

# Tianmin Shu

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CONTACT INFORMATION	Massachusetts Institute of Technology Building 46-4053 77 Massachusetts Avenue Cambridge, MA 02139	<i>Phone:</i> (310) 948-5180 <i>E-mail:</i> tshu@mit.edu <i>Website:</i> <a href="https://www.tshu.io">https://www.tshu.io</a>
RESEARCH INTERESTS	Machine Social Intelligence, Embodied AI, Human-Robot Interaction, and Computational Social Cognition.	
EMPLOYMENT	<b>Massachusetts Institute of Technology</b> <i>Research Scientist</i>	07/2023 - present <i>Advisor: Joshua B. Tenenbaum, Antonio Torralba</i>
	<b>Massachusetts Institute of Technology</b> <i>Postdoctoral Associate</i>	07/2019 - 07/2023 <i>Advisor: Joshua B. Tenenbaum, Antonio Torralba</i>
EDUCATION	<b>University of California, Los Angeles</b> , Los Angeles, CA, USA <i>Ph.D. in Statistics</i>	09/2014 - 06/2019 <i>Advisor: Song-Chun Zhu</i>
	<b>Fudan University</b> , Shanghai, China <i>B.S. in Electronic Engineering</i>	09/2010 - 06/2014
EXPERIENCE	<b>Facebook AI Research</b> , Menlo Park, CA, USA <i>Research Intern</i>	06/2018 - 09/2018 <i>Mentor: Yuandong Tian</i>
	<b>Salesforce Research</b> , Palo Alto, CA, USA <i>Research Intern</i>	06/2017 - 09/2017 <i>Mentor: Caiming Xiong, Richard Socher</i>
SELECTED HONORS AND AWARDS	<b>Excellent Paper Award</b> , IROS Cognitive and Social Aspects of Human Multi-Robot Interaction Workshop 2022 <b>Best Paper Award</b> , NeurIPS Shared Visual Representations in Human and Machine Intelligence Workshop 2020 <b>Best Paper Award</b> , NeurIPS Cooperative AI Workshop 2020 <b>Computational Modeling Prize in Perception/Action</b> , Cognitive Science Society 2017	
PUBLICATIONS	(* indicates equal contribution)  <b>Preprints &amp; Under Review</b>  H. Zhang, W. Du, J. Shan, Q. Zhou, Y. Du, J. B. Tenenbaum, <b>T. Shu</b> , and C. Gan. Building Cooperative Embodied Agents Modularly with Large Language Models. <i>Under review, arXiv:2307.02485</i> .  J. Xiang, T. Tao, Y. Gu, <b>T. Shu</b> , Z. Wang, Z. Yang, and Z. Hu. Language Models Meet World Models: Embodied Experiences Enhance Language Models. <i>Under review, arXiv:2305.10626</i> .  <b>Peer-reviewed Journal Articles</b>  X. Gao, L. Yuan, <b>T. Shu</b> , H. Lu, and S.-C. Zhu. Show Me What You Can Do: Capability Calibration on Reachable Workspace for Human-Robot Collaboration. <i>IEEE Robotics and Automation Letters (RA-L)</i> , 2022.	

**T. Shu**, Y. Peng, S.-C. Zhu, and H. Lu. A Unified Psychological Space for Human Perception of Physical and Social Events. *Cognitive Psychology*, 128: 101398, 2021.

Y. Peng, H. Lee, **T. Shu**, and H. Lu. Exploring Biological Motion Perception in Two-stream Convolutional Neural Networks. *Vision Research*, 178: 28-40, 2021.

Z. Nan, **T. Shu**, R. Gong, S. Wang, P. Wei, S.-C. Zhu, and N. Zheng. Learning to Infer Human Attention in Daily Activities. *Pattern Recognition*, 103: 107314, 2020.

D. Xie, **T. Shu**, S. Todorovic, and S.-C. Zhu. Learning and Inferring “Dark Matter” and Predicting Human Intents and Trajectories in Videos. *IEEE Trans. on Pattern Analysis and Machine Intelligence (TPAMI)*, 40(7): 1639-1652, 2018.

