

Erica Lindsey Busch

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Education

Yale University

New Haven, Connecticut

PhD Candidate, Neuroscience

August 2020 – Present

Master of Philosophy

June 2023

Master of Science

December 2022

Advisors: Nick Turk-Browne, BJ Casey

Thesis topic: Manifold learning and neurofeedback with fMRI

Dartmouth College

Hanover, New Hampshire

BA in Cognitive Science, Computer Science

September 2016 – March 2020

Advisors: James Haxby, Caroline Robertson

GPA: 3.82; Cum Laude

Thesis (High honors): A deep learning approach to scene perception in autism

Centro Tinku Academic Center

Cusco, Peru

Dartmouth Department of Spanish and Portuguese

Fall 2017

Advanced Spanish Language Study Abroad

Publications

Journal articles and conference proceedings

Busch, E.L., Rapuano, K.M., Anderson, K.M., Rosenberg, M.D., Watts, R., Casey, BJ, Haxby, J.V., & Feilong, M. Dissociation of reliability, predictability, and heritability in fine- and coarse-scale functional connectomes during development. (In press, *The Journal of Neuroscience*). [Paper](#)

Skalaban, L.J., Chan, I., Lin, Q., Rapuano, K.M., Conley, M.I., **Busch, E.L.**, Watts, R., Murty, V., & Casey, B.J. Representational dissimilarity of faces and places during a working memory task is associated with subsequent recognition memory during development. (Accepted November 2023, *Journal of Cognitive Neuroscience*)

Busch, E.L., Yates, T.S., & Turk-Browne, N.B. (2023). Tasks constrain the intrinsic dimensionality of activity in non-selective cortex. *Proceedings of the 7th Annual Conference on Cognitive Computational Neuroscience*. [Paper](#).

Busch, E.L., Huang, J., Benz, A., Wallenstein, T., Lajoie, G., Wolf, G., Krishnaswamy, S*, & Turk-Browne, N.B.* (2023). Multi-view manifold learning of human brain-state trajectories. *Nature Computational Science*. 3 (3), 240-253, doi:10.1038/s43588-023-00419-0. [Paper](#), [Analysis capsule](#), [Pip package](#).

Busch, E.L. & Krishnaswamy, S. (2023). Revealing trajectories of the mind via non-linear manifolds of brain activity. *Nature Computational Science*. 3 (3), 192-193, doi: 10.1038/s43588-023-00423-4. *Invited research briefing*.

Huang, J.*, **Busch, E.L.***, Wallenstein, T., Gerasimiuk, M., Benz, A., Lajoie, G., Wolf, G., Turk-Browne, N.B., & Krishnaswamy, S. (2022). Learning shared neural manifolds from multi-subject fMRI data. *Proceedings of the 32nd IEEE Machine Learning for Signal Processing*. doi:10.1109/MLSP55214.2022.9943383. [Paper](#), [arXiv](#).

Busch, E.L.*, Slipski, L.*, Feilong, M., Guntupalli, J.S., Visconti di Oleggio Castello, M., Huckins, J.F., Nastase, S.A., Gobbini, M.I., Wager, T.D., & Haxby, J.V. (2021). Hybrid hyperalignment: A single high-dimensional model of shared information embedded in cortical patterns of response and functional connectivity. *NeuroImage*. 233, 117975, doi:10.1016/j.neuroimage.2021.117975. [Paper](#), [Code](#).

In revision

Roskies, A., **Busch, E.L.**, & Walton, A. Agency as a framework for thinking about neuropsychiatric disease: A prelude to asking causal questions.

In preparation

Busch, E.L., Conley, M.I., & Baskin-Somers, A. The embedded brain: Using a joint neural and environmental manifold to predict youth mental health.

Busch, E.L., Lajoie, G., Krishnaswamy, S., & Turk-Browne, N.B. Learning on the manifold of human brain activity via real-time neurofeedback.

Busch, E.L., & Turk-Browne, N.B. Diverse tasks constrain and inflate intrinsic dimensionality of cortical activity.

