33rd Annual Winter Conference on the Neurobiology of Learning and Memory

Park City, Utah January 3-6, 2009

Overall Session Co-Organizers: Brian Derrick and Carol Barnes

Saturday January 3

Session 1: Dave Olton Data Blitz

Session 2: Imaging plasticity in neuronal networks with immediate-early genes

Moderator: Almira Vazdarjanova

Understanding the mechanisms of complex mental processes, such as learning and memory, requires understanding learning-induced changes occurring at the level of behavior, brain systems, synapses and cellular molecular cascades. Work in the last half century has revealed behavioral, synaptic and molecular mechanisms underlying memory. However, less is known about learning-induced plasticity at the systems level, i.e., plasticity in neuronal ensembles occurring simultaneously across multiple brain regions. Initial investigations with pharmacological, lesion and electrophysiological methods have been focused on interactions between two brain regions at a time. Recent advances in cell-based imaging of plasticity-related immediate-early gene expression have provided a tool to investigate plasticity-related changes across multiple brain regions occurring when an animal is exposed to one or two behavioral events. This session will cover a brief history of how one such method (catFISH) was developed and will present work of how it can be successfully applied to address fundamental questions of learning-induced plasticity occurring across the hippocampus, amydgala and striatum. Dr. Peter Hollandwill discuss similarities and differences in amygdala processing of cues that predict punishment and omission of expected rewards, while Dr. Victor Ramirez-Amaya will discuss whether CA3, CA1, parietal cortex and dorsomedial striatum contribute to context setting in an appetitively-motivated task. Dr. Almira Vazdarjanova will present evidence that, during aversive conditioning CA3, CA1 and perirhinal cortex encode changes in the emotional valence of a place. Lastly, Dr. Susanna Rosi will describe how spatial learning-induced plasticity in DG, CA3, CA1 and entorhinal cortex altered in pathological states, such as during neuroinflammation.

Speakers:

Almira Vazdarjanova
Medical College of Georgia
Emotional learning in the hippocampal system.

Peter Holland
The Johns Hopkins University
Signals for omission of expected rewards and cues for punishers: Commonalities and differences in amygdala processing.

Victor Ramirez-Amaya
University of Mexico, Queretaro
Context setting during positive reinforcement – contributions of the hippocampus and dorsal striatum.

Susanna Rosi
University of California, San Francisco
Neuroinflammation and gene expression involved in synaptic plasticity and memory

Sunday, January 4

Session 3: New cells, new memories, and do we make use of old ones?

Moderator: Paul Frankland

Cell assemblies are thought to be the unit of memory storage, and most neuronal processing involves integrating thousands of synaptic inputs and then forwarding the results of computations on to thousands of target neurons. There are few exceptions in the vertebrate central nervous system but, remarkably, one such exception exists within the neuronal circuitry that is essential for memory formation. Each hippocampal dentate gyrus granule cell receives highly convergent input from the different subdivisions of the entorhinal cortex, but sends only a single axon with very few connections onto a single target cell population in the CA3 region of the hippocampus. Such anatomical sparsity of the dentate projections to CA3 is complemented by the sparse activity in only about 2 % of granule cells. As a result each CA3 cell on average only integrates inputs from few or a single active granule cell, if from any at all. The transformation of a convergent input from an extremely large number of entorhinal cells onto the small array of synaptic boutons of each mossy fiber may be the key to the dentate gyrus' contribution to memory processing, to the significance of neurogenesis, and to the consequences of granule cell dysfunction in neuronal diseases.

Speakers:

Josef Bischofberger
University Freiburg
Differences in synaptic integration and plasticity between mature and newborn cells.

Jill Leutgeb
Center for the Biology of Memory, Trondheim, Norway
Pattern separation in the dentate gyrus is achieved within a subpopulation of cells that remain active in a wide range of contexts.

Paul Frankland
The Hospital for Sick Children, Toronto, Canada
The integration of granule cells into memory circuitry depends on their age.

Heather Cameron

NIMH / NIH Neuroplasticity Unit, Bethesda, Maryland
Young neurons are activated in different regions and by different stimuli than older granule cells.

Session 4: An update on the functional role of the locus coeruleus in cognition.

Moderator: Susan J. Sara

The tiny nucleus locus coeruleus, lying deep in the pons, projects ubiquitously to forebrain regions and is their sole source of noradrenaline. Early research limited the role of this nucleus to regulation of arousal and vigilance. Later studies suggested a modulation of single-to-noise in sensory pathways and a facilitation of synaptic and network plasticity. More recent research points to a role in attention, reward, and the initiation of behavior. The proposed session will provide the latest evidence for the emerging view that the locus coeruleus noradrenergic system plays a key role in regulating a wide range of cognitive adaptations. The session will address the following issues: how functional changes within the nucleus during development are related to changes in neonatal learning; how LC projections to the hippocampus influence experience–dependent plasticity in that region; how reciprocal connections between LC and amygdala influence memory retrieval in humans and rats; and how task related activity in LC influences behavioural outcome.

