34rd Annual Winter Conference on the Neurobiology of Learning and Memory

Park City, Utah January 7-10, 2010

Overall Session Co-Organizers: Christa McIntyre & Craig Stark

Saturday January 7

Session 1: Dave Olton Data Blitz

Session 2: Does Synaptic Protein Translation Underlie Memory Consolidation?

Moderator: Christa McIntyre

Protein synthesis has long been considered a requirement for both long-term plasticity and memory. Increased levels of synaptic proteins are frequently measured following learning or synaptic stimulation and inhibition of protein synthesis impairs both long-term memory and synaptic plasticity. However, alternative explanations for these observations have recently been proposed (NLM issue 3, vol. 89, March, 2008). Current theories of *how* these synaptic proteins are modulated during learning and how their modulation underlies long-term memory will be discussed here.

Speakers:

Christa McIntyre
University of Texas, Dallas
Local translation of Arc plays a role in the consolidation of stressful memories

Eric Klann
New York University
Making synaptic plasticity and memory last: Mechanisms of translational regulation.

Kelsey Martin
University of California, Los Angeles
Synapse- and stimulus-specific translation during long-term plasticity of Aplysia sensory-motor neurons

Os Steward
University of California, Irvine
Local synthesis of proteins at synaptic sites on dendrites: role in synaptic plasticity and memory consolidation?

Sunday, January 8

Session 3: Contrasting Theories of Memory Consolidation

Moderator: Brian Wiltgen

The hippocampus is essential for the formation and retrieval of episodic and contextual memory in humans and animals. It is well established that cell loss or dysfunction in this area produces significant amnesia for newly acquired information. In contrast, the fate of old memories is less clear. Early work indicated that the hippocampus was not involved in the retrieval of episodic or contextual memories formed in the distant past.
These findings gave rise to the idea that the hippocampal system plays a temporary role in the formation and retrieval of new memories as they are being permanently stored in regions of the neocortex (i.e. standard consolidation theory). Recent work, however, has presented several challenges to this theory. Imaging studies, for example, frequently observe hippocampus activation during the retrieval of both new and old episodic memories. Consistent with this finding, damage to the hippocampus in humans and animals often impairs the retrieval of both recent and remote memories. Results like these have contributed to the development of multiple trace theory (MTT), which argues that episodic and contextual memories are permanently stored in the hippocampus. The point of this discussion is to compare and contrast these ideas about memory consolidation using current data from human and animal research.

Speakers:

Brian Wiltgen
University of Virginia
The hippocampus plays a selective role in the retrieval of detailed context memories.

Paul Frankland
The Hospital for Sick Children, Toronto, Canada
Structural plasticity in the anterior cingulate cortex is necessary for the consolidation of fear memories.

Brock Kirwan
Brigham Young University
Intact detailed remote episodic memories following hippocampal damage in humans.

Lynn Nadel
University of Arizona
What really happens to remote episodic memories in humans.

Session 4: All You Ever Wanted to Know About Hippocampal Structure: From Neocortex to Hippocampus, and Back.

Moderator: Craig Stark

Many theories of MTL function justifiably draw inferences based on the anatomy. The anatomy clearly places constraints on, and can inform our understanding of how the system operates in the service of memory. In addition, many theories of MTL function justifiably draw upon results across species. Yet, the underlying anatomy, while similar across species, is not identical. This tutorial session focuses on two central questions: 1) What is the anatomy of the MTL and how might this inform our understanding of the function of and functional divisions within the MTL, and 2) How does the anatomy vary across species?

Speakers:

Menno Witter
Norwegian University of Science and Technology

Pierre Lavenex
University of Fribourg

Monday January 9

Session 5: The Role of Epigenetic Mechanisms in Memory Formation and Persistence of Memory.

Moderator: Marcelo Wood

One of the alluring aspects of examining how epigenetic mechanisms modulate transcription required for long-term memory processes is that epigenetic modifications may provide transient and potentially stable marks in the service of activating and/or maintaining transcriptional processes. These in turn may ultimately participate in the molecular mechanisms required for neuronal changes subserving long-lasting and persistent changes in behavior. As an epigenetic mechanism of transcriptional control, chromatin modification and DNA methylation have been shown to participate in maintaining cellular memory (*e.g.* cell fate). A key open question is whether these mechanisms also underlie long-lasting and persistent memory processes.

