Tomer D. Ullman

CONTACT INFORMATION	Harvard University Department of Psychology tullman@fas.harvard.edu William James Hall Room 1320 http://www.tomerullman.org 33 Kirkland St., Cambridge, MA 02138 USA

POSITION
Assistant Professor, Harvard Department of Psychology. Member of the Center for Brains, Minds, and Machines. Co-PI for the Science of Intelligence group at Harvard.

RESEARCH INTERESTS
Computational cognitive modeling, intuitive theories, child development, probabilistic programming, folk physics, folk psychology, common sense, machine learning, theory-of-self

EDUCATION

Massachusetts Institute of Technology and Harvard University

Postdoctoral associate at the Center for Brains, Minds & Machines (2016-2019)

Massachusetts Institute of Technology

Ph.D. in Brain and Cognitive Sciences (2008-2015)

- Dissertation Topic: On the Nature and Origin of Intuitive Theories

Hebrew University of Jerusalem

B.S. in Physics and Cognitive Science (double major, 2004-2008)

- *Magna Cum Laude*

Grants and Funding

NSF Science of Learning, September 2021 – September 2022, $662,693,
"Loopholes as a window into the learning of meaning", joint project with Harvard and MIT, Harvard component $372,241.

DARPA MCS (Machine Common Sense), June 2019 – June 2023, $12,100,000,
"Building machine common sense the human way", Co-PI with six other investigators from IBM, MIT, Stanford, and Harvard. Harvard component, supporting Ullman, Spelke, and several RAs and postdoctoral researchers, is $1,080,000.

Dean's Competitive Fund for Promising Scholarship, Spring 2021, $39,449,
"Learning from People Who Aren't There".

John Templeton Foundation, Febuary 2020 – April 2022, $240,000,
"Play, a computational perspective".

Director of Science Education Lab Kit Funding, Spring 2021, Competitive proposal to fund novel at-home experiment kits as part of Harvard Class on Decision Making (PSY1322).

Templeton Experience Project, June 2015 – June 2017, $90,000,
"Computational models of the intuitive theory of transformative experiences", with Josh Tenenbaum (PI).

Publications

SUBMITTED MANUSCRIPTS

Paul LA, De Freitas, J., Ullman, T.D., Tenenbaum, J.B., Towards a Computational Self

S Liu, T Ullman, J Tenenbaum, E Spelke, Dangerous ground: Thirteen-month-old infants are sensitive to peril in other people's actions.

MANUSCRIPTS IN PREP

Ullman, T.D., Xu, Y., and Goodman, N.D., The pragmatics of spatial language.

Ullman, T.D., Kosoy, E., Tenenbaum J.B., and Spelke, E., Preschoolers' understanding of heavy and light: Inference and prediction.

Li, Y., Wang, Y., Boger, T., Smith, K., Gershman, S., and Ullman, T.D., An Approximate Representation of Objects Underlies Physical Reasoning.

JOURNAL ARTICLES

Kryven, M., Ullman, T.D., Cowan, W., and Tenenbaum, J.B., (In press) Plans or Outcomes: How do we attribute intelligence to others? *Cognitive Science*

Sosa, F. A., T. D. Ullman, J. B. Tenenbaum, S. J. Gershman, and T. Gerstenberg (In press), Moral dynamics: Grounding moral judgment in intuitive physics and intuitive psychology. *Cognition.*

Ullman, T.D. (2021). What are you talking about. *Nature Human Behaviour.*

Ullman, T.D. and Tenenbaum, J.B. (2020), Bayesian models of conceptual development: Learning as building models of the world. *Annual Review of Developmental Psychology.*

Ullman, T.D. (2020) Heroes of our own story: Self-image and rationalizing in thought experiments. *Behavioral and Brain Sciences* 43.

McCoy, J. and Ullman, T. (2019) Transformative Decisions and Their Discontents. Part of a symposium on L.A. Paul's "Transformative Experience". *Rivista Internazionale di Filosofia e Psicologia*, 10(3), 339 - 345.

Bonawitz E., Ullman, T.D., Gopnik, A., and Tenenbaum, J.B. (2019), Sticking to the evidence? A Computational and behavioral case Study of micro-theory change in the domain of magnetism, *Cognitive Science*, 43(8), e12765.

Ullman, T.D. and McCoy, J.P. (2019), Judgments of effort for magical violations of intuitive physics. (2019) *PloS one*, 14(5), e0217513.

McCoy, J.P., and Ullman, T.D., A Minimal Turing Test. (2018). A Minimal Turing Test. *Journal of Experimental Social Psychology*, 79, 1-8.

