on the person's activity level. We again quantified the joint motion of the lower limbs during a walking task with the largest Lyapunov exponent. The results showed that with a "more appropriate" prosthesis, the individuals obtained greater dynamic stability of the attractors, with reduced largest Lyapunov exponents.[4] Furthermore, for the "more appropriate" prosthesis, the largest Lyapunov exponent of the joint motion at the start of the 3 week period was strongly correlated to the largest Lyapunov exponent at the end of the 3 week period.[5]

Finally, we investigated the complexity within the joint motion for individuals walking with a prosthesis

through the use of surrogate data analysis. When examining the ankle joint motion for the 28 individuals that participated in the 6 week randomized, crossover study, we first found that all surrogate tests that failed were the prosthetic ankle, none were the individuals intact, biological ankle.[6] We also found that the "more appropriate" prosthesis had a lower surrogate failure rate, indicating the presence of increased complexity when prescribing a prosthesis that meshes better with the individual's own movement rhythms.[6]

In conclusion, our laboratory is investigating prosthetic rehabilitation through nonlinear dynamics analysis. We are using these techniques to improve rehabilitation outcomes and outcomes assessment. Future work will investigate means to further improve complexity for amputee gait.

References

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2. Wurdeman SR, Myers SA, Stergiou N. Transtibial amputee joint motion has increased attractor divergence during walking compared to non-amputee gait. Ann Biomed Eng. 2013 Apr;41(4):806-13.

3. Wurdeman SR, Myers SA, Jacobsen AL, Stergiou N. Prosthesis preference is related to stride-to-stride fluctuations at the prosthetic ankle. J Rehab Res Dev. 2013;50(5):671-86.

4. Wurdeman SR. *Adaptation and prosthesis effects on stride-to-stride fluctuations in amputee gait.* Quantifying stride-to-stride fluctuations in amputee gait: Implications for improved rehabilitation. Doctoral dissertation. University of Nebraska Medical Center 2013.

5. Wurdeman SR. *Stride-to-stride fluctuations are related Pre/Post adaptation for an appropriate prosthesis.* Quantifying stride-to-stride fluctuations in amputee gait: Implications for improved rehabilitation. Doctoral dissertation. University of Nebraska Medical Center 2013.

6. Wurdeman SR, Myers SA, Stergiou N. Amputation effects on the underlying complexity within transtibial amputee ankle motion. Chaos. [Epub ahead of print].

Anatoly M. Zhirkov
Saint-Petersburg State University Russia

About year ago I got the position of professor of psycho-physiology and Dean of the Nursing College in Saint-Petersburg State University Russia. In a short time I hope to finish my book about connection between chaos and harmony "Psychosomatic harmonization Concept" with acknowledgments to SCTPLS members. Now we are translating it to English.

Feature Article

(I)

A Crisis in Replication, or a Replication of a Crisis? Some Insights from Nonlinear Dynamical Systems Theory

Stephen J. Guastello, *Marquette University*

Abstract: The current concerns about the replicability of psychological research findings are analogous to an earlier crisis in social psychology from 40 years ago. The solutions that were offered then are still pertinent now: (a) Effect sizes should trump statistical significance in the evaluation of research results. (b) Different types of replication strategies can clarify what is generalizable and what is situationally specific. (c) When faced with a replication dilemma, reframe theories in terms of broader construct domains that include temporal dynamics such as those afforded by nonlinear dynamical systems (NDS) theory. (d) Recognize that humans are complex systems as are the social and economic environments in which they live and have created for themselves. Theories of attitudes and behavior and occupational accidents are presented as examples. Further exploration of NDS constructs indicates that exact replication could be more of a luxury than a staple of psychological science for reasons having little to do with methodological flaws.

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A rather sudden and apparently widespread concern for the replicability of psychological research appears to have been instigated by an incident of blatant fraud in Europe that was uncovered a couple years ago when other researchers found that the phantom results failed to replicate. Given that only a small percentage of psychological research findings ever do meet with replication attempts, *Perspectives in Psychological Sciences* hosted two series of articles (Spellman, 2012, 2013).

Rather than rehash the various positions expressed by others in the discussion, the points I would like to make are: (a) The theories that produce the unreplicable results are probably at fault. (b) The problem can be solved in part by broadening the scope of constructs used in building a theory. (c) The problem can be solved in another part by adopting a theory of temporal dynamics as a *metatheory* that shapes the local theories about specific phenomena. Nonlinear dynamical systems theory (NDS) can make a substantial improvement to the understanding of many important phenomena whether or not a replication issue is in play. (d) The issues of replicability, scope, and lapses in theoretical

acuity occurred during the last crisis 40 years ago, and the recommended pathways out of the crisis that were relevant then are just as relevant now. (e) The complex nature of real living systems itself generates replicability issues that cannot be reduced to matters of editorial policy concerning whether or not to publish replication studies as some *Perspectives* authors have suggested.

Two examples are presented where replication of a basic hypothesis failed and the underlying theories were redeveloped with a broader range of qualitative constructs and by organizing them within a catastrophe-theoretical framework. Some familiar constructs from the broader scope of NDS explain why some of the failures to replicate experimental effects generated from within the classic paradigm could fail.

Forms of Replication

There are three different types of strategies for replication in common use: direct repetition, cross-validation, and replication with expansion. Direct repetition would involve repeating a procedure in all its details to determine if the results turn out the same way twice. Here the good judgment of editors, reviewers, and authors to include all the relevant details of the method, boring as some of them may be, in the published article would be essential. This is also the style of writing that some journals tend to dissuade. Another problem with direct replication is that if there were logical errors in the theory or the laboratory implementation, the errors would be replicated as well as any inherent truth, resulting in a delusion of progress.