Walton, A., **Busch, E.L.**, Ratoff, W., Smith, W., Holtzheimer, P., & Roskies, A. An assessment tool for understanding changes in agency with neurointerventions.

* Denotes equal contribution.

Grants

Graduate Research Fellowship Program	2021-2024
National Science Foundation.	\$147,000
Title: <i>Enhancing human learning along the neural manifold</i> .	
William H. Neukom Scholar Award	2020
Neukom Institute for Computational Science.	\$1000
Research Experience for Undergraduates Grant	2019
National Science Foundation.	\$5500
William H. Neukom Scholar Award	2019
Neukom Institute for Computational Science.	\$1000
David C. Hodgson Endowment Award	2019
Dartmouth Undergraduate Award in Cognitive Neuroscience.	\$5000
James O. Freedman Presidential Scholar Award	2018
Dartmouth Undergraduate Advising and Research.	\$2000
Sophomore Research Scholar Award	2018
Dartmouth Undergraduate Advising and Research.	\$1000

Awards and Honors	Wu Tsai Travel Award, Society for Neuroscience Meeting	2023
	Wu Tsai Institute, Yale University	
	Data competition; first prize team	2022
	Social and Affective Neuroscience Society	
	Outstanding Undergraduate Research Award	2020
	Neukom Institute for Computational Science; 2nd Prize	
	Made at Dartmouth Research Competition Winner	2020
	Dartmouth Undergraduate Advising and Research; Grand Prize	
	Academic Achievement Prize	2020
	Dartmouth College Cognitive Science Program	
	Fulbright Fellowship Finalist (Withdrew due to COVID-19)	2020
	Fulbright Committee	
	High Honors in Cognitive Science	2020
	Dartmouth College Cognitive Science Program	
	Citation for Academic Excellence in Machine Learning	2019
	Dartmouth College Department of Computer Science	
Posters and Presentations	Citation for Academic Excellence in Cognitive Neuroscience	2019
	Dartmouth College Department of Psychological and Brain Sciences	
	Citation for Academic Excellence in Intro to Programming	2017
	Dartmouth College Department of Computer Science	
	Dartmouth College Honors List	2017-2020
	National Merit Scholarship Finalist	2015
	Busch, E.L., Yates, T.S., & Turk-Browne, N.B. (2023). Tasks constrain the intrinsic dimensionality of activity in non-selective cortex. <i>Poster at 7th Annual Conference on Cognitive Computational Neuroscience.</i> , Oxford, United Kingdom.	
	Busch, E.L., Bhaskar, D., Letrou, A., Zhang, X., Noah, J.A., Lajoie, G., Hirsch, J., Turk-Browne, N.B., Krishnaswamy, S. (2022). An encoder-decoder framework for cross-modal translation of brain imaging data. <i>Poster and selected lightning talk, Montreal AI-Neuroscience Meeting.</i> Montreal, QC, Canada.	
	Busch, E.L., Letrou, A., Huang, J., Lajoie, G., Wolf, G., Krishnaswamy, S., & Turk-Browne, N.B. (2022). A neural manifold learning framework for real-time fMRI neurofeedback. <i>Poster at Society for Neuroscience Annual Meeting.</i> San Diego, CA, USA.	
	Busch, E.L., Letrou, A., Huang, J., Lajoie, G., Wolf, G., Krishnaswamy, S., & Turk-Browne, N.B. (2022). A neural manifold learning framework for real-time fMRI neurofeedback. <i>Poster at Real-time Functional Imaging and Neurofeedback Meeting.</i> New Haven, CT, USA.	
	Busch, E.L., Rapuano, K.M., Anderson, K.M., Rosenberg, M.D., Watts, R., Casey, BJ, Haxby, J.V., & Feilong, M. (2022). Heritable template underlies reliable idiosyncrasies in the developing fine-scale connectome. <i>Poster at Organization for Human Brain Mapping Annual Meeting.</i> Glasgow, Scotland.	

Letrou, A., **Busch, E.L.**, & Turk-Browne, N.B., (2022). Relating neural dynamics and emotion dynamics with nonlinear manifold learning. *Poster and talk at Social and Affective Neuroscience Society Annual Meeting*. Virtual.

