Ann Kennedy

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Positions Held

2020 – **Assistant Professor** of Neuroscience
Northwestern University Feinberg School of Medicine

Education and Training

2014 – 2020 **Caltech**
Postdoctoral Scholar
Laboratory of David J. Anderson

2009 – 2014 **Columbia University**
Ph.D. in Neurobiology and Behavior
Advisor: Larry Abbott
Thesis: "Representation and learning in cerebellum-like structures"

2005 – 2008 **Johns Hopkins University**
B.S. in Biomedical Engineering, Computational Biology focus
B.A. in Biology
Minor in Applied Math

Awards and Honors

2023 Sloan Research Fellowship
2022 Eppendorf & Science Prize for Neurobiology
2019 NIMH Pathway to Independence Award (K99/R00)
2015 Helen Hay Whitney Postdoctoral Research Fellowship
2014 Swartz Foundation Postdoctoral Research Fellowship, Caltech
2014 Kavli Award for Distinguished Research in Neuroscience, Columbia University

Ongoing Research Support

R01 NS132912-01 Hong (PI) 9/1/2023 – 8/31/2028
NIH BRAIN Initiative
"Neural circuits for social modulation of a persistent negative emotional state"
The goal of this project is to characterize neural circuit mechanisms for stress-induced persistent neural activity in the medial preoptic area, and the modulation of this activity by affiliative social interactions. We will use modeling to generate testable hypotheses about the effects of circuit perturbations
Role: Co-I

R21 NS135413-01 Miller (PI) 9/6/2023 – 8/31/2025
NIH-NINDS
"Monkey-to-human transfer of trained iBCI decoders through nonlinear alignment of neural population dynamics"
This project expands our recent work using cycle-consistent generative models to stabilize the performance of brain-computer interface decoders for months to years. The goal of this work is to incorporate models of neural

population dynamics into the stabilization algorithm, thus improving its performance via incorporation of domain knowledge.
Role: Co-I

Simons Collaboration on the Global Brain — Meister (PI) — 4/1/2024 – 3/31/2026
Simons Foundation
"Outer brain and inner brain: computational principles and interactions"
This collaboration examines neural computation from the perspective of an "outer" brain that processes sensory and motor signals and an "inner" brain that deals with highly reduced and abstracted signals containing goals, internal states, and memories used to shape decisions. It examines regions within both systems and contrasts neural coding between them.
Role: Co-I

U01 NS131406-01 — Kozorovitskiy (PI) — 9/1/2023 – 8/31/2026
NIH-NINDS
"Dynamic entanglements: the functional role and mechanistic basis of inter-individual neural synchrony"
The goal of this study is to examine the cellular and sub-cellular basis of inter-brain synchrony during free social interactions in mice and prairie voles, and the neuromodulatory mechanisms that may play a role in this synchronous activation.
Role: Co-I

Sloan Research Fellowship — Kennedy (PI) — 9/15/2023 – 9/14/2025
Alfred P. Sloan Foundation
"Genes-to-behavior modeling of complex social interactions and their control by the brain"
This fellowship supports my lab's ongoing efforts to analyze and model the neural population dynamics underlying complex social behavior.

Aligning Science Across Parkinson's — Surmeier (PI) — 11/1/2021 – 10/31/2024
Michael J. Fox Foundation
"Distributed circuit dysfunction underlying motor and sleep deficits in a progressive mouse model of Parkinson's disease"
The goal of this study is to characterize the evolution of circuit pathophysiology and behavior in the inducible MCI-Park mouse model, which shows progressive loss of dopaminergic neurons.
Role: Co-I

U01 NS122124 — Golshani (PI) — 04/15/2021 – 03/31/2024
NIH-NINDS
"Hippocampal neural dynamics driving affiliation and attachment"
The goal of this study is to identify neural signatures of social memory formation in hippocampal CA2 neurons, across three model species with different social structures (mice, prairie voles, and Egyptian fruit bats).
Role: Co-I

R00 MH117264 — Kennedy (PI) — 2/1/2021 – 1/31/2024
NIH-NIMH
"Modeling a neural circuit for the flexible control of innate behaviors"
The goal of this study is to develop computational tools for behavior analysis, and apply these to investigate the neural representations of social behavior in two nuclei of the hypothalamus, VMHvl and MPO.
Role: PI

Publications

(* = equal contribution, † = senior author)

➢ Under Review

Kennedy, A., and Weissbourd, B., (*in review*). The dynamics of neural activity in early nervous system evolution.

