

# Nonlinear Dynamics, Psychology, and Life Sciences

## Special Issue:

## Nonlinear Organizational Dynamics

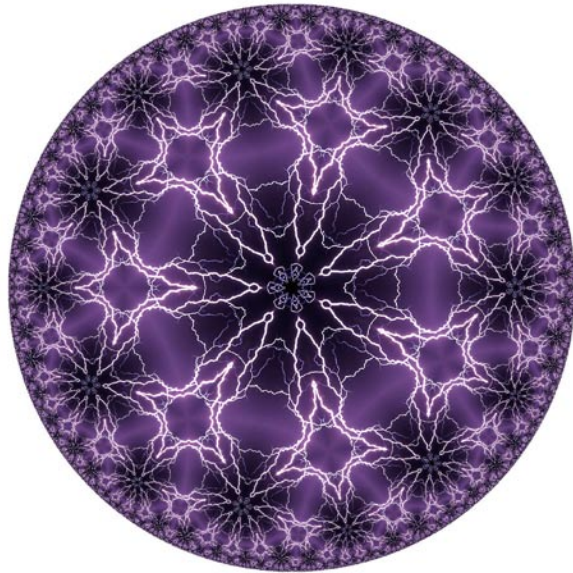
### Guest editors:

Kevin J. Dooley, Arizona State University  
L. Douglas Kiel, University of Texas, Dallas  
A. Steven Dietz, Texas State University, San Marcos

### Abstracts:

#### **Fluctuations in Work Motivation: Tasks do not Matter!**

**José Navarro**, *University of Barcelona, Spain* **Fernando Curioso**,  
*University of Barcelona, Spain* **Duarte Gomes**, *University of*  
*Coimbra, Portugal* **Carlos Arrieta**, *School of Psychology, University*  
*of Costa Rica* **Mauricio Cortés**, *Universidad del Valle, Colombia*



Previous studies have shown that work motivation fluctuates considerably and in a nonlinear way over time. In the present research, we are interested in studying if the task at hand does or does not influence the presence of these fluctuations. We gathered daily registers from 69 workers during 21 consecutive working days (7036 registers) of task developed and levels of motivation, self-efficacy beliefs and instrumentalities perception. These registers were then categorized into a list of labor activities in main tasks and subtasks by means of three judges with a high level of agreement (97.47% for tasks, and 98.64% for subtasks). Taking the MSSD statistic (mean squared successive difference) of the average of motivation, self-efficacy and instrumentality, and using hierarchical regression analysis we have found that tasks ( $\beta = .03$ ;  $p = .188$ ) and subtasks ( $\beta = .10$ ;  $p = .268$ ) do not affect the presence of fluctuations in motivation. These results reveal instability in work motivation independently from the tasks and subtasks that the workers do. We proceed to find that fluctuations in work motivation show a fractal structure across the different tasks we do in a working day. Implications of these results to motivational theory will be discussed as well as possible explanations (e.g. the influence of affect in work motivation) and directions for future research are provided.

#### **The Complexity of Organizational Change: Describing Communication during Organizational Turbulence**

**Philip Salem**, *Texas State University, San Marcos*

Organizational researchers and practitioners have been interested in organizational change for some time. Historically, they have directed most of their efforts at improving the efficiency of planned top-down change. These efforts were strategic attempts at altering parameters leading to transformational change. Most efforts failed to meet their intended purposes. Transformational organizational change has not been likely. The legitimate systems have been robust. There has been little systematic investigation of the communication occurring during these efforts. The purpose of this essay is to describe results of a mixed methods research project answering two research questions. (a) How do organizational members communicate during a time of turbulence? (b) What features of this communication suggest the potential for or resistance to transformative change? Comparing the results at the beginning of the period to other periods, gives insight into how social actors communicate and enact the organization during a threshold period where transformational change was possible. Results reveal identifiable patterns of communication as communication strategies, parameters, or basins of attraction. The overall pattern explains how micro communication patterns intersect and how the accumulation of these patterns may resist or accomplish change at a macro level.

