BIOGRAPHICAL SKETCH

NAME: Matthew Lovett-Barron, Ph.D

POSITION TITLE: Assistant Professor - University of California, San Diego

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
Queen's University, Kingston, ON, Canada	B.Sc.H.	05/2009	Psychology
Columbia University, New York, NY, USA	Ph.D.	01/2014	Neurobiology
Stanford University, Stanford, CA, USA (*Postdoc*)	n/a	06/2020	Neuroscience/ Bioengineering

A. Personal Statement

I am an Assistant Professor in the Division of Biological Sciences (Neurobiology Section) at the University of California, San Diego. My lab investigates the neurobiology of global brain states in individuals and collective decision making in groups, leveraging the unique advantages of two model systems – the larval zebrafish (*Danio rerio*) and adult glassfish (*Danionella translucida*).

We investigate internal states in larval zebrafish, by immersing these small transparent vertebrates into multisensory virtual reality environments and observing their behavior across different internal states: sleepy vs. alert, hungry vs. sated, stressed vs. calm, etc. We use cellular-level optical imaging and manipulation of neural dynamics and biochemical signaling across the entire brain of these animals during state-dependent behaviors, in order to understand *how multiple cellular changes across the brain produce global internal states*,.

We also investigate group behaviors in the micro glassfish (*Danionella translucida*) – a species that remains small and transparent as adults and are capable of robust schooling, shoaling, and other collective social behaviors. We use interactive multi-agent virtual reality environments to enable neural activity recordings from individuals while they actively engage with other fish in a "virtual school", in order to understand *how multiple individual brains collaborate to perform collective behaviors*.

My lab addresses these questions using a variety of experimental approaches, leveraging my extensive experience with animal behavior, electrophysiology, optogenetics, gene expression assays, big data analysis, and multiple forms of light microscopy (2-photon, light sheet, light field, confocal). My work has been published in *Science, Cell, Nature Neuroscience,* and *Neuron*, among others, and I have received several institutional, national, and international awards for my research (including the PhD thesis prize from the Society for Neuroscience, an HHMI-funded Helen Hay Whitney Foundation Postdoctoral Fellowship, an NIH K99/R00 Pathway to Independence Award, and, as an independent investigator, a Searle Scholar Award, Klingenstein-Simons Fellowship, Packard Fellowship, Pew Scholars Award, and Sloan Research Fellowship, among others). The long term goal of my lab is to understand the neurobiological principles of behavioral flexibility, and to harness these mechanisms to better understand and treat neurological and psychiatric disorders.

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B. Positions and Honors

i. Positions and Employment

ACTIVITY/ OCCUPATION	START DATE (mm/yy)	ENDING DATE (mm/yy)	FIELD	INSTITUTION/ COMPANY	SUPERVISOR/ EMPLOYER
Research Assistant	05/07	09/07	Psychology/ Neuroscience	Ryerson University	Dr. Todd Girard/ Dr. James Cantor
Undergraduate Research Fellow	06/2008	08/2008	Neuroscience	The Rockefeller University	Dr. Donald Pfaff
Research Assistant	05/2009	09/2009	Psychology/ Pharmacology	Queen's University	Dr. Mary C Olmstead/ Dr. Eric Dumont
Postdoctoral Fellow	03/2014	06/2020	Neuroscience	Stanford University	Dr. Karl Deisseroth
Assistant Professor	07/2020	---	Neurobiology	UC San Diego	---

