

Kevin J. Miller

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Education

- Ph.D.** in Quantitative and Computational Neuroscience 2017
Princeton University, Princeton, NJ
- B.A.** in Physics and in Cognitive Science 2010
Dartmouth College, Hanover, NH

Research Experience

- Postdoctoral Research Associate**, University College London 2018 – Present
Advisors: Kenneth Harris and Matteo Carandini
- Research Scientist**, DeepMind 2018 – Present
Supervisor: Matthew Botvinick
- Postdoctoral Associate**, Princeton Neuroscience Institute 2017 – 2018
Advisor: Carlos Brody
- Graduate Student**, Princeton Neuroscience Institute 2011 – 2017
Advisors: Matthew Botvinick & Carlos Brody
- Research Assistant**, Brain Engineering Lab, Hanover, NH 2009 – 2011
Advisor: Richard Granger
- Research Assistant**, Onofrio Research Group, Hanover, NH 2008
Advisor: Roberto Onofrio

Publications, Posters, and Talks

Peer Reviewed Articles

- Miller, K., Botvinick, M., Brody, C. (In revision) Value representations in orbitofrontal cortex drive learning, but not choice. *Preprint available on bioRxiv*
- Miller, K.*, Shenhav, A*, Ludvig, E., (2019) Habits without values. *Psychological Review*
(*Contributed equally).
- Miller, K., Botvinick, M., Brody, C. (2017) Dorsal hippocampus contributes to model-based planning. *Nature Neuroscience*
- Oud, B., Krajbich, I., Miller, K., Cheong, J., Botvinick, M., Fehr, E. (2016) Irrational time allocation in decision making. *Proceedings of the Royal Society B*
- Fogelson, S., Kohler, P., Miller, K., Granger, R., Tse, P. (2014) Unconscious neural processing differs with method used to render stimuli invisible. *Frontiers in Consciousness Research*

Other Publications

- Oretga, P., Wang, J., Rowland, M., Genewein, T., Kurth-Nelson, Z., Pascanu, R., Heess, N., Veness, J., Pritzel, A., Sprechmann, P., Jayakumar, S., McGrath, T., Miller, K., Azar, M., Osband, I., Rabinowitz, N., Gyorgy, A., Chiappa, S., Osindero, S., The, YW., van Hasselt, H., Freitas, N., Botvinick, M., Legg, S. (2019) Meta-learning of sequential strategies. *arXiv*
- Miller, K., Botvinick, M., and Brody, C. (2018) From predictive models to cognitive models: An analysis of rat behavior on the two-armed bandit task. *bioRxiv*
- Miller, K., Ludvig, E., Pezzulo, G., Shenhav, A., (2018) Re-aligning models of habitual and goal-directed decision-making. In: Morris, Bornstein, and Shenhav (eds.) *Goal-Directed Decision-Making: Computations and Neural Circuits*

- Miller, K.**, (2017) Neural mechanisms of model-based planning in the rat. *PhD Thesis*
- Miller, K.**, Brody, C., Botvinick, M. (2016) Identifying model-based and model-free patterns in behavior on multi-step tasks. *bioRxiv*
- Bornstein, A., Shenhav, A., **Miller, K.** (2015) Walking bundles of habits (and response-outcome associations). *European Journal of Neuroscience* (commentary)

Conference Talks

- Miller, K.**, (2019). *Neural mechanisms of model-based planning in the rat*. Symposium on the Biology of Decision Making, Oxford, UK
- Miller, K.**, Boyd-Meredith, JT., Daw, N., Botvinick, M., Brody, C. (2017) *Hippocampal Sequences and Model-Based Planning in the Rat*. Society for Neuroscience, Washington DC
- Miller, K.**, Botvinick, M., Brody, C. (2015). *The role of orbitofrontal cortex in cognitive planning in the rat*. Reinforcement Learning and Decision Making, Edmonton, Alberta. **(Best Paper Award)**
- Miller, K.** (2015), Barbados Workshop on Reinforcement Learning, Bellairs Research Institute, Barbados
- Miller, K.** (2015), *A causal role for dorsal hippocampus in cognitive planning in the rat*. Computational & Systems Neuroscience Workshops, Salt Lake City, UT
- Miller, K.** (2014), *Fitting the data as well as they can be fit: Rat behavior in a two-armed bandit task*. Workshop on the Neurobiology of Prediction and Surprise, Rutgers University, New Brunswick, NJ
- Miller, K.** (2014), *Fitting the data as well as it can be fit: An analysis of rodent behavior on the two-armed bandit task*. Computational & Systems Neuroscience Workshops, Salt Lake City, UT

