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EXECUTIVE DIRECTOR'S COLUMN

STEVEN BRECKLER, Executive Director for Science

APA Council of Representatives Moves Forward on Science Issues

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Most of the policies, actions, and programs of the APA are developed, approved, and supported by our system of governance – our Council, Boards, Committees, and Task Forces. For a short course on APA governance, see my recent columns in the June, 2006 (http://www.apa.org/science/psa/homepage_june06.html) and July/August 2006 (http://www.apa.org/science/psa/homepage_july06.html) issues of Psychological Science Agenda (http://www.apa.org/science/psa/).

Earlier this month, the APA Council of Representatives (http://www.apa.org/governance/council.html) held the first of its two meetings for 2007. Council is an extraordinarily important part of APA governance. It is APA's main legislative body. Very little happens at APA without the approval of Council, and many new initiatives and activities have their origin in Council.

Council took action on three agenda items that the Science Community should know about.

Reaffirming Support for Evolutionary Theory

Council passed a resolution, developed initially by the APA Committee on Animal Research and Ethics (CARE) (http://www.apa.org/science/rcr/care.html), rejecting intelligent design as scientific and reaffirming support for evolutionary theory. In adopting the resolution, APA reaffirmed its 1982 Resolution on Creationism (http://www.apa.org/about/division/cpmscientific.html#2), and joined a number of other science and education organizations which have taken similar positions, including the American Association for the Advancement of Science (http://www.aaas.org/news/releases/2006/pdf/0219boardstatement.pdf), the Federation of American Societies of Experimental Biology (http://opa.faseb.org/pdf/EvolutionStatement.pdf) and the National Association of Biology Teachers (http://www.nabt.org/sites/S1/File/pdf/pressrelease_KSbrdofed.pdf).

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SCIENCE BRIEFS

The Fractal Picture of Health and Wellbeing

by Guy Van Orden

Guy C. Van Orden is a professor of psychology at the University of Cincinnati. He received his PhD in Psychology from University of California San Diego in 1984. His current research interests are complexity theory and nonlinear methods applied to problems of cognition and action.

A healthy heart beats in an aperiodic rhythm, not too regular or repetitive, and not too random or chaotic. The healthy rhythm lives between those extremes, exhibiting a pattern of fractal variability. Loss of fractal variability signals heart disease, pathological dynamics of the heart. In congestive heart failure, for example, the heartbeat is overly regular, corresponding to a low fractal dimension. And in atrial fibrillation, the heartbeat is overly random, corresponding to a high fractal dimension (Goldberger, 1996; Goldberger, Amaral, et al., 2002; Havlin, Amaral, et al., 1999). Many dynamical diseases have this common form, a departure away from healthy fractal variability and toward a *loss of complexity* in the dynamical unfolding of a system's behavior across time (Glass & Mackey, 1988).

Fractal rhythms appear widely at multiple levels of analysis in healthy physiology (Bassingthwaighte, Liebovitch, & West, 1994) including brain physiology and also in measurements of a healthy person's behavior. As concerns behavior, fractal behavior has been observed in perceptual learning, postural sway, and the timing of perceived reversals of a reversible Necker cube. It is found in motor performances such as spacing and timing of rhythmic movement and the phase relation between rhythmic movements. It is found in tapping, human gait, and repeated measurements of simple reaction time. It appears in controlled cognitive performances including mental rotation, lexical decision, visual search, repeated production of a spatial interval, repeated judgments of an elapsed time, simple classifications, and variation in word naming by skilled readers, an automatic cognitive performance. And finally it is present in variation of ratings of self-esteem and in mood ratings by bipolar patients (Gilden, 2001; Riley & Turvey, 2002; and Van Orden, Holden & Turvey, 2003, are reviews).

Moreover, just as for heart physiology, recent behavioral and brain findings suggest that fractal variability is a signature of cognitive health and wellbeing. And deviations from the aperiodic rhythm are deviations from health and wellbeing. For example stress, epilepsy, manic-depressive disorder, aging, and neurodegenerative disorders such as Parkinson's and Huntington's disease are all associated with deviations from the healthy fractal pattern (West, 2006). To these we may add major depressive disorder, which is associated with an increase in fractal dimension of EEG recordings (Linkenkaer-Hansen, Monto, et al., 2005), and attention deficit and hyperactivity disorder, which is associated with a decrease in fractal dimension in cognitive behavioral tasks (Gilden & Hancock, 2007).