Goldstein, N., Maes, A., Allen, H.N., Nelson, T.S., Kruger, K.A., Kindel, M., Smith, N.J., Carty, J.R.E., Villari, R.E., Cho, E., Marble, E., Khanna, R., Taylor, B.B., **Kennedy, A.**, and Betley, N.J. (*in review*). A parabrachial hub for the prioritization of survival behavior.

† Minkowicz, S., Mathews, M. A., Mou, F. H., Yoon, H., Freda, S. N., Cui, E. S., **Kennedy, A.*** & Kozorovitskiy, Y.* (*in review*). Striatal ensemble activity in an innate naturalistic behavior. bioRxiv preprint doi: https://doi.org/10.1101/2023.02.23.529669

➢ Peer-Reviewed Machine Learning Conference Papers

Sun, J. J., Karashchuk, L., Dravid, A., Ryou, S., Fereidooni, S., Tuthill, J. C., Katsaggelos, A., Brunton, B.W., Gkioxari, G., **Kennedy, A.**, Yue, Y., & Perona, P. (2023). BKinD-3D: Self-supervised 3D keypoint discovery from multi-view videos. **Computer Vision and Pattern Recognition (CVPR)**.

† Sun, J.J., …, & **Kennedy, A.** (2023). MABe22: A multi-species multi-task benchmark for learned representations of behavior. **International Conference on Machine Learning (ICML)**.

Zhan, E., Sun, J. J., **Kennedy, A.**, Yue, Y., & Chaudhuri, S. (2022). Unsupervised learning of neurosymbolic encoders. **Transactions of Machine Learning Research (TMLR).**

Sun, J. J., Ryou, S., Goldshmid, R., Weissbourd, B., Dabiri, J., Anderson, D.J., **Kennedy, A.,** Yue, Y., & Perona, P. (2022). Self-supervised keypoint discovery in behavioral videos. **Computer Vision and Pattern Recognition (CVPR)**.

† Sun, J.J., Karigo, T., Chakraborty, D., Mohanty, S.P., Anderson, D.J., Perona P., Yue Y., & **Kennedy, A.** (2021). The Multi-Agent Behavior dataset: mouse dyadic social interactions. **NeurIPS Datasets and Benchmarks Track**.

Sun, J.J., **Kennedy, A.,** Zhan, E., Anderson, D.J., Yue, Y., & Perona, P. (2021). Task programming: learning data efficient behavior representations. **Computer Vision and Pattern Recognition (CVPR).** 2876-2885.

➢ Peer-Reviewed Research Articles

† Gast, R., Solla, S., & **Kennedy, A.** (2024). Neural heterogeneity controls computations in spiking neural networks. **PNAS**, 121 (3) e231188512.

† Gast, R., Knösche, T.R., & **Kennedy, A.** (2023). PyRates—a code-generation tool for modeling dynamical systems in biology and beyond. **PLOS Computational Biology**, 19(12) e1011761.

Rizzoglio, F., Altan, E., Ma, X., Bodkin, K. L., Dekleva, B. M., Solla, S. A., **Kennedy, A.**, & Miller, L. E. (2023). From monkeys to humans: observation-based EMG brain-computer interface decoders for humans with paralysis. **Journal of Neural Engineering**, 20(5) 056040.

Kim, H.R., Long, M., Sekerkova, G., Maes, A., **Kennedy, A.**, & Martina, M. (2023). Hyper negative $GABA_A$ reversal potential in pyramidal cells contributes to medial prefrontal cortex deactivation in a mouse model of neuropathic pain. **The Journal of Pain**.

† Ma, X., Rizzoglio, F., Perreault, E.J., Miller, L.E., & **Kennedy, A.** (2023). Using adversarial networks to extend brain computer interface decoding accuracy over time. **eLife**.

Yun, S., Yang, B., Anair, J.D., Martin, M.M., Fleps, S.W., Pamukcu, A., Yeh, N.-H., Contractor, A., **Kennedy, A**., & Parker, J.G. (2023). D1 and D2 receptor-expressing spiny-projection neuron dynamics unequally correlate with antipsychotic drug efficacy. **Nature Neuroscience**,26(8) 1417-1428.

