

Joshua S. Rule

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Research Interests

Computational cognitive science, conceptual development, mathematical development, probabilistic modeling, program induction, programming language theory, foundations of computation

Academic Positions

- 2020–PRES. University of California, Berkeley
Postdoctoral Scholar
Advisors: Alison Gopnik, Steven T. Piantadosi
- 2013–2020 Massachusetts Institute of Technology
Graduate Student
Advisor: Joshua B. Tenenbaum
- 2010–2013 Georgetown University
Research Assistant & Lab Manager
Advisor: Maximilian Riesenhuber
- 2009 University of Illinois, Urbana-Champaign
Research Assistant
Advisor: Dan Roth

Education

- 2020 Massachusetts Institute of Technology
PhD, Brain & Cognitive Sciences, Thesis Advisor: Joshua B. Tenenbaum
- 2009 University of Illinois Urbana-Champaign
BS, Computer Science, Summa cum Laude
BA, Philosophy, Magna cum Laude

Awards & Honors

- 2016 Angus MacDonald Award for Excellence in Undergraduate Teaching, MIT
- 2015 Glushko Student Travel Award, Cognitive Science Society
- 2014 Graduate Research Fellowship, National Science Foundation
Eugene Stark Graduate Fellowship, MIT
- 2013 Leventhal Graduate Fellowship, MIT
- 2010 University Honors, UIUC, top 3% of graduating class

Journal Articles & Book Chapters

Piantadosi, S. T., Muller, D. C. Y., Rule, J. S., Kaushik, K., Gorenstein, M., Leib, E. R., & Sanford, E. (under review). How cognitive science (probably) figured out concepts.

- Rule, J. S., Goddu, M. K., Chu, J., Pinter, V., Reagan, E. R., Bonawitz, E., Gopnik, A., & Ullman, T. (under review). Winning isn't fun: Children selectively manipulate task difficulty when "playing for fun" vs. "trying to win".
- Rule, J. S., & Piantadosi, S. T. (under review). The end of radical concept nativism.
- Rule, J. S., Piantadosi, S. T., & Tenenbaum, J. B. (under review). Efficient learning of symbolic concepts via metaprogram search.
- Piantadosi, S. T., Rule, J. S., & Tenenbaum, J. B. (2024). Learning as Bayesian inference over programs. In T. L. Griffiths, N. Chater, & J. B. Tenenbaum (Eds.), *Bayesian models of cognition: Reverse-engineering the mind*. MIT Press.
- Srivastava, A., Rastogi, A., Rao, A., Shoeb, A. A. M., Abid, A., Fisch, A., Brown, A. R., Santoro, A., Gupta, A., Garriga-Alonso, A., Kluska, A., Lewkowycz, A., Agarwal, A., Power, A., Ray, A., Warstadt, A., Kocurek, A. W., Safaya, A., Tazarv, A., ... Wu, Z. (2023). Beyond the imitation game: Quantifying and extrapolating the capabilities of language models. *Transactions on Machine Learning Research*.
- Rule, J. S., & Riesenhuber, M. (2021). Leveraging prior concept learning improves ability to generalize from few examples in computational models of human object recognition. *Frontiers in Computational Neuroscience*.
- Rule, J. S., Piantadosi, S. T., & Tenenbaum, J. B. (2020). The child as hacker. *Trends in Cognitive Sciences*.
- Glezer, L. S., Kim, J., Rule, J., Jiang, X., & Riesenhuber, M. (2015). Adding words to the brain's visual dictionary: Novel word learning selectively sharpens orthographic representations in the VWFA. *Journal of Neuroscience*, 35(12).

Conference Papers

- Rule, J., Schulz, E., Piantadosi, S. T., & Tenenbaum, J. B. (2018). Learning list concepts through program induction. *Proceedings of the Cognitive Science Society*.
- Rule, J., Dechter, E., & Tenenbaum, J. B. (2015). Representing and learning a large system of number concepts with Latent Predicate Networks. *Proceedings of the Cognitive Science Society*.
- Sammons, M., Vydiswaran, V. G. V., Vieira, T., Johri, N., Chang, M.-W., Goldwasser, D., Srikumar, V., Kundu, G., Tu, Y., Small, K., Rule, J., Do, Q., & Roth, D. (2009). Relation alignment for textual entailment recognition. *Proceedings of the Textual Alignment Conference*.

