

W. Jeffrey Johnston

Postdoctoral researcher in the Center for Theoretical Neuroscience at Columbia University
Pronouns: he/they

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Research positions

2020 - present	Postdoctoral researcher, Center for Theoretical Neuroscience, Columbia University
2015 - 2020	Graduate student, Freedman Lab, The University of Chicago
2014	Summer intern, Allen Institute for Brain Science
2010 - 2014	Research assistant, Saxe Lab, Massachusetts Institute of Technology
2013 - 2014	Research assistant, Interdisciplinary Affective Science Lab, Northeastern University
2011, 2013	Research assistant, Redwood Center for Theoretical Neuroscience, UC Berkeley
2012 - 2013	Research assistant, Relational Agents Group, Northeastern University

Education

2014 - 2020	PhD in Computational Neuroscience, The University of Chicago Committee: David J. Freedman (adviser), Stephanie E. Palmer (chair), John H.R. Maunsell, and Edward Awh
2010 - 2014	BS in Computer Science and Cognitive Psychology with a minor in Mathematics, Northeastern University

Awards, honors, and fellowships

2024 - present	NIH K99/R00 Pathway To Independence Award
2021	Best dissertation award, Computational Neuroscience Program at The University Chicago
2018 - 2020	NIH F31 Kirschstein National Research Service Award Individual Predoctoral Fellowship
2019	Brien O'Brien and Mary Hasten Scholarship to attend Methods in Computational Neuroscience at the Marine Biological Laboratory
2016	BSD Recruitment Travel Award, The University of Chicago
2016	Gordon Research Seminar Neurobiology of Cognition Travel Award
2015 - 2016	Pritzker Fellowship, The University of Chicago
2014	University Honors, Northeastern University
2014	Class Marshall, Northeastern University
2014	Summa Cum Laude, Northeastern University
2010 - 2014	Dean's List, Northeastern University
2010 - 2014	Dean's Scholarship, Northeastern University
2012	Undergraduate Life and Physical Sciences award, RISE 2012, Northeastern University

Advanced coursework

2019	Methods in Computational Neuroscience, Marine Biological Laboratory
2018	Janelia Junior Scientist Workshop on Theoretical Neuroscience

Teaching and service experience

2024 - present	Mentor, CADRE undergraduate research fellowship program
2023 - present	Reviewer, COSYNE
2022 - present	Lecturer, Seminar in Advanced Topics in Theoretical Neuroscience

2022 - present	Mentor, Neuromatch Academy: Computational Neuroscience
2024	Teaching assistant, Methods in Computational Neuroscience summer school at the Marine Biological Laboratory
2023	Co-organizer, "Are neurons interpretable? Disentangled representations and modularity in biological and artificial brains" COSYNE workshop
2022 - 2023	Mentor, Simons Undergraduate Research Fellowship program
2021 - 2022	Center for Theoretical Neuroscience Diversity & Inclusion Committee
2018 - 2020	Co-organizer, Computational Neuroscience Journal Club
2018	Co-organizer, Undergraduate Systems Neuroscience Journal Club
2018	Teaching assistant, Quantitative Biology Bootcamp 4, Marine Biological Laboratory
2017	Member, UChicago Neuroscience Retreat Planning Committee
2016, 2017	Teaching assistant, Brains! Outreach Program
2016	Teaching assistant, Theoretical Neuroscience III: Statistics and Information Theory, Prof. Stephanie E. Palmer
2016	Co-organizer, Python for Neuroscientists Workshop
2015	Teaching assistant, Theoretical Neuroscience I: Single Neuron Dynamics and Computation, Prof. Nicolas Brunel
2012	Tutor and grader, Fundamentals of Computer Science I
2012	Tutor, Bootstrap Program, Orchard Gardens K-8 School, Boston, MA
Ad hoc reviewer	Nature Human Behavior, Neuron, Cell Reports, eLife, iScience, Nonlinear Dynamics, Communications Biology, Journal of Neuroscience Methods, Neural Networks

Publications

** indicates equal contribution*

Menghi N, Johnston WJ, Vigano S, Hinrichs MAB, Maess B, Fusi S, Doeller CF (2025) The effects of task similarity during representation learning in brains and neural networks. bioRxiv, <https://doi.org/10.1101/2025.01.20.633896>

Johnston WJ, Fusi S (2024) Modular representations emerge in neural networks trained to perform context-dependent tasks. bioRxiv, <https://doi.org/10.1101/2024.09.30.615925>

Johnston WJ,* Fine JM,* Yoo SBM, Ebitz RB, Hayden BY (2024). Semi-orthogonal subspaces for value mediate a tradeoff between binding and generalization. Nature Neuroscience, <https://doi.org/10.1038/s41593-024-01758-5>

