Maria Katharina Eckstein

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Education and Employment

Google DeepMind *London & San Francisco*
Senior Research Scientist, Foundational Research Unit. Algorithms of the Mind (Colead) & 2021 - Today
LLM Investigations (Individual Contributor).

University College London *London, UK*
Honorary Lecturer, Department of Experimental Psychology. 2024 - Today

University of California, Berkeley *Berkeley, USA*
PhD, Psychology. Advisors: Profs. Anne Collins and Silvia Bunge. Cognition, Brain & 2015 - 2021
Behavior. Dissertation: Computational Models of Learning and Hierarchy.

Graduate School of Systemic Neurosciences *Munich, Germany*
PhD, Neuroscience (unfinished). Advisor: Klaus Wunderlich. Focus: Model-Based and 2013 - 2015
Model-Free Reinforcement Learning.

Ludwig-Maximilians-Universität *Munich, Germany*
BA, Philosophy. Focus: Philosophy of Mind, Neurophilosophy, History of Science. Thesis: 2011 - 2013
Donald Davidson's Theory of Action: Description, Critique, and Alternatives.

Ludwig-Maximilians-Universität *Munich, Germany*
BSc, Psychology. Focus: Clinical Neuropsychology, Developmental Psychology. Thesis: 2010 - 2013
Empirical Evaluation of the Zurich Model of Motivation.

Albert-Ludwigs-Universität *Freiburg, Germany*
BA, Ancient Languages, Cognitive Science (unfinished). 2009 - 2010

Publications

Journal Papers

[1] **Eckstein MK**, Summerfield C, Daw N, & KJ Miller (2024). "Hybrid Neural-Cognitive Models Reveal How Memory Shapes Human Reward Learning," PsyArXiv. [Link]

[2] Qü AJ, ..., **Eckstein MK**, ... & Wilbrecht L (2024). "Nucleus Accumbens Dopamine Release Reflects Bayesian Inference During Instrumental Learning," *eLife*. [Link]

[3] Binz M, ... **Eckstein MK**, ... & Schulz E (2024). "Centaur: a foundation model of human cognition," *ArXiv*.

[4] **Eckstein MK**, Master S, Xia L, Dahl R, Wilbrecht L & Collins AGE (2022). "The interpretation of computational model parameters depends on the context," *eLife*. [Link]

[5] **Eckstein MK**, Master S, Dahl R, Wilbrecht L & Collins AGE (2022). "Reinforcement learning and Bayesian inference provide complementary models for the unique advantage of adolescents in stochastic reversal," *Developmental Cognitive Neuroscience*. [Link]

[6] Leibo JZ, Vezhnevets A, **Eckstein MK**, Agapiou JP & Duéñez-Guzmán EA (2022). "Learning agents that acquire representations of social groups," *Behavioral and Brain Sciences*. [Link]

[7] **Eckstein MK**, Wilbrecht L & Collins AGE (2021). "What do reinforcement learning models measure? Interpreting model parameters in cognition and neuroscience," *Current Opinion in Behavioral Sciences*. [Link]

[8] Xia L, Master S, **Eckstein MK**, Dahl R, Wilbrecht L & Collins AGE (2021). "Modeling changes in probabilistic reinforcement learning during adolescence," *PLOS Computational Biology*. [Link]

[9] Master S, **Eckstein MK**, Gotlieb N, Dahl R, Wilbrecht L & Collins AGE (2020). "Disentangling the systems contributing to changes in learning during adolescence," *Developmental Cognitive Neuroscience*. [Link]

[10] **Eckstein MK** & Collins AGE (2020). "Computational evidence for hierarchically structured reinforcement learning in humans," *Proceedings of the National Academy of Sciences*. [Link]

[11] **Eckstein MK**, Starr A & Bunge SA (2019). "How the inference of hierarchical rules unfolds over time," *Cognition*. [Link]

[12] **Eckstein MK**, Guerra-Carillo B, Miller Singley AT & Bunge SA (2017). "Beyond eye gaze: What else can eyetracking reveal about cognition and cognitive development?," *Developmental Cognitive Neuroscience*. [Link]

Peer-Reviewed Conference Papers

[1] Rmus M, **Eckstein MK** & Collins AGE (2023). "The role of subgoals in hierarchical reinforcement learning," *Annual Conference of the Cognitive Science Society*.

