Kevin A Smith

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Employment and Education

Massachusetts Institute of Technology
- Research Scientist in Brain and Cognitive Sciences 2019-Present
- Postdoctoral Scholar in Brain and Cognitive Sciences 2016-2019
- Laboratory PI: Joshua Tenenbaum

University of California San Diego 2010-2015
- Ph.D. in Experimental Psychology
- Advisor: Edward Vul

Marine Biological Laboratory Summer Course Summer 2014
- Brains, Minds & Machines program

UCLA IPAM Summer School Summer 2011
- Probabilistic Models of Cognition program

Dartmouth College 2001-2005
- B.A. in Cognitive Science, Minor in Computer Science
- Graduated Magna Cum Laude with High Honors in Cognitive Science

Grants

Templeton Worldwide Charity Foundation Aug 2022 – July 2025
Exploring the role of compositionality and mechanism design in tool use
Role: Co-Director (with Joshua Tenenbaum)
Amount: $233,942

NSF – Perception, Action, & Cognition Standard Grant Sep 2021 – Aug 2024
Collaborative Research: CompCog: Adversarial Collaborative Research on Intuitive Physical Reasoning
Role: Co-PI (with Joshua Tenenbaum, Todd Gureckis, Ernest Davis)
Amount: $685,000

NSF – FRONTIERS grant Oct 2021 – Sep 2024
Collaborative Research: NCS-FR: Beyond the ventral stream: Reverse engineering the neurocomputational basis of physical scene understanding in the primate brain
Role: Key Personnel
Amount: $2,250,000

Fellowships and Awards

Robotics: Science and Systems Best Paper Award	2018
UCSD Interdisciplinary Collaboratory Fellowship	2014
Vision Sciences Society Student Travel Award	2013
Glushko & Samuelson Foundation Student Grant	2012
Oceanids Bertha Lebus Scholarship	2012-2013
Cognitive Science Society Computational Modeling Prize: Perception/Action category	2012
Norman Anderson Travel Grant	2010-2011, 2014
UCSD Dean's Fellowship	2010-2012

Manuscripts submitted or in preparation

KA Smith, JB Hamrick, AN Sanborn, PW Battaglia, T Gerstenberg, TD Ullman, JB Tenenbaum (*in press*). Probabilistic Models of Physical Reasoning. Chapter to appear in *Reverse Engineering the Mind: Probabilistic Models of Cognition.* Eds. TL Griffiths, N Chater, JB Tenenbaum

KA Smith, L Mei, S Yao, A Pareja, J Wu, E Spelke, JB Tenebaum, TD Ullman (*in prep*). Modeling core knowledge of physics.

Publications

** Indicates shared first authorship*

KA Smith, PW Battaglia, JB Tenenbaum (2023). Integrating heuristic and simulation-based reasoning in intuitive physics. *PsyArXiv preprint, https://doi.org/10.31234/osf.io/bckes*

HY Tung, M Ding, Z Chen, D Bear, C Gan, JB Tenenbaum, ... & **KA Smith** (2023). Physion++: Evaluating Physical Scene Understanding that Requires Online Inference of Different Physical Properties. *arXiv preprint arXiv:2306.15668*.

T Chen, KR Allen, SJ Cheyette, JB Tenenbaum, & **KA Smith** (2023). "Just In Time" Representations for Mental Simulation in Intuitive Physics. In *Proceedings of the Annual Meeting of the Cognitive Science Society*.

Y LI, YQ Wang, T Bolger, **KA Smith**, SJ Gershman, T Ullman (2023). An approximate representation of objects underlies physical reasoning. *Journal of Experimental Psychology: General. https://doi.org/10.31234/osf.io/vebu5*

L Zhou, **KA Smith**, J Tenenbaum, T Gerstenberg (2023). Mental Jenga: A counterfactual simulation model of causal judgments about physical support. *Journal of Experimental Psychology: General*.

K Ota, HY Tung, **KA Smith**, A Cherian, TK Marks, A Sullivan, ... & JB Tenenbaum (2023). H-SAUR: Hypothesize, Simulate, Act, Update, and Repeat for Understanding Object Articulations from Interactions. In *2023 IEEE International Conference on Robotics and Automation (ICRA)* (pp. 7272-7278.

A Cherian, KC Peng, S Lohit, **KA Smith**, & JB Tenenbaum (2023). Are deep neural networks SMARTer than second graders?. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 10834-10844).

