

Erie D. Boorman, PhD
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Associate Professor, UC Davis

Academic positions

- 2022-present Associate Professor (tenured), Center for Mind and Brain and Dept. of Psychology, and Director, Learning and Decision Making Lab, UC Davis
- 2016-2022 Assistant Professor, Center for Mind and Brain and Dept. of Psychology, and Director, Learning and Decision Making Lab, UC Davis
- 2014-2016 Postdoctoral Research Fellow, Computational Neuroscience Lab, University of Oxford and University College London (UCL). Professor Tim Behrens
- 2010-2014 Sir Henry Wellcome Postdoctoral Fellow, California Institute of Technology and University of Oxford. Professors Tim Behrens, John O'Doherty and Antonio Rangel

Education

- D.Phil (Ph.D.), Experimental Psychology (Feb 2010), University of Oxford. Advisor: Matthew Rushworth
- M.Sc. (Distinction), Neurosciences (Aug 2006), University of Oxford
- B.A. (Honors), Psychology, Neuroscience track (June 2004), Stanford University.

Select Fellowships and Awards

- NSF CAREER Award**, 2019-2024
- Sir Henry Wellcome Postdoctoral Fellowship**, 2010-2014
- Wellcome Trust Prize Studentship**, University of Oxford, 2005-2010
- Overseas Research Student Award**, University of Oxford, 2006-2009

Select Publications

- Park S.A., Zolfaghar M., Russin J., Miller S.M., O'Reilly R.C., **Boorman E.D.** (under review). *The representational geometry of cognitive maps under dynamic cognitive control*. Preprint: <https://www.biorxiv.org/content/10.1101/2023.02.04.527142v1>
- Yu L.Q. *, Park S.A. *, Sweigart S.C., **Boorman E.D.** †, Nassar M.R. † (submitted). *Do grid codes afford generalization and flexible decision-making?* *arXiv* :2106.16219.
- * , † These authors contributed equally to this work. *Preprint*: <https://arxiv.org/pdf/2106.16219>

- Witkowski P.P., Rondot L., Kurth-Nelson Z., Garvert M.M., Dolan R.J., Behrens T.E., **Boorman E.D.** (in press). Neural mechanisms of credit assignment for delayed outcomes during contingent learning. *eLife*: <https://elifesciences.org/reviewed-preprints/101841>
- Holley D., **Boorman E.D.**, Fox A.S. (2024). *Manipulating the Temporal Dynamics of Uncertainty Drives Anxiety and Avoidance*. **Computational Psychiatry**: 8(1):85-91.
- Orloff M.A., **Boorman E.D.** (2024). *Cognitive Maps: Constructing a Route with Your Snout*. **Current Biology**: 33(18): R963-R965.
- Ianni A., Eisenberg D., **Boorman E.D.**, Constantino S., Hegarty C., Gregory M., Masdeu J., Kohn P., Behrens T.E., and Berman K. (2024). *PET-measured human dopamine synthesis capacity and receptor availability predict trading rewards and time-costs during foraging*. **Nature Communications**, 14(1):6122.
- Crivelli-Decker J., Clarke A., Park S.A., Huffman D.J., **Boorman E.D.**, Ranganath C.R. (2023). *Goal-oriented representations in the human hippocampus during planning and navigation*. **Nature Communications**, 14(1):2946.
- Witkowski P.P., Park S.A., **Boorman E.D.** (2022). *Neural mechanisms of credit assignment for inferred relationships in a structured world*. **Neuron**, 110, 1-11.
- Park, S.A., Miller, D.S., **Boorman, E.D.** (2021). *Novel Inferences in a Multidimensional Social Hierarchy Use a Grid-like Code*. **Nature Neuroscience**, 24: 1292–1301.
- News and Views by Du, M. and Parkinson, C. (2021). *Navigating Social Knowledge*. *Nature Neuroscience* 24, 1195–1197.
- Mizrak E., Bouffard N.R., Libby L.A., **Boorman E.D.**, Ranganath, C. (2021). The hippocampus and orbitofrontal cortex jointly represent task structure during memory-guided decision making. **Cell Reports** 37: 110065.
- Boorman E.D.**, Witkowski P., Zhang Y., Park S.A. (2021). *The orbital frontal cortex, task structure, and inference*. **Behavioral Neuroscience**, 135: 291-300.
- Boorman E.D.**, Sweigart, S.C., Park S.A. (2021). *Cognitive maps and novel inferences: a flexibility hierarchy*. **Current Opinions in Behavioral Sciences**, 38: 141-149.
- Park, S.A., Miller D.S., **Boorman, E.D.** (2021). *Protocol for building a cognitive map of structural knowledge in humans by integrating piecemeal learned abstract relationships from separate experiences*. **Star Protocols**, 2.
- Park S.A., Miller D.S., Nili H., Ranganath C.R., **Boorman E.D.** (2020). *Map Making: Constructing, Combining, and Inferring on Abstract Cognitive Maps*. **Neuron**. S0896-6273(20).
- Commentary by Bellmund J.L.S. (2020). *Piecing Together Cognitive Maps One Dimension at a Time*. *Neuron*. 107:996-999.
- Park, S.A., Sestito, M., **Boorman, E.D.**, Dreher, J.C. (2019). *Neural computations underlying strategic social decision-making in groups*. **Nature Communications** 10:5287.
- Hill, M.R., **Boorman, E.D.**, Fried, I. (2016). *Observational learning computations in single neurons of the human anterior cingulate cortex*. **Nature Communications**: 7:12722.

