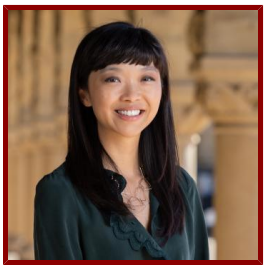
Stanford



Judith Ellen Fan

Assistant Professor of Psychology, by courtesy, of Education and of Computer Science

Bio

BIO

I direct the Cognitive Tools Lab (https://cogtoolslab.github.io/) at Stanford University. Our lab aims to reverse engineer the human cognitive toolkit—in particular, how people use physical representations of thought to learn, communicate, and solve problems. Toward this end, we use a combination of approaches from cognitive science, computational neuroscience, and artificial intelligence to achieve deeper understanding of quintessentially human ways of thinking and imagining. Our broader goal is to leverage such scientific understanding of human cognition to guide the development of technologies that augment human agency and creativity.

ACADEMIC APPOINTMENTS

- Assistant Professor, Psychology
- Assistant Professor (By courtesy), Graduate School of Education
- Assistant Professor (By courtesy), Computer Science
- Member, Wu Tsai Human Performance Alliance
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Assistant Professor, University of California, San Diego, (2019-2023)

HONORS AND AWARDS

- Lila R. Gleitman Prize, Cognitive Science Society (2026)
- Richard E. Guggenhime Faculty Scholar, Stanford University (2025-2028)
- CAREER, National Science Foundation (2021-2026)
- Outstanding Faculty Mentorship Award, UC San Diego Graduate Student Association (2021)
- Robert J. Glushko Prize for Outstanding Doctoral Dissertation, Cognitive Science Society (2017)

PROGRAM AFFILIATIONS

- Symbolic Systems Program

PROFESSIONAL EDUCATION

- PhD, Princeton University , Psychology (2016)
- AB, Harvard College , Neurobiology & Statistics (2010)

LINKS

- Cognitive Tools Lab: https://cogtoolslab.github.io/

Research & Scholarship

RESEARCH INTERESTS

- Assessment & Evaluation
- Cognitive Development
- Data Science
- Educational Neuroscience
- Higher Education
- Learning Technologies

Teaching

COURSES

2026-27

- Cognitive Technologies: The Past, Present, and Future of Human Learning: PSYCH 229 (Spr)
- Computational Models of the Creative Process: PSYCH 230 (Spr)
- Data Science and the Science of Learning: DATASCI 194L, DATASCI 294L, EDUC 139, PSYCH 139 (Win)
- Introduction to Statistical Methods: Precalculus: PSYCH 10, STATS 60 (Aut)

2025-26

- Cognitive Technologies: The Past, Present, and Future of Human Learning: PSYCH 229 (Spr)
- Computational Models of the Creative Process: PSYCH 230 (Win)
- Introduction to Statistical Methods: Precalculus: PSYCH 10, STATS 60 (Aut)

2024-25

- Data Science and the Science of Learning: DATASCI 194L, DATASCI 294L, EDUC 139, PSYCH 139 (Spr)
- Introduction to Statistical Methods: Precalculus: PSYCH 10, STATS 160, STATS 60 (Aut)
- Why College? Your Education and the Good Life: COLLEGE 101 (Aut)

2023-24

- Bids for Scale in Psychological Science: PSYCH 267A (Win)
- Introduction to Statistical Methods: Precalculus: PSYCH 10, STATS 160, STATS 60 (Aut)

STANFORD ADVISEES

Kalu Obasi

Doctoral Dissertation Reader (AC)

Samah Abdelrahim, Bendix Kemmann, Sharon Zhang

Orals Chair

Aryaman Arora

Postdoctoral Faculty Sponsor

Lily Ge, Kushin Mukherjee, Lio Wong

Doctoral Dissertation Advisor (AC)

Linas Nasvytis

Orals Evaluator

Sharon Zhang

Doctoral (Program)