Cross-validation is a form of replication that is amenable to multiple regression models. The various strategies for cross-validation (Darlington, 1990) recognize that regression weights and the overall R^2 capitalize on chance effects in the initial calibration sample. The cross-validation analysis itself determines the extent to which the original regression weights transfer to new samples and the extent to which R^2 declines as a result; sometimes R^2 increases a bit. The more convincing examples of cross-validation would use new samples that are relatively unlike the original one.

Meta-analysis and validity generalization (MAVG) assess the results of many replications. It emphasizes effect size rather than statistical significance in the contributing studies and the advantage of pooling sample sizes, which reduces the standard error of the average effect size and maximizes statistical power which has been often too low in psychological research (Murphy & Myors, 1999; Schmidt, Hunter, & Urry, 1976). Variability in effect sizes can be produced by artefacts such as sample size, reliability of measurements, and restriction of range. Statistical significance still plays a role, however, when the 90% confidence interval is computed around the final effect size; the confidence interval should not include 0.0. Once the overall effect size has been determined and artifacts ruled out, one can then determine if moderator variables can explain differences in effect sizes among different subgroups of replication studies.

The interim point here is that situational specificity and limits to generalizability eventually come to the foreground. The MAVG or review study is in a relatively strong position to determine whether systematic patterns of situational specificity exist. Actually, the contrast between conclusions drawn on the basis of *p*-values and conclusions based on effect sizes had been made some-what earlier. Hayes (1963) noted that significant *p*-values in social science research were often associated with small effect sizes. Larger effect sizes are potentially more useful explanations for phenomena. Effects that are significant but very small lead one to question whether the explanatory value of the theoretical constructs could withstand substantial improvements.

Improving Theory, Revisiting Crisis

Spellman's (2013) reminder of the earlier crisis in social psychology, which was made in conjunction with a posthumously published article by W. J. McGuire (2013), suggested that some of the earlier issues should be revisited. The following remarks are virtual repetitions of observations I made shortly after the earlier debate subsided (Guastello, 1981, p. 71-72). The original context was not directly a commentary on the crisis; rather the issues connected to the crisis provided some supporting arguments for a new theory of motivation that invoked principles of catastrophe theory, which I regarded as one avenue for conducting psychological research in a manner that did justice to the concerns in play at the time:

The crisis in social psychology required a change from a retroactive to a proactive perspective; prediction of future events took precedence over explaining past events. Instrumental to the change was a shift in perspective to focus on the experiences of the research subjects instead of those of the experimenter only. Lewin's original proposal for an agenda in social psychological research was that social psychology should include laboratory and field research (Ring, 1967) because theory building occurred at a time when there was no "group movement." Cognitive dissonance theory (Festinger, 1957) became dominant in the area, but at its peak of notoriety Chapanis and Chapanis (1964) uncovered a series of methodological, theoretical, and computational problems. The paradigm that was being used in social psychology was found inadequate. The crisis had begun, and another approach was needed.

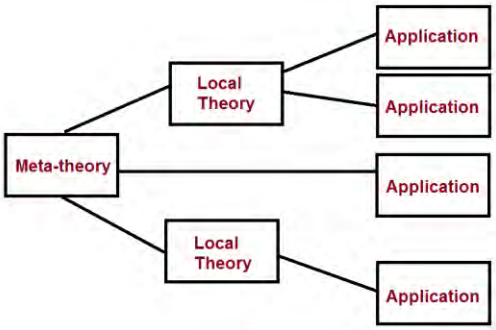
In the dialogues that ensued, Ring (1967) quoted McGuire as proposing that social psychology become a mathematically oriented psychology with the humanistic element left out. McGuire (1967) responded that better methodologies were essential if psychology was to make predictions. The direction of research was shifting from concerns about what happened, such as the construction of the Berlin wall or urban blight, to use McGuire's examples, to concern about how to predict and shape new trends. McGuire (1967) also proposed, furthermore, that experiments be carried out in natural settings to capture the human element that could be disinfected in a carefully controlled laboratory study. Campbell and Stanley's (1969) book on experimental and quasi-experimental design offered methods for analyzing and interpreting data from naturalistic manipulations of variables under study.

The use of deception that was common in cognitive dissonance experiments was also criticized by Chapanis and Chapanis (1964) for not being convincing to the experimental subjects. Also role demands can introduce artefacts, i.e., subjects know they are in an experiment (Orne, 1962; Shulman & Bergman, 1975). As a result, naturalistic experiments and data drawn from field applications would be good alternatives for social psychology. ***

The next problem was to choose some research questions. Moscovici (1972) found some truth to the notion that people, including psychologists, do what they are reinforced for doing. He quoted Collins and Guetzkow (1964) for a case in point: "Since early studies failed to reveal a positive correlation between satisfaction and productivity, satisfaction appears to have lost its place as one of the central variables in social psychology" (Moscovici, 1972, p. 24). Moscovici saw exchange theory and decision making as too individually oriented; group dynamics should have been given a higher priority (which did happen afterwards). Steiner (1974) raised a similar issue.

A time dimension needed to be added to the new perspective if the field had any intentions of futurism. According to Gergen (1973) theories of social behavior are a function of their times, and biased by the value system acquired by their proponents, if not also the research participants, at the time. Social science research can have a real impact on the society that it tries to study (Argyris, 1975). Thus the only true scientific laws would be trans-historic laws. The viability of finding trans-historic laws is left as an open question for present purposes, but those were some of the prominent issues of the day nonetheless.

The two examples that follow depict research topics that entered into crisis mode and then recovered. In both cases, the recovery was made possible in part by broadening the perspective surrounding the critical constructs and adapting more of a systems view of the situation. Further progress was made later by applying catastrophe theory to the same phenomena.



