

Grace W. Lindsay
Postdoctoral Research Fellow
University College London
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Education

Doctorate (PhD), Neurobiology and Behavior Program
Columbia University, New York, NY December 2017

Bachelor of Science in Neuroscience
University of Pittsburgh, Pittsburgh, PA May 2011

Positions Held

Postdoctoral Research Fellow September 2019 - present
Maternity Leave: Aug-Nov 2020
Gatsby Computational Neuroscience Unit/Sainsbury Wellcome Center, in the labs of
Maneesh Sahani and Tom Mrsic-Flogel/Sonja Hofer, University College London.

Postdoctoral Scientist January 2018-August 2019
Center for Theoretical Neuroscience, in the lab of Ken Miller, Columbia University.

Graduate Student September 2013-December 2017
Neurobiology and Behavior Program, in the lab of Ken Miller, Columbia University.

Research Fellow October 2011-July 2012
in the lab of Arvind Kumar, Bernstein Center for Computational Neuroscience in
Freiburg im Breisgau.

Undergraduate Research Fellow August 2009-August 2011
Program in Neural Computation, in the labs of Brent Doiron (Pitt Mathematics) and
Tai Sing Lee (CMU Computer Science), Center for the Neural Basis of Cognition at
Carnegie Mellon University.

Publications

"Bio-inspired neural networks implement different recurrent visual processing strategies than task-trained ones do." Grace W. Lindsay, Tom Mrsic-Flogel, and Maneesh Sahani. *bioRxiv* 2022.03.07.483196.

"Testing the Tools of Systems Neuroscience on Artificial Neural Networks." Grace W. Lindsay. *arXiv*:2202.07035.

"Divergent representations of ethological visual inputs emerge from supervised, unsupervised, and reinforcement learning" Grace W. Lindsay, Josh Merel, Tom Mrsic-Flogel, and Maneesh Sahani. *arXiv*:2112.02027.

"Deep Learning Networks and Visual Perception." Grace W. Lindsay and Thomas Serre. *Oxford Encyclopedia of Psychology* (2021).

"Attention in Psychology, Neuroscience, and Machine Learning." Grace W. Lindsay. *Frontiers in Computational Neuroscience* 14 (2020): 29.

"Convolutional neural networks as a model of the visual system: past, present, and

future." Grace W. Lindsay. *Journal of Cognitive Neuroscience* (2020): 1-15.

"A unified circuit model of attention: Neural and behavioral effects." Grace W. Lindsay, Daniel B. Rubin, and Kenneth D. Miller. *bioRxiv* (2019).

"A deep learning framework for neuroscience." Blake A. Richards, Timothy P. Lillicrap, Philippe Beaudoin, Yoshua Bengio, Rafal Bogacz, Amelia Christensen, Claudia Clopath et al. *Nature neuroscience* 22, no. 11 (2019): 1761-1770.

"How biological attention mechanisms improve task performance in a large-scale visual system model" Grace W. Lindsay and Kenneth D. Miller. *eLife*. 2018 Oct 1;7. pii: e38105. doi: 10.7554/eLife.38105.

"Hebbian Learning in a Random Network Captures Selectivity Properties of the Prefrontal Cortex." Grace W. Lindsay, Mattia Rigotti, Melissa R. Warden, Earl K. Miller, and Stefano Fusi. *Journal of Neuroscience* 8 November 2017, 37 (45) 11021-11036.

"Parallel processing by cortical inhibition enables context-dependent behavior." Kishore V. Kuchibhotla, Jonathan V. Gill, Grace W. Lindsay, Eleni S. Papadoyannis, Rachel E. Field, Tom A. Hindmarsh Sten, Kenneth D. Miller, and Robert C. Froemke. *Nature Neuroscience* 20, no. 1 (2017): 62-71.

"Feature-based Attention in Convolutional Neural Networks." Grace W. Lindsay. *arXiv* preprint arXiv:1511.06408 (2015).

