

# 40TH ANNUAL DISTINGUISHED SCHOLAR LECTURE SERIES

October 18 - 20, 2017 | 3:30 pm

Natural Resources Engineering (NRE) 2-003

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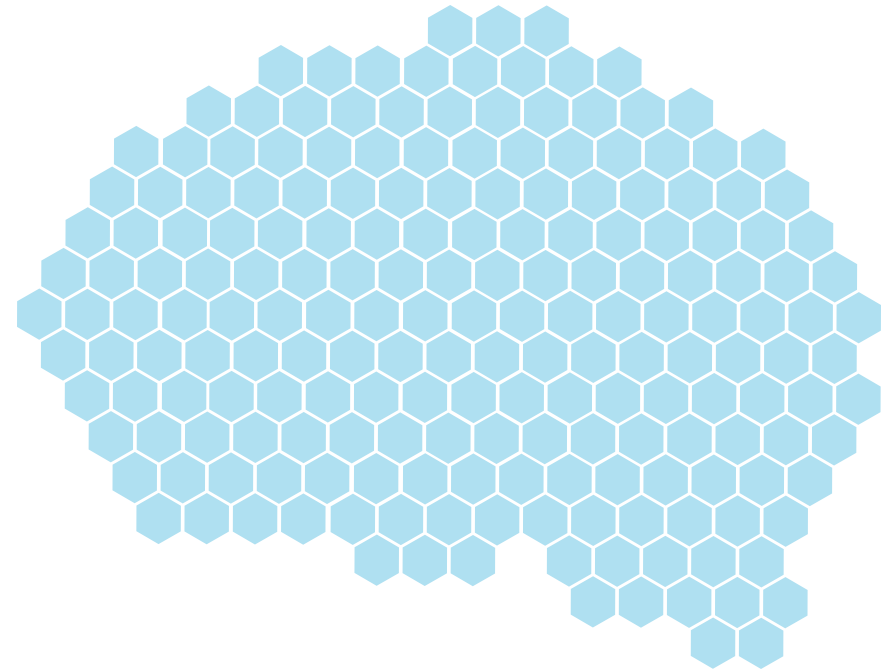
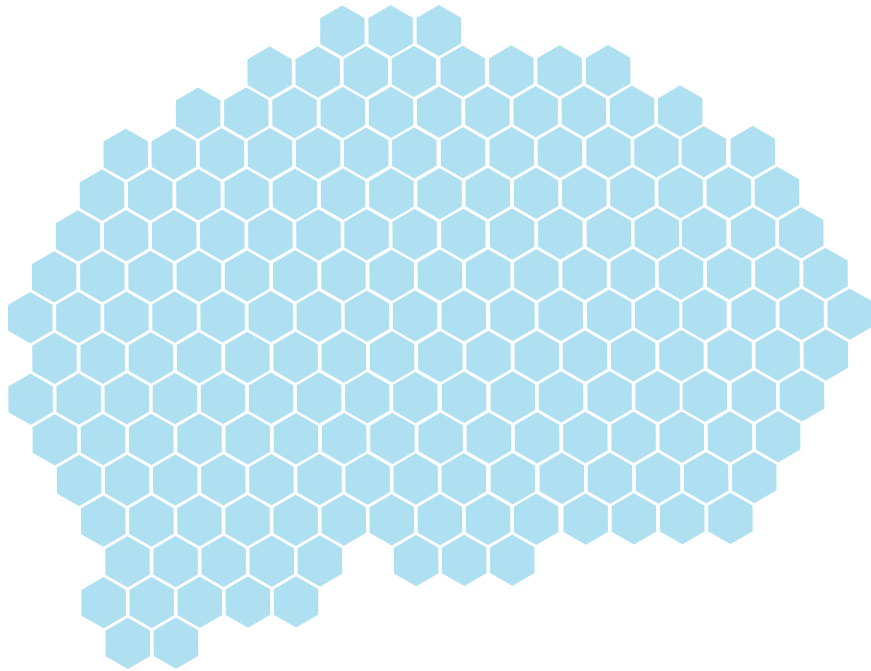
**UNIVERSITY OF ALBERTA**  
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## HOW WE REMEMBER: BRAIN MECHANISMS OF EPISODIC MEMORY

- I) Neural coding of space and time for episodic memory
- II) Cholinergic neuromodulation and episodic memory
- III) A model of episodic memory

For more information, please visit [uab.ca/dsls](http://uab.ca/dsls)



## NOTES:

## ABOUT THE SPEAKER:



### **Dr. Michael Hasselmo**

Professor, Department of Psychological and Brain Sciences;  
Director, Center for Systems Neuroscience;  
Boston University  
D.Phil, Oxford University  
<http://www.bu.edu/hasselmo/>

**Michael E. Hasselmo** is the Director of the Center for Systems Neuroscience at Boston University and a Professor in the Department of Psychological and Brain Sciences and the Graduate Program for Neuroscience. He is principal investigator on two US NIH R01 grants and an ONR MURI award.

