

# NEUROSCIENCE OF CREATIVITY 2015



**October 16, 2015**

**9 am – 1 pm**

Roosevelt University, Department of Psychology

425 S. Wabash Ave., Room 911

Chicago, IL 60605

**THANK YOU TO THE DEPARTMENT OF  
PSYCHOLOGY AT ROOSEVELT UNIVERSITY  
FOR HOSTING THE CONFERENCE!  
AND TO MIZZOU ADVANTAGE WITH  
PUBLICATION COSTS FOR THE PROGRAM!**

# **Neuroscience of Creativity, 2015**

**Friday, October 16, 2015, 9 am – 1 pm**

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425 S. Wabash Ave., Room 911  
Chicago, IL 60605

**9am**

**Introduction: David Beversdorf**

**9:10am**

**Speaker: Mark Beeman**

Professor & Chair, Department of Psychology  
Interdepartmental Program in Neurosciences  
Segal Design Institute  
Northwestern University

**Title: The cognitive processes and neural substrates of sudden insight**

Abstract: Some new ideas, or solutions to old problems, are achieved through methodical, analytical processing. Other new ideas come about in a sudden burst of insight – *Eureka!* Moments. Behavioral, neuroimaging, and eye-tracking results all reveal distinct brain networks contributing to such sudden insight. I will describe a constellation of cognitive processes and corresponding neural substrates that together contribute to the generation of sudden insight.

Objectives:

1. Attendees will be able to describe cognitive processes that contribute to insight.
2. Attendees will be able to understand neural substrates associated with insight.

**9:40 am**

**Speaker: Rex Jung**

Clinical Assistant Professor of Neurosurgery  
University of New Mexico

**Title: Networks of Creativity**

Abstract: Creativity research has matured in the last number of years to include aspects of brain structural and functional correlates of this complex cognitive construct. While most prior research has focused on aspects of *divergent* versus *convergent* thinking, or the *creative person* versus *product*, neurological inquiries have broadened the questions to encompass aspects of evolutionary pressures, reasoning, personality, and even psychopathology. Current challenges center around how to integrate these disparate

findings within the confines of the human brain. This talk endeavors to tie together some of these theoretical perspectives from a brain-behavior point of view. Our recent review of the structural neuroimaging literature (Jung et al., 2013) as well as our recent opinion article (Jung RE, 2014) have provided a model which pulls together many of the loose threads that characterize creativity neurosciences. First, it is hypothesized that evolutionary pressures selected for both common (i.e., deductive) and less common (i.e., inductive/abductive) reasoning processes, the former of which corresponds to intellectual (i.e., convergent) problem solving, and the latter to divergent problem solving. Second, there appears to be a rather consistent *inverse* correlation between measures of creative cognition and those of neuronal fidelity, suggesting either increased neuronal efficiency (Jung et al., 2010) and/or disinhibition of cognitive control mechanisms (Jung et al., 2013). Third, that structural brain measures associated with creative cognition, including lesion studies, measures of cortical thickness, white matter fidelity, and brain biochemistry, overlap significantly with the Default Mode Network. Taken together, we hypothesize that three networks underlie the expression of creative cognition: the Default Mode Network (DMN) for “blind variation,” (aka inductive/abductive reasoning) the Cognitive Control Network (CCN) for “selective retention,” (aka deductive reasoning) and the Salience Network (SN) for modulation of information flow between the two.

Objectives:

1. Attendees will be able to describe a model of creativity.
2. Attendees will be able to describe neural networks hypothesized to be associated with creative cognition.

**10:10am**

**Speaker: Adam E. Green**

Assistant Professor

Department of Psychology & Interdisciplinary Program in Neuroscience

Georgetown University

**Title: Creativity, Within Reason: Semantic Distance and Dynamic State Creativity in Relational Thinking and Reasoning**

Abstract: Human reasoning and creativity represent perhaps the two highest evolutionary reaches of cognition. These two capacities are distinct from each other, but research on creativity in relational cognition (e.g., analogical reasoning) indicates that they may converge at one of the farthest forward and most recently evolved reaches of the brain, frontopolar cortex. New applications of quantitative tools for measuring the “semantic distance” between concepts have advanced the measurement of creativity in relational cognition (more creative relational cognition connects concepts across greater semantic distance). These tools are especially useful for the emerging neuroscience of creativity. Research in my laboratory and elsewhere is using semantic distance-based approaches to investigate not only differences in creative ability between individuals, but also creativity as a dynamic state that varies across time within an individual.