[2] **Eckstein MK**, Summerfield C, Daw N & Miller KJ (2023). "Predictive and interpretable: combining artificial neural networks and classic cognitive models to understand human learning and decision making," *Annual Conference of the Cognitive Science Society*.

[3] Miller KJ, **Eckstein MK**, Botvinick MM & Kurth-Nelson Z (2023). "Cognitive model discovery via disentangled RNNs," *Advances in Neural Information Processing Systems*.

[4] **Eckstein MK** & Collins AGE (2021). "How the mind creates structure: hierarchical learning of complex action sequences," *Annual Conference of the Cognitive Science Society*.

[5] Xia L, Master S, **Eckstein MK**, Wilbrecht L & Collins AGE (2020). "Learning under uncertainty changes during adolescence," *Annual Conference of the Cognitive Science Society*.

[6] Vezhnevets A, Wu YT, **Eckstein MK**, Leblond R, Leibo JZ (2020). "OPtions as REsponses: grounding behavioural hierarchies in multi-agent reinforcement learning," *International Conference on Machine Learning*.

[7] **Eckstein MK**, Master S, Dahl R, Wilbrecht L & Collins AGE (2019). "Modeling the development of decision making in volatile environments using strategies, reinforcement learning, and Bayesian inference," *Conference on Cognitive Computational Neuroscience*.

[8] **Eckstein MK** & Collins AGE (2017). "CHRL: Combining intrinsic motivation and hierarchical reinforcement learning," *Advances in Neural Information Processing Systems, Workshop on Hierarchical Reinforcement Learning*.

Selected Posters

[1] ***Eckstein MK**, Master S, Dahl R, Wilbrecht L & Collins AGE (2019). "Modeling the development of learning strategies in a volatile environment," *Cognitive Neuroscience Society*.

[2] **Eckstein MK** & Collins, AGE (2019). "Evidence for hierarchically-structured reinforcement learning in humans," *Sackler Colloquium: The Brain Produces Mind by Modeling, Irvine, CA, USA*

[3] ***Eckstein MK**, Wunderlich K & Collins AGE (2017). "Manipulating model-based and model-free reinforcement learning in humans," *Multi-Disciplinary Conference on Reinforcement Learning and Decision Making*.

[4] ***Eckstein MK** & Zehetleitner M (2013). "Experimental evaluation of the Zurich model of motivation with respect to smiling," *Interdisciplinary Kolleg Annual Spring School, Günne am Möhnesee, Germany*

*Poster prize or award

Selected Talks

2024

DARPA Inspire Seminar on Computational Neuroscience (Dr. Emily Sherman). *Virtual*. Invited plenary speaker.

Bernstein Conference Workshop on the Physics of Cognition: Dynamical Models of the Ordered and Disordered Brain (Prof. Hamidreza Jamalabadi). *Frankfurt, Germany*. Invited speaker.

Conference on the Mathematics of Neuroscience. *Rome, Italy*. Invited plenary speaker.

Neurotheory Forum (Prof. Rui Ponte Costa). *Oxford, UK*. Invited speaker.

Department of Cognitive Sciences, Colloquium Series (Profs. Angela Yu and Constantin Rothkopf). *Darmstadt, Germany*. Invited speaker.

Department of Psychology. *Harvard University, Boston, USA*. Invited speaker.

Neuroeconomics Seminar (Prof. Stefano Palminteri). *École Normale Supérieure, Paris, France*. Invited speaker.

Center for Theoretical Neuroscience. *Columbia University, New York, USA*. Invited speaker.

Minds and Machines Initiative Launch Event (Profs. Tali Sharot, Bradley Love, Stephen Fleming). *UCL, London, UK*. Invited speaker.

Department of Psychology. *UC Davis, Davis, USA*. Invited speaker.

Department of Psychiatry (Prof. Angela Radulescu). *Icahn School of Medicine at Mt. Sinai, New York, USA*. Invited speaker.

