BIOGRAPHICAL SKETCH

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NAME: Adler, Avital

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POSITION TITLE: Postdoctoral Fellow in Neuroscience

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Tel-Aviv University, Tel Aviv, Israel	B.S.c.	08/2004	Biology and Psychology
Hebrew University, Jerusalem, Israel	M.S.c.	03/2010	Neural Computation
Hebrew University, Jerusalem, Israel	Ph.D.	08/2013	Neural Computation
Skirball Institute, New York University, New York	Postdoctoral	Current	Neuroscience

A. Personal Statement

Since my undergraduate studies I have been fascinated with the plastic abilities of the mammalian brain, its enormous capacity to learn and modify on the one hand and its ability to preserve on the other. I feel watching my daughters mature and learn has made my curiosity grow stronger about the brain's amazing ability for learning and memory storage. Both in my PhD and in my current postdoctoral research I have been studying learning processes, however in different animal models, circuits and techniques.

In my PhD I worked on the sub-cortical circuit of the BG, researching the neuronal mechanisms which encode rewarding and aversive learning signals. I studied how information is processed along the BG network to enable it to implement a reinforcement learning algorithm in order to maximize gained reward. I consider my main finding in my PhD to be the different correlation structure across the sub regions of the input nucleus of the BG, the striatum. Striatal sub regions compete for control over behavior. It is unknown what mechanism enables one region to mediate behavior in a certain state. My result explains how one region is able to efficiently transfer information to BG downstream structures thus gaining control over the learned behavior. My current research is aimed at understanding cortical learning and memory processes at the level of synaptic plasticity. Specifically, in the project proposed here I will study the role of inhibitory interneurons in modulating the cortical excitatory circuits important for learning and memory. The cortical balance between excitation and inhibition is a key regulator of experience-dependent synaptic plasticity. Furthermore, imbalance of excitation/ inhibition is associated with disorders bearing cognitive deficits. I will therefore study how manipulating a specific sub-group of cortical inhibitory interneurons, which could not be targeted before, will affect the functional plasticity of synaptic networks together with their influences on the learning and/or performance of a motor task. In the second part of this project, I will study the function of inhibitory interneurons in motor learning in the full context of intra- and extra-cortical circuits. I will examine the reciprocal regulation between different interneuron sub-types, and the cholinergic modulation onto the inhibitory circuit and how these control experience-dependent synaptic plasticity and govern learning rules.

The project I am proposing here will pave the path for my future research plans. My overarching goal is to conduct an independent research program aimed at understanding the cortical and sub-cortical circuit mechanisms which control learning and memory processes. I am particularly interested in the neuromodulatory regulation of cortical function and plasticity and how this converts into learning and into new behavioral outputs.

Addressing my current and future research goals requires a combination of cutting-edge techniques that I have experience with, including in vivo imaging in awake behaving mice, viral injections and advanced data analysis techniques, but also other skills such as chronic imaging and combined imaging/ optogenetic manipulations that I plan to acquire during the K99 period of this award. Additionally, to accomplish my scientific and career goals I will be assisted by the guidance, advice and expertise of my mentor; Dr. Gan, my postdoctoral advisory committee; Drs. Buszaki, Fishell and Zif and my consultant; Dr. Rinberg.

In my PhD I worked on the sub-cortical circuit of the BG, in primates, using electrophysiology and employing advanced data analysis techniques. In my current postdoctoral fellowship I am working on cortical areas, in mice, combining imaging, genetic manipulations and neural computation. The BG together with the cortex work to execute habitual and goal directed behavior. Working on both systems and employing different methodologies gives me a comprehensive view on the cognitive aspects of learning and memory. Combining my past expertise of electrophysiology with my current and future work in mouse genetics, in vivo synapse imaging, optogenetic manipulations and animal behavior will allow me to conduct complicated experiments and to draw novel conclusions on the causal relationship between neuronal activity and function and the development of learning and memory. Together with a supporting team of mentors and the unique intellectual and collaborative environment of NYU I am confident this award will enable me to accomplish the scientific and career goals I propose here and to launch my own research group.

B. Positions and Honors

Positions and Employment

2006-2007	M.S.c. research with Prof. Hagai Bergman, School of Medicine, Hebrew University, Jerusalem, Israel
2006-2007	Teaching Assistant; cellular physiology and neurophysiology, School of Medicine, Hebrew University, Jerusalem, Israel
2007-2013	Ph.D. research with Prof. Hagai Bergman, Interdisciplinary Center for Neural computation, Hebrew University, Jerusalem, Israel
2009-2012	Teaching Assistant; system physiology, cardiovascular, respiratory and renal systems, School of Medicine, Hebrew University, Jerusalem, Israel
2013-	Postdoctoral fellow, School of Medicine, New York University, New York, NY

Other Experience and Professional Memberships

2011,2013,2015 Member, Society of Neuroscience

Honors

2004	Graduated with honors (Cum Laude) B.S.c. in Biology, Tel Aviv University, Tel Aviv, Israel
2006-2010	Merit based scholarship, Hebrew University, Jerusalem, Israel
2010	IBAGSX Travel Fellowship, International Basal Ganglia Society, Rutgers University, Newark, NJ
2010-2013	Adams PhD fellowship, Israel Academy Adams fellowship program, Jerusalem, Israel
2011	ELSC Travel Fellowship, Hebrew University, Jerusalem, Israel
2011	Psychobiology Institute Travel Fellowship, Hebrew University, Jerusalem, Israel
2012	Nitza Ilan Prize in Electrophysiology, Jerusalem, Israel
2013	Postdoctoral fellowship, The Edmond & Lily Safra Center for Brain Sciences, Hebrew University, Jerusalem, Israel
2013-	Postdoctoral fellowship, Human Frontier Science Program
2014	National Postdoctoral Award for Advancing Women in Science, Weizmann Institute of Science, Israel
2014	Merit based participation, 64th Lindau Nobel Laureate Meeting, Physiology or Medicine
2016	Speaker in Symposium, AAAS Annual Meeting, Washington, DC
2016	Outstanding poster presentation award, Skirball retreat, NYU

