CHING FANG

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EDUCATION

Columbia University Aug 2019-Sept 2024
PhD in Neuroscience, at the Theoretical Neuroscience Center
Advisors: Larry Abbott, Dmitriy Aronov

University of California, Berkeley December 2018
B.A. in Computer Science, B.A. in Molecular & Cell Biology (Honors)

AWARDS

2019 National Science Foundation Graduate Research Fellow
2018 IL Chaikoff Award for excellence in U.C. Berkeley's neuroscience program
2018 Dean's Honors List in recognition of academic performance

RESEARCH EXPERIENCE

Research Fellow | Cambridge-Boston Alignment Initiative June 2024-present

Testing mechanistic interpretability techniques in LLMs finetuned to use encoded reasoning. Work with Samuel Marks.

Postdoctoral Researcher | Kempner Institute at Harvard University Oct 2024 - June 2024

Studying mechanisms of in-context reinforcement learning in transformers. Work with Kanaka Rajan.

Previous Industry Experience

Apple | Machine Learning Research Intern April 2024 - Sep 2024

Topic: building foundation models for multimodal time series using healthcare data. Internship with the Body-Sensing Intelligence Group

Previous Academic Experience:

Larry Abbott | Columbia Theoretical Neuro. Center Jan 2020 - Sep 2024

PhD student. Topic: biological learning algorithms, predictive coding in deep learning models.

Dmitriy Aronov | Columbia University Jan 2020 - Sep 2024

PhD student. Topic: reinforcement learning models of neural activity.

Liam Paninski | Columbia Theoretical Neuro. Center Aug 2019 - Dec 2019

PhD rotation student. Topic: probabilistic graphical models to identify latent behavioral states.

Jose Carmena | UC Berkeley Electrical Engineering May 2018 - Aug 2019

Research assistant. Topic: learning in brain-machine interfaces, interpretable ML models.

Dan Feldman | Helen Wills Neuroscience Institute Jan 2015 - May 2018

Research assistant. Topic: building models of neural population tuning in somatosensory cortex.

Anne Collins | UC Berkeley Cognitive Science June 2016 - Aug 2016

Research assistant. Topic: hierarchical reinforcement learning in human decision making.

Previous Research Collaborators:

- Kim Stachenfeld (Google DeepMind): changes in representational geometry from auxiliary tasks in deep reinforcement learning.
- Guangyu Robert Yang (MIT): biological learning in transformer neural networks.
- Guillermo Horga (Columbia): convolutional neural network models of speech comprehension.

PREPRINTS

Fang, C., Rajan, K. From Memories to Maps: Mechanisms of In-Context Reinforcement Learning in Transformers. *arXiv preprint*, 2025.

JOURNAL & CONFERENCE PAPERS

Fang, C.*, Lindsey, J.*, Abbott, L. F., Aronov, D., Chettih, S. Barcode activity in a recurrent network model of the hippocampus enables efficient memory binding. *eLife*, 2025.

Fang, C., Sandino, C., Mahasseni, B., Minxha, J., Pouransari, H., Azemi, E., Moin, A., Zippi, E. Promoting cross-modal representations to improve multimodal foundation models for physiological signals. *NeurIPS Advances in Medical Foundation Models (AIM-FM) Workshop, 2024.*

Fang, C., Stachenfeld, K. Predictive auxiliary objectives in deep RL mimic learning in the brain. *ICLR*, 2024. (Accepted as oral, top 1.2% of submissions)

Fang, C., Aronov, D., Abbott, L. F., Mackevicius, E. Neural learning rules for generating flexible predictions and computing the successor representation. *eLife*, 2023.

Fang, C.*, Shook, E.*, Buck, J.*, and Horga, G. Predictive Coding Dynamics Improve Noise Robustness in A Deep Neural Network of the Human Auditory System. *NeurIPS Shared Visual Representations in Humans and Machines (SVRHM) Workshop*, 2022. (Accepted as oral)

Fang, C., Aronov, D., Abbott, L., and Mackevicius, E. Biological Mechanisms for Learning Predictive Models of the World and Generating Flexible Predictions. *ICML Beyond Bayes Workshop*, 2022. (Accepted as oral)

Vendrell-Llopis, N., **Fang, C.**, Qu, A., Costa, R., Carmena, J. Diverse operant control of different motor cortex populations. *Current Biology*, 2022.

