Karim Nader

Professor, James McGill Chair

Department of Psychology, McGill University

Initially labile, memory traces are thought to be stabilized into more enduring forms through a process known as consolidation. The consolidation framework guided neurobiological studies of memory in much of the 20th century. Studies in this era established that consolidation of long-term memories required *de novo* protein synthesis. However, consolidation was viewed as a one-way street: For any given memory, consolidation occurred once, and was irreversible.

This view was turned on its head by Karim Nader's seminal *Nature* paper in 2000 (cited >3000 times). Nader showed that retrieved fear memories once again became labile, requiring *de novo* protein synthesis to be re-stabilized through a process termed 'reconsolidation'. The compelling and mechanistic nature of Nader's work immediately brought reconsolidation to the fore, catalyzing studies that generalized this phenomenon across behavioral paradigms and species.

ical and theoretical work on reconsolidation has profoundly shaped memory research in the 21st century, both in the lab and in the clinic. First, his studies highlighted that

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PROGRAM

12:30 **Lunch Poster Session**

Session 3: (Chair: Satoshi Kida, University of Tokyo)

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Marco Leyton
McGill University

4:45 **Memory Retrieval Facilitates Suppression and Reconsolidation Update at Different Temporal Scales**
Daniela Schiller
Mount Sinai

5:00 **Not Your Father's Synapse: Revising the Hebb Synapse for The 21st Century**
Richard Brown
Dalhousie University

5:15 **Multisensory Learning Binds Modality-Specific Neurons into a Cross-Modal Memory Engram**
Scott Waddell
University of Oxford

5:30 **Closing Remarks**

SPEAKERS, HOSTS AND CHAIRS

PAUL FRANKLAND

Paul Frankland is a Senior Scientist in the Neurosciences & Mental Health Program at SickKids Research Institute. He holds a Canada Research Chair in Cognitive Neurobiology and is appointed as a Full Professor in the Department of Psychology, Department of Physiology, and Institute of Medical Science at the University of Toronto. He is a Fellow of the Royal Society of Canada, and a member of the Canadian Institute for Advanced Research (CIFAR) in the program for Child and Brain Development. Dr. Frankland's research program combines behavior, imaging and molecular approaches to understand the neurobiological basis of memory.

MAURO COSTA-MATTIOLI

Mauro Costa-Mattioli was the Cullen Foundation Endowed Professor in Neuroscience at Baylor College of Medicine (BCM). He was also the director of the Memory & Brain Research Center at BCM. He is currently a founding Principal Investigators at Altos Labs, Inc. Costa-Mattioli has elucidated central mechanisms underlying neurological dysfunction. He received his bachelor's degree in biology from the University of Republic (Uruguay) and PhD in microbiology from the University Nantes (France). He performed his postdoctoral training in neurobiology at McGill University (Canada). His laboratory has produced several important contributions to the understanding of the neurobiological basis of memory formation. He is best known for discovering that the protein homeostasis network dubbed the integrated stress response (ISR) is a universal regulator of long-term memory formation, and its

the Netherlands, and finishing in the Department of Anatomy at the University of Toronto. He gained postdoctoral research experience at Cambridge University in England and at the Salk Institute in California.

Talk Abstract: Experiments done by Karim Nader and Tony Bechara when they were graduate students served to double dissociate two separate motivational systems in the brain. Lesions of the tegmental pedunculopontine nucleus (TPP) blocked the rewarding effects of morphine in previously drug naive animals but not in opiate dependent and withdrawn animals, whereas dopamine antagonists blocked the rewarding effects of morphine in opiate dependent and withdrawn animals but not in previously drug naive animals. This double dissociation was seen following both systemic and local brain ventral tegmental area (VTA) morphine injections. The data made a strong prediction