## **Hyper-Competition, Collusion, Free Riding or Coopetition: Basins of Attraction When Firms Simultaneously Compete and Cooperate**

**Surya Pathak**, *University of Washington, Bothell*, **Mohan Pokharel**, *Concord University*, **Sankaran Mahadevan**, *Vanderbilt University*

Using a dyad in a homogeneous market, facing investment decisions, we investigate simultaneous competition and cooperation behavior of firms under the effects of (a) government policies that send signals regarding incentives for different levels of competition and cooperation and (b) two different "states of nature" for the market, i.e., one that rewards firms for building on their existing strategic path and another that rewards firms for exploring new strategies. We conceptualize the dyad and the external environment as a complex adaptive system and formulate simultaneous competition and cooperation as a dynamic duopoly game with variable demand and supply curves. Employing a simulation-based methodology, we investigate the attractors of this two-firm system. We find that in markets that reward firms for building on their existing strategic path, coopetition (sustained simultaneous competition and cooperation) is a common attractor and the system is not affected by imbalances in governmental policies. On the other hand, in markets that reward firms for exploring new strategy, coopetition is rare; rather, the system frequently exhibits hyper-competition, collusion or free-ridership. Additionally, we find that market share of firms as well as a firm's initial disposition toward competition and cooperation are important factors that affect the outcome.

## **Cusp Catastrophe Models for Cognitive Workload and Fatigue: A Comparison of Seven Task Types**

**Stephen J. Guastello**, *Marquette University, Milwaukee, WI*, **Henry Boeh**, *Marquette University, Milwaukee, WI*, **Hillary Gorin**, *Marquette University, Milwaukee, WI*, **Samuel Huschen**, *Marquette University, Milwaukee, WI*, **Natalie E. Peters**, *Marquette University, Milwaukee, WI*, **Megan Fabisch**, *Marquette University, Milwaukee, WI*, and **Kirsten Poston**, *Marquette University, Milwaukee, WI*

The study introduces a nonlinear paradigm that addresses several unresolved problems concerning cognitive workload and fatigue: (a) how to separate the effects of workload versus fatigue, (b) whether the upper boundaries of cognitive channel capacity are fixed or variable, and how multi-tasking produces a bottleneck phenomenon, (c) that prolonged time on task can produce performance decrements but also produce improvements in task performance associated with practice and automaticity, and that (d) task switching can alleviate fatigue but could be mentally costly. This study describes two cusp catastrophe models that have become useful for separating the workload and fatigue performance phenomena and explores the role of task switching and multitasking in both performance phenomena. In the experiment, 105 undergraduates completed seven computer-based tasks seven times under one of four experimental conditions: tasks fully alternated, tasks aggregated with the multi-task module performed first, aggregated with the multi-task module performed last, and where the participants chose the task order themselves. Results supported both the cusp models such that fatigue effects were stronger for tasks with higher memory or attentional demand, and were often counteracted by practice effects; spelling ability acted as a compensation variable in most cases, and the intervening amount of work done acted as the bifurcation variable. For cognitive workload, catastrophic shifts in performance were noted between the single tasks and the multi-task, with relative difficulty of the single task acting as the load (asymmetry) variable and the flexible task ordering condition as the bifurcation variable.

## **Estimating Population Ecology Models for the WWW Market: Evidence of Competitive Oligopolies**

**Ruth Mateos de Cabo**, *Universidad CEU San Pablo and Universidad Complutense de Madrid*, and **Ricardo Gimeno**, *Banco de España, Madrid*

This paper proposes adapting a particle filtering algorithm to model online Spanish real estate and job search market segments based on the Lotka–Volterra competition equations. For this purpose the authors use data on Internet information searches from Google Trends to proxy for market share. Market share evolution estimations are coherent with those observed in Google Trends. The results show evidence of low website incompatibility in the markets analyzed. Competitive oligopolies are most common in such low-competition markets, instead of the monopolies predicted by theoretical ecology models under strong competition conditions.

