ARI BENJAMIN, PHD

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Updated May 23, 2025

CURRENT POSITION

Cold Spring Harbor Laboratory — **Postdoctoral Fellow** — *Aug. 2022 –*

Advisor: **Tony Zador**

- Neural networks for single-cell transcriptomic analysis
- Theory of neuromodulation; neuro-inspired AI

EDUCATION

University of Pennsylvania — **PhD**, Bioengineering — *July 2022*

Advisor: **Konrad Kording**

Dissertation: "Machine Learning as Tool and Theory for Computational Neuroscience"

Northwestern University — **M.S**, Mechanical Engineering — *2016*

(Exited PhD program in order to switch disciplines of study).

Advisor: **Sinan Keten**

Topic: Self-assembly & bio-inspired engineering at the nanoscale.

Williams College — ***B.A.,*** Physics — *2013*

Cum Laude, GPA 3.72

MANUSCRIPTS IN PREPARATION

- "TissueFormer: A Neural Network for Labeling Tissue from Grouped Single-Cell RNA Profiles"
  - *Automated labeling of mouse cortical anatomy from spatial transcriptomics*
- "Walking the Weight Manifold: A Topological Approach to Conditioning Inspired by Neuromodulation"
  - *Theory (for an AI audience) connecting neuromodulation to network flexibility*

PUBLICATIONS

1015 total citations with an h-index of 11 as of May 2025

First author or co-first author

Benjamin, Ari S., Christian Pehle, and Kyle Daruwalla. "Continual learning with the neural tangent ensemble." *Neural Information Processing Systems* (2024) **(spotlight paper)**

Benjamin, Ari S., and Konrad P. Kording. "A role for cortical interneurons as adversarial discriminators." *PLOS Computational Biology* 19, no. 9 (2023): e1011484.

Benjamin, Ari S., Ling-Qi Zhang, Cheng Qiu, Alan A. Stocker, and Konrad P. Kording. "Efficient neural codes naturally emerge through gradient descent learning." *Nature Communications* 13, no. 1 (2022): 1-12.

Benjamin, Ari S., David Rolnick, and Konrad Kording. "Measuring and regularizing networks in function space." in *International Conference on Learning Representations,* 2018

Benjamin, Ari S., Pavan Ramkumar, Hugo Fernandes, Matthew A. Smith, and Konrad Paul Kording. "Hue tuning curves in V4 change with visual context." *bioRxiv* (2020): 780478. *In revision at eNeuro.*

Benjamin, Ari S., Hugo L. Fernandes, Tucker Tomlinson, Pavan Ramkumar, Chris VerSteeg, Raeed H. Chowdhury, Lee E. Miller, and Konrad P. Kording. "Modern Machine Learning as a Benchmark for Fitting Neural Responses." *Frontiers in computational neuroscience* 12 (2018)

Selected as **Editors' Pick 2021:** https://www.frontiersin.org/research-topics/23482/frontiers-in-computational-neuroscience---editors-pick-2021

Benjamin, Ari S., and Sinan Keten, "Polymer Conjugation as a Strategy for Long-Range Order in Supramolecular Polymers." *The Journal of Physical Chemistry B* 120.13 (2016): 3425-3433.

Benjamin, Ari S., Muhtar Ahart, Stephen A. Gramsch, Lewis L. Stevens, E. Bruce Orler, Dana M. Dattelbaum, and Russell J. Hemley. "Acoustic Properties of Kel F-800 Copolymer up to 85 GPa." *J. Chem. Phys.* **137,** 014514 (2012)

Reviews

Glaser, Joshua I.*, Ari S. Benjamin*, Roozbeh Farhoodi*, and Konrad P. Kording. "The roles of supervised machine learning in systems neuroscience". *Progress in neurobiology*. 2019 Apr 1;175:126-37.

Second or later author

Liu, Tingkai, **Ari S. Benjamin**, and Anthony M. Zador. "Token-Level Uncertainty-Aware Objective for Language Model Post-Training." *arXiv preprint* arXiv:2503.16511 (2025).

Salehi, Saeed, Jordan Lei, **Ari S. Benjamin**, Klaus-Robert Müller, and Konrad P. Kording. "Modeling Attention and Binding in the Brain through Bidirectional Recurrent Gating." *bioRxiv* (2024): 2024-09.

