Nikolas McNeal

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Research Interests

How do biological and artificial visual systems come to represent the world, and what does each reveal about the other? My research approaches this question by probing deep networks and the human brain with stimuli designed to expose where their representations converge and where they diverge, and by relating those differences to architecture, training objectives, and data. These comparisons serve two goals. First, they use the brain as a benchmark to diagnose failure modes in machine perception, such as brittleness and reliance on non-human-like features. Second, they use models as tools to understand and non-invasively control neural responses. More recently, I have developed a growing interest in AI agents, safety, and interpretability, where approaches inspired by neuroscience offer a useful lens for probing what models learn and how they fail.

Education

Georgia Institute of Technology — Atlanta, Georgia
Ph.D., Machine Learning — 2023 - Present

Ohio State University — Columbus, Ohio
B.A., Computer Science — 2019 - 2023

Research Experience

Georgia Institute of Technology — 2023 - Present
Graduate Research Assistant, *advised by N. Apurva Ratan Murty* — *Atlanta, Georgia*
- Developed targeted adversarial perturbation methods showing that robust, but not standard, DNN encoding models have brain-like local coding axes.
- Designed and ran fMRI experiments to test model predictions in human visual cortex.
- Building AI agents and RSI pipelines for automated experiment design and brain model improvement.

Carnegie Mellon University — 2021 - 2023
Research Intern, *advised by Tai Sing Lee* — *Remote*
- Modeled human perception of musicality with a predictive coding network.

The Ohio State University — 2021 - 2023
Undergraduate Research Assistant, *advised by Huan Sun and Yu Su* — *Columbus, Ohio*
- Evaluated GPT-3 in-context learning for biomedical information extraction.

The Ohio State University — 2019 - 2023
Undergraduate Research Assistant, *advised by Ian Krajbich* — *Columbus, Ohio*
- Various projects on attention and value-based decision making.

Selected Papers

[1] **McNeal N.**, Ratan Murty N.A. (2025). Targeted perturbations reveal brain-like local coding axes in robustified, but not standard, ANN-based encoding models. **arXiv**.

[2] **McNeal N.**, Deb M., Ratan Murty N.A. (2024). Small-scale adversarial perturbations expose differences between predictive encoding models of human fMRI responses. **NeurIPS** 2024 Workshop on Unifying Representations in Neural Models (UniReps), PMLR 285.

[3] Dipani A.*, **McNeal N.***, Ratan Murty N.A. (2024). Linking faces to social cognition: The temporal pole as a potential social switch. **PNAS** (Commentary).

[4] **McNeal N.**, Huang J., Umoren A., Dai S., Dannenberg R., Randall R., Lee T.S. (2022). Relating Human Perception of Musicality to Prediction in a Predictive Coding Model. **arXiv**.

[5] Gutierrez B.J., **McNeal N.**, Washington C., Chen Y., Li L., Sun H., Su Y. (2022). Thinking about GPT-3 In-Context Learning for Biomedical IE? Think Again. Findings of Empirical Methods in Natural Language Processing (**EMNLP**).

Conference Abstracts

[1] **McNeal N.**, Ratan Murty N.A. (2026). *Robustness aligns the local coding axes of artificial and biological vision.* Vision Sciences Society (VSS), St. Pete Beach, Florida. [Talk]

[2] **McNeal N.**, Deb M., Ratan Murty N.A. (2025). *Small-scale adversarial perturbations expose key differences between ANN-based vision encoding models.* Vision Sciences Society (VSS), St. Pete Beach, Florida. *Journal of Vision* 25(9).

* denotes equal contribution.

[3] Shanahan D., Kang J., **McNeal N.** (2023). *Understanding the Role of Schematic Knowledge in the Preference for Harmonic Asymmetry with Iterative Learning.* ICMPC 17, Tokyo, Japan. [Talk]

[4] **McNeal N.**, Shanahan D., Kang J., Hay N. (2022). *Iterative Learning Suggests a Preference for Harmonic Asymmetry.* SMPC, Portland, Oregon. [Talk]

[5] **McNeal N.**, Shevlin B., Krajbich I. (2022). *What causes enhanced processing of high-value items?* CogSci 44th Annual Meeting, Toronto, Canada.

[6] **McNeal N.**, Umoren A., Huang J., Lee T.S. (2021). *Unsupervised Musicality Prediction of Pitch Sequences.* CMU-Pitt CNBC Undergraduate Program in Neural Computation.

[7] Umoren A., **McNeal N.**, Lee T.S. (2021). *Probing PredNet's Internal Representations using Feature Visualization.* CMU-Pitt CNBC Undergraduate Program in Neural Computation.

Teaching Experience

Foundations of Mathematical Proof, Lecture Assistant — SP26
Math 2106 — Georgia Institute of Technology

Survey of Calculus, Teaching Assistant — FA25
Math 1712 — Georgia Institute of Technology

Differential Equations, Teaching Assistant — FA23, SP24, FA24, SP25
Math 2552 — Georgia Institute of Technology

Quantitative Neuroscience, Teaching Assistant — SP23
Math 4350 — The Ohio State University

Mentorship and Service

Undergraduate Students Advised
Shreyas Angadi, Georgia Tech — Spring 2026 - Present

Directed Reading Program (pairs undergraduates with graduate mentors for independent study)
Introduction to Machine Learning — Spring 2024
Machine Learning for Modeling Dynamical Systems — Fall 2023

Reviewing
UniReps @ NeurIPS (2024, 2025), ICLR (2026), Nature Neuroscience (2024), Science Advances (2024)

Honors and Awards

- **Best Poster Award**, Georgia Tech: Frontiers in Science (Intelligence) — 2025
- **Various Teaching Awards**, School of Mathematics, Georgia Tech — 2024–2025
- **CSE Undergraduate Research Award**, Ohio State — 2023
- **Undergraduate Research Scholarship**, Ohio State — 2021
- **Decision Sciences Collaborative Scholarship**, Ohio State — 2021
- **Stamps Eminence Scholarship**, Ohio State (full cost-of-attendance fellowship) — 2019

Skills

Languages: Python, MATLAB, Bash, Java, Ruby, JavaScript, HTML, CSS, LaTeX
Machine Learning: Generalized Linear Models, Clustering, SVMs, Random Forests, MLPs, CNNs, Transformers
Python Libraries: PyTorch, JAX, Hugging Face, Scikit-learn, NumPy, SciPy, Pandas, Matplotlib, Seaborn
Data Analysis: fMRI, EEG, Eye-tracking, Psychophysics, Images, Text, Audio
Data Collection: fMRI, EEG, Eye-tracking, Psychophysics
Experimental Design: fMRI, Eye-tracking, Psychophysics
Tools/Software: PsychToolBox, PsychoPy, fMRIPrep, FreeSurfer, Nilearn, Git, Docker, Kubernetes, SLURM, Adobe Illustrator