Gerstenberg, T., Ullman, T.D., Nagel, J., Kleiman-Weiner, M., Lagnado, D., and Tenenbaum, J.B. (2018), Lucky or clever? From changed expectations to attributions of responsibility. *Cognition.*

Liu, S., Ullman, T.D., Tenenbaum J.B., and Spelke, E. (In press) 10-month-olds infer the value of goals from the costs of actions. *Science, 358*(6366), 1038-1041.

Ullman, T. D., Spelke, E. S., Battaglia, P., and Tenenbaum, J. B. (2017), Mind Games: Game Engines as an Architecture for Intuitive Physics. *Trends in Cognitive Science, 21*(9), 649–665.

Ullman, T. D., Stuhlmüller, A., Goodman, N.D., and Tenenbaum, J. B. (2017), Learning physical parameters from dynamic scenes. *Cognitive Psychology.*

Lake, B. M., Ullman, T. D., Tenenbaum, J. B., and Gershman, S. J. (2017), Building machines that learn and think like people. *Behavioral and Brain Sciences,* 1–101.

Hamlin, J. K., Ullman, T. D., Tenenbaum, J. B., Goodman, N. D., and Baker, C. L. (2013), The mentalistic basis of core social cognition: Experiments in preverbal infants and a computational model. *Developmental Science 16*(2), 209-226.

Ullman, T. D., Goodman, N. D., and Tenenbaum, J. B. (2012), Theory learning as stochastic search in the language of thought. *Cognitive Development 27*(4), 455–480.

Goodman, N. D., Ullman, T. D., and Tenenbaum, J. B. (2012), Learning a theory of causality. *Psychological Review, 118*(1), 110.

Book Chapters   Ullman, T.D. and Zimmerman, S., Models of transformative decision making, (2020) in *Becoming Someone New: Essays on Transformative Experience, Choice, and Change,* eds. Enoch Lambert and John Schwenkler, Oxford University Press.

Ullman, T. D., McCoy, J. P., and Paul, L. A., (2019), Modal Prospection. *Metaphysics and Cognitive Science,* eds. Alvin Goldman and Brian McLaughlin. Oxford University Press (US).

Peer Reviewed Conference Proceedings   Bridgers, S., Schulz, L.E., and Ullman, T.D. (2021). Loopholes, a Window into Value Alignment and the Learning of Meaning. *Proceedings of the 42nd Annual Meeting of the Cognitive Science Society.*

Kim, P., De Freitas, J., and Ullman, T.D. (2021), Lifelines: Summarizing the Pattern of a Meaningful Life. In *Society for Philosophy and Psychology (SPP).*

Mao, J., Luo, Z., Gan, C., Tenenbaum, J.B., Wu, J.,Kaelbling, J.P., and Ullman, T.D. (2021) Temporal and Object Quantification Networks. In *Thirtieth International Joint Conference on Artificial Intelligence (IJCAI).*

Shu, T., Bhandwaldar, A., Gan, C., Smith, K.A., Liu, S., Gutfreund, D., Spelke, E., Tenenbaum, J.B. and Ullman, T.D. (2021). AGENT: A Benchmark for Core Psychological Reasoning. In *Thirty-eighth International Conference on Machine Learning (ICML).*

Du, Y., Smith, K., Ullman, T.D., Tenenebaum, J.B., and Wu, J. (2021). Unsupervised Discovery of 3D Physical Objects From Video. In *International Conference on Learning Representations (ICLR)*.

Smith, K. A., Mei, L., Yao, S., Wu, J., Spelke, E., Tenenbaum, J. B., and Ullman, T. D. (2020). The fine structure of surprise in intuitive physics: when, why, and how much?. In *Proceedings of the 42nd Annual Meeting of the Cognitive Science Society*.

Gjata, N., Ullman, T. D., Spelke, E. S., and Liu, S. (2020). Look before you leap: Quantitative tradeoffs between peril and reward in action understanding. In *Proceedings of the 42nd Annual Meeting of the Cognitive Science Society*.

Shu, T., Kryven, M., Ullman, T.D., and Tenenbaum, J.B. (2020). Adventures in Flatland: Perceiving Social Interactions Under Physical Dynamics In *Proceedings of the 42nd Annual Meeting of the Cognitive Science Society*.

Smith, K.*, Mei, L.*, Yao, S., Wu, J., Spelke, E., Tenenbaum, J.B., and Ullman, T.D., (2019) Modeling expectation violation in intuitive physics with coarse probabilistic object representations. *Advances in Neural Information Processing Systems*.

