Aditya Nair

I am a computational and systems neuroscientist working at the intersection of neurobiology, machine learning, and dynamical systems. I combine neural imaging, electrophysiology, and generative machine learning tools to understand social behaviors such as aggression and mating. My goal is to uncover key computational properties of neural circuits and re-conceptualize neuropsychiatric disorders as impaired neural computations.

CONTACT INFORMATION

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web: https://adinair.people.caltech.edu/

EDUCATION

California Institute of Technology — 2019-Present
PhD., Computation & Neural Systems

Primary Advisor: David J. Anderson, *Caltech*
Co-Mentors: Scott W Linderman, *Stanford Uni.*
Ann Kennedy, *Scripps Research Institute*
Expected Graduation 2024

National University of Singapore — 2014-2018
B.S., Life Sciences,
Honors with Highest Distinction

Karolinska Institute — 2017
Exchange Semester
Erasmus Scholar

RESEARCH EXPERIENCE

California Institute of Technology — 2019-Present
A*STAR National Science Graduate Fellow in Neuroscience,
Advisor: David J. Anderson.
(1) Identified computational circuit motifs that control the integration of aggressive states in the hypothalamus.
(2) Extensively collaborated with experimentalists to apply unsupervised, machine learning based dynamical systems methods to neural and behavior data.

Institute of Molecular and Cell Biology, Singapore — 2018-2019
Research Officer. Advisors: Weiping Han, George Augustine.

Discovered a neural mechanism for co-release of opposing neuromodulators by combining slice electrophysiology and computational modeling.

Nanyang Technological University, Singapore 2017-2018
Honors Researcher. Advisor: George J. Augustine.
(1) Uncovered the neuromodulatory role of cholinergic inputs to the claustrum. (2) Dissected the composition of cell types in the striatum, claustrum, and cerebellum.

Karolinska Institute, Sweden 2017
Undergraduate Researcher. Advisor: Gilad Silberberg,
Created ML methods for 3D automated reconstruction of neuronal morphology from fluorescent images.

National Neuroscience Institute, Singapore 2015-2017
Undergraduate Researcher. Advisor: Lim Kah Leong,
(1) Studied the role of Parkin and Lipoprotein lipase in Parkinson's disease (2) Created user-friendly computer vision methods for automated analysis of fluorescent images.

AWARDS AND HONORS

Peter and Patricia Gruber International Research Award, Gruber Foundation and Society for Neuroscience 2024

National Science Graduate Scholarship, Agency of Science, Technology and Research, Singapore (A*STAR) 2019-2024

National University of Singapore Science and Technology Undergraduate Scholarship 2014-2018

Simons Foundation Award for Best Poster, Gordon Research Conference (GRC) for Modulation of Neural Circuits and Behavior 2019

Trainee Professional Development Award, Society for Neuroscience 2018

Erasmus Plus Undergraduate Scholarship 2017

PEER REVIEWED PUBLICATIONS

- Amit Vinograd*, **Aditya Nair***, Joseph Kim, Scott W. Linderman and David J. Anderson†. Causal evidence of a line attractor encoding an affective state. *Nature* (2024).

- Mengyu Liu*, **Aditya Nair***, Nestor Coria, Scott W. Linderman and David J. Anderson†. Encoding of female mating dynamics by a hypothalamic line attractor. *Nature* (2024).

- George Mountoufaris, **Aditya Nair**, Bin Yang, Dong-Wook Kim, Amit Vinograd, Samuel Kim, David J. Anderson†. A line attractor encoding a persistent internal state requires neuropeptide signaling *Cell* (2024).

- Amber Hu, David Zoltowski, **Aditya Nair**, David J Anderson, Lea Duncker and Scott W Linderman. Modeling Latent Neural Dynamics with Gaussian Process Switching Linear Dynamical Systems. *Advances in Neural Information Processing Systems (Neurips)*. 2024.

- **Aditya Nair**, Yue Yang Teo, George J. Augustine† and Martin Graf. A functional logic for neurotransmitter co-release in the cholinergic forebrain pathway. *PNAS* (2023)*, 120 (28).*

- **Aditya Nair**, Tomomi Karigo, Bin Yang, Surya Ganguli, Mark J. Schnitzer, Scott W. Linderman, David J. Anderson†, and Ann Kennedy†. An approximate line attractor in the hypothalamus encodes an aggressive state. *Cell* 186, no. 1 (2023): 178-193.