2023

Cognitive Computational Neuroscience (CCN) Conference. *Oxford, UK*. Keynote and Tutorial.

Transcontinental Computational Psychiatry Workgroup (TCPW; Prof. Quentin Huys). *UCL, London, UK*. Invited speaker.

Human Intelligence meets Artificial Intelligence workshop (Prof. Daniel Durstewitz). *Heidelberg University, Heidelberg, Germany*. Invited speaker.

Bayesian and Not so Bayesian Belief Update in Economics, Neuroscience, and Machine Learning (Prof. Benedetto de Martino). *UCL, London, UK*. Invited speaker.

Meeting of the UCL NeuroAI community (Prof. Caswell Berry). *Sainsbury Wellcome Center, London, UK*. Invited speaker.

126th International Titisee Conference: NeuroAI—connecting advances in machine learning and neuroscience (Prof. Caswell Berry & Prof. Matt Botvinick). *Titisee, Germany*. Invited speaker.

Conference of the Cognitive Science Society (CogSci). *Sydney, Australia*. Contributed talk.

Shahar Lab, Tel Aviv University, Israel. *Virtual*. Invited speaker.

Research Group Computational Principles of Intelligence (Prof. Eric Schulz). *Max Planck Institute, Tübingen, Germany*. Invited speaker.

Center for Cognitive Neuroscience (Prof. Clay Holroyd). *Ghent University, Ghent, Belgium*. Invited speaker.

Costa Lab (Prof. Rui Ponte Costa). *Bath, UK*. Invited speaker.

Conference on Computational and Systems Neuroscience (COSYNE), workshop "The What, How, and When of Reinforcement Learning". *Lisbon, Portugal*. Invited speaker.

Multi-disciplinary Conference on Reinforcement Learning and Decision Making (RLDM), workshop "Reinforcement Learning as a Model of Agency". *Providence, Rhode Island, USA*. Invited speaker.

Conference of the Bernstein Network of Computational Neuroscience, workshop "Surprise in the brain". *Berlin, Germany*. Invited speaker.

Hartley Lab, New York University, US. *Virtual*. Invited speaker.

Neural-AI Reading Group at Mila. *Virtual*. Invited speaker.

Flux Conference. *Virtual*. Contributed talk, selected for Jacobs Foundation Colloquium.

NeuroMatch Conference. *Virtual*. Contributed talk.

Donders Institute for Brain, Cognition and Behaviour (Prof. Roshan Cools). *Donders, Netherlands*. Invited speaker.

Max Planck Institute for Biological Cybernetics (Prof. Peter Dayan). *Tübingen, Germany*. Invited speaker.

Conference of the Cognitive Science Society (CogSci). *Madison, Wisconsin, USA*. Contributed talk.

Teaching

Summer Seminar on Automated Discovery and Active Learning	*Virtual*
Teaching faculty	2024
Barcelona Summer School for Advanced Modeling of Behavior (BAMB)	*Barcelona, Spain*
Teaching faculty	2023, 2024
TREND in Africa, Summer School on Computational Neuroscience	*Accra, Ghana*
Co-organizer; Teaching faculty	2023
Summer School on Analytical Connectionism	*London, United Kingdom*
Teaching faculty	2023
International Interdisciplinary Computational Cognitive Science Summer School	*Tübingen, Germany*
Teaching faculty	2023
NeuroMatch Conference	*Virtual*
Research project mentor	2022
Introduction to Cognitive Science	*UC Berkeley, USA*
Graduate student instructor and guest lecturer with Paul Li. Taught 3 weekly discussion sections (class of about 200 students; personally responsible for 60)	2019
Computational Models of Cognition	*UC Berkeley, USA*
Graduate student instructor and guest lecturer with Prof. Anne Collins. Three weekly discussion sections (class of 150 students; responsible for 60)	2018
Basic Issues in Cognition	*UC Berkeley, USA*
Graduate student instructor with Dr. Jennifer Dorfman. Three weekly discussion sections (class of 150 students; responsible for 60)	2015