Funding

Marie Skłodowska-Curie Individual Fellowship (2019-2021)

Gatsby Unit/Sainsbury Wellcome Center Research Fellowship (2019-2022)

Google PhD Fellowship in Computational Neuroscience (2016-2018)

NSF Graduate Research Fellowship Honorable Mention (2013)

DAAD (Deutscher Akademischer Austausch Dienst) Study Scholarship for study at the Bernstein Center in Freiburg, Germany (2011-2012)

CBSG (Complex Biological Systems Group) Undergraduate Fellowship (2010-2011)

uPNC (Program in Neural Computation) Undergraduate Research Fellowship (2009-2010)

Conference Talks

*=invited

*"Transformation over Transmission: Shifting the Focus of the Information Metaphor in Computational Neuroscience" Philosophy of Science Association Conference, online. November 2021.

*"Hypothesis generation and testing in cognitive neuroscience with deep learning" European Society for Philosophy and Psychology, online. September 2021.

*"Discrete Symbols vs. Continuous Neurons" Numerous Numerosity Conference, online. May 2021.

*"Exploring the top-down signals needed for visual attention" Cognitive Neuroscience Society conference, online. March 2021.

*"Modeling the influence of feedback in the visual system" Shared Visual Representations in Human and Machine Intelligence, NeurIPS Workshop, online. December 2020.

*"Attention in neuroscience and machine learning" International Meeting on Artificial Intelligence and its Applications (RIIAA), online. August 2020.

*"Merging neural circuit models with deep learning" Cosyne Workshops, Breckenridge USA. March 2020.

*"Understanding the feedback needed for top-down attention" Workshop on Roles and Mechanisms of Cortico-cortical Feedback at EITN, Paris France, November 2019.

*"Combining neural circuit models with deep learning" ELLIS Meeting, Berlin Germany, September 2019.

*"Attention and Modeling of Cognitive Processes." Organization for Human Brain Mapping (Educational Course), Rome Italy, June 2019.

*"The stabilized supralinear network captures neural and performance correlates of attention." Gatsby Tri-Center Meeting, University College London, June 2019.

"How can we incorporate connectivity data into neural network models?" Cognitive Computational Neuroscience Meeting (Breakout Session), September 2018, Philadelphia USA.

*"Synthesizing Experimental Data with Circuit Models." Cosyne Workshops, March 2018, Breckenridge USA.

"Understanding Biological Visual Attention Using Convolutional Neural Networks." Cognitive Computational Neuroscience Meeting 2017, New York City USA

"The stabilized supralinear network replicates neural and performance correlates of attention." Cosyne 2017, Salt Lake City USA

*"Studying visual attention in convolutional neural networks". Gatsby Tri-Center Meeting, University College London, June 2016.

*"Hebbian learning in a random network replicates pattern of selectivity seen in PFC". Gatsby Tri-Center Meeting, Columbia University, June 2015

*Invited seminar/lab speaker at: Bristol University, Brown University, Cambridge University, Cold Spring Harbor, CogIST, Deep Learning: Classics and Trends Online Seminar, Duke University, École Normale Supérieure, Harvard University, Imperial College London, Intel Labs, Janelia Research Campus, Max Planck Institute for Human Cognitive and Brain Sciences, MIT, Neural Mechanisms Online, Northwestern University, Oxford University, Royal Holloway (University of London), SISSA, Stanford University, and University of Houston

Teaching and Mentoring

Mentor for Simons Collaboration on the Global Brain Undergraduate Research

Fellowship, October 2021-April 2022.

Mentor for Neuromatch Academy Summer School project, July 2021.

Mentor for ATHENA Talaria program (research project for female high school students), July 2021.

