

HAOZHE SHAN

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EDUCATION

- Harvard University** Ph.D., Neuroscience 2017 - 2024
Advisor: Haim Sompolinsky
Thesis: *Theory of Learning in Neural Networks with Small Weight Perturbations*
Research topic: theory of learning and memory in neural networks.
- University of Chicago** B.A., Psychology 2013 - 2017
With honors; Minor in Computational Neuroscience
Advisor: Peggy Mason
Research topic: social behaviors in rats; modeling of animal behaviors.

EXPERIENCE

- ARNI Postdoctoral Fellow**, Columbia University 2024 - Present
Advisors: Ashok Litwin-Kumar and Lea Duncker
Independent fellowship supported by the National Science Foundation (NSF) AI Institute of Artificial and Natural Intelligence (ARNI)
Research topics: Connectome analysis; models of flexible computation.
- Research Intern**, Google Research / Google DeepMind 2023
Hosts: Weiran Wang, Krzysztof Choromanski
Research topic: State-space models for automatic speech recognition.
- Applied Scientist Intern**, Amazon Alexa AI 2021
Host: Hann Wang
Research topic: Long-range dependencies in large language models.

PUBLICATIONS & TALKS

Select publications

- Shan, H.***, Li, Q.*, Sompolinsky H. (2026). Order parameters and phase transitions of continual learning in deep neural networks. *Proceedings of the National Academy of Sciences*, 123(6), e2501899123.
- Shan, H.**, Litwin-Kumar, A. (2025). Graph embeddings for identifying symmetries in connectomes. *bioRxiv*, 2025-12. Under review at *Nature Neuroscience*.
- Shan, H.***, Minni, S.*, Duncker, L. (2025). Separating the what and how of compositional computation to enable reuse and continual learning. *NeuIPS 2025*.
- Shan, H.**, Bachschmid Romano L., Sompolinsky, H. (2023). Error-correcting columnar networks: high-capacity memory under sparse connectivity. *NeurIPS 2023 Associative Memory and Hopfield Networks (AMHN) Workshop*. Journal submission in prep.
- Shan, H.** & Sompolinsky, H. (2022). A minimum perturbation theory of deep perceptual learning. *Physical Review E*. 106.064406.
- Shan, H.*** & Bordelon, B.* (2021). A theory of neural tangent kernel alignment and its influence on training. *arXiv preprint arXiv:2105.14301*.

Shan, H., Moreno-Bote, R., & Drugowitsch, J. (2019). Family of closed-form solutions for two-dimensional correlated diffusion processes. *Physical Review E*, 100.032132.

Shan, H., & Mason, P. (2017). A neuroscience framework for psychophysiology. In *Handbook of Psychophysiology (Cambridge Handbooks in Psychology)*.

Ben-Ami Bartal, I., **Shan, H.**, Molasky, N. M., Murray, T. M., Williams, J. Z., Decety, J., & Mason, P. (2016). Anxiolytic treatment impairs helping behavior in rats. *Frontiers in psychology*, 7, 850.

Additional publications

Shan, H., Gu A., Meng Z., Wang W., Choromanski K., Sainath T. (2024). Augmenting conformers with structured state space models for online speech recognition. *ICASSP 2024*.

Wang, W., Prabhavalkar, R., **Shan H.**, et al. (2024). Massive end-to-end speech recognition models with time reduction. *NAACL 2024*.

Sugano, Y. V., **Shan, H.**, Molasky, N. M. R., & Mason, P. (2022). Helping can be driven by non-affective cues in rat. *bioRxiv*, 2022-07.

Shan, H. & Mason, P. (2020). Unsupervised identification of rat behavioral motifs across timescales. *NeurIPS 2020 Learning Meaningful Representations of Life (LMRL) Workshop*.

Mason, P., & **Shan, H.** (2017). A valence-free definition of sociality as any violation of inter-individual independence. *Proceedings of the Royal Society B: Biological Sciences*, 284(1866), 20170948.

Shan, H., Ben-Ami Bartal, I., & Mason, P. (2016) A rodent model of social rejection. *bioRxiv*, 066993.

Peer-reviewed conference talks/posters

Shan, H., Litwin-Kumar, A. (2026). Graph embeddings for identifying symmetries in connectomes. *Computational and Systems Neuroscience (Cosyne) 2026, Lisbon, Portugal*.

Minni, S.*, **Shan, H.***, Duncker, L. (2026). Flexible skill composition and continual learning via contextual inference. *Computational and Systems Neuroscience (Cosyne) 2026, Lisbon, Portugal*.

Shan, H.*, Li, Q.*, Sompolinsky, H. (2025). Metrics of Task Relations Predict Continual Learning Performance. *Computational and Systems Neuroscience (Cosyne) 2025, Montreal, Canada*.

Shan, H., Bachschmid Romano L., Sompolinsky, H. (2023). The cortical dictionary: high-capacity memory in sparsely connected networks with columnar organization. *Computational and Systems Neuroscience (Cosyne) 2023, Montreal, Canada*.

Shan, H., & Sompolinsky, H. (2019). Optimal cortical plasticity in a model of perceptual learning. *Talk at Computational and Systems Neuroscience (Cosyne) 2019, Lisbon, Portugal* (top 2% submission).

AWARDS

Certificate for Distinction and Excellence in Teaching

Harvard, 2019

3rd Place, Citadel Data Open	<i>Harvard, 2018</i>
Phi Beta Kappa	<i>Univ. of Chicago, 2017</i>
Earl R. Franklin Research Fellowship in Psychology	<i>Univ. of Chicago, 2016</i>
3rd Place, John Crerar Foundation Science Writing Prize	<i>Univ. of Chicago, 2015</i>

TEACHING AND MENTORING

Mentees

Guest lecturer for:

Advanced Topics in Theoretical Neuroscience *Columbia, 2025; 2026*

Teaching fellow/assistant for:

AP 286 Inference, Information Theory, Learning and Statistical Mechanics *Harvard, 2020*

6.864 Advanced Natural Language Processing *MIT, 2020*

MCB 131 Computational Neuroscience *Harvard, 2019*

MCB 120 Introduction to Computational Neuroscience *Harvard, 2018*

CS 281 Advanced Machine Learning *Harvard, 2017*

REVIEWING

Guest Reviewing Editor, *eLife*

Ad-hoc reviewer: *eLife*, *NeurIPS*, *Physical Review E*, *Cell Reports* etc.

SHORT PROGRAMS

Deep Learning from the Perspective of Physics and Neuroscience *November, 2023*
Kavli Institute for Theoretical Physics, UCSB

Workshop: Using Physical Insights for Machine Learning *November, 2019*
Institute for Pure & Applied Mathematics, UCLA

Methods in Computational Neuroscience *August, 2018*
Marine Biological Laboratory

Beg Rohu Summer School of Statistical Physics and Condensed Matter *June, 2018*
Department of Physics, École Normale Supérieure
Topic: Deep Learning and Statistical Physics

Last updated: July 8, 2026