H Balaban, **KA Smith**, JB Tenenbaum, & TD Ullman (2023). Neural evidence that intuitive physics guides visual tracking and working memory. *PsyArXiv preprint,* https://doi.org/10.31234/osf.io/pr4ym

I Bass, **KA Smith,** E Bonawitz, TD Ullman (2022). Partial mental simulation explains fallacies in physical reasoning. *Cognitive Neuropsychology, DOI: 10.1080/02643294.2022.2083950*

DE Walker, **KA Smith**, E Vul (2022). Reconsidering the "Bias" in "The Correspondence Bias". *Decision.*

KR Allen,* **KA Smith,*** LA Bird, JB Tenenbaum, TR Makin, D Cowie (2021). Meta-strategy learning in physical problem-solving: The effect of embodied experience. *bioRxiv preprint, https://doi.org/10.1101/2021.07.08.451333*
In revision at Psychological Bulletin and Review

DM Bear, E Wang, D Mrowca, FJ Binder, HYF Tung, RT Pramod, C Holdaway, S Tao, **KA Smith**, L Fei-Fei, N Kanwisher, JB Tenenbaum, DLK Yamins, JE Fan (2021). *Physion: Evaluating physical prediction from vision in humans and machines.* Advances in Neural Information Processing Systems, Benchmark Track.

T Shu, A Bhandwaldar, C Gan, **KA Smith,** S Liu, D Gutfreund, E Spelke, JB Tenenbaum, TD Ullman (2021). *AGENT: A benchmark for core psychological reasoning.* International Conference on Machine Learning.

Y Du, **KA Smith,** TD Ullman, JB Tenenbaum, J Wu (2021). *Unsupervised discovery of 3D physical objects from video.* International Conference on Learning Representations.

K Ota, DK Jah, D Romeres, J van Baar, **KA Smith**, T Semitsu, T Oiki, A Sullivan, D Nikovski, JB Tenenbaum (2021). Data-efficient learning for complex and real-time physical problem solving using augmented simulation. *IEEE Robotics and Automation Letters,* 6(2): 4241-4248

KA Smith, L Mei, S Yao, J Wu, E Spelke, JB Tenenbaum, TD Ullman (2020). *The fine structure of surprise in intuitive physics: When, why, and how much?* Proceedings of the 41st Annual Meeting of the Cognitive Science Society.

KR Allen,* **KA Smith,*** JB Tenenbaum (2020). Rapid trial-and-error learning with simulation supports flexible tool use and physical reasoning. *Proceedings of the National Academy of Sciences*, 117 (47) 29302-29310

KR Allen, **KA Smith,** U Piterbarg, R Chen, JB Tenenbaum (2020). *Abstract strategy learning underlies flexible transfer in physical problem solving.* Proceedings of the 41st Annual Meeting of the Cognitive Science Society.

KA Smith,* L Mei,* S Yao,* J Wu, E Spelke, JB Tenenbaum, TD Ullman (2019). *Modeling expectation violation in intuitive physics with coarse probabilistic object representations.* Advances in Neural Information Processing Systems. Vancouver, Canada

KA Smith, PW Battaglia, E Vul (2018). Different physical intuitions exist between tasks, not domains. *Computational Brain & Behavior*, 1(2): 101-118

FAB Peres, **KA Smith**, KR Allen, JB Tenenbaum, JZ Kolter (2018). *End-to-end differentiable physics for learning and control*. Advances in Neural Information Processing Systems. Montreal, Canada

I Yildirim,* **KA Smith,*** M Belledonne,* J Wu, JB Tenenbaum (2018). *Neurocomputational modeling of human physical scene understanding*. Proceedings of the 2018 Conference on Cognitive Computational Neuroscience, Philadelphia, PA

I Dasgupta,* **KA Smith,*** E Schulz, JB Tenebaum, SJ Gershman (2018). *Learning to act by integrating mental simulations and physical experiments*. Proceedings of the 40th Annual Meeting of the Cognitive Science Society, Madison, WI

MA Gates, TL Veuthey, MH Tessler, **KA Smith**, T Gerstenberg, L Bayet, JB Tenenbaum (2018). *Tiptoeing around it: Inference from absence in potentially offensive speech*. Proceedings of the 40th Annual Meeting of the Cognitive Science Society, Madison, WI

M Toussaint, KR Allen, **KA Smith,** JB Tenenbaum (2018). *Differentiable physics and stable modes for tool-use and manipulation planning*. Robotics: Science and Systems *Winner of annual Best Paper Award at R:SS 2018*