**Research** in his laboratory includes extracellular recording in rodents of the functional properties of different neurons including grid cells, speed cells and head direction cells, intracellular recording of the effects of neuromodulators on information processing dynamics of single neurons, and computational modeling to link neurophysiological data to the functional dynamics of encoding for memory-guided behavior.

**Prof. Hasselmo** graduated summa cum laude from Harvard College, completed a D.Phil. at Oxford University on a Rhodes scholarship and performed a post-doctoral fellowship at the California Institute of Technology. He is on the editorial boards of the journals *Science*, *Hippocampus*, *Neurobiology of Learning and Memory*, *Behavioral Neuroscience*, *Frontiers in Systems Neuroscience*, and *Brain Structure and Function*. He is a fellow of the American Association for the Advancement of Science (AAAS) and received the 2015 Hebb Award from the International Neural Network Society.

## LECTURE SERIES AT A GLANCE:

# HOW WE REMEMBER: BRAIN MECHANISMS OF EPISODIC MEMORY

The 2017 Distinguished Scholars Lecture Series will consist of **three lectures** delivered by Boston University's Dr. Michael Hasselmo over three days - one lecture each day - from **October 18th to October 20th**, 2017. Each lecture will begin at **3:30 pm** in the University of Alberta's Natural Resources Engineering building (**NRE**), in room **2-003**, according to the following schedule:

### I) Wednesday, October 18<sup>th</sup>

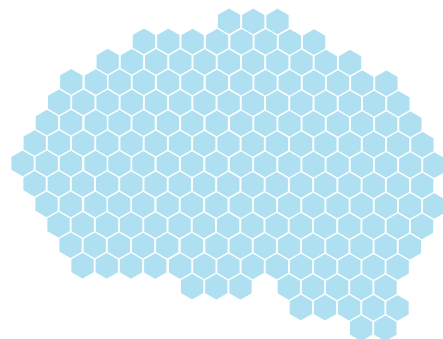
Neural coding of space and time for episodic memory

### II) Thursday, October 19<sup>th</sup>

Cholinergic neuromodulation and episodic memory

### III) Friday, October 20<sup>th</sup>

A model of episodic memory



- 1988** Robert Siegler (Carnegie-Mellon) - "How Children Discover New Strategies."
- 1989** Robert Efron (UC Martinez) - "The Decline and Fall of Hemispheric Specialization."
- 1990** Phil Johnson-Laird (Princeton) - "Human and Machine Thinking."
- 1991** Timothy Salthouse (Georgia Institute of Technology) - "Mechanisms of Age-Cognition Relations in Adulthood."
- 1992** Scott Paris (Michigan) - "Authentic Assessment of Children's Literacy and Learning."
- 1993** Bryan Kolb (Lethbridge) - "Brain Development, Plasticity, and Behaviour."
- 1994** Max Coltheart (Macquarie) - "Our Mental Lexicon: Empirical Evidence of the Modularity of Mind."
- 1995** Norbert Schwarz (Michigan) - "Cognition and Communication: Judgmental Biases, Research Methods, and the Logic of Conversation."
- 1996** Gilbert Gottlieb (UNC Chapel Hill) - "Prenatal Roots of Instinctive Behavior: A Theoretical and Experimental Exposition of Probabilistic Epigenesis."
- 1997** C. Randy Gallistel (UCLA) - "Basic Conditioning from an Interval Timing Perspective."
- 1998** Harold W. Stevenson (Michigan) - "Learning from other Cultures: Achievement and Society."
- 1999** Melvyn A. Goodale (Western Ontario) - "The Origins of Vision."
- 2000** K. Anders Ericsson (Florida State) - "The Complexity and Power of Deliberate Thought: From Protocol Analysis of Exceptional Memory to the In-vivo Dissection of Expert Performance."
- 2001/02** Mark Snyder (Minnesota) - "Personality, Motivation, and Social Behavior: Understanding Individuals and Their Social Worlds."
- 2003** Michael Tomasello (Max Planck Institute for Evolutionary Anthropology) - "Lectures on Children and Chimpanzees."
- 2004** Michael J. Ryan (UT Austin) - "Sexual Selection and Sensory Exploitation."
- 2005** Gary S. Dell (Illinois) - "Slips of the tongue: The Linguistic and Freudian Traditions; Aphasic speech Errors: Testing Freud's Continuity Thesis; and Implicit learning, Phonotactic Constraints, and Speech Errors."
- 2006** Michael A. Arbib (Southern California) - "Crusoe's Brain: Social Cognition and the Mirror System."
- 2007** Richard M. Lerner (Tufts) - "Applying Developmental Science to Promote Positive Youth Development and to Enhance Community Life."
- 2008** Denise C. Park (UT Dallas) - "Images of the Aging Mind; Developing a Cultural Neuroscience of Aging; and Following Doctors' Instructions: Medical Adherence."
- 2009** David C. Rubin (Duke) - "Autobiographical Memory."
- 2011** Tomáš Paus (The Rotman Research Institute) - "How Environment and Genes Shape the Adolescent Brain"
- 2012** Chi-Yue Chiu (Nanyang Business School) - "Socially Motivated Superstitions: Mutual Constitution of Society and the Mind."
- 2013** Arie Kruglanski (Maryland) - "Three Lectures on Motivation."
- 2014** Robert Cook (Tufts) - "Comparative Visual Cognition: The bird's eye view"
- 2017** (Jan.) William H. Warren (Brown) - "The Dynamics of Perception and Action"