Fig, 1. The hierarchical relationships among meta-theory, local theories, and applications.

Catastrophe theory itself is a mathematical theory for describing and predicting discontinuous changes of events (Thom, 1975; Zeeman 1977). Thus it is really only meant for problems where sudden changes in system behavior are possible. It is analytical nonetheless, meaning that the mathematical functions can be rendered into statistical form and used to examine empirical data (Guastello, 1995, 2013a; Guastello & Gregson, 2011). Other NDS constructs are analytic as well, and have made contributions to many areas of psychology (Guastello, 2009; Guastello, Koopmans, & Pincus, 2009).

When NDS principles combine with the theoretical constructs within a particular application, they play the role of a meta-theory: Broad theoretical principles guide the organization of constructs within the local theory, which in turn shapes the approach to studying a local phenomenon (Fig. 1). There could also be occasions where a phenomenon is worth investigating, but a local theory has not been previously developed. Here the meta-theory could shape the development of both.

Example 1: Attitudes and Behaviors

It could be very advantageous to predict someone's behavior tomorrow by asking the right questions today. If anything was replicable about the attitude-behavior relationship in the 1960s, it was that behavior predicts attitude more so than the other way around (Bem, 1967; Fishbein, 1967; Fishbein & Ajzen, 1975). In the case of job satisfaction and performance, the median correlation was .14 (Vroom, 1964); many of the reported examples were negative correlations where positive correlations were expected.

The first phase of the solution required decomposing the dependent measure into behavioral intention, which precedes behavior, and the behavior itself (Fishbein & Ajzen, 1975). Two new constructs perceived norms for the behavior and motivation to comply with the norms. In later evolutions of the theory additional constructs were added to explain the origins of the latter two constructs and the elements of perceived control that fit in between the behavioral intention and behavior (Azjen, 2000). The theory has now seen hundreds of successful applications (read "replications") to different attitude and behavior targets.

The second phase of development reframed the attitude-behavior relationship as a cusp catastrophe process, which has two stable states and two control parameters: (a) attitude toward the behavior target, which can be expressed as perceived benefits of the behavior, and (b) resistance to the behavior. The latter can arise from reactance to peer pressure or pressure from authority, or sources of resistance that might fall between behavioral intention and behavior, such as not having the money to buy a product.

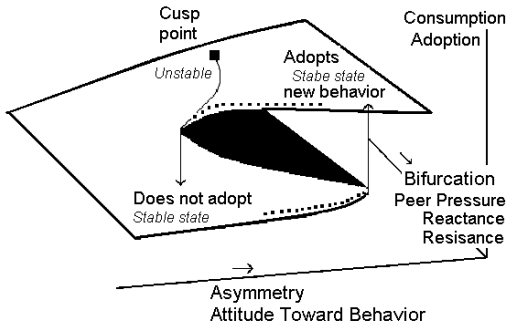


Fig. 2. Cusp catastrophe model for the attitude-behavior relationship.

The cusp model for the attitude-behavior relationship (Fig. 2) has seen four distinct applications (Guastello, Aruka, Doyle, & Smerz, 2008; Jacobsen & Guastello, 2007; Smerz & Guastello, 2008; Tesser & Achee, 1994) to date. The two studies on binge drinking were replications in two different cultures, however, and the study of adoption of energy technologies actually evaluated 13 technology adoption trends with the same respondents. In the latter case (Jacobsen & Guastello, 2007) we saw something interesting about the replicability of our model in that it worked for seven of the technologies that were more mature and had more complete trends of adoption; technologies that were too new to have garner much adoption or that might have been less preferred than other technologies did not illustrate the cusp effect. We regarded this result as information about the technologies and not "failures to replicate." Technologies with the more complete adoption trend also covered more of the full range of the cusp response surface.

Table 1. Summary of results for the cusp catastrophe model for the attitude-behavior relationship.

Attitude topic	*N*	R^2 *Cusp*	R^2 *Alt.*	*Alternative*
Binge Drinking,[a]	1247			Multiple linear,
USA sample		.90	.34	2 IVs with
Frequency		.64	.39	interaction term
Drinks/week		.59	.38	
Binge Drinking [b]	132			Linear, 2 IVs
Japanese Sample		.77	.10	
Frequency		.81	.05	
Drinks/week		.64	.12	
US & Japanese Samples	264			Linear, 3 IVs
combined [c]		.87	.24	
Binge Drinking		.65	.24	
Frequency		.73	.24	
Drinks/week				
Adoption of	102			
technology 1		.95	.11	Linear, 2 IVs
technology 2		.96	.09	Linear, 2 IVs
technology 3		.93	.36	Linear, 2 IVs
technology 4		.78	.41	Linear, 2 IVs
technology 5		.85	.40	Linear, 2 IVs
technology 6		.95	.34	Linear, 2 IVs
technology 7		.96	.45	Linear, 2 IVs
technology 8*		.00	.94	Inverse power law
technology 9*		.00	.36	Linear, 2 IVs
technology 10*		.00	.32	Linear, 2 IVs
technology 11*		.00	.41	Linear, 2 IVs
technology 12*		.00	.32	Linear, 2 IVs
technology 13*		.00	.43	Linear, 2 IVs
Unweighted average		.81	.26	

(* not included).
[a]Smerz & Guastello (2008), [b]Guastello et al. (2008), [c]Jacobsen & Guastello (2007).

Table 1 lists the effect sizes for the cusp models and contrasts them with the next best alternative model. The latter was, in most cases, a multiple linear regression consisting of the two or three variables that were used as control variables. In one study, the contrast model was a two-variable linear regression with an interaction term, and for one of the technologies, it was an inverse power law distribution. The interaction terms had negligible effects within the linear regression models. The analysis of data in Tesser and Achee (1994) was not in a form that facilitated a comparison with the other studies in the table.