**T. Shu\***, Y. Peng\*, L. Fan, H. Lu, and S.-C. Zhu. Perception of Human Interaction Based on Motion Trajectories: from Aerial Videos to Decontextualized Animations. *Topics in Cognitive Science (TopiCS)*, 10(1): 225 - 241, 2018.

### Peer-reviewed Conference Papers

A. Peng, A. Netanyahu, M. K. Ho, **T. Shu**, A. Bobu, J. Shah, P. Agrawal. Diagnosis, Feedback, Adaptation: A Human-in-the-Loop Framework for Test-time Policy Adaptation. *40th International Conference on Machine Learning (ICML)*, 2023. (**Acceptance rate: 1827/6538 = 28%**)

X. Puig\*, **T. Shu\***, J. B. Tenenbaum, A. Torralba. NOPA: Neurally-guided Online Probabilistic Assistance for Building Socially Intelligent Home Assistants. *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.

D. Liu, V. Shah, O. Boussif, C. Meo, A. Goyal, **T. Shu**, M. C. Mozer, N. Heess, Y. Bengio. Stateful Active Facilitator: Coordination and Environmental Heterogeneity in Cooperative Multi-Agent Reinforcement Learning. *11th International Conference on Learning Representations (ICLR)*, 2023. (**Acceptance rate: 31.8%**)

R. Tejwani\*, Y.-L. Kuo\*, **T. Shu**, B. Stankovits, D. Gutfreund, J. B. Tenenbaum, B. Katz, and A. Barbu. Zero-shot Linear Combinations of Grounded Social Interactions with Linear Social MDPs. *37th AAAI Conference on Artificial Intelligence (AAAI)*, 2023. (**Acceptance rate: 1721/8777=20%**)

A. Netanyahu\*, **T. Shu\***, J. B. Tenenbaum, and P. Agrawal. Discovering Generalizable Spatial Goal Representations via Graph-based Active Reward Learning. *39th International Conference on Machine Learning (ICML)*, 2022. (**Acceptance rate: 1235/5630 = 22%**)

M. Deng, J. Wang, C.-P. Hsieh, Y. Wang, H. Guo, **T. Shu**, M. Song, E. Xing and Z. Hu. RLPrompt: Optimizing Discrete Text Prompts with Reinforcement Learning. *Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 2022.

R. Tejwani\*, Y.-L. Kuo\*, **T. Shu**, B. Stankovits, D. Gutfreund, J. B. Tenenbaum, B. Katz, and A. Barbu. Incorporating Rich Social Interactions Into MDPs. *IEEE International Conference on Robotics and Automation (ICRA)*, 2022. (A short version won **Excellent Paper Award** at IROS Cognitive and Social Aspects of Human Multi-Robot Interaction Workshop, 2022)

R. Tejwani\*, Y.-L. Kuo\*, **T. Shu**, B. Katz, and A. Barbu. Social Interactions as Recursive MDPs. *Conference on Robot Learning (CoRL)*, 2021. (**Acceptance rate: 156/400 = 38%**)

**T. Shu**, A. Bhandwaldar, C. Gan, K. A. Smith, S. Liu, D. Gutfreund, E. Spelke, J. B. Tenenbaum,

and T. D. Ullman. AGENT: A Benchmark for Core Psychological Reasoning. *38th International Conference on Machine Learning (ICML)*, 2021. (**Acceptance rate: 1184/5513 = 21%**)

X. Puig, **T. Shu**, S. Li, Z. Wang, J. B. Tenenbaum, S. Fidler, and A. Torralba. Watch-And-Help: A Challenge for Social Perception and Human-AI Collaboration. *9th International Conference on Learning Representations (ICLR)*, 2021. (**Spotlight presentation, acceptance rate: 5.6%**; a short version won **Best Paper Award** at NeurIPS Cooperative AI Workshop, 2020)

