

Eric Schulz

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🌐 <http://cpilab.org>

Employment History

- since 2020 **Max Planck Research Group Leader.** Computational Principles of Intelligence Lab, MPI for Biological Cybernetics, Tübingen, Germany.
- 2017-2019 **Data Science Postdoctoral Fellow.** Harvard University, Cambridge, USA.
- 2013 **Volunteer.** Uganda Virus Research Institute, Entebbe, Uganda.
- 2012 – 2013 **Machine Learning Analyst.** Zalando, Berlin, Germany.
- 2008 – 2010 **Student Research Assistant.** MPI for Human Development, Berlin, Germany.
- 2006 – 2007 **Military Service.** United Nations Training Center, Hammelburg, Germany.

Education

- 2014 – 2017 **PhD Experimental Psychology.** University College London, UK.
- 2013 – 2014 **MRes Computer Science.** University College London, UK.
- 2011 – 2012 **MSc Applied Statistics.** University of Oxford, UK.
- 2010 – 2011 **MSc Cognitive and Decision Sciences.** University College London, UK.
- 2007 – 2010 **Vordiplom Psychology.** Humboldt University, Berlin, Germany.

Funding

- 2021-2025 **Volkswagen Artificial Intelligence and the Society of the Future Grant** to study curiosity in children and robots. (EUR 450,000)
- 2021-2024 **University of Tübingen Machine Learning Mini Graduate School** to study compositionality in minds and machines. (EUR 150,000)
- 2020-2023 **Jacobs Early Career Research Fellowship** for Highly talented young scholars working on child development. (EUR 150,000)
- 2020-2025 **Max Planck Research Group** on Computational Principles of Intelligence.

Publications

- 1 Binz, M., Gershman, S. J., Schulz, E., & Endres, D. (submitted). Heuristics from bounded meta-learned inference.
- 2 Ruggeri, A., Pelz, M., Gopnik, A., & Schulz, E. (submitted). Toddlers search longer when there is more information to be gained.
- 3 Wu, C. M., Schulz, E., Pleskac, T., & Speekenbrink, M. (submitted). Time to explore: adaptation of exploration under time pressure.
- 4 Brändle, F., Allen, K., Tenenbaum, J. B., & Schulz, E. (2021). Using games to understand intelligence.
- 5 Brändle, F., Binz, M., & Schulz, E. (2021). Exploration beyond bandits.
- 6 Saanum, T., Schulz, E., & Speekenbrink, M. (2021). Compositional generalization in multi-armed bandits. *Proceedings of the 43rd Annual Meeting of the Cognitive Science Society*.