Patterns and Paradox

One way to see the pattern of healthy variation is in its spectral portrait, illustrated in the Figure (page 3). The Figure presents behavioral data, about 8000 trials of simple reaction times taken in one sitting, and the wavy aperiodic rhythm of variation from trial to trial across these data points is common to behavior and physiology. The spectral portrait below the trial data graph is derived by artificially reducing the aperiodic rhythm into multiple periodic component frequencies, usually sine waves. One can artificially segregate component waves of variation yielding rapid, higher frequency oscillations plus intermediate frequency oscillations plus low frequency oscillations. Axes have

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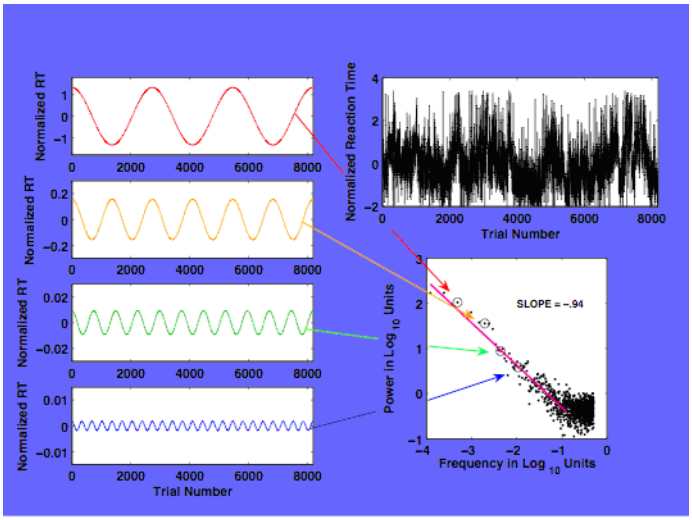
been adjusted in the Figure to make the illustrated sine waves visible.

Emergent properties of the fractal pattern dictate the relationship between amplitudes and frequencies, and the remarkable finding is the lawful scaling relation between amplitudes and frequencies of variation (on log scales). The amplitude of oscillation across blocks of hundreds or thousands of trials finds its value on the same line that captures amplitudes for oscillations with periods of tens, dozens, or scores of trials. The line itself, the red line in the spectral plot, defines the scaling relation in which amplitude of variation scales with frequency of variation. One can derive other pictures of the scaling relation with other fractal tools, but the spectral portrait is most commonly presented.



Spectral portrait of fractal behavior.

The scaling relation in repeated behavioral measures implies that each measurement is part of a common larger pattern that includes all other measurements. This fact can appear paradoxical. For instance, collect more data and you collect more of the aperiodic fractal wave. The amplitude of variation grows with the number of trials in the experiment. As an experiment increases in length from a few dozen to a few hundred to a few thousand trials the amplitude of variation increases proportionally (on log/log scales). Thus variability in human data has no characteristic amount and no preferred scale, which runs against the grain of what we are usually taught about data in courses on experimental design and analysis (Liebovitch & Shehadeh, 2005).

Most standard analyses assume that individual data points are distinct from one another, but they are not distinct if they are part of a larger fractal pattern. The fractal pattern entails long-range dependence—each data point depends on every other data point, as though some unseen hand is stitching together data points across a laboratory context of measurement. The paradox may run as deep as that confronted by quantum physicists. For instance, a measurement that appears both as a datum and as part of a larger fractal wave is not unlike the well-known electron that is both particle and wave (Van Orden, Kello, & Holden, in press). In psychology these paradoxes fuel spirited debate (e.g., Thorton & Gilden, 2005; Wagenmakers, Farrell, & Ratcliff, 2005; Van Orden, Holden, & Turvey, 2005). In physics scientists eventually accepted that quantum phenomena cannot be distinguished from their contexts of measurement, which some physicists take to mean that measurements themselves are emergent (Laughlin, 2005).

