

# Kimberly Lauren Stachenfeld

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## Education

Princeton University June 2018  
Ph.D. Quantitative & Computational Neuroscience  
*Dissertation: Learning Neural Representations that Support Efficient Reinforcement Learning ([link](#))*  
*Advisor: Dr. Matthew Botvinick*

Princeton University January 2015  
M.A. Quantitative & Computational Neuroscience  
*Advisors: Drs. Matthew Botvinick, Kenneth Norman*

Tufts University May 2013  
B.S. Chemical & Biological Engineering  
B.S. Mathematics

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## Positions

2016 – present **Research Scientist**, Structured Intelligence Team, Neuroscience, DeepMind  
Summer 2015 **Research Intern**, Navigation Team, Neuroscience, DeepMind  
Summer 2012 **Research Assistant**, Computational Neurobiology Lab, Yale School of Medicine  
Summer 2011 **Intern**, Analytical Research & Development, Pfizer, Inc.  
2010 – 2011 **Research Assistant**, Tissue & Metabolic Engineering Lab, Tufts University

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## Awards

- 2019 MIT Technology Review 35 Under 35. [Link](#).
- 2014 WiML (Women in Machine Learning) Travel Grant to attend NeurIPS 2014 WiML Workshop.
- 2014 Google Travel Grant to attend NeurIPS 2014.
- 2014 NSF Graduate Research Fellowship Program (GRFP) Honorable Mention.
- 2012 Tau Beta Pi (Engineering Honor Society).
- 2012 Meritorious Award in COMAP International Mathematical Contest in Modeling.
- 2011 Meritorious Award in COMAP International Mathematical Contest in Modeling.
- 2010 Karno Dean's Award for Academic Excellence and Leadership. Tufts University.

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## Journal Articles

- Jesse P. Geerts, Samuel J. Gershman, Neil Burgess, [Kimberly L. Stachenfeld](#) (in prep). Uncertainty and the Successor Representation.
- LT Hunt, ND Daw, P Kaanders, MA Maclver, U Mugan, E Procyk, AD Redish, E Russo, J Scholl, [KL Stachenfeld](#), CRE Wilson, N Kolling. (2021). Formalizing planning and information search in naturalistic decision-making. *Nature Neuroscience*. [article](#).
- Daniel C. McNamee, [Kimberly L. Stachenfeld](#), Matthew M. Botvinick, Samuel J. Gershman. (2021). Flexible modulation of sequence generation in the entorhinal–hippocampal system. *Nature Neuroscience* **24**(6): 851–862. [article](#).
- Jesse P. Geerts, Fabian Chersi, [Kimberly L. Stachenfeld](#), Neil Burgess. (2020). A general model of hippocampal and dorsal striatal learning and decision making. *PNAS* **117**(49): 31427–31437. [article](#).
- Timothy E. J. Behrens, Timothy H. Muller, James C.R. Whittington, Shirley Mark, Alon B. Baram, [Kimberly L. Stachenfeld](#), Zeb Kurth-Nelson. (2018). What is a cognitive map? Organising knowledge for flexible behavior. *Neuron* **100**(2): 490–509. [article](#), [preprint](#).
- Jeremy Manning, Xia Zhu, Theodore L. Willke, Rajesh Ranganath, [Kimberly L. Stachenfeld](#), Uri Hasson, David M. Blei, Kenneth A. Norman. (2018). A probabilistic approach to discovering dynamic full-brain functional connectivity patterns. *NeuroImage* **180**(A):243–252. [article](#), [preprint](#).
- [Kimberly L. Stachenfeld](#), Matthew M. Botvinick, & Samuel J. Gershman. (2017). The hippocampus as a predictive map. *Nature Neuroscience* **20**: 1643–165. [article](#), [preprint](#).
- Marcelo S. Caetano, Lu E. Jin, Linda Harenberg, [Kimberly L. Stachenfeld](#), Amy F.T. Arnsten, & Mark Laubach. (2012). Noradrenergic control of error perseveration in medial prefrontal cortex. *Frontiers in Integrative Neuroscience* **6**: 125. [article](#).

