# JAY A. HENNIG

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## ACADEMIC POSITIONS

**2024 -**  **Assistant Professor, Department of Neuroscience**
Baylor College of Medicine

**2021 - 2024**  **Postdoctoral Fellow, Department of Psychology**
Harvard University
*Advisor:* Samuel Gershman | *Collaborators:* Naoshige Uchida, Scott Linderman

## EDUCATION

**2015 - 2021**  **Ph.D. in Neural Computation and Machine Learning**
Carnegie Mellon University
*Thesis:* "Structure and time course of neural population activity during learning"
*Advisors:* Byron Yu, Steven Chase | *Committee:* Aaron Batista, Robert Kass, Eric Shea-Brown

**2008 - 2011**  **B.S. in Mathematics, with Highest Honors**
University of Texas at Austin
Overall GPA: 3.99/4.0,  Major GPA: 4.0/4.0

## PUBLICATIONS

### *In Press*

**2025**  **"A theory of brain-machine interface learning via low-dimensional control"**
Menéndez, J.A., Hennig, J.A., Golub, M.D., Oby, E.R., Sadtler, P.T., Batista, A.P., Chase, S.M., Yu, B.M., Latham, P.E.
eLife, 14 (2025): RP106309.

### *Published*

**2025**  **"The role of prospective contingency in the control of behavior and dopamine signals during associative learning"**
*Qian, S., *Burrell, M., Hennig, J.A., Matias, S., Murthy, Venkatesh, N., Gershman, S.J., Uchida, N.
Nature Neuroscience (2025), 28 (6) 1280-1292

**2024**  **"Learning leaves a memory trace in motor cortex"**
Losey, D.M., Hennig, J.A.†, Oby, E.R.†, Golub, M.D., Sadtler, P.T., Quick, K.M., Ryu, S.I., Tyler-Kabara, E.C., *Batista, A.P., *Yu, B.M., *Chase, S.M.
Current Biology (2024) 34.7 (2024): 1519-1531.

**2023**  **"Emergence of belief-like representations through reinforcement learning"**
Hennig, J.A., Romero-Pinto, S.A., Yamaguchi, T., Linderman, S.W., Uchida, N., Gershman, S.J.
PLOS Computational Biology (2023) 19 (9): e1011067

**2021**  **"How learning unfolds in the brain: toward an optimization view"**
Hennig, J.A., Oby, E.R., Losey D.M., *Batista, A.P., *Yu, B.M., *Chase, S.M.
Neuron (2021), 109 (23), 3720-3735

2021 **"Learning is shaped by abrupt changes in neural engagement"**
Hennig, J.A., Oby, E.R., Golub, M.D., Bahureksa, L.A., Sadtler, P.T., Quick, K.M., Ryu, S.I., Tyler-Kabara, E.C., *Batista, A.P., *Chase, S.M., *Yu, B.M.
Nature Neuroscience (2021), 24 (5), 727-736

2020 **"Intracortical brain-machine interfaces"**
Oby, E.R., Hennig, J.A., *Batista, A.P., *Yu, B.M., *Chase, S.M.
In Neural Engingeering, Springer, Cham, 2020 (pp. 185-221).

2019 **"New neural activity patterns emerge with long-term learning"**
Oby, E.R., Golub, M.D., Hennig, J.A., Degenhart, A.D., Tyler-Kabara, E.C., *Batista, A.P., *Yu, B.M., *Chase, S.M.
Proceedings of the National Academy of Sciences, 116.30 (2019): 15210-15215.

2018 **"Constraints on neural redundancy"**
Hennig, J.A., Golub, M.D., Lund, P.J., Sadtler, P.T., Oby, E.R., Quick, K.M., Ryu, S.I., Tyler-Kabara, E.C., *Batista, A.P., *Yu, B.M., *Chase, S.M.
eLife, 7 (2018): e36774.

2017 **"A Classifying Variational Autoencoder with Application to Polyphonic Music Generation"**
Hennig, J.A., Umakantha, A. Williamson, R. C.
arXiv preprint arXiv:1711.07050

2015 **"A Distinct Mechanism of Temporal Integration for Motion through Depth"**
Katz, L.N., Hennig, J.A., Cormack, L.K., Huk, A.C.
The Journal of Neuroscience. 35(28), 10212-10216.

2013 **"Signal Multiplexing and Single-Neuron Computations in Lateral Intraparietal Area During Decision-Making"**
Meister, M.LR., Hennig, J.A., Huk, A.C.
The Journal of Neuroscience, 33(6), 2254-2267.

† and * denote equal contribution.

