

Jake Russin

Department of Psychology, Center for Neuroscience
University of California, Davis
1544 Newton Ct, Davis, CA 95618

Email: jlrussin@ucdavis.edu

[Personal website](#)

[Google Scholar](#)

Last updated: 9/18/21

EDUCATION

University of California, Davis: PhD in Psychology Advisor: Dr. Randall O'Reilly (transferred from CU Boulder) GPA: 4.0	2019 – present
University of Colorado, Boulder: PhD in Psychology and Neuroscience Advisor: Dr. Randall O'Reilly GPA: 3.98	2017 – 2019
Yale University: Non-Degree Students Program Took full course load in statistics, mathematics, machine learning, and engineering GPA: 3.8	2016 – 2017
Colorado College: BA in Neuroscience and Philosophy Senior Thesis: Reasoning in the Prefrontal Cortex GPA: 3.7	2010 – 2014

RESEARCH

Computational Cognitive Neuroscience Lab <i>Graduate Student Researcher</i>	2017 - present <i>CU Boulder; UC Davis</i>
Under the direction of Dr. Randall O'Reilly, I build cognitive and neuroscience-inspired deep learning architectures, as well as more biologically plausible computational models of the brain. I have focused in particular on: 1) Compositionality, systematicity, and reasoning in deep learning, 2) Models of human reinforcement learning, with a focus on temporal abstraction, and 3) Biologically plausible models of predictive learning and human vision. I also conduct experiments with human subjects to study how the human brain can accomplish these cognitive functions.	
Analogy group <i>Collaborator/contributor</i>	2017 - present <i>CU Boulder; UC Davis</i>
Ongoing collaborative research group led by Jonathan Cohen (Princeton), Randall O'Reilly (UC Davis), and Alex Petrov (Ohio State). Group of faculty members, postdocs and graduate students meets weekly to discuss topics in computational neuroscience, artificial intelligence, and cognitive science, including models of analogy, reasoning, structure-learning, systematicity/compositionality.	
Microsoft Research <i>Research Intern</i>	Summer 2020 <i>Redmond, WA</i>
Worked in the Deep Learning Group under Dr. Paul Smolensky and Roland Fernandez on interpretability in neuro-symbolic AI and natural language processing. Project included developing methods for analyzing and visualizing representations in novel neuro-symbolic deep learning architectures. Architectures included variants of transformers including the tensor-product transformer and were trained on natural language and mathematical reasoning datasets.	

Montreal Institute for Learning Algorithms (MILA)

Summer 2018

Visiting Student Researcher

Montreal, Canada

Worked under Dr. Yoshua Bengio and Dr. Jason Jo on current limitations of deep learning and the intersection of deep learning and cognitive science. My project included building and testing deep learning systems in PyTorch for compositional generalization tasks in the visual question-answering and neural machine translation settings.

National Institutes of Health

2015 – 2016

Postbac Intramural Research Training Award

Bethesda, MD

Under the direction of Dr. Carolyn Beebe Smith, studied regional rates of protein synthesis in nervous tissue in autism spectrum disorder, using quantitative autoradiography in rodents, and PET in humans.

Institute of Cognitive Science, University of Colorado, Boulder

2014 – 2015

Research Assistant

Boulder, CO

Under the direction of Dr. Albert Kim, used EEG to investigate the neural mechanisms of language processing.

FELLOWSHIPS, AWARDS AND HONORS

Postbac/Graduate (CU Boulder, UC Davis)

T32 Training Program fellowship in learning, memory, and plasticity 2020
National Institute of Mental Health

NSF Graduate Research Fellowships Program honorable mention 2018
National Science Foundation

Postbac Intramural Research Training Award 2015
National Institutes of Health

Undergraduate (Colorado College)

Phi Beta Kappa Society 2014

The J. Glenn Gray Award in Philosophy 2014
Awarded to the most outstanding philosophy major

Distinction in Neuroscience 2014

Distinction in Philosophy 2014

Dean's List: Junior and Senior years 2013, 2014

Psi Chi Honor Society 2013

PUBLICATIONS

2021 **An Analogy Group*** (2021, *in prep*) Turing with a twist: On the relation of natural intelligence to the computational architecture of the human brain.