Example 2: Safety Climate

The next example is a case of a theoretical construct and predictions that were replicated in some respects but was found not be generalizable in the long run. The improvements once again were to broaden the scope of relevant constructs and apply an appropriate dash of catastrophe theory to explain the sudden discontinuities associated with an accidental injury.

Safety climate (Zohar, 1980) is a single construct that captures the management conditions surrounding occupational accidents in hazardous environments as perceived by the workforce. Does management show concern and involvement in safety practices? Do the employees show concern and involvement, use proper procedures, and support each other for doing the same? The measurement of the construct had some attractiveness as a "safety barometer" in some organizations. The construct generated considerable research where it was used as a predictor of individuals' use of proper safe procedures, involvement in safety committees, and involvement in actual accidents.

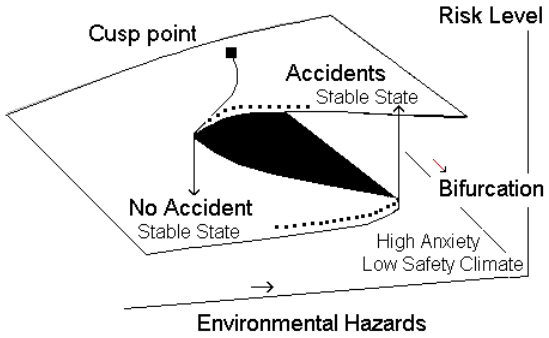


Fig. 3. Cusp catastrophe model for the occupational accident process, based on results from Guastello and Lynn (2014).

A MAVG study (Clark, 2006) eventually showed, however, that the average (population) correlation between safety climate and non-accident criteria was generalizable, but the correlation with accident criteria (R^2 = .05) was not. The 90% confidence interval included .00 and thus there were some observations in the contrary direction. The theoretical solution already existed before Clark's review. The first part was to broaden the scope of the construct base of safety climate to include other safety-relevant variables such as sources of stress and anxiety, hazard levels of specific work environments, and work group size (Guastello, 1988, 1989, 1992; Guastello, Gershon & Murphy, 1999; Guastello & Lynn, 2014). The second part was to apply the cusp catastrophe model (Fig. 3) to model the sudden changes in risk associated with unfortunate combinations of control variables. Once again the nonlinear components of the model accounted for substantial

amounts of variance compared to the next-best alternative model structures (Table 2).

In the particular case of the safety climate construct, low values corresponded to high bifurcation side of the response surface (Guastello & Lynn, 2014). Individuals working in poor climate conditions can experience either high or low accident exposures. In those situations the individual must be self-reliant enough to self-manage the risks, although it might not always be possible to do so. The hazard level makes an important difference in accident outcomes, and it was a bit surprising that hazard levels were not routinely included in safety climate research. It is also relevant that the particular constellation of psychosocial variables and hazards varies by industry and organization (Guastello, 2003).

Table 2. Summary of regression results for safety climate, psychosocial variables, and occupational accidents.

Occupational Setting	*N*	R^2 *Cusp*	R^2 *Alt.*	*Alternative*
Steel Industry[a]	283 groups	.37	.22	Linear
4 data panels		.39	.26	
		.51	.08	
		.37	.09	
Steel Industry[b]	68 groups	.42	.05	Log-transformed linear
Urban Transportation[c]	256 individuals	.63	.26	Linear
Health care[d]	1369 individuals	.75	.07	Linear
Steel Industry[e]	1262 individuals	.72	.08	Log-transformed linear
Unweighted average		.52	.14	

[a] Guastello (1988), [b] Guastello (1989), [c] Guastello (1992), [d] Guastello et al. (1999), [e] Guastello & Lynn (2014)

Dynamic Environments and Limits to Replication

Gergen (1973) recommended a search for trans-historical laws. How broad a time frame was he imagining? Complex human events transpire over a time ecology that consists of facets that transpire over many years, some at the level of days and weeks, and others at the level of minutes and seconds (Koehler, 2003). From the standpoint of NDS they are all good targets of investigation if one bears in mind that the shorter-term dynamics are nested within longer term events that might not change much during the course of a particular study. As a result, things that do not vary cannot be harnessed into a particular research study. We then speak of "context" which can result from people, places, or time periods. NDS nonetheless offers three constructs that could compromise replication if replication is not understood with the proper level of circumspection: sensitivity to initial conditions, self-organization and emergence, and degrees of freedom.

Sensitivity to initial conditions is the formal name for the "butterfly effect" in chaos theory (Lorenz, 1963; Dooley, 2009): If we take two points that are arbitrarily close together and allow them to iterate through their natural deterministic process, and the two points are subjected to the same process, the two trajectories of behavior can become very far apart eventually. It is still an open question as to how many psychological constructs are really chaotic over time, but there seem to be enough of them, if one knows what signals to look for (Guastello, 2009; Navarro, Curioso, Gomes, Arrieta, & Cortes, 2013). Relative to the replication issue, there could be some variation in results from replicating experiments if chaotic processes are involved, and it would be wise to examine why some experiments turned out one way and others turned out differently.

Self-organization is process whereby systems that are in a state of high entropy take on a structure without the influence of outside agents. Autonomous work groups are an example (Cohen, Ledford, & Spreitzer, 1996; Cordery, Mueller, & Smith, 1991; Pearson, 1992; Trist, Susman, & Brown, 1977). The result is a system that requires less internal entropy and fewer degrees of freedom to operate (Nicolis & Prigogine, 1989). Although there are several mechanisms of self-organization, the common denominator is that information flows from one subsystem or agent to another (Guastello & Liebovitch, 1989; Haken, 1988). It is thus plausible that social events do not remain in a state of chaos very long, but adopt a lower-entropy structure instead. By the same token small influences such as the configuration of furniture in a room relative to the number of people in the room could produce different social structures.

