

Han, Zhixian

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SUMMARY OF RESEARCH INTERESTS

I am interested in applying computational models to better understand cognitive and neural processes. Specifically, I am interested in the computational modeling of the visual system. Using artificial neural networks to simulate the ventral and dorsal cortical visual pathways, I have examined how different neural architectures and different neural representations affect computational outcomes. In addition, I am also interested in the computational modeling of the other cognitive systems. I am collaborating with other students to investigate which reinforcement learning models best capture human behaviors in tasks involving time-delayed feedback.

EDUCATION

2019 - present **Ph.D. Candidate in Psychology (Mathematical and Computational Cognitive Science area)** at Purdue University
2021 - present **Joint M.S. student in Statistics and Computer Science** at Purdue University
2017 - 2019 **M.S. in Physics** at Brown University
2014 - 2017 **B.S. in Physics and B.S. in Psychology** at University of Minnesota, Twin Cities
2015 Summer Visiting Undergraduate Student at University of California, Berkeley
2012 - 2014 Undergraduate student major in Physics at Sichuan University

PEER-REVIEWED JOURNAL ARTICLES

Zhixian Han and Anne B. Sereno. “Exploring Neural Architectures for Simultaneously Recognizing Multiple Visual Attributes”. In: *Scientific Reports* 14.30036 (2024). DOI: [10.1038/s41598-024-80679-6](https://doi.org/10.1038/s41598-024-80679-6).

Zhixian Han and Anne B. Sereno. “Understanding Cortical Streams From a Computational Perspective”. In: *Journal of Cognitive Neuroscience* 36.12 (2024), pp. 2618–2626. DOI: [10.1162/jocn_a_02121](https://doi.org/10.1162/jocn_a_02121).

Zhixian Han and Anne B. Sereno. “A Spatial Map: A Propitious Choice for Constraining the Binding Problem”. In: *Frontiers in Computational Neuroscience* 18 (2024). DOI: [10.3389/fncom.2024.1397819](https://doi.org/10.3389/fncom.2024.1397819).

Zhixian Han and Anne Sereno. “Identifying and Localizing Multiple Objects Using Artificial Ventral and Dorsal Cortical Visual Pathways”. In: *Neural Computation* 35.2 (2023), pp. 249–275. DOI: [10.1162/neco_a_01559](https://doi.org/10.1162/neco_a_01559).

Zhixian Han and Anne Sereno. “Modeling the Ventral and Dorsal Cortical Visual Pathways Using Artificial Neural Networks”. In: *Neural Computation* 34.1 (2022), pp. 138–171. DOI: [10.1162/neco_a_01456](https://doi.org/10.1162/neco_a_01456).

CONFERENCE PROCEEDINGS

Zhixian Han, Vlada Volynskaya, and Anne B. Sereno. “A biologically inspired framework for contrastive learning of visual representations: BioCLR”. In: *Vision Sciences Society Annual Meeting (VSS)*. May 22, 2024. DOI: [10.1167/jov.24.10.771](https://doi.org/10.1167/jov.24.10.771).

Zhixian Han and Anne Sereno. “Is it always computationally advantageous to use segregated pathways to process different visual stimulus attributes separately?” In: *Vision Sciences Society Annual Meeting (VSS)*. May 22, 2023. DOI: [10.1167/jov.23.9.5020](https://doi.org/10.1167/jov.23.9.5020).

Anne B. Sereno and **Zhixian Han**. “Independence, not Interactions: What Simulations Suggest about Ventral and Dorsal Pathways”. In: *Vision Sciences Society Annual Meeting (VSS)*. May 19, 2023. DOI: [10.1167/jov.23.9.4606](https://doi.org/10.1167/jov.23.9.4606).

Zhixian Han and Anne Sereno. “Constraining the Binding Problem Using Maps”. In: *Computational and Mathematical Models in Vision (MODVIS)*. May 18, 2023. URL: <https://docs.lib.purdue.edu/modvis/2023/session03/2/>.

Zhixian Han and Anne Sereno. “Identifying and Localizing Multiple Objects Using Artificial Ventral and Dorsal Visual Cortical Pathways”. In: *Computational and Mathematical Models in Vision (MODVIS)*. May 12, 2022. URL: <https://docs.lib.purdue.edu/modvis/2022/session01/3/>.

WORKING PAPERS

“BioCLR: A Contrastive Self-Supervised Learning Model Inspired by Segregated Cortical Visual Pathways in the Brain” Zhixian Han, Vlada Volyanskaya, and Anne B. Sereno

“Using Reinforcement Learning to Mirror Human Behavior under Time-Delayed Feedback” Cynthia Garde, Aloysius Rebeiro, Zhixian Han

RESEARCH EXPERIENCE

Understanding the Visual Cortical Pathways from a Computational Perspective

Advisor: Professor Anne B. Sereno

September 2019 – Present

I am modeling the cortical visual pathways using artificial neural networks and trying to approach the computational properties of the human visual system from different aspects. The results are summarized in my current and future publications.