## **The Organizational Neurodynamics of Teams**

**Ronald Stevens** *The Learning Chameleon, Inc., IMMEX/UCLA*, **Jamie C. Gorman** *Texas Tech University*, **Polemnia Amazeen** *Arizona State University*, **Aaron Likens** *Arizona State University*, **Trysha Galloway** *The Learning Chameleon, Inc., Culver City, CA*

Our objective was to apply ideas from complexity theory to derive expanded neurodynamic models of Submarine Piloting and Navigation showing how teams cognitively organize around task changes. The cognitive metric highlighted was an electroencephalography-derived measure of engagement (termed neurophysiologic synchronies of engagement) that was modeled into collective team variables showing the engagement of each of six team members as well as that of the team as a whole. We modeled the cognitive organization of teams using the information content of the neurophysiologic data streams derived from calculations of their Shannon entropy. We show that the periods of team cognitive reorganization (a) occurred as a natural product of teamwork particularly around periods of stress; (b) appeared

structured around episodes of communication; (c) occurred following deliberate external perturbation to team function; and (d) were less frequent in experienced navigation teams. These periods of reorganization were lengthy, lasting up to 10 minutes. As the overall entropy levels of the neurophysiologic data stream are significantly higher for expert teams, this measure may be a useful candidate for modeling teamwork and its development over prolonged periods of training.

## Communication as a Mechanism for Cultural Integration

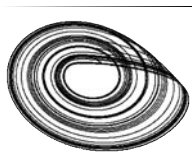
**Tomas Backström, Tom Hagström, and Susanna Göransson, Mälardalen University.**

Providing autonomy for employees ensure innovation competence, if balanced by integration into the organization. The aim of this article is to study processes leading to the integration of employees into the company culture. The two research questions are: What makes the culture of a work group similar to the company culture? How is a work group culture constructed? Theories employed concern culture as an organizing structure emerging in the interaction, company culture as a way to exert control, and social networks as a way to describe the interaction. Empirical data comes from a merchant bank. 105 respondents from ten work groups have answered questions about their communication and their integration into the company culture. The results show that the sub-culture of the group emerge in communication between members of the group. There seems to be a self-reinforcing spiral between collegial talk, especially about goals, plans and changes at the work place, and cultural integration. All members of a group should be included in this communication to create a strong culture. The value system of the supervisor strongly influences the sub-culture of the work group. Appointing supervisors with values corresponding to the company culture and provide for employee communications is thus central for organizations using culture as a tool for control.

## The Effects of Legacy Organization Culture on Post-Merger Integration

**Terrill L. Frantz, HSBC Business School/Peking University and Carnegie Mellon University, and Kathleen M. Carley, Carnegie Mellon University**

We explore the relationship between the characteristics of pre-existing organization cultures and post-merger integration dynamics; this study involves examining data produced by computer simulation. Two characteristics of organization culture, its characteristic complexity and its propensity for members' to share information, are controlled in computational experiments. To characterize post-merger integration dynamics, we measure the transfer of information with respect to two types: (a) that which is necessary in performing work tasks, and (b) that which underlies the features of a group's culture. The extent to which this information is common in a group is indicative of task performance and the cultural cohesiveness of its members; leading to the level of performance for the group. We consider cultural knowledge as it pertains to both that of the entire organization and at the work-team level; often times, these can be dissimilar. We find that cultural-complexity and exchange-motivation vary in their influence on the diffusion of task- and cultural-knowledge: the more complex the culture, the longer for post-merger integration to complete, while simultaneously task-performance suffers. However, the inclination for an organization to energetically share their culture with another group does not immensely impact the diffusion of cultural or task knowledge; moreover, high levels of task focus in a culture can hinder cultural diffusion, though performance is positively correlated with this characteristic. This study has relevance to post-merger integration research and practice by providing a theoretically-grounded, quantitative model useful for estimating the post-merger dynamics of cultural awareness and knowledge diffusion for a specific merger situation.



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