Boorman, E.D., Rajendran, V., O'Reilly, J.X., Behrens, T.E. (2016). *Two computationally and anatomically distinct learning signals predict changes to stimulus-outcome associations in hippocampus*. **Neuron**: 89:1343-54.

Boorman, E.D., O'Doherty, J.P., Adolphs, R., Rangel, A. (2013). *The behavioral and neural mechanisms underlying the tracking of expertise*. **Neuron**: 80:1558-71.

Boorman, E.D., Rushworth, M.F., Behrens, T.E. (2013). *Ventromedial prefrontal and anterior cingulate cortex adopt choice and default reference frames during sequential multialternative choice*. **Journal of Neuroscience**: 33:2242-53.

Rushworth, M.F., Noonan, M.P., **Boorman, E.D.**, Walton, M.E., Behrens, T.E. (2011). *Frontal cortex and reward-guided learning and decision-making*. **Neuron**: 70:1054:69.

Higo, T., Mars, R.B., **Boorman, E.D.**, Buch, E.R., Rushworth, M.F. (2011). *Distributed and causal influence of frontal operculum in task control*. **PNAS**: 108:4230-5.

Boorman, E.D., Behrens, T.E., Rushworth, M.F. (2011). *Counterfactual choice and learning in a neural network centered on human lateral frontopolar cortex*. **PLoS Biology**: 9:e1001093.

Boorman, E.D., Rushworth, M.F. (2009). *Conceptual representation and the making of new decisions*. **Neuron**, 63:721-3.

Boorman, E.D., Behrens, T.E., Woolrich, M.W., and Rushworth, M.F.S. (2009). *How green is the grass on the other side? Frontopolar cortex and the representation of alternative courses of action*. **Neuron**, 62:733-43.

Boorman, E.D., O'Shea, J., Sebastian, C., Rushworth, M.F.S., Johansen-Berg, H. (2007). *Individual Differences in White-Matter Microstructure Reflect Variation in Functional Connectivity during Choice*. **Current Biology**, 17:1426-31.

Peer-reviewed Conference Proceedings

Seongmin A. Park*, Jacob L. Russin*, Maryam Zolfaghar*, Randall C. O'Reilly, **Erie D Boorman** (* contributed equally). (2022). *The geometry of map-like representations under dynamic cognitive control*. Proceedings of the annual meeting of the cognitive science society (CogSci).

Jacob L. Russin, Maryam Zolfaghar, Seongmin A. Park, **Erie D. Boorman**, Randall C. O'Reilly. (2022). *A neural network model of continual learning with cognitive control*, Proceedings of the annual meeting of the cognitive science society (CogSci).

Seongmin A. Park*, Jacob L. Russin*, Maryam Zolfaghar*, Randall C O'Reilly, **Erie D. Boorman** (* contributed equally). (2022). *The geometry of map-like representations under dynamic cognitive control*, Computational and Systems Neuroscience (COSYNE).

Jacob L. Russin, Maryam Zolfaghar, Seongmin A Park, **Erie D. Boorman**, Randall C. O'Reilly, *Complementary structure-learning neural networks for relational reasoning*. (2021). Proceedings of the annual meeting of the cognitive science society (CogSci).

Seongmin A. Park, Douglas S. Miller, **Erie D. Boorman**, *Hexadirectional coding of decision trajectories through abstract and discrete spaces*. (2020). Computational and Systems Neuroscience (COSYNE).

Funding

NIMH RO1 Award, Computational Neuroscience Program, UC Davis 06/01/21-05/31/26
Cognitive maps for goal-directed decision making

Role: Principal Investigator Total Amount: \$2,602,970

NIMH R56 Award, Learning and Memory Program, UC Davis 12/30/19-12/29/22

Model-based credit assignment

Role: Principal Investigator Total Amount: \$770,34

NSF CAREER Award, Science of Learning Program, UC Davis 08/01/19-07/30/24

Contingent Learning in a Structured World

Role: Principal Investigator Total Amount: \$753,918

NSF Grant, Cognitive Neuroscience Program, UC Davis, 9/1/2020-8/31/2023

Mechanisms for causal and non-causal predictive learning Total Amount: \$657,263

Role: Principal Investigator

ONR Grant, Computational Neuroscience Program, UC Davis 07/24/2020-04/12/2024

Dynamic Cortico-Hippocampal Interactions for Flexible Goal-driven Agents.

Role: Co-Investigator (O'Reilly and Ranganath PIs) Total Amount: \$2,250,000

NIMH R21, Social and Affective Neuroscience Program, UC Davis 04/2022 – 03/2024

Rethinking the Neural Correlates of Uncertain Threat Anticipation with a Statistical Learning Approach.

Role : Co-Investigator (Fox PI) Total Amount: \$414,479

NIMH R01, Social and Affective Neuroscience Program, UC Davis 07/01/2022 – 06/30/2027

Using theory- and data-driven neurocomputational approaches and digital phenotyping to understand RDoC Acute and Potential Threat

Role: Co-Investigator (Shackman PI) Total Amount: \$3,869,732.08

Professional Activity

Board Member, Society for Neuroeconomics, 2024-present

Reviewing Editor, Frontiers in Decision Neuroscience