Ullman, T. D., Kosoy, E., Yildrim, I., Soltani, A., Siegel, X., Tenenbaum J.B., and Spelke, E.,(2019), *Draping an Elephant: Uncovering Children's Reasoning About Cloth-Covered Objects Proceedings of the 41st Annual Conference of the Cognitive Science Society*.

Ullman, T. D., Alonso-Diaz, S., Ferringo, S., Zahid, S., and Kidd, C. (2017), Weight matters: The role of physical weight in non-physical language across age and culture. *Proceedings of the 39th Annual Conference of the Cognitive Science Society*.

Liu, S., Ullman, T.d., and McCoy, J.P., (2019), People's perception of others' risk preferences. *Proceedings of the 41st Annual Conference of the Cognitive Science Society*.

Liu, S., Ullman, T. D., Tenenbaum, J. B., and Spelke, E. S. (2017), What's worth the effort: Ten-month-old infants infer the value of goals from the costs of actions. *Proceedings of the 39th Annual Conference of the Cognitive Science Society*.

Kryven, M., Ullman, T. D., Cowan, W., and Tenenbaum, J. B. (2017), Thinking and guessing: Bayesian and empirical models of how humans search. *Proceedings of the 39th Annual Conference of the Cognitive Science Society*.

Chang, M. B., Ullman, T. D., Torralba, A., and Tenenbaum, J. B. (2017), A compositional object-based approach to learning physical dynamics. *International Conference on Learning Representations (ICLR)*.

Ullman, T.D., Xu, Y. & Goodman, N.D. (2016), The Pragmatics of spatial language. *Proceedings of the 38th Annual Conference of the Cognitive Science Society*.

Ullman, T.D., Siegel, M., Tenenbaum, J.B. & Gershman, S.J. (2016), Coalescing the vapors of human experience into a viable and meaningful comprehension. *Proceedings of the 38th Annual Conference of the Cognitive Science Society*.

Kryven, M., Ullman, T.D., Cowan, W. & Tenenbaum, J.B. (2016), Outcome or strategy? A Bayesian model of intelligence attribution. *Proceedings of the 38th Annual Conference of the Cognitive Science Society*.

Gerstenberg, T., Ullman, T. D., Kleiman-Weiner, M., Lagnado, D. A. & Tenenbaum, J. B. (2014), Wins above Replacement: Responsibility attributions as counterfactual replacements. *Proceedings of the 36th Annual Conference of the Cognitive Science society.*

Ullman, T.D., Stuhlmüller A., Goodman, N.D. & Tenenbaum, J.B. (2014), Learning physics from dynamical scenes. *Proceedings of the 36th Annual Conference of the Cognitive Science society.*

Bonawitz E., Ullman, T.D., Gopnik, A. & Tenenbaum, J.B. (2012), Sticking to the evidence? A Computational and behavioral case Study of micro-theory change in the domain of magnetism, *International Conference Developmental Learning and Epigenetic Robotics; best paper award: experiment combined with computational model.*

Ullman, T.D.*, McCoy, J.P.*, Stuhlmuller, A., Gerstenberg, T. & Tenenbaum J.B. (2012), Why blame Bob? Probabilistic generative models, counterfactual reasoning, and blame attribution. *Proceedings of the 33rd Annual Conference of the Cognitive Science Society.*

Ullman, T.D., Goodman, N.D. & J. B. Tenenbaum (2010), Theory acquisition as stochastic search. *Proceedings of the 32nd Annual Conference of the Cognitive Science Society.*

Ullman, T.D., Baker, C.L., Macindoe, O., Evans, O., Goodman, N.D. & Tenenbaum, J.B. (2010), Help or hinder: Bayesian models of social goal inference. *Advances in Neural Information Processing Systems (Vol. 22, pp. 1874-1882).*

Goodman, N.D., Ullman, T.D. & Tenenbaum, J.B. (2009), Learning a theory of causality *Proceedings of the 31st Annual Conference of the Cognitive Science Society.*

Invited Talks and Presentations

Models of Core Knowledge (Physics, Really)
Special Seminar, Department of Neurobiology, Weizmann Institute, 2021.

Computational Models of Core Physics
Colloquium, Center for Cognitive Science, TU Darmstadt, 2021.

Reverse Engineering a Self,
First Person Discussion Group, Columbia University (online), 2021.

