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 real-time neurofeedback

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. (2024). Dissociation of reliability, predictability, and heritability in fine- and coarse-scale functional connectomes during development. *Journal of Neuroscience.* 44(6), doi:10.1523/JNEUROSCI.0735-23.2023. Paper, Code.

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. (2024). *Journal of Cognitive Neuroscience.* 36(3) 415-434, doi:10.1162/jocn_a_02094. Paper.

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.*

1

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.

Preprints

Busch, E.L.*, Conley, M.I.*, & Baskin-Somers, A. Manifold learning uncovers nonlinear interactions between the adolescent brain and the social environment in predicting mental health problems. (submitted)

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., 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.

* Denotes equal contribution.

Grants		
Graduate Research Fellowship Program		2021-2024
National Science Foundation.		$147,000
Title: *Enhancing human learning along the neural manifold.*		
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	
	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

Talks	**ABCD Insights & Innovations Meeting, NIH Campus**	Mar. 2024
	Dissociable representational dimensions reveal scales of individual differences in the functional connectome.	
	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
	The LEGO theory of the developing functional connectome.	
	Guest lecture in NSCI 270: Yale University	Nov. 2021
	Advanced fMRI analysis techniques.	
	FINN Lab Meeting, Dartmouth College	Apr. 2021
	Hyperalignment: Foundations, flavors, and functions	

Posters and Presentations	**Busch, E.L.**, Conley, M.I., & Baskin-Sommers, A. (2024). Using manifold learning to uncover the embedded brain and implications for mental health in youth. *Accepted poster at the Organization for Human Brain Mapping Annual Meeting.* Seoul, South Korea.

Busch, E.L., Fincke, E.C., Lajoie, G., Krishnaswamy, S., & Turk-Browne, N.B. (2024). Learning on the manifold of human brain activity through real-time neurofeedback. *Accepted poster at the Organization for Human Brain Mapping Annual Meeting.* Seoul, South Korea.

Busch, E.L., Yates, T.S., & Turk-Browne, N.B. (2023). Tasks constrain the intrinsic dimensionality of activity in non-selective cortex. *Poster at 7th Annual Conference on Cognitive Computational Neuroscience.*, 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. *Poster and selected lightning talk, Montreal AI-Neuroscience Meeting.* 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. *Poster at Society for Neuroscience Annual Meeting.* 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. *Poster at Real-time Functional Imaging and Neurofeedback Meeting.* 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. *Poster at Organization for Human Brain Mapping Annual Meeting.* 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.

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 2020–2022
	Mentor: BJ Casey Yale University
	Research focus: Modeling youth functional connectivity and neurocognition.
	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 taught workshop for girls to learn cryptography basics.

College Access Coach, Let's Get Ready   Summer 2017

Created and taught SAT prep classes for NYC low-income high school students.

Private tutor   2012–Present

Grade 3 - undergraduate

K-12: NY State Regents math and sciences, English, Spanish; AP: Calculus AB and BC, Statistics, Physics, Computer Science; SAT / ACT

Undergraduate: Algebra, graph theory, programming in Java, Spanish.

Service and outreach	**Innovators in Cognitive Neuroscience**	2020–present

Founding member; Yale coordinator for ICN seminar series.

Wu Tsai Institute Student-Postdoc Committee Fellow   2022–present

Yale Psychology Colloquium Committee   2021–2023

Yale Psychology Diversity Committee Sneak Peek Mentor 2021–2023

SIBS Youth Mentoring Program   2016–2020

Dartmouth Center for Social Impact

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

Nelson A. Rockefeller Center for Public Policy

Facilitated student discussion groups about value-driven leadership.

Reviewing	PNAS, International Conference on Learning Representations (ICLR), Proceedings on Cognitive Computational Neuroscience (CCN).

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.