Using Reinforcement Learning to Mirror Human Behavior under Time-Delayed Feedback

Advisor: Professor Mahsa Ghasemi

September 2024 – Present

I am collaborating with other students to investigate which reinforcement learning models best capture human behaviors in tasks involving time-delayed feedback.

Graduate Data Science Researcher

August 2022 - April 2023

(The Data Mine, Purdue University, West Lafayette, IN)

- Collaborated with the corporate partner Viasat on self-supervised learning and computer vision.
- Used Python to implement self-supervised learning models.

Graduate Data Science Researcher

August 2021 - April 2022

(The Data Mine, Purdue University, West Lafayette, IN)

- Collaborated with the corporate partner Accelerating Therapeutics for Opportunities in Medicine (ATOM) on opioid receptors pIC50 values prediction.
- Used Python to implement Graph Convolutional Neural Network models and Random Forest models.

Using Artificial Neural Networks to Decode Word Spectrograms from Neural Signals Recorded via Intracortical Microelectrode Arrays Implanted in Auditory Superior Temporal Cortex

Advisor: Professor Wilson Truccolo

September 2018 – May 2019

The neural data were collected by other labs when some patients with implanted micro-electrode arrays were listening to some words. I tried to decode the frequency spectrograms from the neural data using Long short-term memory (LSTM) models with the help of my advisor Dr. Wilson Truccolo. I also wrote the code according to the phase retrieval algorithms to retrieve the phase information from the spectrograms. With the retrieved phase information and the ground truth spectrograms of the words, I was able to successfully recover the acoustic signals of the words.

Bayesian Theory and Visual Perception of Size and Depth

Advisor: Professor Daniel Kersten

September 2016 – May 2017

I modeled the visual perception of object size and depth as a Bayesian inference problem and used Markov chain Monte Carlo (MCMC) sampling methods to approach the posterior distributions.

Characterizing the Fluorescent Properties of the mEos2 Proteins for Super-Resolution Microscopy

Advisor: Professor Elias Puchner

September 2015 – May 2017

I characterized the fluorescent properties of the mEos2 proteins in yeast cells so that we can obtain the super-resolution images with the best quality. I experimentally determined the optimum excitation laser power for imaging mEos2 proteins to obtain the highest signal-to-background ratio.

REVIEWER FOR JOURNALS

Neural Networks

Scientific Reports

Vision Research

TEACHING EXPERIENCE

Graduate Lecturer – PSY 51300 Intro to Comp Cog Neuroscience - Purdue University

January 2025 - May 2025

- Design a new course format and update course content for a graduate level course about computational cognitive neuroscience
- Create tutorials with theories and programming exercises
- Give lectures to introduce different topics to students
- Guide student discussions
- Guide student course projects

Lead Teaching Assistant – Neuromatch, Inc.

July 2021

(Computational Neuroscience Summer Course 2021)

- Guided small groups (10) of students in all aspects of live online learning. This includes guiding students in completion of code-based tutorials, guiding students in contextualizing the problemsets, and guiding students in developing peer-programming and self-learning skills.
- Guided students in their final project.
- Managed and provided support for 7-8 junior teaching assistants.

Teaching Assistant – Purdue University

August 2019 - December 2024

- PSY 30500 Understanding And Analyzing Psychological Data (Undergraduate Level)
- PSY 20100 Introduction To Statistics In Psychology (Undergraduate Level)
- PSY 20000 Introduction To Cognitive Psychology (Undergraduate Level)
- PSY 48400 The Psychology of Consciousness (Undergraduate Level)

Teaching Assistant – Brown University

September 2018 - December 2018

- NEUR 2110 Statistical Neuroscience (Graduate Level)

WORK EXPERIENCE

Consultant for the Purdue Statistical Consulting Service (SCS) January 2024 - December 2024

- Experimental Design and Data Analysis Consulting: This service assists with all phases of research projects, including: proposal preparation, design of studies, survey design, data input strategies, data import/export, analysis of data, interpretation of results, presentation of results, other statistics or probability problems.
- Statistical Software Consulting: This service provides assistance with running a wide variety of statistical computing programs.

AWARDS

Compton Graduate Student Research Travel Award, 2024

Purdue Graduate Student Government (PGSG) First-Tier Travel Grant, 2024

Purdue Graduate Student Government (PGSG) Third-Tier Travel Grant, 2023

Yan Jici Physics Scholarship, Institute of Physics Chinese Academy of Sciences, 2014

First-Class Subject Scholarship, Sichuan University, 2014

Third-Class General Scholarship, Sichuan University, 2013

Outstanding Student, Sichuan University, 2013

SKILLS

Programming using Python, MATLAB, R, Mathematica, C++, Database with SQL, Machine Learning, Artificial Neural Networks, TensorFlow, PyTorch, Data Science, Statistical Consulting, Advanced Statistical Analysis