2021 **Russin, J., O'Reilly, R. C.** (2021) Deep predictive learning with local gradient information. Abstract accepted as a poster presentation at: Bernstein Conference 2021. <https://abstracts.g-node.org/conference/BC21/abstracts#/uuid/5966a16f-d11c-4c7d-a20b-a583d6de5801>

*Members: Jonathan Cohen, Zachary Dulberg, Steven Frankland, Tyler Giallanza, Sebastian Musslick, Randall C. O'Reilly, Alexander A. Petrov, **Jacob Russin**, Simon Segert, Taylor Webb, Maryam Zolfaghar

- 2021 O'Reilly, R. C., Ranganath, C., **Russin, J.** (2021, *in press*) The Structure of Systematicity in the Brain. *Current Directions in Psychological Science*. <https://arxiv.org/abs/2108.03387>
- 2021 **Russin, J.**, Fernandez, R., Palangi, H., Rosen, E., Jojic, N., Smolensky, P., Gao, J. (2021). Compositional Processing Emerges in Neural Networks Solving Math Problems. *Proceedings for the 43rd Annual Meeting of the Cognitive Science Society*. *CogSci*. <http://arxiv.org/abs/2105.08961>
- 2021 **Russin, J.**[†], Zolfaghar, M.[†], Park, S. A., Boorman, E., O'Reilly, R. C. (2021). Complementary Structure-Learning Neural Networks for Relational Reasoning. *Proceedings for the 43rd Annual Meeting of the Cognitive Science Society*. *CogSci*. <http://arxiv.org/abs/2105.08944>
- 2021 O'Reilly, R. C., **Russin, J.**, Zolfaghar, M., Rohrlich, J. (2021). Deep Predictive Learning in Neocortex and Pulvinar. *Journal of Cognitive Neuroscience*, 33(6), 1158–1196. https://doi.org/10.1162/jocn_a_01708
- 2020 **Russin, J.**, O'Reilly, R. C., Bengio, Y. (2020). Deep learning needs a prefrontal cortex. *Bridging AI and Cognitive Science (BAICS) Workshop, ICLR 2020*, 11. https://baicsworkshop.github.io/pdf/BAICS_10.pdf
- 2020 **Russin, J.**, Jo, J., O'Reilly, R., Bengio, Y. (2020). Compositional Generalization by Factorizing Alignment and Translation. *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics: Student Research Workshop*, 313–327. <https://doi.org/10.18653/v1/2020.acl-srw.42>
- 2020 **Russin, J.**, Jo, J., O'Reilly, R. C., Bengio, Y. (2020). Systematicity in a Recurrent Neural Network by Factorizing Syntax and Semantics. *Proceedings for the 42nd Annual Meeting of the Cognitive Science Society*, 7. <https://cognitivesciencesociety.org/cogsci20/papers/0027/0027.pdf>
- 2020 O'Reilly, R. C., Nair, A., **Russin, J.**, Herd, S. A. (2020). How Sequential Interactive Processing Within Frontostriatal Loops Supports a Continuum of Habitual to Controlled Processing. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.00380>
- 2019 O'Reilly, R. C., **Russin, J.**, Herd, S. A. (2019). Computational models of motivated frontal function. *Handbook of Clinical Neurology*, 163, 317–332. <https://doi.org/10.1016/B978-0-12-804281-6.00017-3>
- 2019 Cooke, S. K., **Russin, J.**, Moulton, K., Nadel, J., Loutaev, I., Gu, Q., Li, Z., Smith, C. B. (2019). Effects of the presence and absence of amino acids on translation, signaling, and long-term depression in hippocampal slices from *Fmr1* knockout mice. *Journal of Neurochemistry*. <https://doi.org/10.1111/jnc.14874>

[†]Equal contribution

CONFERENCE PRESENTATIONS

- 2021 Russin, J. (2021, September). Deep predictive learning with local gradient information. Poster presented at: Bernstein Conference 2021.
- 2021 Russin, J. (2021, July). Complementary structure-learning neural networks for relational reasoning. Poster presented at: 43rd Annual Meeting of the Cognitive Science Society.
- 2021 Russin, J. (2021, July). Compositional processing emerges in neural networks solving math problems. Poster presented at: 43rd Annual Meeting of the Cognitive Science Society.
- 2020 Russin, J. (2020, April) Deep learning needs a prefrontal cortex. Talk presented at: Bridging AI and Cognitive Science, ICLR 2020 Workshop, Addis Ababa, Ethiopia, April 26, 2020.
- 2020 Russin, J. (2020, July). Systematicity in a recurrent neural network by factorizing syntax and semantics. Talk presented at: 42nd Annual Meeting of the Cognitive Science Society.
- 2020 Russin, J. (2020, July). Compositional generalization by factorizing alignment and translation. Talk presented at: ACL 2020, Student Research Workshop, Seattle, WA.