KA Smith, FAB Peres, E Vul, JB Tenenbaum (2017). *Thinking inside the box: Motion prediction in contained spaces uses simulation.* Proceedings of the 39th Annual Meeting of the Cognitive Science Society, London, UK

T Gerstenberg, L Zhou, **KA Smith**, JB Tenenbaum (2017). *Faulty Towers: A counterfactual simulation model of physical support.* Proceedings of the 39th Annual Meeting of the Cognitive Science Society, London, UK

KA Smith, E Vul (2015). The role of sequential dependence in creative semantic search. *Topics in Cognitive Science*, 7(3): 543-546

KA Smith, E Vul (2015). *Prospective uncertainty: The range of possible futures in physical prediction*. Proceedings of the 37th Annual Meeting of the Cognitive Science Society, Pasadena, CA

JB Hamrick, **KA Smith**, TL Griffiths, E Vul (2015). *Think again? The amount of mental simulation tracks uncertainty in the outcome*. Proceedings of the 37th Annual Meeting of the Cognitive Science Society, Pasadena, CA

DE Walker, **KA Smith**, E Vul (2015). *The "Fundamental Attribution Error" is rational in an uncertain world*. Proceedings of the 37th Annual Meeting of the Cognitive Science Society, Pasadena, CA

KA Smith, E Vul (2014). Reductionism and practicality. *Cosmos and History: The Journal of Natural and Social Philosophy*, 10(1): 78-85

KA Smith, E Vul (2014). *Looking forwards and backwards: Similarities and differences in prediction and retrodiction*. Proceedings of the 36th Annual Meeting of the Cognitive Science Society, Quebec City, Canada

DD Bourgin, JT Abbott, TL Griffiths, **KA Smith**, E Vul (2014). *Empirical evidence for Markov Chain Monte Carlo in memory search.* Proceedings of the 36th Annual Meeting of the Cognitive Science Society, Quebec City, Canada

KA Smith, DE Huber, E Vul (2013). Multiply-constrained semantic search in the Remote Associates Test. *Cognition,* 128(1): 64-75

KA Smith, E Vul (2013). Sources of uncertainty in intuitive physics. *Topics in Cognitive Science*, 5(1): 185-199

CA Rieth, **KA Smith**, S Piantadosi, E Vul (2013). Put your money where your mouth is: Incentivizing the truth by making nonreplicability costly. *European Journal of Personality,* 27: 131-132

KA Smith, E Dechter, JB Tenenbaum, E Vul (2013). *Physical predictions over time.* Proceedings of the 35th Annual Meeting of the Cognitive Science Society, Berlin, Germany

KA Smith, P Battaglia, E Vul (2013). *Consistent physics underlying ballistic motion prediction*. Proceedings of the 35th Annual Meeting of the Cognitive Science Society, Berlin, Germany

KA Smith, E Vul (2012). *Sources of uncertainty in models of intuitive physics*. Proceedings of the 34th Annual Meeting of the Cognitive Science Society, Sapporo, Japan
Awarded the Computational Modeling Prize in the Perception/Action category

Invited Talks

"Modeling infant physical knowledge" May 2023
Computational Cognitive Models of Learning + Development Summer School

"Simulation and symbols: A framework for physical common sense" Apr 2023
UCSD Cognitive Science Computational Social Science Colloquium

"Representations for Physical Scene Understanding" Oct 2022
Brown Perception & Action Seminar

"What does it mean to "understand physics"?" Oct 2022
Building Blocks of Human World Knowledge Workshop

"Object understanding for physical reasoning" Jun 2021
1st Annual Yale Object Cognition Workshop

"Building models of infants' physical understanding" Jul 2020
Origins of Common Sense workshop
42nd Annual Meeting of the Cognitive Science Society

"The resource rational architecture of intuitive physics" Mar 2020
Harvard Psychology Cognition, Brain, and Behavior seminar

"Perception and action from generative models of physics" Dec 2019
Perception as Generative Reasoning workshop
Neural Information Processing Systems

"Strategies for physical reasoning" Jul 2019
Heuristics, Hacks, and Habits workshop
41st Annual Meeting of the Cognitive Science Society

"Simulation and rule use in physical prediction" Jul 2019
45th Annual Meeting of the Society for Philosophy and Psychology

"Efficient and robust physical reasoning" Apr 2019
Perceptive Automata invited talk

"Thinking about thinking about physics" Nov 2018
Stanford Department of Psychology