A. Netanyahu\*, **T. Shu\***, B. Katz, A. Barbu, and J. B. Tenenbaum. PHASE: Physically-grounded Abstract Social Events for Machine Social Perception. *35th AAAI Conference on Artificial Intelligence (AAAI)*, 2021. (**Acceptance rate: 1692/7911=21%**; short version won **Best Paper Award** at NeurIPS Shared Visual Representations in Human and Machine Intelligence Workshop, 2020)

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

X. Gao\*, R. Gong\*, Y. Zhao, S. Wang, **T. Shu**, and S.-C. Zhu. Joint Mind Modeling for Explanation Generation in Complex Human-Robot Collaborative Tasks. *International Conference on Robot & Human Interactive Communication (RO-MAN)*, 2020.

H. Wang, W. Wang, **T. Shu**, W. Liang, and J. Shen. Active Visual Information Gathering for Vision-Language Navigation. *European Conference on Computer Vision (ECCV)*, 2020. (**Acceptance rate: 1360/5150 = 26%**)

**T. Shu**, Y. Peng, H. Lu, and S.-C. Zhu. Partitioning the Perception of Physical and Social Events Within a Unified Psychological Space. *41st Annual Meeting of the Cognitive Science Society (CogSci)*, 2019. (**Oral presentation, acceptance rate: 205/810 = 25.3%**)

**T. Shu** and Y. Tian. M<sup>3</sup>RL: Mind-aware Multi-agent Management Reinforcement Learning. *7th International Conference on Learning Representations (ICLR)*, 2019. (**Acceptance rate: 525/1591 = 33%**)

P. Wei, Y. Liu, **T. Shu**, N. Zheng, and S.-C. Zhu. Where and Why Are They Looking? Jointly Inferring Human Attention and Intentions in Complex Tasks. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2018. (**Acceptance rate: 979/3303 = 30%**)

**T. Shu**, C. Xiong, and R. Socher. Hierarchical and Interpretable Skill Acquisition in Multi-task Reinforcement Learning. *6th International Conference on Learning Representations (ICLR)*, 2018. (**Acceptance rate: 337/935 = 36%**)

**T. Shu\***, Y. Peng\*, L. Fan, H. Lu, and S.-C. Zhu. Inferring Human Interaction from Motion Trajectories in Aerial Videos. *39th Annual Meeting of the Cognitive Science Society (CogSci)*, 2017. (**Oral presentation, acceptance rate: 255/873 = 29%**) **Computational Modeling Prize**

**T. Shu**, S. Todorovic, and S.-C. Zhu. CERN: Confidence-Energy Recurrent Network for Group Activity Recognition. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2017. (**Acceptance rate: 783/2680 = 29%**)

**T. Shu**, X. Gao, M. S. Ryoo, and S.-C. Zhu. Learning Social Affordance Grammar from Videos: Transferring Human Interactions to Human-Robot Interactions. *IEEE International Conference on Robotics and Automation (ICRA)*, 2017. (**Acceptance rate: 939/2289=41%**)

**T. Shu\***, S. Thurman\*, D. Chen, S.-C. Zhu, and H. Lu. Critical Features of Joint Actions that Signal Human Interaction. *38th Annual Meeting of the Cognitive Science Society (CogSci)*, 2016.

**T. Shu**, M. S. Ryoo, and S.-C. Zhu. Learning Social Affordance for Human-Robot Interaction. *25th International Joint Conference on Artificial Intelligence (IJCAI)*, 2016. (**Acceptance rate: 558/2294= 24%**)

**T. Shu**, D. Xie, B. Rothrock, S. Todorovic, and S.-C. Zhu. Joint Inference of Groups, Events and Human Roles in Aerial Videos. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2015. (**Oral presentation, acceptance rate: 71/2123 = 3.3%**)

#### Peer-reviewed Workshop Papers

K. Jha, T. A. Le, C. Jin, Y.-L. Kuo, J. B. Tenenbaum, **T. Shu**. Neural Amortized Inference for Nested Multi-agent Reasoning. *AAAI Summer Symposium*, 2023.