Objectives:

1. Attendees will be able to describe semantic distance as an operationalized measurement of creativity.
2. Attendees will be able to describe the neuroanatomical regions implicated in creativity using semantic distance as measurement.

**10:40am**

**Speaker: David Beversdorf**

Associate Professor of Radiology, Neurology and Psychological Sciences  
William and Nancy Thompson Endowed Chair in Radiology  
Director, Center for Translational Neuroscience

**Title: Stress, pharmacology, and creativity**

Abstract: As our understanding of brain – behavior relationships advances, we are beginning to explore more complicated aspects of how behavior is controlled by the brain. One of the final frontiers in this exploration is the study of creativity. I will review recent evidence exploring the effects of stress and pharmacological systems on creativity, and recent evidence on the relationships between creativity and neurological conditions.

Objectives:

1. Discuss relationships between stress and creativity
2. Discuss relationships between disease states and creativity
3. Discuss pharmacological influences on creativity

**11:10am**

**BREAK FOR COFFEE**

Cafeteria is on the 2<sup>nd</sup> floor of the building

**11:30**

**ABSTRACT PRESENTATIONS (10 minutes plus 5 minutes question & answer)**

**11:30am**

**Listening to the big picture: The effects of music-induced arousal on creativity and perceptual scope**

Michael Coffel & Denise Evert  
Skidmore College, Saratoga Springs, NY, USA

The present set of experiments was designed to test the effects of music-induced arousal on creative performance and the underlying cognitive mechanisms mediating the observed effects. Experiment 1 identified musical selections that were sufficiently high and low on arousal as well as an appropriate control

condition. In Experiment 2, participants were exposed to a music condition while completing a battery of creativity assessments and the Navon task. We hypothesized that 1) participants exposed to high arousal music would have faster response times to the global than local targets because arousal engenders a broader attentional scope and 2) have enhanced performance on divergent thinking creativity tests (Alternative Uses and Abbreviated Torrance Test) and impaired performance on convergent thinking creativity tests (Remote Associates Test) because a broader perceptual scope engenders a broader conceptual scope, facilitating novel, but appropriate solutions. Conversely, we hypothesized that participants exposed to low arousal music would exhibit the opposite pattern of results due to a narrowed attentional scope. We found support for our hypotheses only when arousal was included in the analysis, suggesting that arousal mediates the observed effects of music on creative performance.

Acknowledgments: A very special thank you to the members of Professor Evert's lab for their invaluable assistance on these experiments: Noah Kernis, Renee Schapiro, Daniele Guest, George Dilthey, Sarah Green, & Emily Przysinda. This funding was supported by Skidmore College Student-Faculty Summer Collaborative Research Funds.

**11:45am**

### **Distinct Frontotemporal Networks Guide Remote Associations Between Goals and Objects for Creative Problem Solving**

Evangelia G. Chrysikou, University of Kansas  
Gavin K. Hanson, Case Western Reserve University  
William O. Wright IV, University of California, San Diego

How do brain networks determine whether an object is appropriate for a goal during creative problem solving? Although neuroimaging and neuropsychological studies have shown that ventrotemporal and inferior parietal cortical regions support object similarity judgments on the basis of perceptual properties (e.g., shape), the neural mechanisms that support functional similarity of objects in the context of specific goals during creative problem solving have not been fully explored. Here, we used functional magnetic resonance imaging (fMRI) to examine whether decisions about object functional similarity are modulated by the presence of impromptu goals and supported by anterior frontal and inferior temporal networks. Participants read a series of goals (e.g., to start a fire), followed by an object that could be used to satisfy this goal (e.g., newspaper). They then selected which of two target objects (e.g., pen or pencil) matched the first object in the context of the presented goal (e.g., a pencil [made of wood] and a newspaper [made of paper] can be used to start a fire). Target objects varied in how typically they were associated with a given goal. Analysis of regions of interest determined, in part, by an independent task localizer revealed contributions of frontopolar, dorsal frontal, and temporal networks in establishing ad hoc conceptual representations for goal-oriented tasks. We discuss these results

in support of a frontotemporal network of regions guiding remote goal-object associations during flexible, goal-oriented object knowledge retrieval.