Peysakhovich B, Tetrack SM, Silva AA, Li S, Zhu O, Ibos G, Johnston WJ, Freedman DJ (2024). Primate superior colliculus is engaged in abstract higher-order cognition. Nature Neuroscience, <https://doi.org/10.1038/s41593-024-01744-x>

Alleman M, Panichello MF, Buschman TJ, Johnston WJ (2024) The neural basis of swap errors in working memory. Proceedings of the National Academy of Sciences, <https://doi.org/10.1073/pnas.2401032121>
press coverage: [New Scientist](#)

Johnston WJ, Fusi S (2023) Abstraction emerges naturally in networks trained to perform multiple tasks. Nature Communications, <https://doi.org/10.1038/s41467-023-36583-0>
spotlight article: [Trends in Cognitive Sciences](#)

Johnston WJ, Freedman DJ (2023) Redundant representations are required to disambiguate simultaneously presented complex stimuli. PLOS Computational Biology, <https://doi.org/10.1371/journal.pcbi.1011327>

Johnston WJ, Tetrack SM, Freedman DJ (2022) The lateral intraparietal area is preferentially engaged in directed tasks rather than undirected free behavior. bioRxiv, <https://doi.org/10.1101/2022.03.09.483625>

Johnston WJ, Palmer SE, Freedman DJ (2020) Nonlinear mixed selectivity produces noise-tolerant neural representations. PLOS Computational Biology, <https://doi.org/10.1371/journal.pcbi.1007544>

Open Science Collaboration (2015) Estimating the reproducibility of psychological science. Science, <https://doi.org/10.1126/science.aac4716>

Open Science Collaboration (2012) An open, large-scale, collaborative effort to estimate the reproducibility of psychological science. Perspectives on Psychological Science, <https://doi.org/10.1177/1745691612462588>

Conference, workshop, and seminar talks

Representational geometry shapes working memory errors. Center for Theoretical Neuroscience Lab Meeting, Columbia University, July 28, 2025.

Representational geometry shapes working memory errors. Theory Meeting, Allen Institute for Brain Science, July 17, 2025.

Functional modularity in neural networks trained to perform context-dependent tasks. Center for Computational and Systems Neuroscience, Icahn School of Medicine at Mount Sinai, March 4, 2025.

Functional modularity in neural networks trained to perform context-dependent tasks. Center for Neural Science, New York University, February 14, 2025.

Functional modularity in neural networks trained to perform context-dependent tasks. University of California, San Francisco, February 5, 2025.

Functional modularity in neural networks trained to perform context-dependent tasks. Neuroscience Institute, New York University, January 28, 2025.

Modular representations emerge in neural networks trained to perform context-dependent tasks. Center for Vision Research and Center for Integrative and Applied Neuroscience Seminar Series, York University, October 23, 2024.

The emergence of abstract and modular representations in simple neural networks. University of Pittsburgh and Carnegie Mellon postdoc seminar series, November 31, 2023.

Why is everything everywhere? Center for Theoretical Neuroscience Lab Meeting, Columbia University, August 14, 2023

The emergence of abstract and modular representations in simple neural networks. The Center for Neuroscience Imaging Research, Sungkyunkwan University, Suwon, South Korea, June 14, 2023

The emergence of abstract representations in simple neural networks. Gatsby Tri-Centre Meeting, Hawarden, Wales, June 13, 2023

Selection from working memory can lead to catastrophic misbinding errors. Dynamical Geometric Transformations workshop, COSYNE, March 14, 2023.

Selection from working memory can lead to catastrophic misbinding errors. Center for Theoretical Neuroscience Lab Meeting, Columbia University, March 1, 2022.

Understanding the tradeoff between generalization ability and stimulus binding through the geometry of the neural code. Center for Theoretical Neuroscience Lab Meeting, Columbia University, October 18, 2021.

Reliable and distributed computation in the brain. The University of Chicago, August 26, 2020

The lateral intraparietal area is preferentially engaged in directed tasks rather than undirected free behavior. Computational and Theoretical Neuroscience Seminar Series, Duke University, August 20, 2020

Noise robust and metabolically efficient neural representations within and across brain regions. Computation & Theory Group, Janelia Research Campus, March 19, 2020

Noise robust and metabolically efficient neural representations within and across brain regions. Center for Theoretical Neuroscience, Columbia University, February 13, 2020

Nonlinear mixed selectivity supports reliable neural computation. UChicago Recruitment Weekend, February 9, 2020

This or that: How the brain makes sense of multiple representations of the same thing. UChicago Neuroscience Student Talk series, April 15, 2019

Channel coding for neuroscientists. Janelia Junior Scientist Workshop for Theoretical Neuroscience, October 21-26, 2018