Emergence is best captured by the idiom that "The whole is greater than the sum of its parts." Psychologists might associate this idea with the gestalt psychologists, but it was actually introduced to the social sciences somewhat earlier by Durkheim who was trying to define scientific sociology and was looking for phenomena that could not be explained simply by the psychology of individuals (Sawyer, 2005). Emergence and self-organization have much in common, especially where a superordinate structure is formed from the interactions of agents. Emergence has a stronger form, however, whereby the superordinate structure exerts a downward influence on the behavior of the individual agents, especially new agents coming into the system. There are several forms of emergence as well (Goldstein, 2011; McKelvey & Lichtenstein, 2007). It can also take the form of emer-gent variables that are not relevant at one point in the research participants' history, but become relevant later on (Guastello, 2002). Relative to the replication issue, there could be some variation in results from replicating experiments if emergent processes are involved. It would be difficult to say with much assurance how often they occur in psychological research, but Kozlowski and Ilgen (2006) interpreted the results of many studies of group dynamics as resulting from emergent processes.

Underneath a self-organizing or emergent process are *degrees of freedom*. The concept is also relevant to psychomotor movements (Bernstein, 1967) cognitive processes and perception-action sequences (Guastello, 2013b; Turvey, 1990). In any particular complex movement, each limb of the body has limited capabilities, and the movements made by one limb limit the possibilities for another limb. The notion of internally connected models of movement is substantially simpler and more efficient than assuming that all elements of movement

are controlled by a central executive function. In the early stages of learning, the individual would explore several possible combinations of cognitive and movement elements. Once learning has set in, however, the cognitive and movement combinations gravitate toward conserving degrees of freedom, which is in essence the path of least resistance (Friston, 2010; Hong, 2010). A strong impetus from either natural circumstances or the laboratory protocol to change behavior can result in a reorganization of the degrees of freedom into what is known as a *phase shift*. In the case of psychological research, the cognitive and social movements are not fully controlled by the experimenter, although the experimenter might imagine otherwise. The greater the number of possible degrees of freedom in the system, the greater the number of possible outcomes would be.

Cusp catastrophes and some chaotic processes arise from relatively simple systems. If a system were more complex with many interrelated parts and feedback loops going every which way, the challenge for replicating phenomena of scientific interest becomes complexified as well. Allen and Varga (2007) observed:

> Traditional science was based on the idea that there was an objective reality outside, and that we could study it and do experiments on it that allowed us to build, cumulatively, an increasingly accurate picture of that reality. Whilst for simple physical problems and for planetary motion this was a reasonable working hypothesis, for biological and social systems this has always been a problem. Experiments are not always replicable or transferable, and situations are historically evolved involving local, co-evolving contexts, and therefore can potentially all be unique and lacking in any generic behaviors or laws. Complexity science brings us face to face with this elusive reality. It tells us that we must accept uncertainty and admit that our cognition, our descriptions and our models are necessarily incomplete and temporary props to our current functioning. They help us make some sense of the past and the present, and are all we have to help us in taking steps into the future (p. 20) ... What matters over time is the expansion of any system into new dimensions and conceptual spaces, as a result of successive instabilities involving dimensions additional to those the current "system" appears to occupy (p. 21).

Three points should be evident by now: (a) It is the nature of complex living systems to produce challenges to replicability. (b) Psychology is not alone in this regard; biology and economics feel the same pinch. (c) Handling these challenges advantageously requires broadening the conceptual space of some of our theories or adopting a more circumspective viewpoint on those we have already.

Summary

The contributions to *Perspectives* on the current crisis in replicability covered numerous shenanigans of reviewers, editors, and auth-ors that have self-organized into the present situation. One might also include funding agencies and general politics among the shadowing influences that could be involved. This article addressed an idea not previously considered that perhaps part of the problem is that the quality of ideas could withstand some improvement. Better ideas would be more likely to replicate, and more researchers would become sufficiently interested to replicate and expand. What constitutes "better" There is no universal answer, but several clues have been offered here that already have had some practical utility.

Authors and reviewers should shift more focus to effect size. This orientation combined with a bit of self-regulation will screen out spurious findings, and MAVG can compensate for deficits in statistical power or sampling errors. One also gains a valuable perspective on a problem by knowing that a widely acclaimed effect is really only very small compared to other effects. Also, there are analytic techniques currently in vogue that do not give comparable indicators of effect size. Thus there is a limit to how far this recommendation can go.

When faced with a replication issue, researchers should consider broadening the scope of the problem-solution nexus. A richer understanding of phenomena might be obtained by exploring relationships to other phenomena that are not obviously connected to the target one. Doing so might solve the more immediate problem. As the zone of replicability becomes larger, it becomes possible to separate what is the same across replications, what is situation-specific, and maybe why so. Broadening the concept space could also produce a coherent big picture that contains the new and old elements. NDS has helped by articulating processes that are often missing.

McGuire (2013) described logical positivism and dust-bowl empiricism as two extreme orientations leading to what many authors have identified as a replication problem. Meta-theories, and we do not know how many viable ones there are exactly, could bridge or hedge the deficits of the two extreme views. Mathematical structures could be helpful, and there is considerable evidence on record to support that direction, most of which was not presented here.

Time matters. Theories should shift focus from static to dynamic relationships with general systems constructs for understanding change. Although it was tempting to digress into NDS as a paradigm, those points have been covered by others in *NDPLS*, January, 2007.