OTHER PRESENTATIONS

- 2021 Russin, J. (2021, October). Complementary structure-learning systems. Talk presented at: The Reasoning Lab (Khemlani), Naval Research Laboratory, Washington DC.
- 2021 Russin, J. (2021, July). Structure-learning and compositionality in neural networks. Talk presented at: Laboratory of Neural Computation and Cognition (Frank), Carney Institute for Brain Science, Brown University, Providence, RI.
- 2021 Russin, J. (2021, July). Cognitive control of cognitive maps. Talk presented at: Analogy Group (Princeton, CU Boulder, Ohio State University).
- 2021 Russin, J. (2021, April). Complementary structure-learning systems. Talk presented at: Analogy Group (Princeton, CU Boulder, Ohio State University).
- 2021 Russin, J. (2021, March). Complementary structure-learning systems. Talk presented at: PCCN Brownbag, Department of Psychology, University of California Davis, Davis, CA.
- 2020 Russin, J. (2020, May). Systematicity in neural networks. Talk presented at: PCCN Brownbag, Department of Psychology, University of California Davis, Davis, CA.
- 2020 Russin, J. (2020, April). Generalization, structure, and cognitive maps. Talk presented at: Memory Meeting, Center for Neuroscience, University of California Davis, Davis, CA.
- 2019 Russin, J. (2019, September) Temporal abstraction in reinforcement learning. Talk presented at: Learning and Decision-Making Lab, Center for Mind and Brain, University of California Davis, Davis, CA.

- 2019 Russin, J. (2019, May). Systematicity, selective attention, and the prefrontal cortex. Talk presented at: 38th Annual Ekstrand Mini-Convention, Department of Psychology and Neuroscience, University of Colorado, Boulder, Boulder, CO.
- 2019 Russin, J. (2019, February). Systematicity in a recurrent neural network by factorizing syntax and semantics. Talk presented at: Analogy Group (Princeton, CU Boulder, Ohio State University).
- 2018 Russin, J. (2018, December). Compositional Attention Networks. Talk presented at: Statistics, Optimization, and Machine Learning Seminar, Department of Computer Science, University of Colorado, Boulder, Boulder, CO.
- 2018 Russin, J. (2018, October). Temporal abstraction in reinforcement learning. Talk presented at: Kilpatrick Group, Department of Applied Mathematics, University of Colorado, Boulder, Boulder, CO.
- 2018 Russin, J. (2018, May). Temporal abstraction in reinforcement learning. Talk presented at: 37th Annual Ekstrand Mini-Convention, Department of Psychology and Neuroscience, University of Colorado, Boulder, Boulder, CO.
- 2014 Russin, J. (2014, May). Reasoning in the prefrontal cortex: A review of three subcomponents and their functions. Poster presented at: Psychology and Neuroscience Poster Day, Colorado College, Colorado Springs, CO.

TEACHING

- Fall 2018 Teaching assistant: Research Methods in Psychology, CU Boulder.
Gave lectures and led discussions in weekly lab sections, graded assignments, attended lectures, held weekly office hours.
- Spring 2018 Teaching assistant: History of Psychology, CU Boulder.
Graded assignments, attended lectures, held weekly office hours.

MENTORING

- 2021 – present Graduate Mentor for [Transfer Research Society](#)
- 2021 – present Ayush Chakravarthy (undergraduate, UC Davis)
Research mentor for project in deep learning.
- 2020 – present Andrew Carlson (graduate student, UC Davis)
Research mentor and advisor on career development, publishing, presentations, etc.
- 2021 Graduate student mentor for CogSci 2021 Mentoring Program

2020 – 2021 Taiqi He (junior specialist, UC Davis)
Research mentor for projects in deep learning and natural language processing.

SERVICE

2021 Conference reviewer: CogSci 2021
2020 Conference reviewer: CogSci 2020
2019 Ad hoc reviewer (assisted): Trends in Cognitive Sciences 2019

SKILLS

Programming languages: Python, R, MATLAB

PyTorch and TensorFlow for building deep neural networks for natural language processing, vision, and reinforcement learning.

Biologically plausible neural network modeling with Emergent.