# HISTORY OF THE DISTINGUISHED SCHOLAR LECTURE SERIES

Thanks to the generous sponsorship of the University of Alberta's Faculties of Arts and Science (and, this year, the Neuroscience and Mental Health Institute), the Department of Psychology has had the honour of hosting the Distinguished Scholar Lecture Series nearly every year since 1975. For each iteration, the Department has invited an internationally renowned psychologist to deliver three hour-length, public lectures over three consecutive days. During these lectures, anyone interested in attending has the exciting and valuable opportunity to learn about some of the most fascinating and innovative research currently taking place in the burgeoning field of psychology.

## Past Lecture Series:

**1975** Frank Geldard (Princeton) - "Sensory Saltation: Metastability in the Perceptual World."

**1976** Benton Underwood (Northwestern) - "Temporal Codes for Memories: Issues and Problems."

**1977** David Elkind (Rochester) - "The Child's Reality: Three Developmental Themes."

**1978** Harold Kelley (UCLA) - "Personal Relationships: Their Structures and Processes."

**1979** Robert Rescorla (Yale) - "Pavlovian Second-Order Conditioning: Studies in Associate Learning."

**1980** Mortimer Mishkin (NIMH - Bethesda) - "Cognitive Circuits."

**1981** James Greeno (Pittsburgh) - "Current Cognitive Theory in Problem Solving."

**1982** William Uttal (Michigan) - "Visual Form Detection in 3-Dimensional Space."

**1983** Jean Mandler (UC La Jolla) - "Stories, Scripts, and Scenes: Aspects of Schema Theory."

**1984** George Collier (Rutgers) - "Learning and Motivation: Function and Mechanism."

**1985** Alice Eagly (Purdue) - "Sex Differences in Social Behavior: A Social Role Interpretation."

**1986** Karl Pribram (Stanford) - "Holonomic Brain Theory: Cooperative Processing in the Configural Aspects of Perception and Action."

**1987** Abram Amsel (UT Austin) - "Behaviourism, Neobehaviourism and Cognitivism in Learning Theory."

# LECTURE I

Wednesday, October 18<sup>th</sup>

## Neural coding of space and time for episodic memory

Episodic memory is defined as memory for events occurring at a specific time and place. Neurophysiological recordings from brain regions in behaving rodents demonstrate neuron response properties that may code space and time for episodic memory. This includes the coding of space by grid cells in entorhinal cortex (Moser and Moser, 2008) and place cells in hippocampus, and coding of temporal intervals by time cells in both regions (Kraus et al., 2013; 2015). Experimental data indicates potential mechanisms for the neural coding of time and space. Inactivation of input from the medial septum influences network oscillatory dynamics such as theta rhythm, and impairs the responses of neurons coding space (Brandon et al., 2011) and time (Wang et al., 2014). These effects on the coding of space and time may involve modulation of cellular neural mechanisms of resonance and rebound spiking (Dickson et al., 2000; Giocomo et al., 2007; Shay et al., 2015). Models demonstrate how intrinsic properties may contribute to coding of space and time.

## LECTURE II

Thursday, October 19<sup>th</sup>

### **Cholinergic neuromodulation and episodic memory**

A wide range of behavioral studies indicate that the neuromodulator acetylcholine plays an important role in regulating the encoding of episodic memories, whereas low levels of acetylcholine could be important for consolidation of memories. Cellular effects of acetylcholine (reviewed in Hasselmo, 2006) indicate that cholinergic modulation may enhance encoding by increasing the spiking response to afferent input and enhancing the modification of synapses that store associations. Acetylcholine also induces persistent spiking activity that could actively maintain information for encoding. Acetylcholine causes a robust presynaptic inhibition of glutamate release at excitatory feedback synapses in most cortical regions. Computational modeling demonstrates how this presynaptic inhibition could enhance encoding by preventing interference from retrieval of previously stored associations mediated by excitatory feedback. Acetylcholine levels show a dramatic decrease during quiet waking and slow-wave sleep (reviewed in Hasselmo, 1999), resulting in an enhancement of excitatory cortical feedback that could underlie the consolidation of episodic memory traces into semantic representations in neocortical structures.

## LECTURE III

Friday, October 20<sup>th</sup>

### **A model of episodic memory**

The third talk in the series will address a model of episodic memory that focuses on coding of spatiotemporal trajectories that bring together representations of time cells, grid cells, place cells and head direction cells, with modulatory regulation of encoding and retrieval dynamics. The talk will also review modeling of the potential mechanism of influence of visual stimuli on grid cells (Raudies and Hasselmo, 2015) and the encoding of associations between spatial representations and visual stimuli. In addition, this talk will address the potential role of these same circuits in memory-guided goal-directed spatial behavior (Erdem and Hasselmo, 2014).