Paradoxically, history repeats itself sometimes in spite of the one-way arrow of co-evolutionary time. If any trans-historical laws can exist in psychology, we might have found one. Replicability crises have happened before. There were good analyses of the problem and suggested solutions, but the subsequent cohorts of academics did not appear to have assimilated them widely enough. Thus the foregoing remarks stand as a replication and expansion of earlier arguments from the last crisis.

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(II)

Emotional Inertia: A Key to Understanding Psychotherapy Process and Outcome

by

Xavier Bornas, Miquel Noguera, David Pincus, & Gualberto Buela-Casal

The following article is an excerpt from a longer manuscript in press for publication in: International Journal of Clinical and Health Psychology

In this theoretical study we present a novel model of psychotherapy process. This model specifies the relationship between a client's emotional trajectory and the force of intervention necessary to modify this trajectory. Within the nonlinear dynamical systems (NDS) paradigm, emotional inertia appears to be a general aspect of personality (Kuppens, Oravecz, & Tuerlinckx, 2010) that is related to psychopathology (Kuppens, Allen, & Sheeber, 2010), and yet has not been applied to the context of psychotherapy research. Kuppens et al. (2010a, p. 985) formally define emotional inertia as: "…resistance to emotional change, formalized as the degree to which a person's current emotional state can be predicted by his or her emotional state at a previous moment (with high predictability reflecting high inertia)," which leads to the basic operational definition as degrees of autocorrelation in emotional dynamics over time.

Dynamical systems often display very complex, random-looking behaviors. NDS shows that these apparently erratic behavior may follow some simple rules, that is, regularities and patterns may be hidden,

particularly when using traditional linear statistics (i.e., couched in the general linear model). Discovering such patterns requires the reconstruction of the system's so-called phase or state space. The emotional state of a patient at any moment can be located within the system's phase space where attractors are the emotional states to which the patient converges.

Psychotherapies can be understood as impacting ever-changing emotional systems of clients. The first goal of therapy will be to change the current direction of the system. Treatment should account for emotional inertia with interventions that move the system to healthier regions in its phase space. This first goal is consistent with an initial focus upon remoralization or instilling hope for eventual change, a common process across approaches that helps establish a positive therapeutic alliance (Baldwin, Wampold, Imel, 2007; Frank & Frank, 1993; Pincus, 2009; Wampold, 2001). The effort required to change the direction of the system in a certain moment is proportional to the angle formed by the vector of the client's emotional trajectory in that moment and the vector of treatment. Therefore, we can predict the effect of the treatment *as far as we know the direction of its force and the trajectory of the patient's emotional system* (see Figure 1).

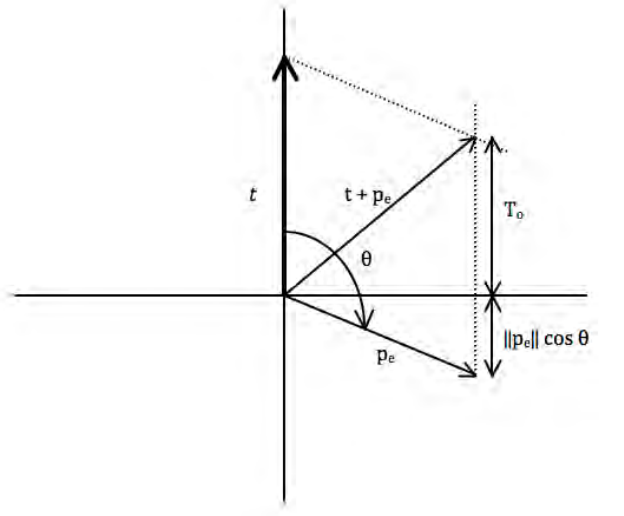

Figure 1. Treatment outcome (T_o) as a result of the interaction between the vector of the system's current trajectory (p_e), the vector of the treatment (t), and the angle θ from vector t to vector p_e.

If p_e is the tangent vector of the trajectory (emotional momentum or inertia) and t is the vector of the treatment, and $||t||$ the energy of the treatment, then we can estimate the treatment outcome T_o as

$$T_o = ||t|| + ||p_e|| \cos \theta$$

where θ is the angle from vector t to vector p_e.

To better understand this formula let us think of two patients, A and B while having in mind Figure 1. The state (e.g. depressive state) of the patients when treatment is applied is the origin point in figure 1, i.e. where the x axis crosses the y axis, which can be thought of as depressive state. Patient A is feeling worse (in fact Figure 1 would represent this specific instance), so that a force is pulling her down, and this force is represented by vector p_e. Treatment, on the other hand, is represented by vector t as it is a force that pulls patient A up to a less depressive state. The direction patient A will take as a result of treatment depends on how strong is the "worsening force", and this is formally represented by the sum of both vectors $t+p_e$. Treatment outcome (T_o) is the distance from the initial state (remember this is the origin in figure 1) to the state achieved by the sum of vectors, and it is calculated by subtracting the distance due to the worsening force p_e from the distance $||t||$ achieved by the force of treatment. Trigonometry shows us that to calculate the first distance we have to multiply $||p_e||$ (the length of vector p_e) by the $cos\ \theta$ (and as $\theta > 90$ degrees, the $cos\ \theta$ will be a negative value). Therefore $T_o=||t||+||p_e||cos\theta$. Patient B, unlike patient A, is not feeling worse. Her current state is the origin in Figure 2. There is no force pulling her down, so that the vector of the "worsening force" would be horizontal (not shown in Figure 1). Then the angle between treatment force t (which is the same than for patient A and pulls her up) and this horizontal vector would equal 90 degrees. In this case, the $cos\theta=0$, so that the distance $||p_e||$ multiplied by zero is zero and T_o will equal distance $||t||$, the expected result if treatment force has no opposing force or resistance. To sum up, the greater the angle, the higher the energy of the treatment needed to get the desired outcome.