What Do the Fractal Patterns Mean?

Fractal data force us outside of the comfort zone of standard statistical thinking, to the windy cliff above uncharted territory. For instance, no one yet knows exactly why fractal behaviors are ubiquitous or what they tell us in each case. A few clues have surfaced however. Fractal behavior is unlikely to refer to a single source for example (Duarte & Zatsiorsky, 2000). Rather, it reflects system properties of temporal coordination, how the system coordinates real-time activity within organ systems and across organ systems and in the macro-activities of an organism (Kello, Beltz, Holden & Van Orden, 2007). This coordination appears to be a form of allometric control. In this way of thinking the stability and control of hierarchical biological systems results from nested systems "i.e., organelles into cells, cells into tissue, tissues into organs, etc." (West, 2006, p. 313).

Dynamical diseases illustrate the crucial importance of coordination. The key then to understanding dynamical disease and perhaps human behavior is to understand the way component processes interact, the basis of flexible adaptive coordination. Component processes must work together across their different spatial scales and must coordinate their changes despite different intrinsic timescales of change. Flexible coordination is integral to health and wellbeing, and the loss of complexity in dynamical disease is the loss of the flexible coordination among processes that must adapt and work together. Thus, for example, loss of stability or complexity in the interaction among organ systems, and their consequent rapid decline, may be the basis for the otherwise baffling multiple organ dysfunction syndrome in critically ill patients (Buchman, 2006).

In all likelihood then, fractal behavior tells us about coordination of component processes in the minds and bodies of living organisms. It is tantalizing in this respect that the common fractal signature of healthy functioning is found widely in natural systems that self-organize their behavior, that self-organization actually predicts the ubiquitous fractal signature (e.g., Bak, 1996; Solé & Goodwin,

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2001). Self-organization requires a particular kind of interaction to coordinate the processes that must work together. The precise form of this interaction balances competitive and cooperative processes to create an optimally adaptive and flexible working configuration or *critical state*, hence the technical term *self-organized criticality*. The interaction that yields critical states has been worked out for simple physical systems and serves as a working hypothesis for more complex biological and cognitive behavior. The name for this kind of interaction among component processes is *interaction-dominant dynamics*. The key fact of interaction-dominant dynamics is that system components change each other's dynamics to coordinate their collective behavior (Jensen, 1998).

Recent progress in systems neuroscience has converged on similar ideas about self-organization of central nervous system activity (e.g., Freeman & Holmes, 2005; Kozma, Puljic, et al., 2005; Sporns, Chialvo, Kaiser, & Hilgetag, 2004). Perhaps the day is not too far off when a more fully elaborated hypothesis of self-organization will explain ordinary coordination and control of cognitive and motor activity (Gibbs & Van Orden, 2002; Gilden, 2001; Kugler & Turvey, 1987; Riley & Turvey, 2002; Turvey & Moreno, 2006; Van Orden et al., 2003), including anticipation of changes in the environment (Kloos & Van Orden, in press; Raichle & Gusnard, 2005), and intentional behavior (Juarrero, 1999; Van Orden & Holden, 2002).

Prospects at Hand

In a new book, West (2006) argues that the emerging fractal picture of physiology and behavior will replace standard ways of thinking about living systems and lead to innovations in diagnosis and treatment. Whether or not this dramatic change in our thinking will occur, there is a present need for better methodological tools for empirical studies and a wider understanding of the tools that already exist and what they can tell us about cognition and behavior.

A more complete and integrated understanding of the fractal patterns that nature presents to us will require new nonlinear tools with which to examine fractal phenomena. Presently one usually relies on a single measure that corresponds explicitly or implicitly to the fractal dimension of variability in behavior. The fractal dimension or its equivalent is estimated using linear tools that are effectively cobbled together to converge on a reliable estimate. These important tools have successfully established the presence of fractal variability in behavioral and physiological phenomena, as well as departures from fractal variability, but they are limited in their scope and may not fully address the complexity of fractal phenomena. However, better nonlinear tools exist that may soon be available to study fractal behavior (Thomasson, Hoeppner, Webber, & Zbilut, 2001; Thomasson, Webber & Zbilut, 2002).