Quantitative Methods Workshop,
CBMM, MIT 2020

Models of Core Knowldge
Cognitive Seminar Series, Brown University, 2020

Models of Core Knowledge
Center for Human-Compatible AI at UC Berkeley (CHAI), 2020

Discussant in 'Is that so? How children evaluate claims and conjectures'
Child Development Society (CDS) Meeting, Louisville, KT, 2019.

Computational Models of Core Intuitive Physics,
Yale Current Works series, Yale, CN, 2019.

Neuro-symbolic Computing and Machine Common Sense
AI Research Week, IBM, MA, 2019.

Computational Models of Core Intuitive Physics,
Facebook Workshop on Understanding Human and Machine Intelligence, NYC, NY,
2019.

Reverse Engineering a Self,
Formal and Experimental Conference, Northeastern, MA, 2019

Thinking New Thoughts,
Workshop on Possibility and Value, Radcliffe Institute for Advanced Studies, MA,
2019.

Evaluating Future Selves,
Workshop on Imagination, Simulation, and the Self, Tufts, MA, 2018.

Physics Meets Development,
CVPR workshop on Vision Meets Cognition, Salt Lake City, UT, 2018.

Canonical Mass: Preschoolers Expectations of Dynamic Variables for Solid Objects,
Society for Research in Child Development, Austin, TX. 2017.

Modal Imagination,
Ranch Metaphysics Workshop, Tucscon, AZ. 2017.

People and Things,
Current Work in Developmental Psychology Colloquium. Boston College, MA. 2016.

Development, Psychology, Physics.
DeepMind Technologies, London. 2016.

Modal Prospection
Philosophy Seminar. Rutgers University, NJ. 2016.

Imagining and Evaluating Possible Future Selves,
42nd Meeting of the Society for Philosophy and Psychology. Austin, TX. 2016.

Computational Cognitive Science,
Interdisciplinary College on AI, Germany. 2016.

Probabilistic Programming,
Interdisciplinary College on AI, Germany. 2016.

Effort as a Bridge Across Action and Action Understanding,
The 20th International Congress on Infant Studies. New Orleans, LA. 2016.

Children's Learning as Stochastic Search,
Society for Research in Child Development. Philadelphia, PA. 2015.

Theories, Imagination, and the Generation of New Ideas,

Center for Brains, Minds and Machines Summer School. Woods Hole, MA. 2015.

Probabilistic Programming Tutorial,
Center for Brains, Minds and Machines Summer School. Woods Hole, MA. 2015.

Theories of Physics,
More on Development. Columbus, OH. 2015.

Modeling a Theory of the Self,
Workshop on Transformative Experiences. Chicago, IL. 2015.

Deep Thoughts: The Value of Understanding,
Commentator at 41th Meeting of the Society for Philosophy and Psychology. Duke University, NC. 2015.

Wins Above Replacement: Responsibility Attributions as Counterfactual Replacement,
40th Meeting of the Society for Philosophy and Psychology. Vancouver, Canada. 2014.

Theories, Imagination, and the Generation of New Ideas,
Center for Brains, Minds and Machines Summer School. Woods Hole, MA 2014.

Probabilistic Programming Tutorial,
Center for Brains, Minds and Machines Summer School. Woods Hole, MA. 2014.

Learning Physics from Dynamic Scenes,
36th Annual Meeting of the Cognitive Science Society. Quebec, Canada. 2014.

Theories, Imagination, and the Generation of New ideas,
Pre-conference debate at Child Development Society Meeting. Memphis, TN. 2013.

Help or Hinder? Bayesian Models of Social Goal Inference,
Simons Center, MIT. 2010.

Why Blame Bob? Probabilistic Generative Models and Blame Attribution,
34th Annual Meeting of the Cognitive Science Society. Sapporo, Japan. 2012.

Theory Learning as Stochastic Search,
$32nd$ Annual Meeting of the Cognitive Science Society. Portland, OR. 2010.

Help or Hinder? Bayesian Models of Social Goal Inference,
Machine Learning Summer School, Cambridge, UK. 2009.

Help or Hinder? Bayesian Models of Social Goal Inference,
$23rd$ Annual Conference on Neural Information Processing Systems. Vancouver. 2009.