ii. Other Experiences and Professional Memberships

2011-present: Society for Neuroscience

iii. Honors

2005-2009: Dean's Honor List, Queen's University
2008: Summer Undergraduate Research Fellowship, The Rockefeller University
2009: W.R. Thompson Prize in Psychology, Queen's University (*for B.Sc. Honors thesis*)
2009: Certificate of Academic Excellence, Canadian Psychological Association (*for B.Sc. Honors thesis*)
2010: Natural Science and Engineering Research Council of Canada Postgraduate Fellowship (PGS-M)
2011: Society for Neuroscience Graduate Student Travel Award
2011: Kavli Foundation Travel Award
2011: Best Poster Presentation, FENS/IBRO/SfN Causal Neuroscience Summer School, Bertinoro, Italy
2011: National Science Foundation Graduate Research Fellowship – Honorable Mention
2011-2014: Natural Science and Engineering Research Council of Canada Postgraduate Fellowship (PGS-D)
2014: Dean's Award for Excellence in Research, Columbia University (*for PhD thesis*)
2015: Donald B. Lindsley Prize in Behavioral Neuroscience, Society for Neuroscience (*for PhD thesis*)
2015-2018: Postdoctoral Fellowship, Helen Hay Whitney Foundation (HHMI)
2016: Best Poster Prize, Gordon Research Conference "Optogenetic approaches & neural circuits"
2017-2019: NARSAD Young Investigator award (BBRF)
2017: *Forbes* Magazine 30 under 30 - Science
2017: COSYNE Presenters Travel Grant
2017-2023: NIH Pathway to Independence Award (K99/R00)
2021: Scialog Advanced Bioimaging Fellow
2021: Searle Scholar Award
2021: Klingenstein-Simons Fellowship
2021: Packard Foundation Fellowship
2022: Alfred P. Sloan Research Fellowship
2022: Pew Biomedical Scholar Award (Kathryn W. Davis Aging Brain Scholar)

C. Contributions to Science

1. Doctoral Research (2009-2014): Dendritic inhibition in the hippocampus

I conducted my PhD thesis research in the lab of Dr. Attila Losonczy, as a graduate student in the Neurobiology and Behavior program at Columbia University. There I examined the physiological and behavioral role of inhibitory circuits in the mouse hippocampus using patch clamp electrophysiology, *in vivo* 2-photon calcium imaging, optogenetics, and behavioral analysis. I first found that dendrite-targeting interneurons control pyramidal cell burst spiking through inhibition of local dendritic electrogenesis (Lovett-Barron et al., *Nature Neuroscience*, 2012). This biophysical function is exploited to facilitate learning during contextual fear conditioning: unconditioned stimuli recruit dendrite-targeting interneurons through cholinergic input, producing inhibition of pyramidal cell tuft dendrites; this prevents erroneous dendritic integration of aversive sensory input from the entorhinal cortex, ensuring the hippocampal population encodes context alone (Lovett-Barron et al., *Science*, 2014). These two key papers have now been cited over 700 times, and my thesis was honored with the Dean's Award from Columbia University and the Donald B Lindsley Prize from the Society for Neuroscience.

1) **Lovett-Barron M**, Kaifosh P, Khierbek MA, Danielson N, Zaremba JM, Turi GF, Reardon TR, Hen R, Zemelman BV, and Losonczy A (2014). Dendritic Inhibition in the Hippocampus Supports Fear Learning. ***Science***, *343*, 857-863. PMID: 24558155

2) **Lovett-Barron M**, Turi GT, Kaifosh P, Lee P, Bolze F, Sun X-H, Nicoud J-F, Zemelman BZ, Sternson SM, and Losonczy A (2012). Regulation of Neuronal Input Transformations by Tunable Dendritic Inhibition. ***Nature Neuroscience***, *15*, 423-430. PMID: 22246433

3) Kaifosh P, **Lovett-Barron M**, Turi GT, Reardon TR, and Losonczy A (2013). Septo-hippocampal GABAergic Signaling Across Multiple Modalities in Awake Mice. ***Nature Neuroscience***, *16*, 1182-1184. PMID: 23912949

4) Danielson N, Kaifosh P, Zaremba JD, **Lovett-Barron M**, Tsai J, Denny CA, Balough EM, Goldberg AR, Drew LJ, Hen R, Losonczy A, and Khierbek MA (2016). Distinct Contribution of Adult-Born Hippocampal Granule Cells to Context Encoding. ***Neuron***, *90*, 101-112 PMID: 26971949