The other need I mentioned is for a wider understanding of existing tools and an expanded study of human behavior as a complex system. To meet this need, for example, *The Society for Chaos Theory in Psychology and Life Sciences* runs tutorial workshops at its annual meetings. Also the *National Science Foundation* recently supported preparation of *Contemporary Nonlinear Methods for Behavioral Scientists: A Webbook Tutorial* that can be downloaded from the NSF website of the *Social, Behavioral and Economic Science Directorate*, program in *Perception, Action and Cognition*. My own recent efforts, with those of my colleagues, have gone to creating an *Advanced Training Institute in Nonlinear Methods for Psychological Science* sponsored by the *American Psychological Association*. The next workshop will be held June 11-15, 2007, at the University of Cincinnati (please go to http://www.apa.org/science/ati_nlm.html for more information).

For more information about Guy Van Orden's research, please visit his website:

http://homepages.uc.edu/~vanordg/guy.html

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Nominations Sought for Culture of Service Awards

by: Suzanne Wandersman

The Science Directorate is looking for nominations for its two Culture of Service awards. One award honors individuals and the other award honors academic departments.

Award for Distinguished Service to Psychological Science

The APA Board of Scientific Affairs (BSA) is soliciting nominations for the Award for Distinguished Service to Psychological Science. This Award recognizes individuals who have made outstanding contributions to psychological science through their commitment to a culture of service. Award recipients will receive an honorarium of $1,000. The deadline for nominations is **April 20, 2007**.

Nominees will have demonstrated their service to the discipline by aiding in association governance; serving on boards, committees and various psychological associations; editing journals; reviewing grant proposals; mentoring students and colleagues; advocating for psychological science's best interests with state and federal lawmakers; and promoting the value of psychological science in the public eye. Nominees may be involved in one service area, many of the areas, or all of the service areas noted above. An individual's service to the discipline and not a person's scholarly achievements are the focus of this award.

Additional information and instructions on submitting applications can be found on the APA Science Directorate website (http://www.apa.org/science/serv_award.html).

Departmental Award for Culture of Service in the Psychological Sciences

The APA Board of Scientific Affairs (BSA) is soliciting nominations for the Departmental Award for Culture of Service in the Psychological Sciences. This Award recognizes departments that demonstrate a commitment to service in the psychological sciences. Departments selected for this award will show a pattern of support for service from faculty at all levels, including a demonstration that service to the discipline is rewarded in faculty tenure and promotion. Successful Departments will also demonstrate that service to the profession is an integral part of training and mentoring. Each Department selected will receive an award of $5,000 to be used for departmental activities. The deadline for nominations is **April 20, 2007**.

Service to the discipline includes such activities as departmental release time for serving on boards and committees of psychological associations; editing journals; serving on a review panel; or chairing an IRB. Other culture of service activities that a department would encourage include mentoring students and colleagues; advocating for psychological science's best interests with state and federal lawmakers; and promoting the value of psychological science in the public eye. The focus of this award is a department's faculty service to the discipline and not their scholarly achievements.

Both Undergraduate and Graduate Departments of Psychology are eligible. Self-nominations are encouraged.

Additional information and instructions on submitting applications can be found on the APA Science Directorate website (http://www.apa.org/science/dept_award.html). ■

Office of Applied Psychological Science Seeks Career Descriptions

by Stephanie Johnson

The Science Directorate's Office of Applied Psychological Science is continuing to develop and implement both existing and new programs within the Directorate. One of the existing programs that has been of considerable interest over the years, especially to students, is the "interesting careers" description that was published in PSA. These columns featured career descriptions from a number of scientifically trained psychologists who work outside of academe.

Given the expressed interest, PSA will again highlight the unique careers of psychological scientists working in a variety of areas, such as non-profits, corporations, and government. If you or someone you know is a scientifically trained psychologist working outside of academe, please send his or her name, job title, place of employment, and contact information to srjohnson@apa.org.