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## Refereed Conference Proceedings

- [Kimberly L. Stachenfeld](#), Drummond B. Fielding, Dmitrii Kochkov, Miles Cranmer, Tobias Pfaff, Jonathan Godwin, Can Cui, Shirley Ho, Peter Battaglia, Alvaro Sanchez-Gonzalez. (in review). Learned Simulators for Astrophysical Turbulence. **Selected for contributed talk.**
- [Kimberly L. Stachenfeld](#), Jonathan Godwin, Peter Battaglia. (2020). Graph Networks with Spectral Message Passing. In *NeurIPS Workshop: Interpretable Inductive Biases and Physically Structured Learning*. [arXiv](#). **Selected for contributed talk.**
- Jesse Geerts, [Kimberly L. Stachenfeld](#), Neil Burgess. (2019). Probabilistic Successor Representations with Kalman Temporal Differences. In *Cognitive Computational Neuroscience*. [arXiv](#).
- Victor Bapst, Alvaro Sanchez-Gonzalez, Omar Shams, [Kimberly L. Stachenfeld](#), Peter W Battaglia, Satinder Singh, Jessica B Hamrick. (2019). Object-oriented state editing for HRL. In *NeurIPS Workshop: Perception as Generative Reasoning*. [arXiv](#).
- Victor Bapst, Alvaro Sanchez-Gonzalez, Carl Doersch, [Kimberly L. Stachenfeld](#), Pushmeet Kohli, Peter W. Battaglia, Jessica B. Hamrick. (2019). Structured Agents for Physical Construction. In *International Conference on Machine Learning (ICML)*. [arXiv](#).

David Pfau, Stig Petersen, Ashish Agarwal, David G. T. Barrett, [Kimberly L. Stachenfeld](#). (2019). Spectral Inference Networks: Unifying Deep and Spectral Learning. In *International Conference on Learning Representations (ICLR)*. [arXiv](#).

[Kimberly L. Stachenfeld](#), Matthew M. Botvinick, & Samuel J. Gershman. (2014). Design principles of the hippocampal cognitive map. In *Advances in Neural Information Processing Systems (NeurIPS)* **27**: 2528–2536. [proceedings](#). **Selected for spotlight presentation.**

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## Conference & Workshop Talks

May 2021 Deep Learning for Simulation (SimDL), ICLR Workshop.  
May 2021 Generalization beyond the training distribution in brains and machines, ICLR Workshop.  
Dec 2020 Interpretable Inductive Biases and Physically Structured Learning, NeurIPS Workshop.  
Dec 2020 Biological and Artificial RL, NeurIPS Workshop.  
July 2020 Graph Representation Learning and Beyond (GRL+), ICML Workshop.  
Apr 2020 Bridging AI and Cognitive Science (BAICS), ICLR Workshop.  
Apr 2020 Bridging AI and Cognitive Science, ICLR Workshop.  
Mar 2020 15 Years of Grid Cells, COSYNE Workshop, Breckenridge, CO.  
Mar 2020 Structure Learning: Graphs, manifolds, and geometries, COSYNE Workshop, Breckenridge, CO.  
Sep 2019 Tutorial on “Representing states and spaces”, CCN, Berlin, Germany.  
Jun 2019 Machine learning in Neuroscience, SfN Virtual Conference.  
May 2019 Symposium on the Biology of Decision Making (SBDM), Oxford, UK.  
Apr 2019 Grid cells beyond self-location. BNA2019 Festival of Neuroscience, Dublin, Ireland.  
Mar 2019 Beyond trial-based choice, COSYNE Workshop, Lisbon, Portugal.  
Nov 2018 Nanosymposium: 111 - Decision Making: Circuits and Computations, SfN 2018, San Diego, CA.  
Nov 2018 Nanosymposium 633 - Animal Cognition and Behavior: Learning and Memory: Cortical Hippocampal Interactions II, SfN 2018, San Diego, CA.  
May 2018 Symposium on Hippocampal Network and Memory Across the Lifespan: Circuit, Code, Cognition, Hungarian Academy of Sciences & Max Planck, Budapest, Hungary.  
May 2018 London Grid Cell Meeting, Sainsbury Wellcome Center, London, UK.  
Mar 2018 Hippocampal computations and interactions supporting statistical learning and decision making, COSYNE Workshop, Breckenridge, CO.  
Jun 2015 Contributed Talk, Reinforcement Learning Decision Making (RLDM), Edmonton, AB.  
Mar 2015 Memory in action, COSYNE Workshop, Snowbird, UT.  
Dec 2014 Spotlight Talk, Neural Information Processing Systems (NeurIPS), Montreal, QC.