2. Postdoctoral Research I (2014-2020): Internal states and distributed neuromodulation

After studying computations in local circuits during graduate school, I felt compelled to take a broader view, and examine the mechanisms that coordinate circuits throughout the brain. As an HHMI Fellow of the Helen Hay Whitney Foundation in the lab of Karl Deisseroth at Stanford University, I set out to establish larval zebrafish as a model system to study brain-wide neuromodulation and internal states. I developed a novel method to merge whole-brain neural activity recording with *post hoc* molecular identification, permitting the discovery of multiple monoaminergic, cholinergic, and peptidergic cell types that are co-active during heightened arousal states. I then found that these same cell types were active during arousal in mice, demonstrating that collective neuromodulatory control of arousal is conserved across vertebrates (Lovett-Barron et al., *Cell*, 2017). In subsequent work, funded by a K99/R00 award from the NIMH and a NARSAD Young Investigator Award, I used serial registration of multiple fluorescent *in situ* hybridization (fISH) markers to link neuropeptide gene expression with activity imaging in the hypothalamus. I found that different homeostatic challenges evoke similar escape behaviors, by recruiting diverse peptidergic cell types that converge on common premotor networks (Lovett-Barron et al., *Nature Neuroscience*, 2020). Together, this work demonstrates that brain states and adaptive behaviors are regulated by multiple overlapping neuromodulatory systems. In this time, I also contributed to two other studies of internal states and neuromodulation in zebrafish – a collaboration with Philippe Mourrain's lab on the role of hypothalamic RFamide neuropeptides in pain (Madeline, Lovett-Barron et al., *Scientific Reports*, 2017), and an investigation of coupled habenula-raphe circuits in the expression of behavioral passivity (Andalman, Burns, Lovett-Barron et al., *Cell*, 2019).

1) **Lovett-Barron M**, Andalman AS, Allen WE, Vesuna S, Kauvar I, Burns VM, and Deisseroth K (2017). Ancestral circuits for the coordinated modulation of brain state. ***Cell,*** *171*, 1411–1423. PMID: 29103613

2) **Lovett-Barron M**, Chen R, Bradbury S, Andalman, AS Wagle M, Guo, S, and Deisseroth K (2020). Multiple convergent hypothalamus-brainstem circuits drive defensive behavior. ***Nature Neuroscience***, *23*, 959-967. PMID: 32572237

3) Andalman AS, Burns VM, **Lovett-Barron M**, Broxton M, Poole B, Yang SJ, Grosenick L, Lerner TN, Chen R, Benster T, Mourrain P, Levoy M, Rajan K, and Deisseroth K. (2019). Neuronal dynamics regulating brain and behavioral state transitions. ***Cell***, *177*, 970-985. PMID: 31031000

4) Madeline RM, **Lovett-Barron M**, Halouin C, Andalman AS, Liang J, Skariah GM, Leung LC, Burns VM, Skariah G, and Mourrain PM (2017). The hypothalamic NPVF circuit modulates ventral raphe activity during nociception. ***Scientific Reports***, *7*, 41528. PMID: 28139691

3. Postdoctoral Research II (2014-2020): Development and application of zebrafish neurotechnology

In addition to my primary research described above, I spent a substantial amount of effort as a postdoc contributing to the development of larval zebrafish as a useful model system for cellular and systems neuroscience. This includes the development of an extended depth-of-field light sheet microscope for high-speed *in vivo* imaging (Tomer, Lovett-Barron et al., *Cell*, 2015), and two collaborations with Ivan Soltesz's lab to study brain-wide network hubs during experimentally-induced epilepsy (Hadjiabadi, Lovett-Barron et al. *Neuron*, 2021) and conserved hypothalamic cell types for locomotor speed control (Farrell, Lovett-Barron et al. *Science*, 2021), among a number of other currently unpublished collaborations.