### **12:00noon**

#### **Effects of Paced Breathing on Cognitive Flexibility**

Bradley Ferguson, Brianne Herriott, University of Missouri

Allison Halt, Washington College

David Beversdorf, University of Missouri, Columbia, MO

Previous studies show a decline in problem solving capacity with stress, and that propranolol, a beta-adrenergic antagonist, can decrease these effects. Further studies demonstrate that cognitive flexibility is regulated by the noradrenergic system and can be improved with propranolol, even in the absence of stressors. In order to determine if meditation could be utilized in place of propranolol, we examined if similar cognitive improvements could result from a slowed breathing technique, an easily implemented proxy to meditation. Furthermore, we assessed if changes in heart rate variability due to slowed breathing were associated with increases in cognition. Anagram task performance was compared in 30 participants using a within-subject design. Electrocardiogram readings, blood pressure, and stress perception were recorded during independent sessions of normal breathing and paced breathing exercise for 10 minutes respectively. After completion of a normal or paced breathing exercise, participants completed cognitive assessments. Dependent-sample t-tests assessed differences in blood pressure or heart rate. Blood pressure was significantly different between breathing conditions only at the end of the study. No significant differences were found between heart rate, heart rate variation, or stress perception. Overall, performance on cognitive tasks was not significantly different between breathing conditions. However, linear regression revealed a significant positive association between the letter fluency change score and the standard deviation in heart rate change score, a measure of heart rate variability, suggesting inter-individual variability in response to paced breathing. Future studies may wish to investigate if daily paced breathing exercises can increase cognitive function.

Acknowledgments: This funding was supported by the University of Missouri summer medical student research scholar program and the National Science Foundation summer REU program.

### **12:15pm-1pm**

#### **Business and Future Planning Meeting**

**1pm – break for lunch**

## **ATTENDEES REGISTERED**

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## **ANNOUNCEMENT:**

### ***Neurocase*: Call for Papers**

### **Special Issue on How Music Plays the Mind**

#### **Guest Editors:**

**Indre Viskontas**, University of San Francisco and the San Francisco Conservatory of Music

**Elizabeth Hellmuth Margulis**, University of Arkansas

#### **Aims, Scope and Rationale:**

The neuroscience of music cognition is a growing field of study and the last two decades have witnessed an explosion of interest and work on the topic. Much of the work remains scattered across sub-disciplines and institutions and there is a need for synthesis. To that end, we are dedicating a special issue of the journal *Neurocase* to bring together findings from a number of different tools and approaches to the study of how music influences and changes us. *Neurocase* is known for its rapid publication rate and its emphasis on work that is cross-disciplinary and at the frontier of neuroscience. Since music is by its nature a subjective experience, our willingness to publish case studies and small group studies makes the journal a particularly appropriate venue for this work.

Inquiries are welcome regarding this special issue Call for Papers especially from members of the Society for Music Perception and Cognition. Any original articles, case studies, group studies, and review articles are welcome for submission to this special issue on music and the brain.

#### **Submission information**

Researchers wishing to submit a manuscript in response to this call for papers must submit by **December 31st, 2015**. Your paper should be prepared in accordance with the *Neurocase* [Instructions to Authors](#), and submitted through the journal's [ScholarOne Manuscripts](#) peer review site. When prompted, authors should select the special issue title from the available drop-down menu. Please indicate in the cover letter accompanying your manuscript that you would like to have the paper considered for the special issue ***How Music Plays the Mind***. If you have any questions regarding the special issue, please contact the Guest Editors at [iviskontas@sfc.edu](mailto:iviskontas@sfc.edu).

#### **Guest Editor contact Information:**

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**Elizabeth Hellmuth Margulis**, University of Arkansas, USA, [ehm@uark.edu](mailto:ehm@uark.edu)



**ANNOUNCEMENT:**

**MARK YOUR CALENDARS**

**2<sup>nd</sup> Annual Neuroscience of Creativity Meeting**  
**Friday, November 11, 2016**  
**San Diego, California**