† Gast, R., Solla, S. A., & **Kennedy, A.** (2023). Macroscopic dynamics of neural networks with heterogeneous spiking thresholds. **Physical Review E**, 107(2), 024306.

† Nair, A., Karigo, T., Yang, B., Ganguli, S., Schnitzer, M. J., Linderman, S. W., Anderson, D. J.*, & **Kennedy, A**.* (2023). An approximate line attractor in the hypothalamus encodes an aggressive state. **Cell**, *186*(1), 178-193.

Ichiki, T., Wang, T., **Kennedy, A.**, Pool, A.H., Evisu, H., Anderson, D.J., & Oka, Y. (2022). Sensory representation and detection mechanisms of gut osmolality change. **Nature**, 602 (7897), 468-474.

Weissbourd, B., Momose, T., Nair, A., **Kennedy, A.**, Hunt, B., & Anderson, D. J. (2021). A genetically tractable jellyfish model for systems and evolutionary neuroscience. **Cell**, *184*(24), 5854-5868.

† Segalin, C., Williams, J., Karigo, T., Hui, M., Zelikowsky, M., Sun, J. J., Anderson, D.J., Perona, P., & **Kennedy, A.** (2021). The Mouse Action Recognition System (MARS) software pipeline for automated analysis of social behaviors in mice. **eLife**, 2021; 10:e63720.

Karigo, T., **Kennedy, A.**, Yang, B., Liu, M., Tai, D., Wahle, I.A., & Anderson, D.J. (2021). Distinct hypothalamic control of same- and opposite-sex mounting behavior in mice. **Nature**, *589*(7841) 258-263.

Kennedy, A.*, Kunwar, P. S.*, Li, L. Y.*, Stagkourakis, S., Wagenaar, D. A., & Anderson, D. J. (2020). Stimulus-specific hypothalamic encoding of a persistent defensive state. **Nature**, *586*(7831) 730–734.

Jung, Y., **Kennedy, A**., Chiu, H., Mohammad, F., Claridge-Chang, A., & Anderson, D. J. (2020). Neurons that function within an integrator to promote a persistent behavioral state in Drosophila. **Neuron**, *105*(2), 322-333.

Remedios, R.*, **Kennedy, A.***, Zelikowsky, M., Grewe, B. F., Schnitzer, M. J., & Anderson, D. J. (2017). Social behaviour shapes hypothalamic neural ensemble representations of conspecific sex. **Nature**, *550*(7676), 388.

Hong, W., **Kennedy, A.**, Burgos-Artizzu, X. P., Zelikowsky, M., Navonne, S. G., Perona, P., & Anderson, D. J. (2015). Automated measurement of mouse social behaviors using depth sensing, video tracking, and machine learning. **PNAS**, *112*(38), E5351-E5360.

Kennedy, A., Wayne, G., Kaifosh, P., Alviña, K., Abbott, L. F., & Sawtell, N. B. (2014). A temporal basis for predicting the sensory consequences of motor commands in an electric fish. **Nature Neuroscience**, *17*(3), 416.

Chew, L. J., King, W. C., **Kennedy, A.**, & Gallo, V. (2005). Interferon-γ inhibits cell cycle exit in differentiating oligodendrocyte progenitor cells. **Glia**, *52*(2), 127-143.

- **Review Articles and Perspectives**

Kennedy, A. (2022). Boiling over. **Science**, 378 (6619) 484-485.

Kennedy, A. (2022). The what, how, and why of naturalistic behavior. **Current Opinions in Neurobiology**.

Kennedy, A. (2022). In the windmills of your mind: circles and spirals construct a persistent encoding of value. **Neuron**, 110(3) 358-360.

Kennedy, A. (2020). Computational behavior analysis takes on drug development. **Nature Neuroscience**, *23*(11), 1314-1316.

Kennedy, A. (2018). Seeing order and disorder in the behaving brain. **Neuron**, *100*(3), 519-520.

Kennedy, A., Asahina, K., Hoopfer, E., Inagaki, H., Jung, Y., Lee, H., Remedios, R., & Anderson, D. J. (2014). Internal states and behavioral decision-making: toward an integration of emotion and cognition. **Cold Spring Harbor symposia on quantitative biology** (Vol. 79, pp. 199-210). CSHL Press.