1) Tomer R, **Lovett-Barron M**, Kauvar I, Andalman A, Burns VM, Sankaran S, Grosenick L, Broxton M, Yang S, and Deisseroth K (2015). SPED light sheet microscopy: fast mapping of biological system structure and function. ***Cell***, *163*, 1796–1806. PMID: 26687363

2) Hadjiabadi D, **Lovett-Barron M,** Raikov IG, Sparks FT, Liao Z, Baraban SC, Leskovec J, Losonczy A, Deisseroth K, and Soltesz, I. (2021). Maximally selective single-cell target for circuit control in epilepsy models. ***Neuron***, *109*, 2556-2572. PMID: 34197732

3) Farrell, JS, **Lovett-Barron M,** Klein PM, Sparks FT, Gschwind T, Ortiz AL, Ahanonu B, Bradbury S, Tereda S, Oijala M, Hwaun E, Dudok B, Sxabo G, Schnitzer MJ, Deisseroth K, Losonczy A, and Soltesz I. (2021). Supramammillary regulation of locomotion and hippocampal activity. ***Science***, *374*, 1492-1496. PMID: 34914519

4) Wagle M, Zarei M, **Lovett-Barron M**, Poston KT, Xu J, Ramey V, Pollard KS, Prober DA, Shulkin J, Deisseroth K, and Guo S. (2022). Brain-wide perception of the emotional valence of light is regulated by distinct hypothalamic neurons. ***Molecular Psychiatry***, 1-17.

4. Publications from first year as Assistant Professor at UCSD (2020-present)

In the first year of establishing my lab at UCSD, I have contributed review and opinion pieces on a variety of topics.

1) **Lovett-Barron M** (2021). Linking cell types to behavior in the vertebrate hypothalamus. ***Neuropsychopharmacology,*** *46*, 254. PMID: 32895452

2) **Lovett-Barron M** (2021). Learning-dependent neural dynamics across the larval zebrafish brain. ***Current Opinion in Neurobiology***, *67*, 42-49. PMID: 32861055

3) **Lovett-Barron M** (2021). Sensory Neuroscience: Smelling salts lead fish to safety. ***Current Biology,*** *31*(4), R199-201. PMID: 33621509

4) Flavell SW*, Gogolla N*, **Lovett-Barron M***, and Zelikowsky M* (2022). The emergence and influence of internal states. ***Neuron***, *110*. *equal contribution/alphabetical order

Full publication list:
NCBI MyBibliography: https://www.ncbi.nlm.nih.gov/myncbi/matthew.lovett-barron.1/bibliography/public/
Google Scholar Profile: https://scholar.google.com/citations?user=wfBXbNMAAAAJ&hl=en&oi=ao
ORCID: https://orcid.org/0000-0003-1425-5277

D. Additional Information: Research Support

Ongoing Support

R00 MH112840 Lovett-Barron (PI) 07/2020 – 07/2023
Discovery and characterization of brain-wide neuromodulatory circuits regulating arousal.
Role: PI

Searle Scholar Lovett-Barron (PI) 07/2021 – 07/2024
Neural circuits for information sharing in schooling fish
Role: PI

Klingenstein-Simons Fellowship Lovett-Barron (PI) 07/2021 – 07/2024
Cellular and network mechanisms for internal state persistence
Role: PI

Packard Foundation Fellowship Lovett-Barron (PI) 11/2021 – 11/2026
The neurobiology of collective decision making in animal groups
Role: PI

Alfred P Sloan Research Fellowship Lovett-Barron (PI) 04/2022 – 04/2024
The neurobiology of collective decision making in animal groups
Role: PI

Pew Biomedical Scholar Lovett-Barron (PI) 08/2022 – 08/2026
The neurobiology of action coordination in animal groups
Role: PI

Support completed in last 3 years

Kavli Institute for Brain Science Seed Grant Lovett-Barron (co-PI) 07/2021 – 07/2022
Imaging and quantifying neuromodulatory signal flow in behaving animals
Role: co-PI with Mikio Aoi (UCSD Data Science)

K99 MH112840 Lovett-Barron (PI) 09/2017 – 09/2019
Discovery and characterization of brain-wide neuromodulatory circuits regulating arousal.
Role: PI

NARSAD Young Investigator Award Lovett-Barron (PI) 01/2017 – 06/2020
Brain-wide search for conserved neuromodulatory circuits regulating alertness and attention.
Role: PI

Helen Hay Whitney Foundation Fellowship Lovett-Barron (PI) 04/2015 – 04/2018

Whole-brain neuromodulatory dynamics underlying internal state .
Role: PI/Postdoctoral Fellow