Teaching assistant for IBRO-Simons Computational Neuroscience Imbizo (South African summer school), January 2019 and 2020

Teaching assistant for "Introduction to Theoretical Neuroscience" Graduate Course, Columbia University, Spring 2017

Teacher and course developer for "Introduction to Programming with Python" and "Artificial Intelligence" for Upward Bound Summer Academy (serving under-represented high school students), Summer 2016

Lecturer and curriculum developer for "Quantitative Approaches for Experimental Neuroscientists" Graduate Course, Columbia University, Fall 2015 and Fall 2017

Teaching assistant for "Systems & Developmental Neuroscience" undergraduate course, Columbia University, January-May 2014

Teacher and course developer for Columbia Splash! program, November 2013-December 2017

Teacher and course developer for BRAINYAC programming course, June-July 2013

Mentor for Masters student internship, Bernstein Center, June 2012

Tutor for Quantitative Methods course, Bernstein Center, May 2012

Communications and Outreach

Author of *Models of the Mind: How physics, mathematics and engineering have shaped our understanding of the brain*, published May 2021 (Bloomsbury Sigma)

Chair of Communications and Outreach, Neuromatch Academy (massive online computational neuroscience summer school), April-July 2020.

Producer and co-host of *Unsupervised Thinking* (monthly podcast on neuroscience and AI), October 2015-January 2020.

Freelance science writer for the Simons Foundation and other outlets, May 2015-present.

Neuwrite (Neuroscience-Journalist Collaborative) member, February 2013-present.

Harvard BHI Essay Competition Winner, 2018.

ICVSS Essay Competition Winner, 2015.

Nerve Newsletter Staff Writer, February 2014-March 2016.

Columbia University Neuroscience Outreach, August 2012-November 2017

-Social Media Coordinator, 2013-2014 Academic Year

Poster Presentations

"Modeling the separate functions of feedforward and feedback pathways in the visual system", Cosyne, February 2020, Denver USA.

"Do Biologically-Realistic Recurrent Architectures Produce Biologically-Realistic Models?", Cognitive Computational Neuroscience Meeting, September 2019, Berlin Germany.

"Combining convolutional neural networks with a model of the dynamics of visual cortex", Cognitive Computational Neuroscience Meeting, September 2018, Philadelphia USA.

"Hebbian-inspired rewiring of a random network replicates pattern of selectivity seen in PFC", CNS Meeting Poster Session, August 2014.

"'Within' versus 'between' pairwise correlations and their relation to the network structure", Society for Neuroscience Conference Poster Session, October 2012.

"Membrane potential statistics reveal detailed correlation structure", Bernstein Conference on Computational Neuroscience Poster Session, September 2012.

"Tuning Curve Quality and Its Effect on Population Coding", COSYNE Poster Session, February 2011.

Academic Service

Reviewer for *eLife*, *Nature Neuroscience*, *PLoS Computational Biology*, *Neural Computation*, *PNAS*, *Nature Communications*, *NBDT*, *Cosyne*, the Cognitive Computational Neuroscience conference, and several others

Social Media Chair, Cosyne Conference 2022.

Co-chair for Cognitive Neuroscience Society conference symposium on neuroscience and machine learning, 2021

Executive board member for Neuromatch Academy, 2020

Organizer and moderator for the Neuromatch 2.0 conference, 2020

Panel moderator for "Biological and Artificial Reinforcement Learning" NeurIPS Workshop, 2019 and 2020

Organizer for Breakout Session at the Cognitive Computational Neuroscience conference, 2018

Summer Schools and Workshops Attended

Workshop on Learning in Artificial and Biological Neural Networks, Bridgetown, Barbados. February 2019

Turing Institute Data Study Group, London, UK. December 2017

DataKindUK Data Dives, London, UK. July 2017 and March 2018

Janelia Theoretical Neuroscience Workshop, Janelia Campus, September 2016.

Deep Learning Summer School, Montreal, Canada. August 2015.

International Computer Vision Summer School (ICVSS), Sicily, Italy. July 2015