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in honor of Walter J. Freeman III

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Activity during Learning and the Nonlinear Differentiation of Experience

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***Abstract:** Walter Freeman's work emphasises the role of individual activity and intentionality as opposed to the traditional stimulus-reaction view and the machine metaphor. The results of our computer modeling studies suggest the nonlinear dynamics of experience emerging from perception-action cycles. We consider the perception-action cycle as a behavioral continuum of anticipated outcomes of actions. Neuroscientific research shows that each behavioral act is based on the activity of behaviorally specialized neurons distributed across the brain. Active learning during individual development leads to an increasing differentiation of the structure of individual experience through the formation of such groups of behaviorally specialized neurons. We consider the differentiation of individual experience as a nonlinear process which is implemented at different levels, and argue that consciousness and emotion can be described as dynamic characteristics prominent at the most and least differentiated systemic levels, correspondingly.*

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Modeling Stochastic Complexity in Complex Adaptive Systems: Non-Kolmogorov Probability and the Process Algebra Approach

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***Abstract:** Walter Freeman III pioneered the application of nonlinear dynamical systems theories and methodologies in his work on mesoscopic brain dynamics. Sadly, mainstream psychology and psychiatry still cling to linear correlation based data analysis techniques, which threaten to subvert the process of experimentation and theory building. In order to progress, it is necessary to develop tools capable of managing the stochastic complexity of complex biopsychosocial systems, which includes multilevel feedback relationships, nonlinear interactions, chaotic dynamics and adaptability. In addition, however, these systems exhibit intrinsic randomness, non-Gaussian probability distributions, non-stationarity, contextuality, and non-Kolmogorov probabilities, as well as the absence of mean and/or variance and conditional probabilities. These properties and their implications for statistical analysis are discussed. An alternative approach, the Process Algebra approach, is described. It is a generative model, capable of generating non-Kolmogorov probabilities. It has proven useful in addressing fundamental problems in quantum mechanics and in the modeling of developing psychosocial systems.*

Functional Constructivism: In Search of Formal Descriptors

Irina Trofimova, McMaster University, Hamilton, Ontario, Canada

Abstract: *The Functional Constructivism (FC) paradigm is an alternative to behaviorism and considers behavior as being generated every time anew, based on an individual's capacities, environmental resources and demands. Walter Freeman's work provided us with evidence supporting the FC principles. In this paper we make parallels between gradual construction processes leading to the formation of individual behavior and habits, and evolutionary processes leading to the establishment of biological systems. Referencing evolutionary theory, several formal descriptors of such processes are proposed. These FC descriptors refer to the most universal aspects for constructing consistent structures: expansion of degrees of freedom, integration processes based on internal and external compatibility between systems and maintenance processes, all given in four different classes of systems: (a) Zone of Proximate Development (poorly defined) systems; (b) peer systems with emerging reproduction of multiple siblings; (c) systems with internalized integration of behavioral elements ("cruise controls"); and (d) systems capable of handling low-probability, not yet present events. The recursive dynamics within this set of descriptors acting on (traditional) downward, upward and horizontal directions of evolution, is conceptualized as diagonal evolution, or di-evolution. Two examples applying these FC descriptors to taxonomy are given: classification of the functionality of neuro-transmitters and temperament traits; classification of mental disorders. The paper is an early step towards finding a formal language describing universal tendencies in highly diverse, complex and multi-level transient systems known in ecology and biology as "contingency cycles."*

Walter Freeman III and the Chaotic Nature of Dreams

Allan Combs, California Institute of Integral Studies, San Francisco, CA, and **Stanley Krippner**, Saybrook University, Oakland, CA

Abstract: *The contributions and life of Walter Freeman III are celebrated through an understanding of the neurodynamics of the dreaming brain. Beginning with a brief review of the universal dynamics of self-organizing systems, this paper turns to an exploration of dreaming through the application of concepts from chaos theory to brain activity during REM-state dreaming. Recent studies of the electrophysiology of the brain during REM state dreaming are reviewed, such as the active inhibition of sensory stimulation and, especially in REM sleep, alterations in the brain's dominant neuromodulatory systems, bombardment of the visual cortex with bursts of PGO activity, increased limbic system activity, and a reduction of activity in the brain's prefrontal regions. The paper briefly examines these findings in terms of the experience of dreaming itself as revealed by dream reports. The results suggest a reconciliation of brain-based and content-based attempts to understand the nature of dreaming.*