X. Gao, R. Gong, **T. Shu**, X. Xie, S. Wang, and S.-C. Zhu. VRKitchen: an Interactive 3D Environment for Learning Real Life Cooking Tasks. *ICML Reinforcement Learning for Real Life Workshop*, 2019.

**T. Shu**, C. Xiong, Y. N. Wu, and S.-C. Zhu. Interactive Agent Modeling by Learning to Probe. *NeurIPS 2018 Deep Reinforcement Learning Workshop*, 2018.

#### Peer-reviewed Conference Posters

**T. Shu**, A. Netanyahu, M. Kryven, J. Muchovej, N. Shenoy, B. Katz, A. Barbu, T. D. Ullman, J. B. Tenenbaum. Perceiving social events in a physical world. *The Annual Meeting of the Vision Sciences Society (VSS)*, 2021.

MEDIA COVERAGE “A faster way to teach a robot.” *MIT News*. Jul. 18, 2023

“A framework that could improve the social intelligence of home assistants.” *Tech Xplore*. Jan. 31, 2023

“A new explainable AI paradigm that could enhance human-robot collaboration.” *Tech Xplore*. Aug. 10, 2022

“Scientists Are Trying to Give Robots Social Skills.” *Discover Magazine*. Jul. 25, 2022

“Easy for you, tough for a robots.” *Science News for Students*. Nov. 18, 2021

“Giving robots social skills.” *MIT News*. Nov. 5, 2021

“Can you teach AI common sense?” *VentureBeat*. Jul. 27, 2021

“Researchers design virtual environment to spur development of helpful home robots.” *VentureBeat*. Oct. 24, 2020

“AI can learn real-world skills from playing StarCraft and Minecraft.” *Science News*. May 14, 2019

“VRKitchen: An interactive virtual environment to train and test AI agents.” *Tech Xplore*. Mar. 27, 2019

“Robots taught to work alongside humans by giving high fives.” *New Scientist*. Apr. 27, 2017

INVITED TALKS

“Benchmarking Human-Level Machine Social Intelligence.”

- *Cognitive-AI Benchmarking Workshop in Conjunction with CogSci 2023*, Jul. 17, 2023

“Cognitively Inspired Machine Social Intelligence.”

- *Social Cognitive Neuroscience Lab, University of Iowa*, Mar. 3, 2023

- *Computational Cognition, Vision, and Learning Group, Johns Hopkins University*, Dec. 2, 2022

- *Robotics Seminar, University of New Hampshire*, Oct. 28, 2022

- *University of Maryland*, Jul. 25, 2022

- *Johns Hopkins University*, Jul. 20, 2022

- *Vision Seminar, Columbia University*, Jun. 29, 2022

- *Visual Intelligence for Transportation (VITA) Lab, EPFL*, Jan. 5, 2022

- *AI Seminar, Information Sciences Institute, USC*, Oct. 22, 2021

“Benchmarking Machine Social Intelligence.”

- *Sony Computer Science Laboratories, Paris*, Feb. 17, 2021

“Perceiving Social Interactions Under Physical Dynamics.”

- *Virtual Computational Neuroscience (VCN) Journal Club hosted by Stanford, MIT/Harvard, and Princeton*, Nov. 18, 2020

“A Unified Modeling of Physical and Social Events.”

- *The Annual Meeting of Multidisciplinary University Initiative (MURI), Edinburgh, UK*, Sep. 4, 2019

“Towards a Better Agent Modeling for Multi-agent Reinforcement Learning.”

- *CLVR Speaker Series, University of Southern California*, Nov. 29, 2018

“Social Perception on Heider-Simmel Animations.”

- *The Annual Meeting of Multidisciplinary University Initiative (MURI), White Mountain, NH*, Sep. 26, 2018

“Modeling Human Social Interactions.”

- *The Annual Meeting of Multidisciplinary University Initiative (MURI), UCLA*, Aug. 23, 2017

“Inferring Human Interactions.”