Once the relations between emotional vectors and treatment strength are formalized mathematically, therapists working with client emotional trajectories essentially have two broad ranges of strategies: a) Increase the force of treatment (e.g., using interpersonal leverage or increasing directiveness with a specific technique); or b) reduce the angle of intervention, which is essentially a question of fit.

Through this rather simple mathematical model of emotional momentum, one may see a resolution to the most significant conflict in psychotherapy research over general versus specific factors in treatment. Emotional momentum makes clear the complementary roles of "common factors," such as empathy, and forceful techniques, such as exposure. Common factors move a patient's emotional trajectories toward the 90 degree vector to allow for greater leverage, while forceful techniques provide greater force. Ideally, sensitive and skilled therapists can do both.

Preventing relapse is another major goal of any psychotherapeutic intervention. NDS theory can help us

to understand why relapse occurs, and to better prevent relapse. Once psychotherapy has successfully moved the system from the unhealthy attractor to a healthy region of its phase space, the trajectory has been changed but the phase space may remain the same, so that the unhealthy attractor may be still there. It is important to notice that in the future the system can fall into one of these attractors. From a NDS perspective, the patient's emotional phase space must be reconfigured to prevent relapse. To some extent reconfiguring the emotional phase space of the patient would be like irreversibly changing the core aspects of a client's attitudes, values, beliefs, or life philosophy, which is in fact the deeper goal of nearly all psychological therapies.

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Aruka, Y. A. (2015). *Evolutional Foundations of Economic Science*. Tokyo: Springer.

This book aims to discern and distinguish the essential features of basic economic theories and compare them with new theories that have arisen in recent years. The book focuses on seminal economic ideas and theories developed mainly in the 1930s to 1950s because their emergence eventually led to new branches of economics. The book describes an alternative analytical framework spreading through the interdisciplinary fields of socioeconophysics and sociodynamics. The focus is on a set of branching or critical points that separate what has gone before from what has followed. W. Brian Arthur used the term "redomaining" when he referred to technological innovation. In the present volume the author aims to redomain economic theories suited for a new social order. Major technological innovations accompany not only changes in the economy and the market but changes in their meaning as well. In particular, the evolution of trading technology has changed the meaning of the "invisible hand." At the end of the last century, the advent of socioeconophysics became a decisive factor in the emergence of a new economic science. This emergence has coincided with changes in the implications of the economy and the market, which consequently require a redomaining of

economic science. In this new enterprise, the joint efforts of many scientists outside traditional economics have brought brilliant achievements such as power law distribution and network analysis, among others. However, the more diverse the backgrounds of economic scientists, the less integrated the common views among them may be, resulting in a sometimes perplexing potpourri of economic terminology. This book helps to mitigate those differences, shedding light on current alternative economic theories and how they have evolved. *E-books are available now from Springer. Hard copy books will be available on the dates indicated.*

Douc, R., Moulines, E., & Stoffer, D. (2014). *Nonlinear Time Series: Theory, Methods and Applications with R Examples*. Boca Raton, FL: Chapman & Hall/CRC Press. ISBN 9781466502253. Designed for researchers and students, Nonlinear Times Series: Theory, Methods and Applications with R Examples familiarizes readers with the principles behind nonlinear time series models—without overwhelming them with difficult mathematical developments. By focusing on basic principles and theory, the authors give readers the background required to craft their own stochastic models, numerical methods, and software. They will also be able to assess the advantages and disadvantages of different approaches, and thus be able to choose the right methods for their purposes. The first part can be seen as a crash course on "classical" time series, with a special emphasis on linear state space models and detailed coverage of random coefficient autoregressions, both ARCH and GARCH models. The second part introduces Markov chains, discussing stability, the existence of a stationary distribution, ergodicity, limit theorems, and statistical inference. The book concludes with a self-contained account on nonlinear state space and sequential Monte Carlo methods. An elementary introduction to nonlinear state space modeling and sequential Monte Carlo, this section touches on current topics, from the theory of statistical inference to advanced computational methods.

McCandless, K., & Lipmanowicz, H. (2014). *The Surprising Power of Liberating Structures: Simple Rules to Unleash A Culture of Innovation*. Seattle WA: Liberating Structures Press. ISBN 978-0615893372. Smart leaders know that they would greatly increase productivity and innovation if only they could get everyone fully engaged. So do professors, facilitators and all changemakers. The challenge is how. Liberating Structures are novel, practical and no-nonsense methods to help you accomplish this goal with groups of any size. Part One: The Hidden Structure of Engagement will ground you with the conceptual framework and vocabulary of Liberating Structures. It contrasts Liberating Structures with conventional methods and shows the benefits of using them to transform the way people collaborate, learn, and discover solutions together. Part Two: Getting Started and Beyond offers guidelines for experimenting in a wide range of applications from small group interactions to system-wide initiatives: meetings, projects, problem solving, change initiatives, product launches, strategy development, etc. Part Three: Stories from the Field illustrates the endless possibilities Liberating Structures offer with stories from users around the world, in all types of organizations — from healthcare to academic to military to global business enterprises, from judicial and legislative environments to R&D. Part Four: The Field Guide for Including, Engaging, and Unleashing Everyone describes how to use each of the 33 Liberating Structures with step-by-step explanations of what to do and what to expect.