Busch, E.L., Huang, J., Benz, A., Wallenstein, T., Lajoie, G., Wolf, G., Krishnaswamy, S., & Turk-Browne, N.B. (2021). Manifold learning to capture brain-state trajectories in fMRI. *Poster at Society for Neuroscience Annual Meeting*. Virtual.

Walton, A.E., Nizzi, M.C., West, B., Mofe, E., Roth, R.M., **Busch, E.L.**, Holtzheimer, P.E., & Roskies A.L. (2021). The impact of anxiety and depression on dimensions of agency. *Poster at Seventh Annual NIH BRAIN Initiative Annual Meeting*. Virtual.

Sivitilli, D.M., Weertman, W.L., **Busch, E.L.**, Ullmann, J.F., Smith, J.R., Gire, D.H. (2021). Strategies of single arm foraging in Octopus rubescens in the absence of visual feedback. *Poster at Society for Integrative and Comparative Biology*. Virtual.

Busch, E.L., Haskins, A.J., Isik, L., & Robertson, C.E. (2020) A deep learning approach to understanding real-world scene perception in autism. *Presidential Undergraduate Research Symposium, Dartmouth College*. Virtual.

Walton, A.E., **Busch, E.L.**, Ratoff, W., Smith, W., Holtzheimer, P.E., & Roskies, A.L. (2020). Developing an agency assessment tool for understanding changes in agency with neurointerventions: Preliminary results. *Sixth Annual NIH BRAIN Initiative Annual Meeting*. Virtual.

Botch, T.L., **Busch, E.L.**, & Robertson, C.E. (2020). Application of deep neural networks to model omnidirectional gaze behavior in immersive VR. *Vision Sciences Society Annual Meeting*. Virtual.

Busch, E.L., Sivitilli, D.M., & Gire, D.H. (2019). Using deep learning to model octopus arm motion. *Center for Neurotechnology Research Symposium, University of Washington*. Seattle, WA, USA.

Busch, E.L., Ma, F., Nastase, S.A., & Haxby, J.V. (2019). Individual differences in fine-grained neural correlates of mental states. *Wetterhahn Science Symposium, Dartmouth College*. Hanover, NH, USA.

Talks

Society for Neuroscience Annual Meeting, Washington D.C. Nov. 2023
Nanosymposium on Neural Decoding and Neuroprosthetics
Learning on the manifold of human brain activity via real-time neurofeedback

Projects in Progress, Wu Tsai Institute Nov. 2023
Learning on the manifold of human brain activity via real-time neurofeedback

Shine Lab Meeting, University of Sydney Apr. 2023
Multi-view manifold learning of human brain-state trajectories.

Yale Brain Imaging Center Users Meeting Oct. 2022
Enhancing human learning along the neural manifold.

ABCD Imaging Analytics Working Group Sept. 2022
The LEGO theory of the developing functional connectome.