Nonlinear mixed selectivity produces noise-tolerant neural representations. Janelia Junior Scientist Workshop for Theoretical Neuroscience, October 21-26, 2018

Nonlinear mixed selectivity produces noise-tolerant neural representations. Gordon Research Seminar, Neurobiology of Cognition, July 21-22, 2018

Nonlinear mixed selectivity produces noise-tolerant neural representations. UChicago Neuroscience Student Talk series, April 9, 2018

Looking where we want to look: Relating neuronal and behavioral correlates of image familiarity. UChicago Neuroscience Student Talk series, April 17, 2017

Looking where we want to look: Relating neuronal and behavioral correlates of image familiarity. Gordon Research Seminar, Neurobiology of Cognition, July 23-24, 2016

Other conference presentations

Hashim R, Gulli RA, Johnston WJ, Fusi S, Salzman CD. The neural representation of emotional states in primate amygdala and insula. Poster presented at: Society for Neuroscience, October 5 - 9, 2024.

Alleman M, Panichello MF, Buschman, Johnston WJ. Modeling behavioral imprecision from neural representations. **Spotlight talk** (by MA) and poster presented at: Convention on the Mathematics of Neuroscience and AI, May 28 - 31, 2024.

Johnston WJ, Fusi S. Why is everything everywhere? Broad mixing leads to increased reliability in neural representations. Poster presented at: COSYNE, February 29 - March 5, 2024.

Mehnoor K, Johnston WJ, Fusi S. Abstract representations emerge in linear networks trained to perform multiple tasks. Poster presented at: Simons Foundation Undergraduate Research Fellowship Symposium, April 17, 2023.

Johnston WJ, Fusi S. Modularity emerges in neural networks trained to perform context-dependent behavior. Poster presented at: COSYNE, March 9 - 12, 2023.

Alleman M, Panichello MF, Buschman TJ, Johnston WJ. Selection from working memory can lead to catastrophic misbinding errors. Poster presented at: COSYNE, March 17 - March 20, 2022

Johnston WJ, Fusi S. Abstract representations emerge naturally in neural networks trained to perform multiple tasks. Poster presented at: Simons Foundation Annual Meeting, March 11, 2022.

Johnston WJ, Freedman DJ. Solutions to the assignment problem balance tradeoffs between local and catastrophic errors. Poster presented at: COSYNE, February 27-March 1, 2020

Johnston WJ, Freedman DJ. Two tradeoffs between local accuracy and catastrophic errors in a solution to the representation assignment problem. Poster presented at: Society for Neuroscience, October 19-23, 2019

Peysakhovich B, Zhu O, Ibos G, Johnston WJ, Freedman DJ. Dissociating cognitive and sensory representations in posterior parietal cortex. Poster presented at: Society for Neuroscience, October 19-23, 2019

Johnston WJ, Mohan K, Freedman DJ. What goes where: Using stimulus representations from both visual streams to guide behavior. Poster presented at: Society for Neuroscience, November 3-7, 2018

Johnston WJ, Palmer SE, Freedman DJ. Nonlinear mixed selectivity produces noise-tolerant neural representations. Poster presented at: Gordon Research Conference, Neurobiology of Cognition, July 22-27, 2018

Johnston WJ, Palmer SE, Freedman DJ. Nonlinear mixed selectivity produces noise-tolerant neural representations. Poster presented at: COSYNE, March 1-4, 2018

Johnston WJ, Mohan K, Freedman DJ. Looking where we want to look: Relating neuronal and behavioral correlates of image familiarity. Poster presented at: Society for Neuroscience, November 12-16, 2016

Johnston WJ, Mohan K, Freedman DJ. Looking where we want to look: Relating neuronal and behavioral correlates of image familiarity. Poster presented at: Gordon Research Conference, Neurobiology of Cognition, July 24-29, 2016

Johnston WJ, Denman D, Gaudreault NG, Long B, Peng H, Blanche TJ. The path of least resistance: minimizing vascular damage from electrode array insertions. Poster presented at: Society for Neuroscience, October 17-21, 2015

Mohan K, Johnston WJ, Freedman DJ. Impact of visual familiarity on neuronal representations in inferotemporal cortex and behavior. Poster presented at: Society for Neuroscience, October 17-21, 2015

Johnston WJ, Bruneau E, Saxe R. Mind the gap: bridging the gap in intergroup empathy in arbitrary and real groups. Poster presented at: Northeastern University Research, Innovation, and Scholarship Expo, March 22, 2013

Johnston WJ, Koster-Hale J, Yazzolina L, Saxe R, Bedny M. To peek and to peer: “visual” verb meanings are largely unaffected by congenital blindness. Poster presented at: Northeastern University Research, Innovation, and Scholarship Expo, March 29, 2012