Mosekilde, E. (2014). ***Topics in Nonlinear Dynamics Applications to Physics, Biology and Economic Systems.* Singapore: World Scientific.** Through a series of examples from physics, engineering, biology and economics, this book illustrates the enormous potential for application of ideas and concepts from nonlinear dynamics and chaos theory. The overlap with examples published in other books is virtually equal to zero. The book takes the reader from detailed studies of bifurcation structures of relativity simple models to pattern formation in spatially extended systems. The book also discusses the different perspectives that nonlinear dynamics brings to different fields of science. *Contents:* Deterministic Approach to Die Tossing, Bifurcation Analysis of Simple Nonlinear Systems, Coupled Period-Doubling Systems, Chaos in Technical Control Systems, Ecological and Microbiological Population Dynamics, Physiological Control Systems, Chaos and Hyperchaos in Economic and Managerial Systems, Spatiotemporal Phenomena in Extended Systems.

Owen, K. Q., Dietz, A. S., & Culbertson, R. (2014). *Iron has memory, rocks breathe slowly, crystals learn: Long term thinking and cultural change—revisited.* Litchfield Park, AZ: Emergent Publications. ISBN 9781938158124 (140 pages). This short book examines the need for change in human systems and provides an opportunity for achieving lasting, sustainable change. This book is set out in three chapters which address: the challenges with change in organizations and how those challenges relate to organizational culture; a methodology for exploring cultures in organizations; and a model for using our understanding of organizational culture to develop lasting, purposeful organizational change. The underlying concepts of organizational change described in this book are founded in systems theory and evidence-based assessment. *"Insightful, thorough and practical, the ideas put forth by Owen, Dietz and Culbertson urge business leaders to take an active role in shaping culture as a business imperative. Using sound data and meaningful metaphors, the authors make a powerful argument for how doing so will heighten business performance and employee engagement." -- Nancy P. Dunnells, Senior Director, Darden Executive Education, University of Virginia.*

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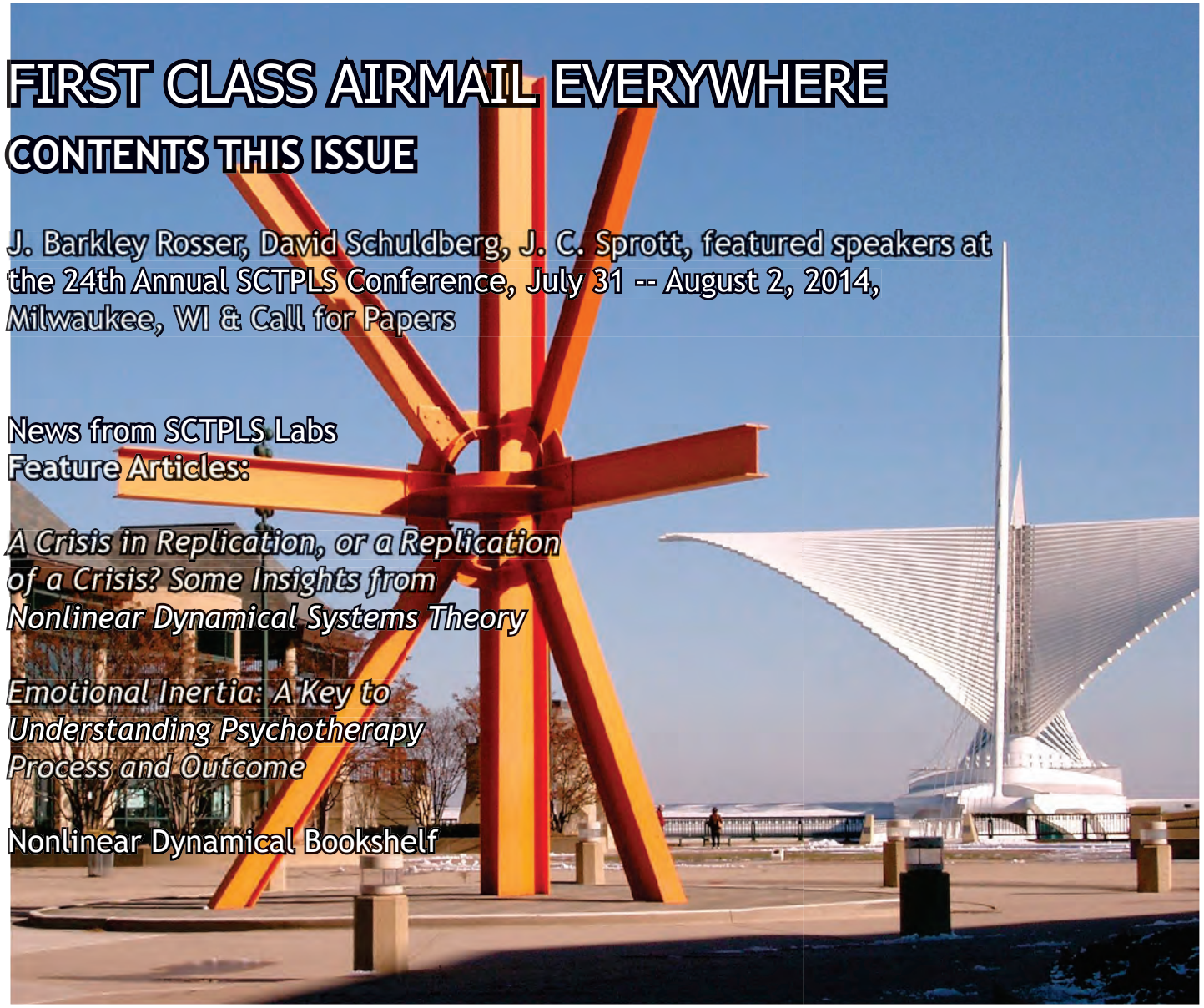

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