- *3rd Vision Meets Cognition Workshop in Conjunction with CVPR 2017, Honolulu, HI*, Jul. 21, 2017

PROFESSIONAL  
SERVICE

**Conference Reviewer:**

- CVPR (2017-2023)

- ICCV (2017, 2019, 2021)

- ECCV (2018, 2020, 2022)

- ICLR (2021-2022)

- NeurIPS (2020-2023)

- ICML (2021-2023)

- AAAI (2019-2022)

- ICRA (2019)

- CoRL (2023)

- IROS (2017, 2019, 2021, 2022)

- RO-MAN (2021)

- CogSci (2022-2023)

- WACV (2021)

- BMVC (2019-2020)

- ACCV (2019)

- PRCV (2019-2020)

**Journal Reviewer:**

- International Journal of Computer Vision (IJCV)
- IEEE Transactions on Image Processing (TIP)
- IEEE Robotics and Automation Letters
- Autonomous Robotics
- Frontiers in Psychology
- Quarterly Journal of Experimental Psychology
- Computers in Industry

**Workshop Organizers & Committee:**

- RSS 2023 Workshop on Social Intelligence in Humans and Robots
- ICML 2023 Workshop on Theory of Mind in Communicating Agents
- ICML 2023 Workshop on Interactive Learning with Implicit Human Feedback
- 1st Challenge on Machine Visual Common Sense: Perception, Prediction, Planning at ECCV 2022
- RSS 2022 Workshop on Social Intelligence in Humans and Robots
- ICRA 2021 Workshop on Social Intelligence in Humans and Robots
- ICLR 2021 Workshop on Embodied Multimodal Learning
- NeurIPS 2019 Workshop on Learning with Rich Experience: Integration of Learning Paradigms
- ICML 2018 Workshop on Theoretical Foundations and Applications of Deep Generative Models
- 3rd Vision Meets Cognition Workshop in Conjunction with CVPR 2017

**Department and University Services:**

- Student Reviewer, UCLA Computer Science Graduate Admission (2017-2019)
- Grad Student Consultant, the American Statistical Association (ASA) DataFest (2015)

TEACHING  
EXPERIENCE

**Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences**

*9.66: Computational Cognitive Science* Fall 2020, Fall 2021, Fall 2022  
- Project Teaching Assistant

**University of California, Los Angeles, Department of Statistics**

*STATS 232C: Cognitive Artificial Intelligence* Spring 2018  
- Teaching Assistant

*STATS 102A: Introduction to Computational Statistics with R* Fall 2017, Winter 2018  
- Teaching Assistant

*STATS 232A: Statistical Modeling and Learning in Vision and Cognition* Winter 2016  
- Teaching Assistant

*STATS 130: Getting Up to Speed with SPSS, Stata, SAS, and R* Spring 2015  
- Teaching Assistant

MENTORING

**At MIT**

**Undergraduate Research:**

- Hao Liu (visiting student from Tsinghua University, 2023 - present)
- Chuanyang Jin (visiting student from New York University, 2023 - present)
- Jing Cao (2023 - present)
- Harry Chen (2023 - present)
- Andy Wang (2022)
- Kunal Jha (visiting student from Dartmouth College, 2022 - present)
- Karen Chung (2021 - 2022)

- Nakul Shenoy (2020 - 2022)
- Annika Magaro (2020 - 2022)
- Arpan Kaphle (2021)

**Master's Research:**

- Yutong Wu (2023 - present)

**At UCLA**

**Master's Research:**

- Yixin Chen (2017 - 2018; currently Ph.D. student in Statistics at UCLA)

**Undergraduate Research:**

- Qingyi Zhao (2018; Master's in Computer Science, UCLA)
- Adam Brownell (2017 - 2018)
- Xiaofeng Gao (2016 Summer; currently Ph.D. student in Statistics at UCLA)
- Xiaopei Zhang (2015 - 2018; Master's in Electrical Engineering, UCLA)
- Peimeng Sui (2015 - 2016; Master's in Data Science, NYU)
- Zhe Ji (2015; Master's in Industrial Engineering & Operations Research, UC Berkeley)