Mentoring

2023-	Jessica Passlack (PhD student at UCL London, postdoc at University of Edinburgh)
2023-	Sebastian Bruijns (PhD student with Prof. Peter Dayan, MPI Tuebingen)
2023-	Fabian Tatai (PhD student with Prof. Constantin Rothkopf, University of Darmstadt)
2023-	Daniel Weinhardt (PhD student with Prof. Sebastian Musslik, University of Osnabrueck)
2023-2024	Leo Chi U Seak (post-doc with Prof. Ray Dolan, UCL)
2019-2020	Aram Moghaddassi (undergraduate research assistant)
2018-2019	Zisu Dong (undergraduate research assistant; SMART program, UC Berkeley)
2018-2020	Lucy Whitmore (undergraduate research assistant; SURF program, UC Berkeley)
2017-2019	Vy Pham, Rachel Arsenault, Josephine Christon, Shoshana Edelman, Lucy Eletel, Julie Liu, Justin Morillo, Nithya Rajakumar, Nick Spence, Tanya Smith, Benjamin Tang, Talia Welte (undergraduate research assistant team for a large-scale project during my PhD)
2016-2019	Amy Zou (undergraduate research assistant)
2016-2018	Haley Keglovits (undergraduate research assistant)
2015-2016	Leon Zhang (undergraduate research assistant)
2015-2016	Scarlett Wu (undergraduate research assistant)

Awards and Honors

2019	**Fellowship**:	Sackler trainee fellowship for the colloquium brain produces mind by modeling
2019	**Award**:	Cognitive neuroscience society graduate student award
2018	**Award**:	Society for neuroscience trainee professional development award
2018	**Fellowship**:	UC Berkeley SURF fellowship for research mentorship
2018	**Fellowship**:	UC Berkeley SMART fellowship for research mentorship
2015/2016	**Fellowship**:	Gateway fellow at Berkeley international house
2015	**Research Grant**:	UC Berkeley XLAB research grant
2013/2014	**Scholarship**:	German academic exchange service (DAAD) annual scholarship
2009/2010	**Scholarship**:	Sparkasse college fellowship
2008	**Valedictorian**:	Gymnasium Tegernsee

Service to the Community

3-Day Collaborative Research in Computational Neuroscience (CRCNS) Grant Proposal Review Panel
NSF / NIH / DOE / BMBF / ANR / BSF / NICT / AEI
Invited reviewer — 2024

Conference of the Bernstein Network of Computational Neuroscience
Frankfurt, Germany
Workshop committee chair — 2024

Google DeepMind NeuroLab Workshop
Google DeepMind, London, UK
Co-organized an international, 3-day workshop with 50 attendees — 2024

Computational Cognitive Neuroscience (CCN) Conference
Oxford, UK
Program committee member. Involved in designing the program, selecting invited speakers, and reviewing submitted contributions — 2024

Google DeepMind NeuroLab Workshop
Google DeepMind, London, UK
Co-organized an international, 2-day workshop with over 40 attendees — 2023

Computational Cognitive Neuroscience (CCN) Conference
Oxford, UK
Program committee member. Involved in designing the program, selecting invited speakers, and reviewing submitted contributions — 2023

Conference of the Bernstein Network of Computational Neuroscience
Berlin, Germany
Workshop committee co-chair — 2023

TREND in Africa, Summer School on Computational Neurosciences
Accra, Ghana
Co-organizer and instructor — 2023

UC Berkeley Pupillometry Working Group
Berkeley, US
Co-founder — 2015-2016

Review Activity

Scientific Journals

Nature Communications; Science Advances; Nature Machine Intelligence; Psychological Review; PLOS Computational Biology; Journal of Experimental Psychology: Learning, Memory, and Cognition; Cognition; Developmental Science; Scientific Reports; Developmental Cognitive Neuroscience

Grant Reviews

Collaborative Research in Computational Neuroscience (CRCNS) 3-day grant panel; National Science Foundation (NSF) grant reviewer; Google PhD scholarship reviewer

Conference Reviews

Computational Cognitive Neuroscience (CCN) Conference, Cognitive Science Conference, Neural Information Processing Systems (NeurIPS) Conference, International Conference on Machine Learning (ICML), Computational and Systems Neuroscience (COSYNE)