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## Invited Seminar Talks

Jun 2021 Brains@Bay, An Exploration of Grid Cells in Machine Learning, Numenta (virtual).  
Apr 2021 Duke CCN Colloquium (virtual).  
Apr 2021 Columbia CTN Seminar (virtual).  
Feb 2021 The Learning Salon (virtual).  
Feb 2020 Stanford MBCT Colloquium, Palo Alto, CA.  
Jan 2020 Invited Talk, University of Nottingham, Nottingham, UK.  
Jan 2020 Theoretical Neurobiology Meeting, UCL, London, UK.  
Sep 2019 Invited Talk, Magdeburg DZNE.  
Aug 2019 Invited Talk, Boston University, Boston, MA.  
Aug 2019 Methods in Neuroscience Dartmouth (MIND) Summer School, Hanover NH.  
Oct 2018 Allergic Seminar, University of Sussex Wellcome Center, London, UK.  
Sep 2018 Data Club, Sainsbury Wellcome Center, London, UK.

Aug 2018	Invited Seminar Talk, Janelia Research Campus, Ashburn, VA.
Feb 2018	London Judgment and Decision Making Seminar, University College London, UK.
May 2016	EADS Computer Science Talk, University of Copenhagen, Copenhagen, DK.
Apr 2016	Invited Talk, Max Planck Centre, University College London, London, UK.
Jan 2016	PNI In-House Seminar, Princeton Neuroscience Institute, Princeton, NJ.

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## Posters

Jesse Geerts, [Kimberly Stachenfeld](#), Neil Burgess. Probabilistic Successor Representations with Kalman Temporal Differences. In *Computational Cognitive Neuroscience (CCN)*, Berlin, Germany (2019).

Jesse Geerts, Fabian Chershi, [Kimberly Stachenfeld](#), Neil Burgess. Hippocampal and striatal localisation and navigation strategies. In *HBP Neural SLAM Workshop*, Paris, France (2019).

Daniel McNamee, [Kimberly Stachenfeld](#), Matthew Botvinick, Samuel Gershman. Factoring space and time in the hippocampal-entorhinal system. In *47th Meeting of the Society for Neuroscience (SfN)*, San Diego, CA (2018).

Jesse Geerts, Fabian Chershi, [Kimberly Stachenfeld](#), Neil Burgess. Modelling hippocampal and striatal contributions to reward-based navigation. In *iNav Symposium*, Mont Tremblant, Canada (2018).

[Kimberly L. Stachenfeld](#), Matthew M. Botvinick, Samuel J. Gershman. The hippocampus as a predictive map. In *Collaborative Research in Computational Neuroscience (CRCNS) Conference 2016*, Paris, France (2016).

[Kimberly L. Stachenfeld](#), Jeremy R. Manning, Xia Zhu, Jeremy M. Cohen, Rajesh Ranganath, Erez Simony, Janice Chen, Uri Hasson, Ted Willke, David M. Blei, and Kenneth A. Norman. A probabilistic approach for exploring functional brain networks in fMRI during story-telling and at rest. In *45th Meeting of the Society for Neuroscience (SfN)*, Chicago, IL (2016).

[Kimberly L. Stachenfeld](#), Matthew M. Botvinick, Samuel J. Gershman. Reinforcement learning objectives constrain the cognitive map. In *Reinforcement Learning Decision Making (RLDM) 2015*, Edmonton, AB, Canada (2015).

[Kimberly L. Stachenfeld](#), Matthew M. Botvinick, Samuel J. Gershman. Design Principles of the Hippocampal Cognitive Map. In *Neural Information Processing Systems (NeurIPS) 27*, Montreal, QC, Canada (2014).

[Kimberly L. Stachenfeld](#), Matthew M. Botvinick, Samuel J. Gershman. Representations in Place Fields Facilitate Navigation and Reinforcement Learning. In *44th Meeting of the Society for Neuroscience (SfN)*, Washington, D.C. (2014).

Jeremy R. Manning, [Kimberly L. Stachenfeld](#), Rajesh Ranganath, Kenneth A. Norman, David M. Blei. Efficient Discovery of Functional Brain Networks in Large Multi-Subject fMRI Datasets. In *44th Meeting of the Society for Neuroscience (SfN)*, Washington, D.C. (2014).