Speakers:

Regina Sullivan
University of Oklahoma
Locus coeruleus developmental changes and infant learning.

Carolyn Harley
Memorial University, St. Johns, Newfoundland
Selective locus coeruleus modulation of hippocampal plasticity (from anatomy to electrophysiology).

Susan J. Sara
College de France, Paris
Locus coeruleus-amygdala network for memory retrieval.

Sebastien Bouret
NIMH, Bethesda, MD
Single-unit activity in locus coeruleus neurons in monkey: relation to instinctive and goal-directed behavior.

Monday January 5

Session 5: New insights into the function of parietal cortex: implications for learning and memory

Moderator: David Bucci

In recent years there has been renewed interest in the functions of the parietal cortex in both human and non-human animals. These functions include higher order processes such as attention, perception, and sensory-motor integration, which greatly influence long-term memory representations of spatial, temporal, numeric, and sensory information. The aim of the proposed session is to provide a current and integrative perspective on the role of parietal cortex in learning and memory by considering recent data from human, monkey and rodent models across multiple levels of analyses.

Speakers:

Douglas A Nitz, PhD
Neurosciences Institute
Higher-order mapping of behavioral sequences by parietal cortex.

Christos Constantinidis, PhD
Wake Forest University School of Medicine
Neural correlates of learning and working memory in the primate posterior parietal cortex.

Michael D. Rugg PhD
University of California, Irvine
Lateral parietal contributions to human episodic memory: evidence from fMRI.

David J. Bucci, PhD
Department of Psychological & Brain Sciences Dartmouth College
Contributions of Posterior Parietal Cortex to Attention and Associative Learning in Rodents.

Session 6: What can ROC analysis tell us about Memory?

Moderators: Wendy Suzuki and Howard Eichenbaum

Recognition memory is widely viewed as consisting of two components, recollection and familiarity. A notable debate in the current literature concerns the relative roles of individual medial temporal lobe structures in these two major components of recognition. While some argue that different structures within the medial temporal lobe play distinct roles in recollection and familiarity, others suggest that both components of recognition are similarly supported by all medial temporal lobe areas. One powerful analytic tool that has been brought to bear in this debate is signal detection theory, which has been used to differentiate Receiver Operating Characteristic (ROC) signatures of recollection and familiarity both at the behavioral level of analysis and in the interpretation of data from amnesic patients and functional imaging. However, the precise interpretation of the ROC results has been a major point of contention in this debate. In this session we will bring together eminent experts on both sides of the debate to discuss how they have used ROC analysis to analyze the functional organization of the MTL and what the data tells us about how recognition memory is supported by the brain.

Speakers:

John Wixted,
University of California at San Diego
On the shape of a recollection-based ROC.

Andy Yonelinas
University of California at Davis
How important is the hippocampus?

Scott Slotnick
Boston College
Artifact free source ROCs support a single-process model of memory.

Charan Ranganath
University of California at Davis
Binding items and contexts: A model for the functional organization of the medial temporal lobes.

Tuesday January 6

Session 7: **Exercise, Physical Activity and their beneficial effects on brain function.**
Moderators: Donna Korol

Until relatively recently, studies of physical activity effects were focused on general health using measures of strength and fitness, and not on brain health in particular. However, epidemiological findings have suggested that increased physical fitness plays a protective role against cognitive and neural aging. Over the past few decades, increased interest in understanding the neural mechanisms contributing to the actions of physical activity on neural function and plasticity has led to substantial evidence suggesting that exercise promotes neurogenesis, synaptic plasticity, cortical remapping, angiogenesis, cell signaling cascades, and protects against neurodegeneration caused by experimental toxins, aging, and other factors. We will take a multidimensional approach to the biology underlying the benefits and risks of exercise on brain health, learning, memory, and neural plasticity. Examining not only the substrates of exercise effects, such as synaptic plasticity, trophic factors, and neural structures, but also the modulators that mediate or interact with exercise effects, such as sex hormone status, age, and lifestyle factors, which should promote a more synthetic view of how physical activity impacts brain function.

Speakers:

Brian Christie,
University of Victoria, Canada
Effects of exercise on hippocampal structure and function.

Monika Fleshner,
University of Colorado at Boulder
The stress buffering effects of exercise.

Fernando Gomez-Pinilla,
UCLA
Molecular mechanisms for the effects of exercise on cognition.

Kirk Erickson,
University of Pittsburgh
Aerobic exercise: a method for preserving and enhancing cognitive and brain function in old age.