- 7 Tomov, M., Schulz, E., & Gershman, S. J. (2021). Multi-task reinforcement learning in humans. *Nature Human Behaviour*.
- 8 Bertram, L., Schulz, E., Hofer, M., & Nelson, J. D. (2020). . the psychology of human entropy intuitions. *Proceedings of the 42nd Annual Meeting of the Cognitive Science Society*.
- 9 Brändle, F., Wu, C. M., & Schulz, E. (2020). What are we curious about? *Trends in Cognitive Sciences*, 24(9), 685–687.
- 10 Dasgupta, I., Schulz, E., Tenenbaum, J. B., & Gershman, S. J. (2020). A theory of learning to infer. *Psychological Review*, 127(3), 412.
- 11 Schulz, E. & Dayan, P. (2020). Computational psychiatry for computers. *iScience*, 101772.
- 12 Schulz, E., Franklin, N. T., & Gershman, S. J. (2020). Finding structure in multi-armed bandits. *Cognitive Psychology*, 119, 101261.
- 13 Schulz, E., Quiroga, F., & Gershman, S. J. (2020). Communicating compositional patterns. *Open Mind*, 4, 25–39.
- 14 Stojić, H., Schulz, E., P Analytis, P., & Speekenbrink, M. (2020). It's new, but is it good? how generalization and uncertainty guide the exploration of novel options. *Journal of Experimental Psychology: General*.
- 15 Wu, C. M., Schulz, E., Garvert, M. M., Meder, B., & Schuck, N. W. (2020). Similarities and differences in spatial and non-spatial cognitive maps. *PLoS Computational Biology*.
- 16 Schulz, E., Betram, L., Hofman, M., & Nelson, J. D. (2019). Exploring the space of human exploration using entropy mastermind. In *Proceedings of the Forty-first Annual Conference of the Cognitive Science Society*.
- 17 Schulz, E., Bhui, R., Love, B. C., Brier, B., Todd, M. T., & Gershman, S. J. (2019). Structured, uncertainty-driven exploration in real-world consumer choice. *Proceedings of the National Academy of Sciences*, 116(28), 13903–13908.
- 18 Schulz, E. & Gershman, S. J. (2019). The algorithmic architecture of exploration in the human brain. *Current Opinion in Neurobiology*, 55, 7–14.
- 19 Schulz, E., Wu, C. M., Ruggeri, A., & Meder, B. (2019). Searching for rewards like a child means less generalization and more directed exploration. *Psychological Science*.
- 20 Wu, C. M., Schulz, E., Gerbaulet, K., Pleskac, T. J., & Speekenbrink, M. (2019). Under pressure: the influence of time limits on human exploration. In *Proceedings of the Forty-first Annual Conference of the Cognitive Science Society*.
- 21 Wu, C. M., Schulz, E., & Gershman, S. J. (2019). Generalization as diffusion: human function learning on graphs. In *Proceedings of the Forty-first Annual Conference of the Cognitive Science Society*.
- 22 Dasgupta, I., Schulz, E., Goodman, N. D., & Gershman, S. J. (2018). Remembrance of inferences past: Amortization in human hypothesis generation. *Cognition*, 178, 67–81.
- 23 Dasgupta, I., Schulz, E., Smith, K. A., Tenenbaum, J. B., & Gershman, S. J. (2018). Learning to act by integrating mental simulations and physical experiments. In *Proceedings of the Fortieth Annual Conference of the Cognitive Science Society*.
- 24 Jones, A., Schulz, E., Meder, B., & Ruggeri, A. (2018). Active function learning. In *Proceedings of the Fortieth Annual Conference of the Cognitive Science Society*.
- 25 Krusche, M., Schulz, E., Guez, A., & Speekenbrink, M. (2018). Adaptive planning in human search. In *Proceedings of the Fortieth Annual Conference of the Cognitive Science Society*.

- 26 Rule, J., Schulz, E., Piantadosi, S. P., & Tenenbaum, J. B. (2018). Learning list concepts through program induction. In *Proceedings of the Fortieth Annual Conference of the Cognitive Science Society*.
- 27 Schulz, E., Speekenbrink, M., & Krause, A. (2018). A tutorial on Gaussian process regression: Modelling, exploring, and exploiting functions. *Journal of Mathematical Psychology*, 85, 1–16.
- 28 Schulz, E., Wu, C. M., Huys, Q. J. M., Krause, A., & Speekenbrink, M. (2018). Generalization and search in risky environments. *Cognitive Science*. doi:10.1101/227322
- 29 Wu, C. M., Schulz, E., Garvert, M. M., Meder, B., & Schuck, N. W. (2018). Connecting conceptual and spatial search via a model of generalization. In *Proceedings of the Fortieth Annual Conference of the Cognitive Science Society*.
- 30 Wu, C. M., Schulz, E., Speekenbrink, M., Nelson, J. D., & Meder, B. (2018). Exploration and generalization in vast spaces. *Nature Human Behaviour*.
- 31 Dasgupta, I., Schulz, E., & Gershman, S. J. (2017). Where do hypotheses come from? *Cognitive Psychology*, 96, 1–25.
- 32 Dasgupta, I., Schulz, E., Goodman, N. D., & Gershman, S. J. (2017). Amortized hypothesis generation. In *Proceedings of the Thirty-Ninth Annual Conference of the Cognitive Science Society*.
- 33 Schulz, E., Klenske, E., Bramley, N. R., & Speekenbrink, M. (2017). Strategic exploration in human adaptive control. In *Proceedings of the Thirty-Ninth Annual Conference of the Cognitive Science Society*.
- 34 Schulz, E., Konstantinidis, E., & Speekenbrink, M. (2017). Putting bandits into context: how function learning supports decision making. *Journal of Experimental Psychology: Learning, Memory, and Cognition*.
- 35 Schulz, E., Tenenbaum, J. B., Duvenaud, D., Speekenbrink, M., & Gershman, S. J. (2017). Compositional inductive biases in function learning. *Cognitive Psychology*, 99, 44–79.
- 36 Wu, C. M., Schulz, E., Speekenbrink, M., Nelson, J. D., & Meder, B. (2017). Mapping the unknown: The spatially correlated multi-armed bandit. In *Proceedings of the Thirty-Ninth Annual Conference of the Cognitive Science Society*.
- 37 Schulz, E., Huys, Q. J., Bach, D. R., Speekenbrink, M., & Krause, A. (2016). Better safe than sorry: Risky function exploitation through safe optimization. In *Proceedings of the Thirty-Eighth Annual Conference of the Cognitive Science Society*.
- 38 Schulz, E., Speekenbrink, M., Hernández-Lobato, J. M., Ghahramani, Z., & Gershman, S. J. (2016). Quantifying mismatch in bayesian optimization. In *NIPS Bayesian Optimization workshop*.
- 39 Schulz, E., Speekenbrink, M., & Meder, B. (2016). Simple trees in complex forests: Growing Take The Best by Approximate Bayesian Computation. In *Proceedings of the Thirty-Eighth Annual Conference of the Cognitive Science Society*.
- 40 Schulz, E., Tenenbaum, J. B., Duvenaud, D., Speekenbrink, M., & Gershman, S. J. (2016). Probing the compositionality of intuitive functions. In *Advances in Neural Information Processing Systems*.
- 41 Parpart, P., Schulz, E., Speekenbrink, M., & Love, B. C. (2015). Active learning as a means to distinguish among prominent decision strategies. In *Proceedings of the Thirty-Seventh Annual Conference of the Cognitive Science Society*.