SHEENA JOSSELYN

Sheena Josselyn is a Senior Scientist at The Hospital for Sick Children (SickKids) and a Professor in the departments of Psychology and Physiology at the University of Toronto in Canada. She holds a Canada Research Chair in Brain Mechanisms underlying Memory, and is a Fellow of the Royal Society of Canada. Her undergraduate degrees in Psychology and Life Sciences and a Masters degree in Clinical Psychology were granted by Queen's University in Kingston (Canada). Sheena received a PhD in Neuroscience/Psychology from the University of Toronto with Dr. Franco Vaccarino as her supervisor. She conducted post-doctoral work with Dr. Mike Davis (Yale University) and Dr. Alcino Silva (UCLA). Dr. Josselyn received several awards, including the Innovations in Psychopharmacology Award from the Canadian College of Neuropsychopharmacology (CCNP) and the Effron Award from the American College of Neuropsychopharmacology (ACNP). Dr. Josselyn is interested in understanding how the brain encodes, stores and uses information. Several human disorders (ranging from autism spectrum disorder to Alzheimer's disease) may stem from disrupted information processing. Therefore, this basic knowledge is not

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University), with a Fulbright Fellowship (1999). Appointed Associate Professor of the Dept. of Cell Biology of the Univ. of València in 2002, and Full Professor in the same University since 2020. His research focuses on neural circuits underlying social and sexual behaviors, such as sexual attraction, aggression and maternal behavior, in which the amygdala plays a critical role.

Talk Title and Abstract: The neural base of territorial learning in mice - Mice are territorial animals and use urinary signals, detected by the vomeronasal system, to delimitate the boundaries of the individual territories. Consequently, learning the territorial map should incorporate the vomeronasal signals indicating individual identity (the "who" component of memory) into the hippocampal spatial representation. In this work we show that navigating a virtual environment induced synchronic activity in the vomeronasal amygdala and the dorsal CA1 of the hippocampus in the theta frequency range, and the detection of urinary signals elicited a common pattern of theta-nested gamma activity in this amygdalo–hippocampal network. The detection of urine stimuli induced synaptic plasticity (measured as long-term potentiation) in the vomeronasal pathway and the dorsal hippocampus, associated with the overexpression of pAKT and pGSK3β in the dorsal hippocampus. A newly described amygdalo-entorhino-hippocampal circuit likely underlies the formerly unknown influence of pheromonal information in hippocampal learning. We suggest that this circuit is the neural substrate of territorial behavior in mice, and it mediates the integration of social and spatial information, that is, the "who" and "where" components of episodic memory.

NATALIE TRONSON

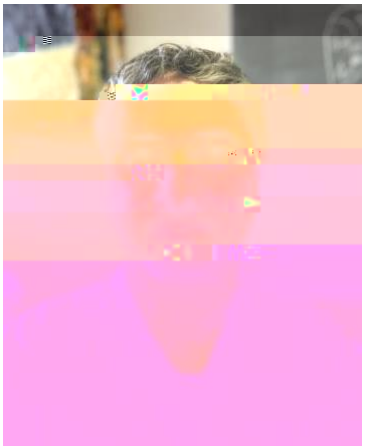
Natalie Tronson, Ph.D. is Assistant Professor of Psychology at the University of Michigan. Her research focuses on the molecular mechanisms of learning and memory; the internal and external factors that can lead to changes in memory; and the role of memory dysregulation in psychiatric and neurological disorders including post-traumatic stress disorder, and post-operative cognitive decline. She is particularly intrigued by questions

to understand what information is learned during Pavlovian conditioning (and retrieved during recall), and thereby conceptualize a more complex structure of “simple” associative memories.

JOHANNES FELSENBERG

Johannes is a group leader at the Friedrich Miescher Institute for Biomedical Research in Basel, Switzerland. His research focuses on understanding the neural circuit mechanisms that allow to adjust learned information. To address the function of specific circuits, the Felsenberg lab uses a combination of genetic tools to manipulate neuronal activity, behavioral assays and in vivo calcium imaging. Utilizing these tools, his team aims to identify the general circuit motifs underlying memory re-evaluation in the relatively simple brain of the fruit fly Drosophila. Revealing common circuit principles in this context will help to understand how to re-write existing memories.