- Willcyn Tang, John Thundyil, Grace Gui Yin Lim, Teddy JW Tng, Sean Qing Zhang Yeow, **Aditya Nair**, Chou Chai, Tso-Pang Yao, and Kah-Leong Lim†. Parkin regulates neuronal lipid homeostasis through SREBP2-lipoprotein lipase pathway—implications for Parkinson's disease. *Human Molecular Genetics* (2023).

- Brandon Weissbourd†, Tsuyoshi Momose, **Aditya Nair**, Ann Kennedy, Bridgett Hunt, and David J. Anderson†. A genetically

*co-first author | † senior author

tractable jellyfish model for systems and evolutionary neuroscience. *Cell* 184, no. 24 (2021): 5854-5868.

- Kelly LL Wong, **Aditya Nair**, and George J. Augustine†. Changing the cortical conductor's tempo: neuromodulation of the claustrum. *Frontiers in Neural Circuits* 15 (2021): 658228.

- Ana Badimon*, Hayley J. Strasburger*, Pinar Ayata*, Xinhong Chen, **Aditya Nair**, Ako Ikegami, Philip Hwang et al. Negative feedback control of neuronal activity by microglia. *Nature* 586, no. 7829 (2020): 417-423.

- Martin Graf, **Aditya Nair**, Kelly LL Wong, Yanxia Tang, and George J. Augustine†. Identification of mouse claustral neuron types based on their intrinsic electrical properties. *ENeuro* 7, no. 4 (2020).

- Miaomiao Mao, **Aditya Nair**, and George J. Augustine†. A novel type of neuron within the dorsal striatum. *Frontiers in Neural Circuits* 13 (2019): 32.

PREPRINTS AND SUBMITTED WORKS

- Kathy Cheung, **Aditya Nair**, Lingyun Lin, Mikhail Shapiro, and David J. Anderson†. Population coding of predator imminence in the hypothalamus. BiorXiv. *In revision*.

INVITED TALKS

- **Cosyne 2023, Montreal, Canada**
  Workshop on Generative Models for Neuroscience.
  Latent dynamical models discover state dependent line attractor-like representations in the hypothalamus during social behavior.

- **Gordon Research Conference (GRC) on the Hypothalamus, 2022, Ventura, CA**
  An approximate line attractor in the hypothalamus that encodes an aggressive internal state.

- **Cosyne 2022, Cascais, Portugal.**
  Dynamical systems analysis reveals a novel hypothalamic encoding of state in nodes controlling social behavior.

*co-first author | † senior author

(Selected from top 3% of all submissions)

- **Society for Claustrum Research Meeting, Salk Institute, 2018, San Diego, CA**
  The claustrum receives neuromodulatory input from the basal forebrain.

CONFERENCE PRESENTATIONS

- Amit Vinograd*****, **Aditya Nair*,** Scott W Linderman, David J Anderson.
  Neural implementation of a hypothalamic line attractor encoding an internal state.
  HHMI Annual Science Meeting, 2023

- **Aditya Nair,** Martin Graf, George J. Augustine.
  Opposing cholinergic gain control of the claustrum.
  Society for Neuroscience 49th Annual Meeting, 2019.

- **Aditya Nair,** Martin Graf, George J. Augustine.
  Opposing cholinergic gain control of the claustrum.
  Gordon Research Conference on Neuromodulation, 2019,
  Awarded Simon's Foundation Award for best poster.

- **Aditya Nair**, Martin Graf, George J. Augustine.
  Cell-type specific cholinergic modulation of the claustrum.
  Society for Neuroscience 48th Annual Meeting, 2018.
  Awarded Trainee Professional Development Award, SfN.

REVIEWING EXPERIENCE

Neuron

TEACHING EXPERIENCE

Co-organizer and Lecturer — 2023, 2022
Chen Institute Data Science and AI for Neuroscience Summer School, *Caltech*
I co-founded and organized a summer school for computational neuroscience, creating a curriculum, lecture series and homework notebooks.

Guest Lecturer, CNS 220: Genetic Dissection of Neural Circuit Function, *Caltech* — 2021-2024

I teach a section focused on computational approaches to understand cell-type specific computations in social behavior.

GRANTS AWARDED

2023

Schmidt Academy for Software Engineering
Wrote and secured a grant from the Schmidt Foundation to develop neural data analysis tools at scale for research and biomarker development.

COURSES AND TRAINING

Max Plank Florida Institute for Neuroscience Florida, Advanced Neuroimaging Techniques — 2020

Riken Center for Brain Science, Japan, Summer Program in Neurotechnology — 2019

COMMUNITY INVOLVEMNT

Mentor for Wave Fellowship, Caltech — 2021-present

Resident Assistant and Student Mentor, National University of Singapore — 2015-2018