

# Kimberly Lauren Stachenfeld

Senior Research Scientist  
DeepMind  
London, UK  
[stachenfeld@google.com](mailto:stachenfeld@google.com)  
[www.neurokim.com](http://www.neurokim.com)  
[@neuro\\_kim](https://twitter.com/neuro_kim)

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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

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

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## Positions

2021 – present **Senior Research Scientist**, DeepMind  
2016 – 2021 **Research Scientist**, DeepMind  
Summer 2015 **Research Science Intern**, 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

Tom George, Will de Cothi, [Kimberly L. Stachenfeld](#), Caswell Barry (in prep). Rapid approximation of Successor Representations with STDP and theta phase precession.

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. Learned Coarse Models for Efficient Turbulence. (*in review*).

[Kimberly L. Stachenfeld\\*](#), Alvaro Sanchez-Gonzalez\*, Drummond B. Fielding, Dmitrii Kochkov, Miles Cranmer, Tobias Pfaff, Jonathan Godwin, Can Cui, Shirley Ho, Peter Battaglia. Learning General-Purpose CNN-based Simulators for Astrophysical Turbulence. *Workshop on Deep Learning for Simulation, ICLR, 2021*. [Link](#). **Contributed talk**.

[Kimberly L. Stachenfeld](#), Jonathan Godwin, Peter Battaglia. Graph Networks with Spectral Message Passing. *Workshop on Interpretable Inductive Biases and Physically Structured Learning, NeurIPS, 2020*. [arXiv](#). **Contributed talk**.

Jesse Geerts, [Kimberly L. Stachenfeld](#), Neil Burgess. Probabilistic Successor Representations with Kalman Temporal Differences. *Cognitive Computational Neuroscience, 2019*. [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. *Workshop on Percpetion as Generative Reasoning, NeurIPS*. [arXiv](#).

Victor Bapst, Alvaro Sanchez-Gonzalez, Carl Doersch, [Kimberly L. Stachenfeld](#), Pushmeet Kohli, Peter W. Battaglia, Jessica B. Hamrick. Structured Agents for Physical Construction. *International Conference on Machine Learning (ICML)*, 2019. [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)*, 2019. [arXiv](#).

[Kimberly L. Stachenfeld](#), Matthew M. Botvinick, & Samuel J. Gershman. Design principles of the hippocampal cognitive map. *Advances in Neural Information Processing Systems (NeurIPS)*, 2014. [Link](#). **Spotlight presentation**.

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## Conference & Workshop Talks

Oct 2021 Reinforcement Learning Forward and Backward, Microsoft Research Summit (virtual).  
Oct 2021 Neural and Machine Intelligence, Champalimaud Research Symposium, Lisbon, Portugal.  
Jun 2021 Brains@Bay, An Exploration of Grid Cells in Machine Learning, Numenta (virtual).  
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.  
Dec 2020 Montreal AI and Neuroscience (MAIN). [Video](#).  
July 2020 Graph Representation Learning and Beyond (GRL+), ICML Workshop.  
Apr 2020 Bridging AI and Cognitive Science (BAICS), ICLR Workshop.  
Mar 2020 15 Years of Grid Cells, COSYNE Workshop, Breckenridge, CO.  
Mar 2020 Structure Learning, 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 Decision Making: Circuits and Computations Nanosymposium, SfN, San Diego, CA.  
Nov 2018 Cortical Hippocampal Interactions II Nanosymposium, SfN, San Diego, CA.  
May 2018 Hippocampal Network and Memory Across the Lifespan, 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

Apr 2021 Duke CCN Colloquium (virtual).  
Apr 2021 Columbia CTN Seminar (virtual).  
Feb 2021 The Learning Salon (virtual). [Video](#).  
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.
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, UCL, UK.
May 2016	EADS Computer Science Talk, University of Copenhagen, Copenhagen, DK.
Apr 2016	Invited Talk, Max Planck Centre, UCL, 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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## Organization

Sep 2022 **Organizing Committee**, Cognitive Computational Neuroscience (CCN) 2022 (upcoming)

Jun 2022 **Program Committee**, Reinforcement Learning & Decision-Making (RLDM) 2022 (upcoming)

Jun 2021 **Co-Organizer**, How does the brain combine generative models and direct discriminative computations in high-level vision? CCN GAC Workshop 2021

Mar 2020 **Organizer**, Structure learning: graphs, manifolds, and geometries, COSYNE Workshop

Mar 2020 **Organizer**, Structure learning: graphs, manifolds, and geometries, COSYNE Workshop

Oct 2019 **Panel Moderator**, Symposium on Abstraction & Generalisation, Sainsbury-Wellcome Centre & Gatsby

Jun 2019 **Organizer**, [Generative Modeling & Model-Based reasoning for Robotics and AI](#), ICML

Apr 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

Mar 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. [Video](#).

Aug 2019 **Pop-up PI**, Tutorial + Lab, Methods in Neuroscience at Dartmouth, Summer School. [Lecture](#), [Notebook](#).

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

May 2021                      Isabel Metzger, LatinX in AI Mentorship Program

Dec 2020 – present        Tom George, PhD Student, UCL

Oct 2020 – present        Raghad Zuraiki, Masters Student, DeepMind Scholars Program

July 2020                      Neuromatch Academy Mentor

Dec 2019 – present        Ayla Richardson, Masters Student, DeepMind Scholars Program

Mar 2018 – 2021            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.