HONORS AND
AWARDS

	2020	Harvard University Special Commendation: Extraordinary Teaching in Extraordinary Times
	2011	ICDL Best Paper Award: Experiment with computational model
	2011	MIT Continued Dedication to Teaching award
	2010	MIT Excellence in Teaching award
	2010	National Science Foundation (NSF) fellowship
	2009	Singleton Graduate Fellowship
	2009	National Science Foundation (NSF) honorable mention
	2004-2007	Hebrew University of Jerusalem Scholarships of Excellence
TEACHING EXPERIENCE AND OUTREACH	2021	Instructor, 'Decisions Big and Small' (Harvard PSY1322)
	2021	Instructor and organizer, 'Research Seminar in Cognition, Brain, and Behavior' (Harvard PSY3340)
	2021	Guest lecturer, 'Biological and Artificial Intelligence' (Harvard NEURO140)
	2021	Guest lecturer, Harvard Developmental Seminars
	2021	Guest lecturer, Harvard Cognition, Brain, Behavior Seminar
	2021	Colloquium committee member, Harvard Psychology
	2020	Instructor, 'Imagination, Pretense, and Make-Believe Worlds' (Harvard PSY1340)
	2020	Instructor, 'Decisions Big and Small' (Harvard PSY1322)
	2020	Instructor and organizer, 'Research Seminar in Cognition, Brain, and Behavior' (Harvard PSY3340)
	2020	Colloquium committee member, Harvard Psychology
	2019	Guest lecturer, Harvard Developmental Seminars
	2018	Guest lecturer, Harvard Developmental Seminars
	2017	Lecturer and Teaching Assistant, CBMM summer school
	2015	Lecturer and Teaching Assistant, CBMM summer school
	2014	Lecturer and Teaching Assistant, CBMM summer school
	2012	Teaching Assistant, Topics in early childhood cognition (MIT 9.85)
	2011	Teaching Assistant, Cognitive processes (MIT 9.65)
	2010	Planning committee member, Cambridge Science Festival
	2009	Presenter and volunteer at Neuroscience Day, Museum of Science

SERVICE
Reviewer (partial): Brain and Behavioral Sciences, Cognition, Cognitive Psychology, Cognitive Development, Cognitive Science, Cognitive Research: Principles and Implications, Developmental Psychology, Developmental Science, JEP: General, Memory and Cognition, Nature Human Behavior, Nature Communications, Psychological Review, Proceedings of the Royal Society B, Topics in Cognitive Science, Philosophical Psychology, Neural Information Processing Systems (NeurIPS), The Annual Conference of the Cognitive Science Society (CogSci), AAAI, PLoS ONE

Grant Reviews: Templeton Foundation, Israel Science Foundation (ISF)

Mentor in PPREP Harvard Workshop to help students from historically minoritized groups with their applications to positions in academia

Guest Editor for Open Mind

Ongoing organizer of Machine Common Sense reasoning meetings (intuitive psychology and general track, 2019-2020)

Co-organizer of "The Origins of Commonsense in Humans and Machines" Workshop, Cogsci (2020)

Co-organizer of Lorentz Center "Developing Models of the Word" Workshop, Leiden, Netherlands (2020)

Co-organizer of Cognition, Brain, Behavior lunch seminar series, Harvard (2019, 2020)

PC Member AAAI main track

Organizer of "More on Development (MOD)" special workshop on learning (Ohio, 2015)

Co-Organizer of Child Development Society pre-conference on "computational cognitive models and cognitive development" (2014)

STUDENTS
MENTORED
(PARTIAL LIST)

Eric Bigelow (2020-), Mariel Goddu (2020-), Sophie Bridgers (2020-), Yichen Li (2020-), YingQiao Wang (2020-), Tal Boger (2021), Izabele Jonusaite (2021-), Colin Conwell (2019-), Pechthida Kim (2020-2021, won Mary Gordon Roberts MBB Research Fellowship during this time), Zana Bucina (2020), Konstantina Katsimeni (2020), Julian De Freitas (2020, now faculty at HBS), Arunima Sarin (2019), Enosa Ogbeide (2019), Nensi Gjata (2019), Shari Liu (2018-2020, went on to post-doc at MIT and soon faculty at JHY), Felix Sosa (2017-), Cameron Nieters (2017), Michael Chang (2016, 2017, went on to graduate studies Berkeley), Eliza Kosoy (2016–2017, went on to graduate studies at Berkeley), Heather Tarr (2016, went on to graduate studies at Brown), Alexandra Wheeler (2016), Samuel Zimmerman (2016-2017), Marta Kryven (2016, went on to post-doc position at MIT)

MEMBERSHIP

Association for Psychological Science (APS)

Cognitive Science Society (CSS)

Society for Research in Child Development (SRCD)

Cognitive Development Society (CDS)

Society for Philosophy and Psychology (SPP)

Society for Personality and Social Psychology (SPSP)