- 42 Schulz, E., Konstantinidis, E., & Speekenbrink, M. (2015). Exploration-exploitation in a contextual multi-armed bandit task. In *International Conference on Cognitive Modeling* (pp. 118–123).
- 43 Schulz, E., Konstantinidis, E., & Speekenbrink, M. (2015). Learning and decisions in contextual multi-armed bandit tasks. In *Proceedings of the Thirty-Seventh Annual Conference of the Cognitive Science Society*.
- 44 Schulz, E., Tenenbaum, J. B., Reshef, D. N., Speekenbrink, M., & Gershman, S. J. (2015). Assessing the perceived predictability of functions. In *Proceedings of the Thirty-Seventh Annual Conference of the Cognitive Science Society*.
- 45 Schulz, E., Speekenbrink, M., & Shanks, D. R. (2014). Predict choice – a comparison of 21 mathematical models. In *Proceedings of the Thirty-Sixth Annual Conference of the Cognitive Science Society*.
- 46 Cokely, E. T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (2012). Measuring risk literacy: the berlin numeracy test. *Judgment and Decision Making*, 7(1), 25.
- 47 Cokely, E. T., Ghazal, S., Galesic, M., Garcia-Retamero, R., & Schulz, E. (2012). How to measure risk comprehension in educated samples. *Transparent Communication of Health Risks*, 29–52.
- 48 Schulz, E., Cokely, E. T., & Feltz, A. (2011). Persistent bias in expert judgments about free will and moral responsibility: a test of the expertise defense. *Consciousness and Cognition*, 20(4), 1722–1731.

Awards

- 2020 ■ **Jacobs Research Fellowship** for building algorithms that learn and explore like children.
- 2018 ■ **Robert J. Glushko Award** for Outstanding Doctoral Dissertation in Cognitive Science.
- 2017 ■ **Harvard Data Science Postdoctoral Fellowship**.
- 2016 ■ **UCL Bogue Research Fellowship** funding 3 month visit to Harvard and MIT.
- **EPS Grindley Award** to attend the International Conference of Thinking.
- **SLMS Graduate School Conference Fund**.
- 2015 ■ **UCL Sully Award** for best PhD upgrade talk.
- **Cognitive Science Travel Award**
- 2013 ■ **ESPRC scholarship** funding both MRes and PhD at UCL by the Centre for Doctoral Training in Financial Computing and Analytics.
- 2011 ■ **Haniel scholarship** funding MSc at the University of Oxford.
- 2010 ■ **DAAD scholarship** funding MSc at University College London.

Invited Talks

- 2021 ■ **University of Ghent**. Center for Cognitive Neuroscience.
- **TU Darmstadt**. Center for Cognitive Science.
- 2020 ■ **University of Tübingen**. Cognitive Science Colloquium.
- **University of New South Wales**. Departmental Colloquium.
- **University of Oxford**. Summerfield Lab Meeting.
- **University of Warwick**. Cognitive Science Group.
- **The University of Edinburgh**. Computational Cognitive Science Group.