König, Nico, Szymon Mikolaj Szostak, Josefine Eilsø Nielsen, Martha Dunbar, Su Yang, Weike Chen, **Ari Benjamin** et al. "Stability of Nanopeptides: Structure and Molecular Exchange of Self-assembled Peptide Fibers." *ACS nano* (2023)

Lange, Richard D., **Ari S. Benjamin**, Ralf M. Haefner*, and Xaq Pitkow*. "Interpolating between sampling and variational inference with infinite stochastic mixtures." *Proceedings of the Association for Uncertainty in Artificial Intelligence* (2022)

Marius't Hart, Bernard, Achakulvisut, ..., **Ari S. Benjamin**, ..., Gunnar Blohm, Konrad Kording, Megan AK Peters, Athena Akrami, Bradly Alicea et al. "Neuromatch Academy: a 3-week, online summer school in computational neuroscience." *Journal of Open Source Education* 5.49 (2022): 118.

Lei, Jordan, **Ari S. Benjamin**, and Konrad P. Kording. "Object Based Attention Through Internal Gating" arXiv preprint arXiv:2106.04540 1(2021).

Glaser, Joshua I., **Ari S. Benjamin**, Raeed H. Chowdhury, Matthew G. Perich, Lee E. Miller, and Konrad P. Kording. "Machine learning for neural decoding." *Eneuro* 7, no. 4 (2020).

Shen, Hanfei, Tony Liu, Jesse Cui, Piyush Borole, **Ari Benjamin**, Konrad Kording, and David Issadore. "A web-based automated machine learning platform to analyze liquid biopsy data." *Lab on a Chip* 20, no. 12 (2020): 2166-2174.

Chang, Jeffery, **Ari S. Benjamin**, Benjamin Lansdell, and Konrad Paul Kording. "Augmenting Supervised Learning by Meta-learning Unsupervised Local Rules." *NeurIPS 2019 Workshop Neuro AI* (2019)

Ruiz, Luis, **Ari Benjamin**, Matthew Sullivan, and Sinan Keten. "Regulating ion transport in peptide nanotubes by tailoring the nanotube lumen chemistry." *The journal of physical chemistry letters* 6, no. 9 (2015): 1514-1520.

Reviews

Kording, Konrad P., **Ari S. Benjamin**, Roozbeh Farhoodi, and Joshua I. Glaser. "The Roles of Machine Learning in Biomedical Science." In *Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2017 Symposium*. National Academies Press, 2018.

CONFERENCES, WORKSHOPS, AND TALKS

Organizer

"Why networks learn what they do; Insights from deep learning theory for neuroscience" Computational and Systems Neuroscience (COSYNE) 2023

Contributed Talks

COSYNE 2023, "Balanced inhibition could help estimate gradients," Estelle Shen, Konrad Kording, Richard Lange, Ari Benjamin. *Presented in Estelle's stead due to a visa issue.*

Neuromatch Conference 3.0 Traditional Talk, (2020), "Teaching causality to neuroscientists: a case study in causal estimation"

Neuromatch Conference 2.0 Short Talk, (2020), "Learning with a wake-sleep discriminator that resembles surprise"

Year of Brain Sciences UnRetreat, Mahoney Institute for Neurosciences at UPenn, (2020), "A wake-sleep algorithm for sensory learning that uses a discriminator"

Statistical Analysis of Neural Data (SAND8) 2017 Young Investigator Talk, "Modern machine learning far outperforms GLMs at predicting spikes."

Conference Posters

From Neuroscience to Artificially Intelligent Systems (NAISys) 2024, "Interpreting networks as mixtures of experts yields an update preserving Dale's law", Ari Benjamin, Christian Pehle, Kyle Daruwalla

COSYNE 2023, "Better cell typing from transcriptomic data via probabilistic models," Ari Benjamin, Xiaoyin Chen, Tony Zador.

Cognitive Computational Neuroscience (CCN) 2019, "Shared visual illusions between humans and artificial neural networks." Ari Benjamin*, Cheng Qiu*, Ling-Qi Zhang*, Konrad P. Kording, and Alan A. Stocker.

Bernstein Conference for Computational Neuroscience (2019), "Hue tuning curves in V4 change with visual context." Benjamin, Ari S., Pavan Ramkumar, Hugo Fernandes, Matthew A. Smith, and Konrad P. Kording.

COSYNE 2017, Better encoding models with neural nets and boosted trees." Benjamin, Ari S., Hugo L. Fernandes, Tucker Tomlinson, Pavan Ramkumar, Chris VerSteeg, Raeed H. Chowdhury, Lee E. Miller, and Konrad P. Kording.