C. Contribution to Science

1. The basal ganglia (BG) are a group of sub-cortical nuclei, which together with the cortex, work to execute habitual and goal directed behaviors requiring motor, cognitive and limbic structures. The motor, cognitive and limbic sub-territories of the input stage of the BG, the striatum, all converge downstream onto the same

pathway suggesting competing control systems over behavior. In these studies I found that although neurons in all striatal territories displayed similar temporal modulations of their discharge rates to significant behavioral events, their correlation structure was profoundly different. Furthermore, I demonstrated a functional, not just anatomical convergence of striatal activity to its downstream target. These results therefore explain how one striatal region is able to efficiently transfer information to BG downstream structures thus gaining control over the behavior.

a. Adler A, Katabi S, Finkes I, Israel Z, Prut Y, Bergman H. Temporal convergence of dynamic cell assemblies in the striato-pallidal network. J Neurosci. 2012 Feb 15;32(7):2473-84. PubMed PMID: 22396421.
b. Adler A, Finkes I, Katabi S, Prut Y, Bergman H. Encoding by synchronization in the primate striatum. J Neurosci. 2013 Mar 13;33(11):4854-66. PubMed PMID: 23486956.
c. Adler A, Katabi S, Finkes I, Prut Y, Bergman H. Different correlation patterns of cholinergic and GABAergic interneurons with striatal projection neurons. Front Syst Neurosci. 2013;7:47. PubMed PMID: 24027501; PubMed Central PMCID: PMC3760072.

2. Experimental and theoretical studies have suggested that the BG nuclei implement a reinforcement learning algorithm. Midbrain dopaminergic neurons increase their activity when an outcome is better than expected thus providing with the BG a reinforcing teaching signal. However, the low tonic discharge rate of dopaminergic neurons suggest that they are limited at encoding negative events by firing suppression. These publications demonstrated that throughout the BG, the neuronal activity is strongly modulated by expectation of rewarding but not aversive outcomes. The neuronal-behavioral asymmetry found in those papers showed that aversive and rewarding events are encoded by segregated neuronal systems in the mammalian brain.
   a. Joshua M, Adler A, Mitelman R, Vaadia E, Bergman H. Midbrain dopaminergic neurons and striatal cholinergic interneurons encode the difference between reward and aversive events at different epochs of probabilistic classical conditioning trials. J Neurosci. 2008 Nov 5;28(45):11673-84. PubMed PMID: 18987203.
   b. Joshua M, Adler A, Rosin B, Vaadia E, Bergman H. Encoding of probabilistic rewarding and aversive events by pallidal and nigral neurons. J Neurophysiol. 2009 Feb;101(2):758-72. PubMed PMID: 19052110.
   c. Joshua M, Adler A, Prut Y, Vaadia E, Wickens JR, Bergman H. Synchronization of midbrain dopaminergic neurons is enhanced by rewarding events. Neuron. 2009 Jun 11;62(5):695-704. PubMed PMID: 19524528.

3. The external and internal segments of the Globus Pallidus (BG output) display distinct activity profiles and are predicted to display reciprocal discharge patterns. However, these studies found that the activity changes in response to different brain states were positively correlated between the two segments suggesting both are modulated by a common driving force. They further demonstrated a functional homology between the primate Globus Pallidus and the song bird area x suggesting that song learning in birds and motor learning in mammals use conserved BG signaling strategies.
   a. Mitelman R, Joshua M, Adler A, Bergman H. A noninvasive, fast and inexpensive tool for the detection of eye open/closed state in primates. J Neurosci Methods. 2009 Apr 15;178(2):350-6. PubMed PMID: 19126413.
   b. Adler A, Joshua M, Rivlin-Etzion M, Mitelman R, Marmor O, Prut Y, Bergman H. Neurons in both pallidal segments change their firing properties similarly prior to closure of the eyes. J Neurophysiol. 2010 Jan;103(1):346-59. PubMed PMID: 19864438.
   c. Goldberg JH, Adler A, Bergman H, Fee MS. Singing-related neural activity distinguishes two putative pallidal cell types in the songbird basal ganglia: comparison to the primate internal and external pallidal segments. J Neurosci. 2010 May 19;30(20):7088-98. PubMed PMID: 20484651; PubMed Central PMCID: PMC2874984.
   d. Schechtman E, Adler A, Deffains M, Gabbay H, Katabi S, Mizrahi A, Bergman H. Coinciding decreases in discharge rate suggest that spontaneous pauses in firing of external pallidum neurons are network driven. J Neurosci. 2015 Apr 29;35(17):6744-51. PubMed PMID: 25926452; PubMed Central PMCID: PMC4412894.

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/1zmtJEgZMhfQD/bibliography/50182381/public/?sort=date&direction=ascending

D. Research Support

Ongoing Research Support

Completed Research Support
Adams PhD fellowship, Israel Academy Adams fellowship program 10/01/10-04/30/13
Value encoding in the Striatum in view of serotonin neurotransmission
The goal of this study was to determine and compare the encoding of appetitive and aversive learning signals in the different nuclei of the input stage of the Basal Ganglia, the Striatum.
Role: PhD student

Human Frontier Science Program Postdoctoral fellowship 09/01/13-08/31/16
Role of inhibition in experience-dependent structural synaptic plasticity
The goal of this study is to understand the role of inhibitory interneurons in modulating the cortical excitatory circuits important for learning and memory.
Role: Postdoctoral fellow