Talk Title and Abstract: Recovery of forgotten memory in *Drosophila* - Learned information can be forgotten. Encountering related cues, however, can reinstate the forgotten memory. How this change in accessibility of memory traces is achieved, is not understood. We developed a new paradigm to investigate the neuronal circuit mechanisms that underlie the recovery of forgotten memory in the fruit fly *Drosophila melanogaster*. Re-exposing flies to training-related reminder cues recovers forgotten aversive memories. In this process, the presence of contextual information that match the learning situation seem to be crucial. Addressing the circuits that underlie this process reveals that output from two different olfactory centers, the lateral horn and the mushroom body, seem to recruit a single pair of dopamine neurons to recover forgotten memory. The capacity of these two dopamine neurons to reinstall learned avoidance seem to depend on odor specific plasticity established during initial learning. This is in line with the finding that the identified dopamine pathway is known to strengthen learning in repeated experiences but not in initial training trials. Comparing the recovered memory with the initial memory reveals differences in strength and retrieval circuitry, suggesting that the recovery process can implement changes in the stored information. Indeed, we find evidence that changing the reminder settings has direct impact on the expression and the valence of the recovered memory. Based on these findings I will argue that recovering forgotten memories is a dopamine driven process with the potential to change the recovered memory.



JONATHAN PHILLIP BRITT

Jonathan Britt is an Associate Professor at McGill University. He earned his PhD at the University of Chicago under the mentorship of Dan McGehee and completed postdoctoral research at NIDA in the lab of Antonello Bonci. His research examines how striatal circuitry contributes to reward learning and psychopathology.

Talk Title and Abstract: Striatal circuit disruptions and compulsive grooming behaviour - Obsessive-compulsive disorder is associated with aberrant corticostriatal activity. In mice, stimulation of corticostriatal fibers for 5 minutes a day elicits compulsive grooming behaviour, which is a hallmark of mouse models of this pathology. Here, we show that stimulation of thalamic, but not hippocampal, inputs to the ventral striatum also induce compulsive grooming behaviour that persists for weeks. With the goal of informing therapeutic deep brain stimulation-based interventions, we are now testing in vivo synaptic plasticity protocols and trying to identify behavioural and physiological measures of pathway-specific synaptic strength in vivo.

JEFF MOGIL

Jeffrey S. Mogil is currently the E.P. Taylor Professor of Pain Studies and the Canada Research Chair in the Genetics of Pain at McGill University, and the past Director of the Alan Edwards Centre for the Study of Pain. Dr. Mogil has made seminal contributions to the field of pain genetics and is the author of many major reviews of the subject, including an edited book, The Genetics of Pain (IASP Press, 2004). He is also a recognized authority in the fields of sex differences in pain and analgesia, and pain testing methods in the laboratory mouse. Dr. Mogil is the author of over 270 journal articles and book chapters since 1992 and has given almost 400 invited lectures in that same period. His h-index is currently 91. He has trained almost 30 graduate students, postdocs, and visiting scholars, over 170 undergraduate research assistants, and lectures on pain to over 400 undergraduates every year. He is the recipient of numerous awards, including: the Neal E. Miller New Investigator Award from the Academy of Behavioral Medicine Research; the Patrick D. Wall Young Investigator Award from the International Association for the Study of Pain; the SGV Award from the Swiss Laboratory Animal Science Association; the Donald O. Hebb Award from the Canadian Psychological Association; the John C. Liebeskind (early career) and Frederick W.L. Kerr (lifetime achievement) awards from the American Pain Society; and Early Career, Distinguished Career, and Outstanding Mentorship awards from the Canadian Pain Society. He recently served as a Councilor at IASP and was the Chair of the Scientific Program Committee of the 13th World Congress on Pain.