Cognitive Computational Neuroscience (CCN) (2017), "Color Tuning Curves in V4 Do Not Generalize to Natural Images." Ari Benjamin, Pavan Ramkumar, Hugo Fernandes, Matthew A. Smith, and Konrad P. Kording.

Invited Talks

Deep Learning Theory reading group, Montreal Institute for Learning Algorithms (MILA), August 2018

Neuro+ML workshop, Montreal Institute for Learning Algorithms (MILA), August 2018

CNI (Computational Neuroscience Initiative) talk, UPenn, October 2017

TEACHING

Materials

Organizational TA for CIS-522, "Deep Learning" 2021
Helped organize course infrastructure, train TAs, and develop interactive Python course materials. Available at https://github.com/CIS-522/course-content

Neuromatch Academy Course Developer (NMA-CD) 2020
Developed interactive Python course materials for W3D3 "Causality" and W1D4 "Machine Learning: GLM". Available at https://academy.neuromatch.io/nma2020/course-materials.

Chemistry teacher, *10th and 12th grade, Colegio Atid, Mexico City* *2013-2014*
Built the year's curriculum from scratch, adapting materials to the new cultural context and the educational goals of the IB curriculum

Teaching

Chemistry teacher, *10th and 12th grade, Colegio Atid, Mexico City* *2013-2014*
Taught ~70 students
Worked to bridge cultural context and learning style.
Guided independent research projects as part of the IB curriculum.

Teaching Assistant

TA for Computational Biology, Cold Spring Harbor Laboratory 2024

TA for Neuromatch Academy (NMA) 2020
Led 12 neuroscientists (PhDs, Postdocs, and 1 Assis. Prof.) through the 15 days of NMA course materials on modeling in computational neuroscience, and provided mentorship for course projects.

TA for ME 418, "Multi-scale modeling and simulation" 2016
Designed two homeworks and delivered two lectures

Mentoring

Served as a research advisor to master's and undergraduate researchers:
Jordan Lei, Jeffery Chang, Piyush Borole, Ryan Jeong, Ryan Guan, Shizhe Feng, Ashly Pinarkyil, Estelle Shen

Mentor for Mentorship Opportunities for Research Engagement 2015
Northwestern University

PAST POSITIONS

Colegio Atid — **Chemistry teacher,** 10th and 12th grade *2013-2014*
Mexico City — 3 classes, ~70 students
IB Curriculum school — Personally designed lab and classroom curricula

Carnegie Institute of Washington	**Research Experience for Undergraduates (NSF REU)** *Advisor:* Muhtar Ahart *Project:* "Acoustic Properties of Kel F-800 Copolymer up to 85 GPa."	*2012*

SUMMER SCHOOLS AND COURSES

TA	Neuromatch Academy (NMA) *Computational neuroscience*	2020
Student	Analytical Connectionism *Theoretical neuroscience meets deep learning theory meets psychology.* Gatsby Institute for Computational Neuroscience at UCL	2023
	Summer Workshop on the Dynamic Brain (SWDB) *A how-to on accessing and analyzing Allen Institute data.* *Co-hosted by the* Allen Institute for Brain Science *and* the Computational Neuroscience Program at the University of Washington.	2017

ACADEMIC SERVICE

Reviewing	Served as reviewer for Nature Communications, Nature Neuroscience, NeurIPS (Neural Information Processing Systems), ICML (International Conference of Machine Learning), COSYNE (Computational and Systems Neuroscience), CCN (Cognitive Computational Neuroscience), eLife, PLoS Computational Biology, Journal of Vision, Nature Scientific Reports, and Cell STAR Protocols.	
Volunteer Research	**Scientist Action and Advocacy Network (ScAAN),** UPenn Chapter Collaborating with the Radiology Departments of the Jefferson and UPenn medical systems to estimate the long-term monetary costs of gun injuries. IRB approved study. Serving as a data analyst.	2019-
Student Organizations	**Diversity Initiative for the Advancement of STEAM,** Co-secretary	2022
	Mechanical Engineering Graduate Student Society, President	2016
	Mechanical Engineering Graduate Student Society, Social chair	2015

MEDIA

Invited talk	**Science Society** "Efficient codes naturally emerge via gradient descent learning" Available at https://www.clubhouse.com/room/m70kjW0E	2023
Interviewed for story	**BBC,** "Elon Musk to show off working brain-hacking device" Available at https://www.bbc.com/news/technology-53921596	2020
	ABC News Radio, *Tech Trends*, September 3 Interviewed for comment on Neuralink. Recordings unavailable online.	2020