## PRESENTATIONS

*Conference abstracts*

2025 **"Increases in Attentional Intensity Shift Auditory Cortical Responses Towards Object-Oriented Coding"**
K. Yu, H. Srivastava, J. Fine, B. Hayden, K. Jaspe, N. A. Scarcelli, H. Jiang, J. A. Hennig, M. J. McGinley
Association for Research in Otolaryngology (ARO)

**"Pupil-indexed brain state modulates activity at multiple stations in the auditory brainstem"**
H. Srivastava, K. Kim, H. Jiang, D. Lipshutz, J. A. Hennig, M. J. McGinley
ARO

**"Temporal difference learning models explain behavior and dopamine during contingency degradation"**
M. Burrell, L. Qian, J. A. Hennig, S. Matias, V. Murthy, S. J. Gershman, N. Uchida
Computational and Systems Neuroscience (Cosyne)

**2024** **"Neural dynamics in prefrontal regions as a candidate mechanism for instantiating belief states"**

S. A. Romero Pinto, J. A. Hennig, D. Okada, C. Benquet, M. Burrell, S. W. Linderman, N. Uchida, S. J. Gershman

Cosyne

**"A link between memory traces in motor cortex and savings"**

J. Couras, E. R. Oby, A. Motiwala, S. E. Snyder, D. M. Losey, J. A. Hennig, B. M. Yu*, S. M. Chase*, A. P. Batista*

Cosyne

**"Network models for distinguishing population-level learning mechanisms"**

J. Sacks, E. R. Oby, J. A. Hennig, A. D. Degenhart, P. T. Sadtler, K. M. Quick, S. I. Ryu, E. C. Tyler-Kabara, S. M. Chase, B. M. Yu, A. P. Batista, M. D. Golub

Cosyne

**2023** **"A link between memory traces in motor cortex and savings"**

J. Couras, E. R. Oby, A. Motiwala, S. E. Snyder, D. M. Losey, J. A. Hennig, B. M. Yu*, S. M. Chase*, A. P. Batista*

Society for Neuroscience

**"Signatures of belief representations in recurrent neural networks and prefrontal cortex"**

J. A. Hennig, S. A. Romero Pinto, S. W. Linderman, N. Uchida, S. J. Gershman

Cosyne

**2021** **"Learning is shaped by an abrupt change in neural engagement"**

J. A. Hennig, E. R. Oby, M. D. Golub, L. A. Bahureksa, P. T. Sadtler, K. M. Quick, S. I. Ryu, E. C. Tyler-Kabara, A. P. Batista*, S. M. Chase*, B. M. Yu*

Cosyne

**2020** **"Evidence of a memory trace in motor cortex after short-term learning"**

D. M. Losey, J. A. Hennig, E. R. Oby, M. D. Golub, P. T. Sadtler, K. M. Quick, S. I. Ryu, E. C. Tyler-Kabara, A. P. Batista*, B. M. Yu*, S. M. Chase*

Cosyne (invited talk)

**"A motor cortical model of brain-machine interface learning, fast and slow"**

J. A. Menendez, J. A. Hennig, M. D. Golub, E. R. Oby, A. P. Batista, S. M. Chase, B. M. Yu, P. E. Latham

Cosyne

**2019** **"Evidence of a memory trace in motor cortex after short-term learning"**

D. M. Losey, J. A. Hennig, E. R. Oby, M. D. Golub, P. T. Sadtler, K. M. Quick, S. I. Ryu, E. C. Tyler-Kabara, A. P. Batista*, B. M. Yu*, S. M. Chase*

Society for Neuroscience

**2018** **"Learning can generate new patterns of neural population activity"**

E. R. Oby, M. D. Golub, J. A. Hennig, A. D. Degenhart, E. C. Tyler-Kabara, B. M. Yu*, S. M. Chase*, A. P. Batista*

Cosyne (invited talk)

**2017** **"Predicting neural activity in behaviorally-irrelevant dimensions"**

J. A. Hennig, Golub, M. D., P. J. Lund, P. T. Sadtler, K. M. Quick, S. I. Ryu, E. C. Tyler-Kabara, A. P. Batista, B. M. Yu*, S. M. Chase*

Cosyne

2016 **"Predicting neural activity in behaviorally-irrelevant dimensions"**
J. A. Hennig, M. D. Golub, P. J. Lund, P. T. Sadtler, K. M. Quick, S. I. Ryu, E. C. Tyler-Kabara, A. P. Batista, B. M. Yu\*, S. M. Chase\*
Society for Neuroscience

2010 **"The aperture problem in three dimensions"**
J. A. Hennig, T. B. Czuba, L. K. Cormack, A. C. Huk, B. Rokers
Vision Sciences Society

\* denotes equal contribution.