Sean Anderson, Matt Caren, Alexa Tartaglini

Postdoctoral Research Mentor

Erik Brockbank, Junyi Chu

Publications

PUBLICATIONS

- **Evaluating convergence between two data visualization literacy assessments.** *Cognitive research: principles and implications*
  Brockbank, E., Verma, A., Lloyd, H., Huey, H., Padilla, L., Fan, J. E.
  2025; 10 (1): 15
- **Understanding Physical Dynamics with Counterfactual World Modeling**
  Venkatesh, R., Chen, H., Feigelis, K., Bear, D. M., Jedoui, K., Kotar, K., Binder, F., Lee, W., Liu, S., Smith, K. A., Fan, J. E., Yamins, D. L. K.
  edited by Leonardis, A., Ricci, E., Roth, S., Russakovsky, O., Sattler, T., Varol, G.
  SPRINGER INTERNATIONAL PUBLISHING AG.2025: 368-387
- **Drawing as a means to characterize memory and cognition.** *Memory & cognition*
  Bainbridge, W. A., Chamberlain, R., Wammes, J., Fan, J. E.
  2024
- **Using games to understand the mind.** *Nature human behaviour*
  Allen, K., Brandle, F., Botvinick, M., Fan, J. E., Gershman, S. J., Gopnik, A., Griffiths, T. L., Hartshorne, J. K., Hauser, T. U., Ho, M. K., de Leeuw, J. R., Ma, W. J., Murayama, et al
  2024
- **Parallel developmental changes in children's production and recognition of line drawings of visual concepts.** *Nature communications*
  Long, B., Fan, J. E., Huey, H., Chai, Z., Frank, M. C.
  2024; 15 (1): 1191
- **How do video content creation goals impact which concepts people prioritize when generating B-roll imagery?**
  Huey, H., Leake, M., Aneja, D., Fisher, M., Fan, J. E., ASSOC COMPUTING MACHINERY
  ASSOC COMPUTING MACHINERY.2024: 542-549
- **Open Vocabulary Semantic Scene Sketch Understanding**
  Bourouis, A., Fan, J. E., Gryaditskaya, Y., IEEE COMPUTER SOC
  IEEE COMPUTER SOC.2024: 4176-4186
- **Communicating Design Intent Using Drawing and Text**
  McCarthy, W. P., Matejka, J., Willis, K. D. D., Fan, J. E., Pu, Y., ASSOC COMPUTING MACHINERY
  ASSOC COMPUTING MACHINERY.2024: 512-519
- **Consistency and Variation in Reasoning About Physical Assembly.** *Cognitive science*
  McCarthy, W. P., Kirsh, D., Fan, J. E.
  2023; 47 (12): e13397
- **Creating ad hoc graphical representations of number.** *Cognition*
  Holt, S., Fan, J. E., Barner, D.
  2023; 242: 105665

- **Developmental changes in drawing production under different memory demands in a U.S. and Chinese sample.** *Developmental psychology*
  Long, B., Wang, Y., Christie, S., Frank, M. C., Fan, J. E.
  2023; 59 (10): 1784-1793
- **Drawing as a versatile cognitive tool** *NATURE REVIEWS PSYCHOLOGY*
  Fan, J. E., Bainbridge, W. A., Chamberlain, R., Wammes, J. D.
  2023; 2 (9): 556-568
- **Drawing as a versatile cognitive tool.** *Nature reviews psychology*
  Fan, J. E., Bainbridge, W. A., Chamberlain, R., Wammes, J. D.
  2023; 2 (9): 556-568
- **Socially intelligent machines that learn from humans and help humans learn.** *Philosophical transactions. Series A, Mathematical, physical, and engineering sciences*
  Gweon, H., Fan, J., Kim, B.
  2023; 381 (2251): 20220048
- **Visual resemblance and interaction history jointly constrain pictorial meaning.** *Nature communications*
  Hawkins, R. D., Sano, M., Goodman, N. D., Fan, J. E.
  2023; 14 (1): 2199
- **Physion plus plus : Evaluating Physical Scene Understanding that Requires Online Inference of Different Physical Properties**
  Tung, H., Ding, M., Chen, Z., Bear, D. M., Gan, C., Tenenbaum, J. B., Yamins, D. L. K., Fan, J., Smith, K. A.
  edited by Oh, A., Neumann, T., Globerson, A., Saenko, K., Hardt, M., Levine, S.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2023
- **SEVA: Leveraging sketches to evaluate alignment between human and machine visual abstraction**
  Mukherjee, K., Huey, H., Lu, X., Vinker, Y., Aguina-Kang, R., Shamir, A., Fan, J. E.
  edited by Oh, A., Neumann, T., Globerson, A., Saenko, K., Hardt, M., Levine, S.
  NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2023
- **Common Object Representations for Visual Production and Recognition** *COGNITIVE SCIENCE*
  Fan, J. E., Yamins, D. L. K., Turk-Browne, N. B.
  2018; 42 (8): 2670-2698
- **Improving analytical reasoning and argument understanding: a quasi-experimental field study of argument visualization.** *NPJ science of learning*
  Cullen, S., Fan, J., van der Brugge, E., Elga, A.
  2018; 3: 21