This session will include recent advances in our understanding of how epigenetic mechanisms modulate memory consolidation as well as the persistence of memory (*i.e.* enduring information storage capable of being successfully retrieved over very long periods of time). In particular, we will discuss: one, how chromatin modification via histone acetylation can modulate consolidation resulting in long-term memory that persists beyond the point at which normal memory fails; two, how histone acetylation can modulate extinction resulting in persistent extinction that is not reversed by reminder treatments; three, how chronic increases in histone acetylation ameliorate memory impairments in a mouse model of familial Alzheimer's disease in a manner that is persistent; and four, how stable DNA methylation changes may participate in system consolidation underlying persistent memory. Together, these new findings reveal important insight into a key open question in our understanding of how epigenetic mechanisms are involved in memory formation and long-lasting maintenance of memory.

Speakers:

Marcelo A. Wood
University of California, Irvine
The role of chromatin modifying enzymes in memory processes.

Matt Lattal
Oregon Health & Science University
Long-term consequences of histone deacetylase inhibition during extinction.

Gavin Rumbaugh
University of Alabama, Birmingham
Histone deacetylase inhibitors reverse contextual memory deficits in a mouse model of Alzheimer's Disease.

Courtney Miller
University of Alabama, Birmingham
Lasting cortical DNA methylation following hippocampus-dependent learning.

Session 6: Cross-Species Investigations of Hippocampal Theta

Moderators: Beth Buffalo

Oscillatory hippocampal activity in the theta frequency has been linked to a variety of functions including the formation of place-fields, hippocampal-cortical interactions, and memory consolidation. Although theta activity is a hallmark of rodent hippocampal neurons, it has rarely been investigated in other species. Recent data have emerged which suggest that hippocampal theta may be modulated by the rate of sensory input, which can vary across species and behavioral paradigms. These new data have the potential to inform a unifying framework for the function of theta-frequency oscillations. The aim of this session is to provide a current and integrative perspective on the role of theta-frequency oscillations in the hippocampus by considering recent data from a variety of species: rat, bat, monkey, and human.

Speakers:

Adam Kepecs
Cold Spring Harbor Laboratory
Sniffing, whisking, and hippocampal theta: Independent or inter-dependent rhythms

Nachum Ulanovsky
Weizman Institute
Hippocampal neural activity in freely moving echolocating bats

Elizabeth Buffalo
Emory University
Theta-frequency oscillations in the primate hippocampus related to visual exploration

Michael Kahana
University of Pennsylvania

Theta-band oscillations and place cells in the human hippocampus

Tuesday January 10

Session 7: Approaches to the Study and Treatment of PTSD: Animal Models, Extinction and Reconsolidation

Moderators: Christa McIntyre

In these times of war and natural disaster, many of us are finding important implications for our research in the study and treatment of posttraumatic stress disorder (PTSD). While all share the goal of inhibiting unwanted memories, approaches often appear to be contradictory. For example, some aim to treat those who have developed PTSD by facilitating extinction of fear memories using memory-enhancing treatments while others attempt to impair the reconsolidation of those memories with the use of memory-impairing treatments. Furthermore, only 20-30% of humans exposed to a traumatic event develop PTSD and the diagnosis depends upon psychological evaluations, making the development of animal models a significant challenge.

This session will include recent advances in our understanding of how these approaches can be used in the study and treatment of PTSD. Speakers will share their thoughts on the advantages and disadvantages of animal models in PTSD research and will aim to clearly define and establish common ground among extinction and reconsolidation approaches. The findings discussed have obvious implications for the quality of life of sufferers and their families, but they also provide important insights into the fundamental question of how long-term memories are stored and maintained.

Speakers:

Mohammad Milad
Massachusetts General Hospital
Presence and acquired origin of reduced recall for fear extinction in PTSD: results of a twin study.

Michael Davis
Emory University
Impaired safety signal learning in PTSD patients.

Marie Monfils
University of Texas, Austin
Extinction-Reconsolidation Boundaries: Key to Persistent Attenuation of Fear Memories.

Benno Roozendaal
University of Groningen
Glucocorticoid protection from PTSD: enhanced consolidation and impaired retrieval.