Abstracts & Posters

- Rule, J. S., & Piantadosi, S. T. (2023). Algorithmic foundations of mathematical development [Symposium chair]. *Proceedings of the Mathematical Cognition and Learning Society*.
- Goddu, M. K., Rule, J. S., Bonawitz, E., Gopnik, A., & Ullman, T. (2022a). Fun isn't easy: Children optimize for difficulty when "playing for fun" vs. "playing to win" in a game design task [Talk and abstract]. *Budapest CEU Conference on Cognitive Development Programs and Abstracts*.
- Goddu, M. K., Rule, J. S., Bonawitz, E., Gopnik, A., & Ullman, T. (2022b). Fun isn't easy: Children optimize for difficulty when "playing for fun" vs. "playing to win" in a game design task [Poster and abstract]. *Cognitive Development Society Abstract Book*.
- Goddu, M. K., Rule, J. S., Bonawitz, E., Gopnik, A., & Ullman, T. (2022c). Fun isn't easy: Children optimize for difficulty when "playing for fun" vs. "playing to win" in a game design task [Poster and abstract]. *Society for Research in Child Development's Learning through Play and Imagination: Expanding Perspectives*.
- Rule, J. S., Piantadosi, S. T., & Tenenbaum, J. B. (2022). Learning as programming: Efficient search in models of human concept learning [Talk and abstract]. *Proceedings of the Cognitive Science Society*.
- Rule, J. S., Piantadosi, S. T., & Tenenbaum, J. B. (2019). Learning a novel rule-based conceptual system [Poster and abstract]. *Proceedings of the Cognitive Science Society*.

- Dechter, E., Rule, J., & Tenenbaum, J. B. (2015). Latent Predicate Networks: Concept learning with probabilistic context-sensitive grammars [Poster and abstract]. Proceedings of the AAAI Spring Symposium Series.
- Dechter, E., Rule, J., & Tenenbaum, J. B. (2014). Unsupervised learning of probabilistic programs with Latent Predicate Networks [Poster and abstract]. Proceedings of the NIPS Workshop on Probabilistic Programming.
- Glezer, L. S., Kim, J. S., Rule, J., Jiang, X., & Riesenhuber, M. (2013). Novel word learning selectively sharpens orthographic representations in the VWFA [Poster and abstract]. Neuroscience 2013 Abstracts.

Dissertation

- 2020 The child as hacker: Building more human-like models of learning
Committee: Susan Carey, Steven T. Piantadosi, Laura Schulz (chair), Joshua B. Tenenbaum

Invited Talks

- Mar. 2024 Efficiency learning of rule-based concepts via metaprogram search, UC Berkeley, CS 294-258 guest lecture
- Oct. 2023 The child as hacker, Dagstuhl, Approaches and Applications of Inductive Programming
- Apr. 2022 The child as hacker, UC Berkeley, CogSci C131 guest lecture
- Oct. 2021 The child as hacker, UC Berkeley, Computational Cognitive Neuroscience Lab
- Mar. 2021 Learning as hacking, NSF Expeditions: Understanding the world through code, Cognitive science working group
- Jan. 2021 The child as hacker, MPI Tübingen, Computational Principles of Intelligence Lab
- Oct. 2020 The child as hacker, UC Berkeley, Institute for Human Development & Developmental Psychology Colloquium
- Feb. 2019 Learning in a flexible language of thought, UC Berkeley, Computation and Cognition Lab
- Jul. 2018 Learning list concepts through program induction, Cognitive Science Society, Learning as Program Induction Workshop
- May 2018 Learning structured concepts through program induction, MIT, Brain and Cognitive Sciences CogLunch
- Jul. 2015 Representing and learning a large system of number concepts with Latent Predicate Networks, Cognitive Science Society

Reviewing

Nature Human Behavior, Trends in Cognitive Sciences, Cognition, OpenMind, eLife, CogSci, IJCAI-ECAI Workshops

Mentoring

- 2023 – PRES. Justine Krieger (Project Manager)
- 2022 Li Chenyi (BS), MSCS student at NYU Tandon
- 2020 – 2021 Shardul Chiplunkar (BS), PhD student at EFPL, Switzerland
- 2018 – 2019 Nicholas Alvarado (BS), Software Engineer, Google
- 2017 Benjamin Kaplan (BS), Data, Thrive Capital

Teaching

Fall 2015	9.660 - Computational Cognitive Science Teaching Assistant with Joshua Tenenbaum, MIT
Fall 2014	9.660 - Computational Cognitive Science Teaching Assistant with Joshua Tenenbaum, MIT
Spring 2009	CS225 - Data Structures Teaching Assistant with Cinda Heeren, UIUC
Fall 2008	CS225 - Data Structures Teaching Assistant with Cinda Heeren, UIUC
Spring 2008	CS225 - Data Structures Teaching Assistant with Cinda Heeren, UIUC