Courses Taught

Summer 2024	Co-director, Cajal Summer School on Quantitative Approaches to Behavior and Virtual Reality, Champalimaud, Lisbon
Spring 2024	Co-instructor and course developer, NUIN 443: Computational Neuroscience, Northwestern University
2022 –	Co-director, the Short Course on the Application of Machine Learning for Automated Quantification of Behavior, the Jackson Laboratory
2021 – 2022	Co-Instructor, NUIN-408: Quantitative Methods, Northwestern University
2019	Instructor and course developer, Bi 23-6: Methods in Neural Data Analysis, Caltech

Workshops and Symposia Organized

2021 – 2023 Multi-Agent Behavior Workshop: Representation, Modeling, Measurement, & Applications, Computer Vision and Pattern Recognition conference (CVPR)
2019 Quantifying Social Behaviors Workshop, Cosyne conference

Other Teaching and Outreach

Northwestern:
2023 Guest Lecturer, NUIN 470: Cellular and Molecular Basis of Information Storage
2022 Guest Lecturer, NUIN 411-3: Great Experiments in Systems/Cognitive Neuroscience
2021, 2022 Guest Lecturer, NUIN 480: Circuits and Systems for Motor Control
2021 Guest Lecturer, NUIN 470: Cellular and Molecular Basis of Information Storage

Elsewhere:
2023 Speaker, Cajal Summer School on Machine Learning for Neuroscience, Champalimaud, Lisbon
2023 Speaker, Neural Data Science course, Cold Spring Harbor Laboratory
2022 Speaker, Chen Center for Data Science and Artificial Intelligence (DataSAI) Summer School, Caltech
2022 Speaker, Cajal Summer School on Computational Neuroscience, Champalimaud, Lisbon
2022 Speaker, Cajal Summer School on Quantitative Approaches to Behavior, Champalimaud, Lisbon
2021, 2023 Guest Lecturer, LINdoscope: Advanced Optical Imaging & Data Analysis in Systems Neuro, Leibniz Inst. for Neurobiology
2021 Project Design Team and student project mentor, Neuromatch Academy
2021 Guest Lecturer, BOI 181 KS: Neurological Disorders, Claremont McKenna College
2020 Project Mentor, CMS 273: Frontiers in Computing and Mathematical Sciences, Caltech
2018 Guest Lecturer, BE 203: Introduction to Programming for the Biological Sciences, Caltech
2017 Guest Lecturer, EE 148: Selected Topics in Computational Vision, Caltech
2016, 2018 Guest Lecturer, CNS 200: Genetic Dissection of Neural Circuit Function, Caltech
2015, 2016 Guest Lecturer, CNS 187: Neural Computation, Caltech
2014 Teaching Assistant, Methods in Computational Neuro., Marine Biological Laboratory at Woods Hole
2014 Teaching Assistant, Advanced Topics in Theoretical Neuroscience, Columbia University
2010 Teaching Assistant, Introduction to Theoretical Neuroscience, Columbia University
2009 – 2011 Member, Columbia University Neuroscience Outreach program

Invited Talks at Workshops, Symposia, and Conferences

2023
- Bernstein Conference invited speaker
- Workshop on Low-dimensional manifolds of neural dynamics and their role in brain function, Computational Neuroscience (CNS) Annual Meeting
- NSF Workshop on the Neural Basis of Internal States, Carnegie Mellon University
- Workshop on Functional Logic of Neural Circuits, National Science Foundation

2022
- Minisymposium on Advances in Behavioral Quantification to Understand the Brain, Society for Neuroscience Annual Meeting
- Session on Neural Control of Movement during Free Behavior, Neural Control of Movement Annual Meeting
- Minisymposium on Data-Driven Neural Modeling, SIAM Conference on the Life Sciences
- European Behavioral Pharmacology Society Biennial Workshop
- Minisymposium on Quantitative Approaches to Behavior, International Behavioral and Neural Genetics Society (IBANGS) Annual Meeting
- Session on Neural Mechanisms that Generate Internal States across Organisms, BRAIN Initiative 8th Annual Meeting
- Winter Conference on the Dynamics of Social Interactions, Aspen Center for Physics
- Workshop on Functional Logic of Neural Circuits, National Science Foundation
- Planning Workshop on Neurotheory, Allen Institute for Neural Dynamics