Isotopic Self-Organization as an Informational Factor in Biological Systems

Alexander A. Berezin, McMaster University, Hamilton, Ontario, Canada, and **Vladimir V. Gridin**, Israel Institute of Technology (Technion), Haifa, Israel

Abstract: *We outline possible effects of isotopic randomness and isotopic self-organization (isotopicity) for biology, genetics, neurodynamics and consciousness. Prime ideas are (a) isotopic genetic code based on isotopic permutations in genomes, and (b) catalytic effects of decays of radioactive isotopes in physiology and psychology. We discuss the reasons why these ideas are presently severely under-appreciated by the biomedical research community. We propose some steps to foster interest in isotopic effects in biology.*

The Extended Trust Hypothesis: Single-Attractor Self-Contagion in Day-to-Day Changes in Implicit Positive Affect Predicts Action-Oriented Coping and Psychological Symptoms

Julius Kuhl, University of Osnabrück, Germany, **Olga Mitina**, Lomonosov Moscow State University, Russia, and **Sander L. Koole**, Free University of Amsterdam. The Netherlands

Abstract: *According to the extended trust hypothesis, the ability to cope with negative experiences is grounded in intuitive positive feelings about one's existence (Kuhl, Quirin, & Koole, 2015). In the present study, the authors empirically tested this hypothesis by examining the nonlinear dynamics in a series of day-to-day autoregressive functions of affective states taken from a 30-day daily mood diary study among 40 participants. A parameter (λ) related to the asymptotic level of day-to-day changes in implicit positive mood predicted action orientation, a personality variable that relates to coping with negative affect, and psychological symptoms. This effect did not emerge when using a similar parameter λ for self-reported positive affect or any linear characteristic (mean or standard deviation) of changes in positive or negative mood. These findings are considered within the broader framework of Personality Systems Interaction theory (PSI theory) that interprets λ , under specified conditions, as a form of basic trust that enables people to confront negative affect and permit self-growth through self-confrontational rather than defensive coping.*

Applying the Neurodynamics of Emotional Circular Causalities in Psychosocial and Cognitive Therapy using Multi-Sensory Environments: An ORBDE Case Study Analysis

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Abstract: This exploratory, evidence-based practice research study focuses on presenting a plausible mesoscopic brain dynamics hypothesis for the benefits of treating clients with psychosocial and cognitive challenges using a mindful therapeutic approach and multi-sensory environments. After an extensive neuroscientific review of the therapeutic benefits of mindfulness, a multi-sensory environment is presented as a window of therapeutic opportunity to more quickly and efficiently facilitate the neurobiological experience of becoming more mindful or conscious of self and environment. The complementary relationship between the default mode network and the executive attention network is offered as a neurobiological hypothesis that could explain positive occupational engagement pattern shifts in a case study video of a hospice client with advanced dementia during multi-sensory environment treatment. Orbital Decomposition is used for a video analysis that shows a significant behavioral pattern shift consistent with dampening of the perceptual system attractors that contribute to negative emotional circular causalities in a variety of client populations. This treatment approach may also prove to be valuable for any person who has developed circular causalities due to feelings of isolation, victimization, or abuse. A case is made for broader applications of this intervention that may positively influence perception during the information transfer and processing of hippocampal learning. Future research is called for to determine if positive affective, interpersonal, and occupational engagement pattern shifts during treatment are related to the improved default mode network-executive attention network synchrony characteristic of increased mindfulness.

Comparing the Cognitive Process of Circular Causality in Two Patients with Strokes through Qualitative Analysis

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Abstract: Walter J. Freeman pioneered the neurodynamic model of brain activity when he described the brain dynamics for cognitive information transfer as the process of circular causality at intention, meaning, and perception (IMP) levels. This view contributed substantially to establishment of the Intention, Meaning, and Perception Model of Neuro-occupation in occupational therapy. As described by the model, IMP levels are three components of the brain dynamics system, with nonlinear connections that enable cognitive function to be processed in a circular causality fashion, known as Cognitive Process of Circular Causality (CPCC). Although considerable research has been devoted to study the brain dynamics by sophisticated computerized imaging techniques, less attention has been paid to study it through investigating the adaptation process of thoughts and behaviors. To explore how CPCC manifested thinking and behavioral patterns, a qualitative case study was conducted on two matched female participants with strokes, who were of comparable ages, affected sides, and other characteristics, except for their resilience and motivational behaviors. CPCC was compared by matrix analysis between two participants, using content analysis with pre-determined categories. Different patterns of thinking and behavior may have happened, due to disparate regulation of CPCC between two participants.