"Integrating rules and simulation" Jul 2018
Strategies and representations in physical inference symposium,
40th Annual Meeting of the Cognitive Science Society

"Simulation and other strategies for physical reasoning" Apr 2018
Concepts and Categories Symposium,
NYU Department of Psychology

"Approximate simulation and sampling in intuitive physics", Jul 2017
Bridging levels of analysis with rational process models symposium, MathPsych / ICCM 2017

"Looking forwards and backwards: Similarities and differences in prediction and retrodiction" Jul 2014
36th Annual Meeting of the Cognitive Science Society

"Physical predictions over time" Aug 2013
35th Annual Meeting of the Cognitive Science Society

"Physical prediction biases are faithful physics plus visual uncertainty" May 2013
13th Annual Meeting of the Vision Sciences Society

"Sources of uncertainty in models of intuitive physics" Aug 2012
34th Annual Meeting of the Cognitive Science Society

Teaching Experience

Course Consultant, Brains Minds and Machines summer school Summer 2016-19, 21
- Lead advisor for *Development of Intelligence, Core Knowledge* projects
- Taught tutorials on Optimization, Probabilistic Programming, Developing Online Experiments

Invited Lecturer, Dept. of Brain and Cognitive Sciences, MIT
- Computational Cognitive Science: *Mental Models as Probabilistic Programs* Fall 2020
- Computational Cognitive Science: *Metareasoning and Intuitive Physics* Fall 2018

Teaching Assistant, Psychology Dept., UCSD
- Quantitative Methods in Psychology (graduate level) Fall/Winter 2011-15
- Childhood Disorders Fall 2015
- Principles of Behavior Spring, Summer 2015
- Biological Psychology Fall 2010

Invited Lecturer, UCSD
- Big Data Analytics: *Introduction to R* (Dept. of International Relations / Pacific Studies) Spring 2014
- Analytical Methods in Computational Neuroscience: *Bayesian Inference* (Dept. of Neurosciences) Spring 2013, 2014

Service

Co-organizer of workshop “Vision and Language Algorithmic Reasoning” at International Conference for Computer Vision	Oct 2023
Co-organizer of workshop “Machine Visual Common Sense: Perception, Prediction, and Planning” at European Conference on Computer Vision	Oct 2022
Lead organizer of General Adversarial Collaboration “To what extent does the brain simulate the external world?” at Cognitive Computational Neurosciences conference	Aug 2022
Co-organizer of workshop “Differentiable Simulation for Robotics” at Robotics: Science and Systems conference	Jun 2022
Co-organizer of workshop “Physical Reasoning and Inductive Biases for the Real World” at Neural Information Processing Systems	Dec 2021
Co-organizer of Boston/Cambridge local meet-up for the Annual Meeting of the Cognitive Science Society	Jul 2021
Mentor through the CogSci 2021 mentor-match program	Jul 2021
Lead organizer of workshop “The Origins of Common Sense in Humans and Machines” at the Annual Meeting of the Cognitive Science Society	Jul 2020
Co-organizer of workshop “Modeling the Physical World: Perception, Learning, and Control” at Neural Information Processing Systems	Dec 2018
Organizer of symposium “Strategies and Representations in Physical Inference” at the Annual Meeting of the Cognitive Science Society	Jul 2018
Postdoctoral Executive Committee, Center for Brains, Minds, and Machines	2016-17
Graduate Statistics Assistant, Psychology Dept., UCSD	2011-15
Statistical analyst for undergraduate enrollment analysis, Psychology Dept., UCSD	2015
Co-founder of *Graduate Talk Series* Psychology Dept., UCSD	2011

Ad-hoc reviewer: American Journal of Psychology, Behavior Research Methods, Cereberal Cortex, Cognition, Cognitive Psychology, Cognitive Science, Cognitive Science Society Annual Meeting, Collabra:Psychology, IEEE Transactions on Pattern Analysis and Machine Intelligence, Philosophy and Psychology, Journal of Creativity, Journal of Experimental Psychology: General, Nature Human Behavior, Neural Information Processing Systems, Neural Information Processing Systems Benchmarks and Datasets, PLOS One, PLOS Computational Biology, Scientific Reports

Workshop Program Committee Member: Bridging AI and Cognitive Science (ICLR, 2020), Evaluation Beyond Metrics (IJCAI-ECAI, 2022)

Grant reviews: NSF Perception, Action, and Cognition program, NSF EHR Core Research (panelist)