Talk Title and Abstract: Pain, Sex, and Death - With the implementation of sex-as-a-biological-variable policies in funding agencies around the world, more and more evidence of sex differences in the biological mechanisms underlying pain is being uncovered. We have been performing experiments investigating the interaction of sex with another often-ignored factor of great relevance to pain: time. Evidence will be provided suggesting that the long-term sequelae of painful nerve injuries are sex-dependent in mice, and that pain affects lifespan in a sex-specific manner, likely due to telomere dysfunction-induced cellular senescence in spinal cord microglia. Our data reinforce the importance of performing all preclinical experiments on both sexes, and suggest that “chronic” pain in mice occurs over a much longer time span than is addressed by the current literature.

SZU-HAN WANG

Szu-Han Wang is an Alzheim ך ضذ

Reactivating a memory can render the memory labile and susceptible to disruption. This has been demonstrated by Prof Karim Nader and colleagues since their Nature article in 2000 which reinvigorated reconsolidation research. Interfering reconsolidation that leads to the weakening of fear memory provides promising therapeutics for post-traumatic stress disorders. In this talk, I will cover work demonstrating a boundary condition of reconsolidation due to the strength of the fear memory and the correlated receptor mechanism - work that was developed in the Nader lab. I will then cover evidence demonstrating 'boosting' memory reconsolidation in improving persistence of competitive memories which has implication in cognitive aging and in dementia.

PETER FINNIE

Peter Finnie is an Associate Research Fellow at the University of Toronto, Canada. He completed his BA in Psychology from McGill University in 2006. He then received a PhD in Psychology from McGill University in 2016. He worked as a Postdoctoral Research Fellow in the Bear Lab at the Massachusetts Institute of Technology. He began his research pursuits in the field of drug addiction and relapse, before transitioning to the development, implementation, and evaluation of clinical therapies in children diagnosed with a range of comorbid behavioural and/or developmental disorders.

SATOSHI KIDA

Satoshi Kida was an undergraduate at the University of Tokyo in 1989. He then received a Ph.D from the University of Tokyo in 1994. He worked in the Institute of Molecular and Cellular Biosciences in the University of Tokyo and then moved to Cold Spring Harbor Laboratory as a postdoctoral fellow. In 1997, he joined the Tokyo University of Agriculture as an associate professor and then became a professor in 2008. In 2019, he became a professor at the Graduate School of Agriculture and Life Sciences, the University of Tokyo. He is the President of Molecular and Cellular Cognition Society-

David Glanzman graduated from Indiana University with a B.A. in psychology in 1973. He completed his Ph.D. in psychology at Stanford University in 1980. Afterwards, he did postdoctoral research in neurobiology and behavior with Frank Krasne in the Department of Psychology at UCLA, and with Eric Kandel at the Howard Hughes Medical Institute at Columbia University. In 1990 he returned to UCLA as an Assistant Professor. Currently, he is a Distinguished Professor in the Departments of

improved memory performance, even when each sensory modality was tested alone. Temporal control of neuronal function revealed visually-

KARL PETER GIESE

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decoupling agent measurably affects basal synaptic transmission. However, both reverse established late-

MELANIE SEKERES

Melanie Sekeres received her PhD in Physiology from the University of Toronto under Dr. Sheena Josselyn, and completed postdoctoral training at the Rotman Research Institute under the supervision of Drs. Cheryl

research focuses on the causes of addictions and their commonly comorbid conditions*. Thank you, Karim, for convincing me to apply memory reconsolidation principles to the treatment of substance use disorders.*

Talk Title and Abstract: A Stress-Based Intervention to Reduce Cigarette Use in Non-Tr Ignatio

mediated mRNA translation is crucial for cognitive function, which is dependent on OXPHOS and neuronal morphogenesis.

6. Astrocytes involvement in the effects of early-life stress on cognitive dysfunction

Anthony Bosson[1], Ifeoluwa Adedipe[1,2], Lewis Depaauw-Holt[1,2], Ciaran Murphy-Royal[1,2]
[1]

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The Neuroscience & Mental Health Research Program (SickKids)

Committee

Paul Frankland, The Hospital for Sick Children

Wayne Sossin, McGill University

Mauro Costa-Mattioli, Baylor College of Medicine

Debbie Rashcovsky, Neuro Events, The Neuro