	- Workshop on Supervised Machine Learning for Behavior, Winter Conference on Brain Research
2021	- SymPOSEium Workshop, U Minnesota
	- Workshop on Control Mechanisms for Contextual Computations and Behavior, Bernstein Conference
	- Inspire Series data analysis tutorial, Inscopix
	- Munich Online Workshop on Linking Behavior and Neural Dynamics, Munich Center for Neuroscience
2020	- Chen Institute Workshop on Measurement and Analysis of Behavior, Caltech
	Physics of Behavior Virtual Workshop, Emory University
2018	- Quantitative Approaches to Naturalistic Behavior, Banbury Center
	- Simons Collaboration for the Global Brain West Coast Postdoc Meetup
	- Cosyne Conference contributed talk
2017	- Chen Institute Workshop on Computational Neuroscience, Caltech
	- Pavlovian Society Annual Meeting
	- Swartz Foundation Annual Meeting
2016	- Swartz Foundation Annual Meeting
2015	- Theoretical Neuroscience Workshop, Janelia Research Campus
	- Swartz Foundation Annual Meeting
2013	- Gatsby Tri-Center Meeting
	- Cosyne Conference contributed talk

Invited Seminars

2023	Washington University in St. Louis
	UCSD
	University of Montreal
	MILA
	Duke University
	Columbia University
	Janelia Research Campus
	Shanghai Institute of Neuroscience
2022	Cincinnati Children's Hospital
	City University of New York
	University of Washington
	University of Pennsylvania
	UCLA
	University of Chicago
2021	University College London, Sainsbury Wellcome seminar
	UC Davis Department of Biological Psychology
2020	Friedrich Miescher Institute for Biomedical Research

Mentorship

Postdoctoral:

2022 –	Amadeus Maes
2022 –	Richard Gast
2021 –	Arin Pamukcu

Graduate:

2023 –	Andrew Ulmer
2023 –	Ryan Lu
2022 –	Sebastian Malagon-Perez
2022 –	Ruize Yang

Thesis committees:

2023 –	Mark Agrios (chair)
2023 –	Nai-Hsing Yeh
2023 –	Melissa Fajardo
2022 –	Zachary Jessen
2021 –	Natalie Koh
2020 – 2023	Jennifer Sun
2020 – 2023	Sam Minkowicz

Qualifying exam committees:

2023	Alec Lei (chair)
2023	Qiaohan Yang (chair)
2023	Isabelle Rieth
2022	Mark Agrios (chair)
2022	Peter Salvino

Graduate rotations:

2022	Ryan Lu
	Alec Lei
	Qiaohan Yang
2021	Sebastian Malagon-Perez
	Ruize Yang

Post baccalaureate:

2020 – 2022	Andrew Ulmer (next position: Northwestern Neuroscience grad program)
2018 – 2019	Charlene Kim (next position: technician in Henry Lester lab, Caltech)

Undergraduate:

2022 –	Lauren Hyoseo Yoon
2020 – 2022	Megan Tjandrasuwita (next position: MIT Computer Science grad program)
2020 – 2021	James Deacon (next position: Engineer at advanced.farm computer vision startup)
2017 – 2020	Iman Wahle (next position: Caltech Schmidt Scholar, Princeton Neuroscience grad program)
2018 – 2019	Aya Jishi (next position: Case Western Biomedical Sciences grad program)
2017 – 2019	Jalani Williams (next position: CMU Computer Science grad program)

Reviewing

Grant reviewing: NSF CRCNS, Aligning Science Across Parkinson's, BRAIN Initiative, NIH Neurobiology of Motivated Behavior study section

Editorial board: Science Advances

Reviewer: Science | Nature Neuroscience | Nature Communications | Neuron | eLife | Current Opinion in Neurobiology | Communications Biology | PLoS | Advanced Science | Nature Computational Sciences | BMC Biology | Neuroinformatics | Molecular Psychiatry | Oxford Open Science | Cosyne

Committee membership

Northwestern

2022, 23	Neuroscience department faculty search committee
2021 –	Neural Information Storage and Processing T32 advisory board member
2021 –	Mechanisms of Aging and Dementia T32 preceptor
2021 –	Neural Information Storage and Processing Dementia T32 preceptor
2021 –	Northwestern Behavioral Phenotyping Core redesign committee
2020, 21, 23	NUIN graduate admissions committee