Conference Posters

- Miller, K.**, Wang, J., Kurth-Nelson, Z., Botvinick, M. (2019). *Understanding emergent structure-based learning in recurrent neural networks*. Reinforcement Learning and Decision Making, Montreal, Quebec.
- Venditto, SJ., **Miller, K.**, Botvinick, M., Daw, N., Brody, C. (2019) *Hippocampal Sequences and Model-Based Planning in the Rat*. Computational & Systems Neuroscience, Lisbon, Portugal
- Miller, K.**, Botvinick, M., Brody, C. (2018) *Value representations in the orbitofrontal cortex drive learning, not choice*. Society for Neuroscience, San Diego, CA
- Miller, K.**, Venditto, SJ., Daw, N., Botvinick, M., Brody, C. (2018) *Hippocampal Sequences and Model-Based Planning in the Rat*. Computational & Systems Neuroscience, Denver, CO
- Miller***, K., Shenhav*, A., Ludvig, E. (2017). *Habits without values*. Computational Cognitive Neuroscience, New York City, NY (*Contributed equally)
- Miller, K.**, Botvinick, M., Brody, C. (2017). *Orbitofrontal cortex and planning: The role of model-based value signals*. Computational & Systems Neuroscience, Salt Lake City, UT
- Miller, K.**, Botvinick, M., Brody, C. (2016). *Role of orbitofrontal cortex in model-based planning in the rat*. Society for Neuroscience, San Diego, CA
- Miller, K.**, Botvinick, M., Brody, C. (2016). *Role of orbitofrontal cortex in model-based planning in the rat*. Computational & Systems Neuroscience, Salt Lake City, UT
- Miller, K.**, Botvinick, M., Brody, C. (2015). *Role of orbitofrontal cortex in model-based planning in the rat*. Society for Neuroscience, Chicago, IL
- Shenhav*, A., **Miller***, K., Ludvig, E. (2015). *Habits without values: A case in which RL can be left out of DM*. Reinforcement Learning and Decision Making, Edmonton, Alberta (*Contributed equally)
- Miller, K.**, Botvinick, M., Brody, C. (2015). *Neural mechanisms of model-based planning in the rat*. Computational & Systems Neuroscience, Salt Lake City, UT

- Miller, K.,** Erlich, J., Kopec, C., Botvinick, M., & Brody, C. (2014). *A multi-step decision task elicits planning behavior in rats*. Computational & Systems Neuroscience, Salt Lake City, UT
- Miller, K.,** Erlich, J., Kopec, C., Botvinick, M., & Brody, C. (2013). *A multi-step decision task in rats to distinguish model-based from model-free reinforcement learning*. Society for Neuroscience, San Diego, CA
- Miller, K.,** Erlich, J., Kopec, C., Botvinick, M., & Brody, C. (2013). *A seven-parameter mixture model that describes steady-state rodent behavior on a two-armed bandit task nearly as well as it can be described: Applications to orbitofrontal cortex inactivations*. Reinforcement Learning and Decision Making, Princeton, NJ
- Fogelson, S., **Miller, K.** Kohler, P., Granger, R., & Tse, P. (2012) *Equally invisible but neurally unequal: Cortical responses to invisible objects differ as a function of presentation method*, Vision Science Society, Naples, Florida
- Fogelson, S., **Miller, K.** Kohler, P., Granger, R., & Tse, P. (2011). *Not all suppressions are created equal: Categorical decoding of unconsciously presented stimuli varies with suppression paradigm*, European Conference on Visual Perception, Toulouse, France
- Wei, Q., **Miller, K.,** Davalt, D., & Onofrio, R. (2009). *Distance dependence of contact potential in cylindrical-plane Casimir force measurements*. Bulletin of the American Physical Society. Pittsburgh, PA.

Awards and Honors

Harold W. Dodd Honorific Fellowship , Princeton University	2015 – 2016
Best Paper Award , Reinforcement Learning and Decision Making Conference	2015
Graduation <i>cum laude</i> , Dartmouth College	2010
Honors in the Cognitive Science Major , Dartmouth College	2010
Cognitive Science Award , Dartmouth College	2010
Presidential Research Fellowship , Dartmouth College	2008 – 2009
Valedictorian , Devon Preparatory School	2006

Teaching Experience

Instructor , Prison Teaching Initiative, Princeton University	
College accredited courses for inmates in local prisons	
▪ Math 37 – Prealgebra	Spring, 2016
▪ Math 140 – Intermediate Algebra	Fall, 2015
▪ Math 135 – Intermediate Algebra	Summer, 2015
▪ Math 37 – Prealgebra	Spring, 2015
Teaching Assistant , Princeton Neuroscience Institute	
▪ BCNN – summer course in methods of neuroscience	Summer, 2013
▪ Neuroscience 101 – introductory lab course for non-science majors	Spring, 2013
▪ Neuroscience 501a – intensive course for first-year grad students	Fall, 2012
Study Group Leader , Academic Skills Center, Dartmouth College	2007 – 2010
Private Tutor , Hanover, NH	2009 – 2010
Teaching Assistant , Department of Physics, Dartmouth College	2008 – 2009
Teaching Opportunities in Physical Science , Massachusetts Institute of Technology	2009
Intensive six-week summer program on teaching physics. Developed and presented a series of hour-long interactive lessons on the physics of waves and light to groups of middle and high school students.	
Dartmouth ESL Tutors	2006 – 2008

Worked individually with elementary and high school students whose first language is not English to help them overcome language barriers interfering with academic success.

Other Experience

Princeton University Mountaineering Club

President

2014 - 2015

Vice President

2012 - 2014; 2015 - 2017

Helped to run the graduate student outing club at Princeton. Initiated a now-annual "Big Fall Trip" to welcome new graduate students, as well as spring break trips, summer and winter cabin trips, and many weekend and day trips.

Cabin and Trail (CnT), Dartmouth Outing Club

Chair

2009 - 2010

Ran an outing club with over 500 members, including over 30 leaders. Managed an annual budget of \$38,000. During my time as chair, CnT maintained a network of eleven cabins, eight shelters and 75 miles of the Appalachian Trail, and ran an average of five trips each week.

Leader

2008 - 2011

Planned, organized, and led hiking, skiing, trailwork, and other outdoor trips. Led over 50 trips, totaling over 1500 hours and 50 nights on the trail. Assisted twelve underclassmen to become leaders, co-leading over 20 trips, and running many skill seminars.

Dartmouth Chamber Orchestra, Double Bass 2006-2008, **Section Leader** (three terms)

Boy Scout Troop 181, Paoli, PA, **Eagle Scout**, Summer 2004