Invited Talks (continued)

- 2019
 - **Stanford University.** FriSem.
 - **Max Planck Institute for Human Cognitive and Brain Sciences.** Guest Lecture.
 - **Max Planck Institute for Biological Cybernetics.** MPRG Symposium.
 - **Cognitive Lunch.** MIT.
- 2018
 - **Ohio State Univeristy.** Brown bag seminar series. Invited by Jay Myung.
 - **Early Childhood Cognition Lab.** Lab Meeting at MIT.
 - **ONR Science of Autonomy.** Grant Review.
 - **Ecole Normale Supérieure.** Workshop organized by Stefano Palminteri.
 - **Cognitive Science Conference.** Symposium for Glushko award winners.
- 2017
 - **ConCats seminar series.** New York University.
 - **CBB Lunch.** Harvard University.
 - **Cognitive Psychology Colloquium.** University of Göttingen.
 - **Cognitive Science Colloquium.** University of Onabrück.
- 2016
 - **London Judgement and Decision Making Seminar.** University College London.
 - **Gershman Lab Meeting.** Harvard University.
 - **Coffee and Tea Talk.** Max Planck Institute for Human Development.
- 2015
 - **Psychology Seminar Series .** City University.
 - **Krause Lab Meeting .** ETH Zürich.
 - **Oberauer Lab Meeting .** University of Zürich.
 - **Economic Psychology Colloquium .** University of Basel.

Supervision

Postdocs

- 2021- ■ **Mirko Thalmann.** Memory-efficient generalization.
- 2021- ■ **Marcel Binz.** Resource-rational meta-learning.

Graduate Students

- 2021- ■ **Susanne Haridi.** Scaling laws of human inference.
- 2021- ■ **Akshay Jagadish.** Meta-learning psychiatric symptoms.
- 2021- ■ **Tankred Saanum.** Compositional reinforcement learning.
- 2020- ■ **Franziska Brändle.** A computational theory of fun.
- 2020- ■ **Shuchen Wu.** A resource-rational account of chunking.
- 2020- ■ **Alexander Kipnis.** Program induction in minds and brains.
- 2020- ■ **Lion Schulz** (collaborating student). Misinformation search.
- 2020- ■ **Lara Bertram** (collaborating student). Perception of entropy.

Master Students

- 2020-2021 ■ **Lena Stocks.** Exploration as empowerment.
- 2020-2021 ■ **Akshay Jagadish.** Meta-learning compositional inference.

Research Students

- 2021- ■ **Can Demircan.** Bayesian cognitive maps.
- 2021- ■ **Lena Stocks.** Exploration as empowerment.
- 2020- ■ **Tobias Ludwig.** Planning in generative bandits.

Supervision (continued)

2020- ■ **Kristin Witte.** Safe exploration.

Professional Service

since 2012 ■ **Reviewer.** Proceedings of the National Academy of Sciences, Psychonomic Bulletin and Review, Journal of Experimental Psychology: General, Journal of Cognitive Neuroscience, Neural Information Processing and Systems, Cognitive Science Society, PLOS: Computational Biology, Journal of Experimental Psychology: Learning, Memory, and Cognition, Journal of Mathematical Psychology, Nature Human Behaviour, PLOS One, Developmental Science.

2020 ■ **Workshop organizer.** How to become a good scientist. Workshop at the Max Planck Institute for Biological Cybernetics.

2019 ■ **Workshop organizer.** Heuristics, Hacks, and Habits (jointly with Ishita Dasgupta). Workshop at the Annual Meeting of the Cognitive Science Society.

■ **Workshop organizer.** Structure for Efficient Reinforcement Learning (jointly with Nick Franklin). Workshop at the Multi-Disciplinary Conference on Reinforcement Learning and Decision Making.

2018 ■ **Workshop organizer.** Learning as program induction (jointly with Neil Bramley). Workshop at the Annual Meeting of the Cognitive Science Society.

2015-2017 ■ **Seminar organizer.** London Judgement and Decision Making seminar series.

Teaching Experience

2014-2017 ■ **Teaching assistant.** PSYCGR01: Statistics for graduate students.

■ **Ad-hoc lecturer.** PSYCGD04: Knowledge, Learning and Inference.

2015 ■ **Teaching assistant.** COMPG011: Data Analytics using R.