Thank you for helping us highlight these important contributions in applied psychological science! ■

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A New Public Education Campaign

Council approved funding to begin the planning for a psychology public education campaign. The funded proposal represents a collaboration between the APA Science, Education, and Public & Member Communications Directorates. The objective of this public education campaign will be to enhance the image and influence of psychology as a science. The foundational message will be that psychologists are scientific problem solvers whose work improves our daily lives. The new public education effort will complement APA's existing public education campaign (http://www.apapractice.org/apo/public.html#) in support of psychological practice as a health care profession.

Scientific Programming at Convention

Council approved funding for a new task force to look at how the APA Convention can be better organized to attract scientists. This effort represents a collaboration between the Board of Scientific Affairs (BSA) and the Board of Convention Affairs (BCA), and was developed in response to concerns being expressed by many of the APA Divisions about the structure and functioning of the annual convention. The task force will examine the current model for programming, and make recommendations for improving the process.

Keeping You Informed

As professional associations go, APA is very large. We have a large membership, supported by a large and complex governance and staff infrastructure. It can be a challenge to stay informed of every developing initiative, policy, and program. Our goal in the APA Science Directorate is to keep you informed. Over the next several months, Psychological Science Agenda will begin introducing regular governance updates to help the science community keep better track of the issues being addressed by our governance groups. ■

Tanaka Memorial Dissertation Award: Apply Now!

APA's Committee on Ethnic Minority Affairs (CEMA) is requesting nominations for the Jeffrey S. Tanaka Memorial Dissertation Award in Psychology, which recognizes work that contributes to a better understanding of the psychological issues and concerns facing communities of color.

Tanaka was an Asian-American scholar and psychologist whose work emphasized the importance of culture and ethnicity in the scientific understanding of behavior. A fellow of APA's Division 5 (Evaluation, Measurement and Statistics), and member of Divisions 8 (Society for Personality and Social Psychology) and 45 (Society for the Psychological Study of Ethnic Minority Issues), Tanaka was Chair-elect of CEMA at the time of his death in 1992.

CEMA welcomes applications for this prestigious annual award from individuals who filed their dissertations in 2005 or 2006. The winner receives a nominal cash award, APA Convention registration, a travel award sponsored by the APA Science Directorate to APA's 2007 convention in San Francisco, and an invitation to share the dissertation's highlights with the membership.

The deadline for submission of abstracts is April 1, 2007.

Please contact the APA Office of Ethnic Minority Affairs (202-336-6029) for more information, or visit the **website at http://www.apa.org/pi/oema/programs/Tanaka_Award_Announcement_2007.pdf**

APA Seeks Distinguished Science Awards Nominations

by Suzanne Wandersman

The APA Board of Scientific Affairs (BSA) invites nominations for its ongoing awards program. Awards are given in three categories:

The **Distinguished Scientific Contribution Award** is presented to individuals who have made distinguished theoretical or empirical contributions to basic research in psychology.

The **Distinguished Scientific Award for the Applications of Psychology** is given to individuals who have made exceptional theoretical or empirical advances in psychology leading to the understanding or amelioration of important practical problems.

To submit a nomination for the Distinguished Scientific Contribution Award and the Distinguished Scientific Contribution Award for the Applications of Psychology, you should provide a letter of nomination; the nominee's current vita with list of publications; the names and addresses of several scientists who are familiar with the nominee's work; a list of ten most significant and representative publications, and at least five reprints representative of the nominee's contribution (reprints, preferably in electronic form).

The **Distinguished Scientific Award for Early Career Contribution to Psychology** is awarded to outstanding young psychologists who are 9 years or less post-PhD (1998 or later). The Early Career Awards will be given in five areas:

- animal learning and behavior, comparative
- psychopathology
- health
- developmental
- cognition/human learning

The categories should be interpreted broadly and are not meant to be exclusive; all areas of psychology are of sufficient merit to be considered for awards.

To submit a nomination for the Distinguished Scientific Award for Early Career Contribution to Psychology, you should provide a letter of nomination, the nominee's current vita with list of publications, and up to five representative reprints.

To obtain nomination forms and more information, you can go to the Science Directorate web page (www.apa.org/science/sciaward.html) or you can contact Suzanne Wandersman, Science Directorate, American Psychological Association, 750 First Street, NE, Washington, DC 20002-4242; by phone, (202) 336-6000; by fax, (202) 336-5953; or by E-mail, swandersman@apa.org.