Tyulmankov, D.*, **Fang, C.***, Vadaparty, A., and Yang, G.R. Biological key-value memory networks. *NeurIPS*, 2021.

(* equal contribution)

TALKS

Yale NeuroAI Journal Club New Haven, March 2025

International Conference on Learning Representations (ICLR)
Main conference; top 1.2% of submissions *Vienna, May 2024*

Computational and Systems Neuroscience (COSYNE)
Main conference; top 3% of submissions *Lisbon, March 2024*

Computational and Systems Neuroscience (COSYNE) Learning rules workshop
Invited talk *Lisbon, March 2024*

DeepMind NeuroLab Workshop *London, March 2024*

Flatiron Institute Junior Theoretical Neuroscientists Workshop *NYC, June 2023*

National Institute of Neurological Disorders and Stroke T32 *Philadelphia, June 2023*

DeepMind NeuroLab Workshop *London, Feb 2023*

Max Planck UCL Centre for Computational Psychiatry *London, Feb 2023*

NeurIPS SVRHM Workshop *New Orleans, Dec 2022*

Cognitive Computational Neuroscience (CCN) *San Francisco, Aug 2022*

Flatiron Institute Center for Computational Neuroscience *New York, Aug 2022*

ICML Beyond Bayes Workshop *Baltimore, July 2022*

Gatsby Tri-Center Meeting for Theoretical Neuroscience *Jerusalem, June 2022*

SELECT POSTERS

Fang, C., Stachenfeld, K., "Connecting hippocampal representations to predictive auxiliary tasks in deep reinforcement learning". *Cognitive Computational Neuroscience (CCN)*, 2023.

Fang, C., Shook, E., Buck, J., and Horga, G., "Predictive Coding Dynamics Improve Noise Robustness in A Deep Neural Network of the Human Auditory System". *Computational and Systems Neuroscience (COSYNE)*, 2023.

Mackevicius, E., **Fang, C.**, Chettih, S., Hale, S., and Aronov, D., "Representations of one-shot and consistent information in the hippocampus of memory-expert birds". *Society for Neuroscience*, 2022.

Tyulmankov, D., **Fang, C.**, Dong, Ling L., Vadaparty, A., and Yang, G.R., "Biological learning in key-value memory networks". *Computational and Systems Neuroscience (COSYNE)*, 2022.

Vendrell-Llopis, N., **Fang, C.**, Qu, A., Kitano, M., Costa, R., Carmena, J. "Isolating cell-type specific subpopulations of motor cortex neurons in neuroprosthetic learning". *Society for Neuroscience*, 2019.

Fang, C., Laboy-Juarez, K., Feldman, D., "Neural Coding of Whisker Timing in Multi-Whisker Sensation." *California Cognitive Science Conference*, 2018

TEACHING

TA, *Intro to Theoretical Neuroscience* at Columbia University Aug 2023 - Dec 2023

Lecturer, *Math Tools for Neuroscience* at Columbia University Jan 2022 - May 2023

TA, *Reinforcement Learning Workshop* at COSYNE conference March 2023

TA, *Synthetic Biology* at UC Berkeley Aug 2018 - Dec 2018

TA, *Algorithms & Intractable Problems* at UC Berkeley Aug 2017 - Dec 2017

TA, *Data Structures* at UC Berkeley Aug 2016 - Aug 2017

MENTORING, OUTREACH, & ORGANIZATION

- Organized Cosyne 2025 workshop "Agent-Based Models in Neuroscience"

- Columbia Access Neuroscience: helped organize a predoctoral outreach program to encourage participation of underrepresented students in neuroscience research.
- Zuckerman Institute Gender Inclusion Group: helped organize a seminar series discussing gender inequities in science.
- Leadership Alliance Summer Research Program: mentored an undergraduate student through a summer research project, with final poster presentations.
- Columbia *Scientist on the Subway*: wrote profiles on neuroscientists from diverse backgrounds.
- Zuckerman Institute Climbing Group: started group with funding from ZI neuroscience institute
- UC Berkeley Computer Science Mentors: tutored students in small-group teaching sections

REVIEWS FOR CONFERENCES AND JOURNALS

CoSyNe 2025, *Neural Computation*, NeuRIPS Unifying Representations in Neural Models 2024 Workshop, Cognitive Computational Neuroscience (CCN) 2022, ICLR Workshop on Representational Alignment 2025