Michael C. Yi, Gautham V. Sridharan, Katherine K. Carson, [Kimberly L. Stachenfeld](#), Kyongbum Lee. Targeted Metabolomics of Cofactors in Altered Liver Metabolism. In *Annual American Institute of Chemical Engineering Meeting*, Minneapolis, MN (2013).

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## Press + Outreach

- [Several brain regions help us anticipate what's going to happen next](#) by PNAS. 30 April 2021.
- [Of Brains and Machines](#) by Carry the One Radio. 6 July 2020.
- [EmTech](#) by MIT Technology Review. 18 September 2019.
- [What is AI Anyway?](#) AI panel at Cheltenham Science Festival. 8 June 2019.
- [Mind over Matter](#). GSN Munich podcast with Ekaterina Sytnik. 22 April 2019.
- [A Hexagonal Theory of Memory](#). *The Atlantic* (reprint of the Quanta article). 18 January 2019.
- [The Brain Maps Out Ideas and Memories Like Spaces](#). *Quanta Magazine*. 14 January 2019.
- [The Surprising Relativism of the Brain's GPS](#). *Nautilus*. 22 March 2018.
- [The hippocampus as a 'predictive map'](#). *DeepMind Blog*. 2 October 2017.
- [DeepMind's New Way to Think About the Brain Could Improve How AI Makes Plans](#). *MIT Technology Review*. 3 October 2017.

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## Ad hoc Reviewer

- Journals** Nature Communications, Scientific Reports, eLife, PLOS Computational Biology, Hippocampus, IEEE Transactions on Neural Networks and Learning Systems
- Conferences** CoSyNe, ICML, NeurIPS, ICLR, UAI

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## Workshops

- March 2020 **Organizer**, Structure learning: graphs, manifolds, and geometries, COSYNE Workshop
- October 2019 **Panel Moderator**, Symposium on Abstraction & Generalisation, Sainsbury-Wellcome Centre & Gatsby
- August 2019 **Pop-up PI**, Methods in Neuroscience at Dartmouth ([MIND](#)) Summer School
- June 2019 **Organizer**, [Generative Modeling & Model-Based reasoning for Robotics and AI](#), ICML
- April 2019 **Session Chair**, S1 Grid cells beyond self-localization, BNA2019 Festival of Neuroscience
- Nov 2018 **Nanosymposium Chair**, 111. Decision Making: Circuits and Computations, SfN
- May 2018 **Session Chair**, [Grid Cells and Cognitive Maps Meeting](#), Sainsbury-Wellcome Centre
- March 2018 **Organizer**, [Model-Based Cognition](#), COSYNE Workshop
- May 2015 **Organizer**, Princeton Neuroscience Department Retreat

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## Teaching

- Dec 2020 **Guest Lecture**, SWC Graduate Course in Neuroscience, UCL
- Sep 2019 **Tutorial**, Representing States & Spaces, Cognitive Computational Neuroscience
- Aug 2019 **Tutorial + Lab**, Methods in Neuroscience at Dartmouth (MIND) Summer School
- Spring 2015 **Teaching Assistant**, NEU259: Intro to Cognitive Neuroscience, Princeton University
- Fall 2014 **Teaching Assistant**, NEU258: Fundamentals of Neuroscience, Princeton University
- Fall 2014 **Instructor**, Math 135 & 37, Prison Teaching Initiative, Princeton University  
In an NJ university? [Get involved!](#)
- 2010 – 2012 **Tutor**, Physics, Chemistry, & Calculus, Academic Resource Center, Tufts University

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## Mentoring

Dec 2020 – present	Tom George, PhD Student, UCL
Oct 2020 – present	Raghad Zuraiki, Masters Student, DeepMind Scholars Program
Dec 2019 – present	Ayla Richardson, Masters Student, DeepMind Scholars Program
Mar 2018 – present	Jesse Geerts, PhD Student, UCL
Jan 2012 – May 2012	Freshmen Engineers, Tufts Chemical & Biological Engineering Senior Mentoring

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## Beyond Science

- **Martial Arts.** Blackbelts in Tae Kwon Do (2009—15, 1<sup>st</sup> dan) & Isshinryu Karate (1998—2009, 3<sup>rd</sup> dan)
- **Painting & drawing.** I especially like life drawing.
- **Going outside.** I like running, hiking, trekking, canyoning, and skiing, particularly with friends.