The deadline for all award nominations is June 1, 2007. ■

Call for Nominations: Meritorious Research Service Commendation

The APA Board of Scientific Affairs (BSA) is soliciting nominations for the Meritorious Research Service Commendation. This commendation recognizes individuals who have made outstanding contributions to psychological science through their service as employees of the federal government or other organizations. Contributions are defined according to service to the field that directly or indirectly advances opportunities and resources for psychological science. This may include staff at federal or non-federal research funding, regulatory or other agencies. Nominees may be active or retired but ordinarily will have a minimum of 10 years of such service. The individual's personal scholarly achievements (i.e., research, teaching, and writing) are not considered in the selection process independent of their service contributions.

To submit a nomination provide the following:

~A letter of nomination that describes and supports the individual's contributions (e.g., nature of the individual's service to psychological science, positions held, program development activities). The nomination letters should be no more than two pages long.
~A curriculum vita
~Three letters of support from scientists, at least two from outside the nominee's organization

Deadline for submitting nominations is March 15, 2007. Please send nominations to Suzanne Wandersman (swandersman@apa.org). For a list of past recipients, visit the APA website (http://www.apa.org/science/meritorious.html).

APA Science Directorate Sponsors Science Café

On March 26, 2007, the Foundation for the Advancement of Behavioral and Brain Sciences (FABBS) and the APA Science Directorate will once again collaborate on a Science Café. The topic for the coming event is "Unraveling the Mysteries of the Brain and Mind in the Aftermath of Terri Schiavo and Related Cases." The Cafe will take place at the headquarters building of the American Association for the Advancement of Science in Washington, DC.

FABBS, the organizer of the Science Café series, asked Nicholas Schiff and Daniel Wegner to speak at the event. Schiff is Assistant Professor of Neurology and Neuroscience at Weill Medical College of Cornell University and Wegner is Professor of Psychology at Harvard University.

Schiff will examine several recent cases of severe brain injury and consider their proper placement within the spectrum of disorders of human consciousness. He will explore how modern neuroimaging may extend our understanding of mechanisms underlying these conditions.

Wegner will consider how persistent vegetative states and minimally conscious states are judged from the outside, by examining how people perceive other inscrutable minds, such as those of animals, babies, and robots.

Both speakers will discuss how current research, including neuroimaging technologies, addresses the important questions surrounding these difficult conditions.

Please contact FABBS at info@fabbs.org if you are interested in attending the March 26th Science Café.

The Science Directorate is sponsoring this event, which is open to the public free of charge, as the capstone to its eight-year long training activity on functional magnetic resonance imaging. A grant to APA from the National Institute of Mental Health provided funding to train nearly 300 psychological scientists in fMRI

technology from 2000 to 2006. Robert Savoy of Massachusetts General Hospital, one of the country's most distinguished educators in neuroimaging, was the Institute leader.

In late March, the final activity on this grant will be completed – two public education brochures designed to explain the uses of fMRI in psychological science. One brochure has been designed for an adult population and the other has been written with a teenage audience in mind. The March issue of PSA will include links to pdfs for both documents. A limited number of paper copies will be made available; ordering information will be available in March. ■

Reviewers Needed for Program Evaluation Standards

The Joint Committee on Standards for Educational Evaluation is seeking reviewers for the third edition of its program evaluation standards. The standards are sanctioned by ANSI, and are widely used in the US and internationally for evaluations focusing on educational programs. APA is an institutional member of the JCSEE; therefore, it is important for APA members to act as reviewers so that the standards reflect member perspectives.

The new standards will be available online to selected reviewers February 15 to March 15, 2007. Reviewers are expected to review at least one standard, and preferably at least one chapter, during that time. Written feedback is due on March 15, and will be used by the JCSEE to ensure that standards reflect the views of experts, and sound program evaluation practices. Reviewers will be acknowledged in the new standards (unless they wish to remain anonymous).

If you are interested in reviewing the standards, or would like more information, please contact Jeff Braden (APA's representative to the JCSEE) via e-mail at jeff_braden@ncsu.edu, or by phone at 919-513-7393.

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