### *Invited talks*

2025 **"Learning and computation in neural populations"**
Rush and Helen Record, BCM Neuroscience Retreat

2021 **"Learning is shaped by an abrupt change in neural engagement"**
IEEE EMBS Neural Engineering

2019 **"Constraints on neural redundancy"**
Carnegie Mellon Center for Neural Basis of Cognition Retreat

## FUNDING

2024 - 2030 **McNair Scholars Program, The Robert and Janice McNair Foundation**
Baylor College of Medicine

2018 - 2019 **Andrew Carnegie Prize Fellowship in Mind and Brain Sciences**
Carnegie Mellon University

2015 - 2016 **Richard King Mellon Presidential Fellowship in the Life Sciences**
Carnegie Mellon University

## HONORS AND AWARDS

2019 **McClelland Prize: Outstanding Paper Award** for *Constraints on neural redundancy*
Center for the Neural Basis of Cognition, Carnegie Mellon University

2016 **2nd place in Qualcomm Neurohackathon** (included travel award)
Carnegie Mellon University

2011 **Phi Beta Kappa**
University of Texas at Austin

2007 **Valedictorian**
Booker T. Washington High School, Dallas, TX

## TEACHING EXPERIENCE

**Guest Lecturer, Systems Neuroscience** Spring 2025
*Electrical and Computer Engineering, Rice University*

- · Guest lectures on "Reinforcement Learning and Reward", and "AI and Deep Learning"
- · Graduate course (ECE 477/677), Instructor: Benjamin Hayden

### Guest Lecturer, Neural Signal Processing — Spring 2019
*Electrical and Computer Engineering & Biomedical Engineering, Carnegie Mellon University*

- Guest lecture on "Introduction to Clustering," covering k-means and Gaussian mixture models
- Graduate course (42-590/18-699), Instructor: Byron Yu

### Teaching Assistant, Neural Signal Processing — Spring 2018
*Electrical and Computer Engineering & Biomedical Engineering, Carnegie Mellon University*

- Graduate course (42-590/18-699), Instructor: Byron Yu

### Teaching Assistant, Introduction to Machine Learning — Fall 2017
*Machine Learning, Carnegie Mellon University*

- Graduate course (10-601), Instructor: Roni Rosenfeld

## PROFESSIONAL EXPERIENCE

### Software developer and consultant — 2011 - 2013
*Biarri Optimisation* — *Melbourne, VIC, Australia*

- Designed a linear programming formulation and developed a working implementation, in C++ and Python, for optimizing the capacity of existing production facilities and the locations of new facilities. This tool was used by Australia Post, Australia's national postal service, to plan upgrades to their existing postal network.
- Contributed to development of a software tool in C++ for designing fiber optic networks to minimize materials cost. Used by NBN Co. as part of an Australian government project to provide high-speed internet to 98% of the nation.

## ACADEMIC MENTORING & SERVICE

### Academic and research mentor — 2016 - present
*Carnegie Mellon University & Harvard University*

- Mentored multiple undergraduate, masters, and graduate students

### Mentor for Harvard Psychology's PPREP Program — 2022, 2023

- Mentoring program for prospective Psychology graduate and RA students in underrepresented groups
- Psychology Department, Harvard University

### Mentor for Carnegie Mellon's A.I. Mentoring Program — 2019, 2020

- Mentoring program for undergraduates in underrepresented groups interested in machine learning
- Machine Learning Department, Carnegie Mellon University

### PhD Admissions Committee member — 2019/20, 2020/21

- Machine Learning Department, Carnegie Mellon University

## ACADEMIC OUTREACH & EXTRACURRICULAR

### Archiving academic paper summaries called 'tweeprints' — 2019 - 2021

- Dataset: link
- @tweeprint: https://twitter.com/tweeprint

### *Paper Trails*, an e-newsletter covering recent scientific research — 2018 - 2020

· I wrote a series of posts relating recent scientific research to non-scientific readers (100+ subscribers)
· `https://mobeets.github.io/paper-trails/`

### *mpm*, a package manager for Matlab 2018 - present
· I developed and maintain a package manager for Matlab
· `https://github.com/mobeets/mpm`

### *Speak Neuron*, an educational comic about neural coding 2011 - 2014
· I wrote and illustrated a mini graphic novel to introduce concepts of signal processing and neural coding.
· `https://mobeets.github.io/speak-neuron/`