Current Works in Behavior, Genetics, and Neuroscience Apr. 2022

	<i>The LEGO theory of the developing functional connectome.</i>	
	Guest lecture in NSCI 270: Yale University	Nov. 2021
	<i>Advanced fMRI analysis techniques.</i>	
	FINN Lab Meeting, Dartmouth College	Apr. 2021
	<i>Hyperalignment: Foundations, flavors, and functions</i>	
Research experience	Turk-Browne Lab	2020 – Present
	Mentor: Nick Turk-Browne	Yale University
	Research focus: Machine learning, real-time fMRI, neurofeedback.	
	Fundamentals of the Adolescent Brain (FAB) Lab	2020 – Present
	Mentor: B.J. Casey	Yale University
	Research focus: Computational models of heritability, functional connectivity, and neurocognition in adolescents.	
	Haxby Lab	2018 – 2020
	Mentors: James V. Haxby and Feilong Ma	Dartmouth College
	Research focus: Hyperalignment algorithms, naturalistic stimuli.	
	Robertson Lab	2019 – 2020
	Mentor: Caroline Robertson	Dartmouth College
	Research focus: Deep learning models of visual perception in autism.	
	Laboratory of Comparative Systems Neuroscience	Summer 2019
	Mentor: David Gire	University of Washington
	Research focus: Deep learning models of octopus foraging.	
Teaching experience	Teaching Fellow, Department of Psychology Yale University	Spring 2023
	PSYC 258/558/NCSI 258: Computational methods in human neuroscience.	
	Teaching Fellow, Department of Psychology Yale University	Fall 2022
	NSCI 160/PSYC 160: The human brain.	
	Teaching Fellow, Department of Psychology Yale University	Spring 2022
	PSYC 258/558/NCSI 258: Computational methods in human neuroscience.	
	Teaching Fellow, Department of Psychology Yale University	Fall 2021
	PSYC 270 /NCSI 270: Research methods in cognitive neuroscience.	
	TA, Department of Computer Science Dartmouth College	Spring 2020
	COSC 74: Machine learning and statistical data analysis	
	TA, Department of PBS Dartmouth College	Winter 2019
	PSYC 6: Introduction to neuroscience	
	Peer Tutor, Tutor Clearinghouse Dartmouth College	2017 - 2020
	SPAN 1-3 (Intro Spanish), SPAN 9 (Culture and Conversation: Advanced), SPAN 20 (Writing and Reading)	
	COSC 1 (Intro to Programming and Computation), COSC 10 (Object-Oriented Programming), COSC 50 (Software Design), COSC 74 (Machine Learning)	
	PSYC 6 (Intro to Neuroscience), PSYC 10 (Statistics)	
	COGS 1 (Intro to Cognitive Science)	
	Instructor, Sonia Kovalevsky Math Day Dartmouth College	Spring 2018

	Co-developed and facilitated workshop for young female students to learn the basics of cryptography.	
	College Access Coach, Let's Get Ready	Summer 2017
	Created and taught bi-weekly math and verbal SAT prep classes for NYC low-income high school students.	
	Private tutor	2012 – Present
	<i>Grade 3 - undergraduate</i>	
	K-12: New York State Regents mathematics and sciences, English, writing, Spanish, history, Advanced Placement (AP) Calculus AB and BC, AP Statistics, AP Physics, AP Computer Science, SAT / ACT	
	Undergraduate: Algebra, graph theory, programming in Java, Spanish.	
Service and outreach	Innovators in Cognitive Neuroscience	2020–present
	Founding member and Yale University coordinator for the Innovators in Cognitive Neuroscience speaker series.	
	Wu Tsai Institute	2022–present
	Student-Postdoc Committee Fellow.	
	Yale Psychology Colloquium Committee	2021–2023
	Yale Psychology Diversity Committee Sneak Peek	2021–2023
	Graduate school application mentor.	
	SIBS Youth Mentoring Program	2016 – 2020
	<i>Dartmouth Center for Social Impact</i>	
	Directed and mentored for a one-on-one youth mentorship program for Dartmouth undergrads and Upper Valley youth. Responsible for communication with mentors, parents, and social workers, and interviewing/training mentors.	
	Dartmouth Leadership, Attitudes, and Behaviors Program	2018 – 2019
	<i>Nelson A. Rockefeller Center for Public Policy</i>	
	Facilitated student discussion groups about value-driven leadership, both on campus and in practice.	
Reviewing	Proceedings of the National Academy of Sciences of the United States of America; International Conference on Learning Representations; Proceedings on Cognitive Computational Neuroscience.	
Other skills	Neuroimaging: rt-cloud (Real-time fMRI with cloud computing), MRI operator certified, Magnetoencephalography experienced. Software: BrainIAK Contributor, PyMVPA Contributor, FSL, FreeSurfer, AFNI. Programming: Python, BASH, C, C++, C# for Unity, Java, MATLAB, R, HTML, Unity, PsychoPy, PsychToolbox, PyTorch, Keras, TensorFlow. Languages: Spanish (fluent), Italian and Portuguese (intermediate) Miscellaneous: Equestrian, freelance data science, running, hiking.	