Judith E. Fan

Assistant Professor Department of Psychology University of California, San Diego La Jolla, CA 92093 U.S.A.

email: jefan@ucsd.edu

URL: https://cogtoolslab.github.io

Academic Positions

Assistant Professor, Psychology, University of California, San Diego

Affiliated Faculty, Neurosciences Graduate Program, Halıcıoğlu Data Science
Institute, The Design Lab, Computational Social Sciences Program

Postdoctoral Scholar, Psychology, Stanford University

2016 Postdoctoral Research Associate, Neuroscience Institute, Princeton University

Education

2011–2016 *PhD*, Psychology, Princeton University
2006–2010 *AB*, Neurobiology and Statistics, Harvard College summa cum laude

Honors

2021	Outstanding Faculty Mentorship Award, UC San Diego Graduate Student Association
2017	Robert J. Glushko Prize for Outstanding Doctoral Dissertation, Cognitive Science Society
2017	Finalist for the NIH Director's Early Independence Award
2015	Computational Modeling Paper Prize in Perception & Action, Cognitive Science Society
2013	Early Graduate Student Researcher Award, American Psychological Association
2013	Object Perception, Attention, and Memory (OPAM) Student Travel Award
2009	Phi Beta Kappa, Harvard University
2007-2008	John Harvard Scholar, Harvard University (top 5% of class)
2006-2007	Harvard College Scholar, Harvard University (top 10% of class)
2006	Presidential Scholar, U.S. Department of Education (1 of 2 selected from state)

Research Grants

2021-2026 Faculty Early Career Development Program (CAREER) Award

Source: National Science Foundation

Title: Mechanisms enabling the flexible expression of visual concepts

Role: PI

Science of Autonomy Research Grant

Source: Office of Naval Research

Title: Harnessing human intelligence for adaptive human-robot collaboration

Role: co-PI, w/ Dorsa Sadigh (PI)

2021-2023 Hoffman-Yee Research Grant

Source: Stanford Institute for Human-Centered Artificial Intelligence

Title: Curious, self-aware AI agents to build cognitive models and understand de-

velopmental disorders

Role: co-PI, w/ Daniel Yamins (PI), Mike Frank, Nick Haber, & Dennis Wall (co-PIs)

2020-2021 Course Development and Instructional Improvement Program Grant

Source: UC San Diego

Title: Enhancing the Psychology core methods curriculum: a new emphasis on computational literacy, open-science practices, and project-based collaboration

Role: PI, with Emma Geller and Celeste Pilegard (co-PIs)

2015-2016 Council of the Humanities David A. Gardner '69 Magic Project Grant

Source: Princeton University

Title: Drawing as a window into the mind Role: PI, with Nick Turk-Browne (co-PI)

Fellowships

2015-2016	Cognitive Science Graduate Student Fellowship, Princeton University
2015-2016	Cognitive Science Graduate Research Grant, Princeton University
2015-2016	Council on Science and Technology Research Grant, Princeton University
2013-2016	Graduate Research Fellowship, National Science Foundation
2011-2012	Andrew W. Mellon Foundation Research Fellowship in Cultural Policy, Princeton University
2011-2012	Walker McKinney '50 Life Sciences Fellowship, Princeton University
2010-2011	Michael C. Rockefeller Foundation Memorial Fellowship, Harvard University
2009	Mary G. Roberts Mind/Brain/Behavior Thesis Fellowship, Harvard University
2009	Program for Research in Science and Engineering Fellowship, Harvard University
2008	Weissman International Internship Program Fellowship, Harvard University
2008	Lowe Career Decision Loan Fund Recipient, Harvard University
2007	Museum of Comparative Zoology Grants-in-Aid Recipient, Harvard University
2007-2009	Harvard College Research Program Fellowship, Harvard University
2006-2010	T.W. Lewis Foundation Scholar & Robert C. Byrd Scholar

Publications

2021

Huey, H., Lu, X., Walker, C. and Fan, J. (under review). Explanatory drawings prioritize funcunder review tional properties at the expense of visual fidelity. Hawkins, R., Sano, M., Goodman, N., and Fan, I. (under review). Visual resemblance and under review communicative context constrain the emergence of graphical conventions. Long, B., Fan, J., Chai, Z., and Frank, M. (under review). Parallel developmental changes in under review children's drawing and recognition of visual concepts. *Bear, D., *Wang, E., *Mrowca, D., *Binder, F., Tung, H.-Y., RT, P, Holdaway, C., Tao, S., Smith, 2021 K., Sun, F.-Y., Li, F.-F., Kanwisher, N., Tenenbaum, J., **Yamins, D., and **Fan, J. (2021). Physion: Evaluating physical prediction from vision in humans and machines. In Advances in Neural Information Processing Systems (Datasets & Benchmarks Track) 2021. Binder, F., Mattar, M., Kirsh, D. and Fan, J. (2021). Visual scoping operations for physical 2021 assembly. Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. Holdaway, C., Bear, D., Radwan, S., Frank, M., Yamins, D., and Fan, J. (2021). Measuring 2021 and predicting variation in the interestingness of physical structures. *Proceedings of the 43rd* Annual Meeting of the Cognitive Science Society. Holt, S., Barner, D., and Fan, J. (2021). Improvised numerals rely on 1-to-1 correspondence. 2021 Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. Huey, H., Walker, C., and Fan, J. (2021). How do the semantic properties of visual explana-2021 tions guide causal inference? Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. Kachergis, G., Radwan, S., Long, B., Fan, J., Lingelbach, M., Bear, D., Yamins, D., and Frank, 2021 M. (2021). Predicting children's and adults' preferences in physical interactions via physics simulation. Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. *McCarthy, W., *Hawkins, R., Wang, H., Holdaway, C., and Fan, J. (2021). Learning to com-2021 municate about shared procedural abstractions. Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. McCarthy, W., Mattar, M., Kirsh, D. and Fan, J. (2021). Connecting perceptual and procedural 2021 abstractions in physical construction. Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. Wang, H., Polikarpova, N., and Fan, J. (2021). Learning part-based abstractions for visual 2021 object concepts. Proceedings of the 43rd Annual Meeting of the Cognitive Science Society. Wang, H., Vul, E., Polikarpova, N., and Fan, J. (2021). Theory acquisition as constraint-based 2021

program synthesis. *Proceedings of the 43rd Annual Meeting of the Cognitive Science Society.* Yang, J. and **Fan, J.** (2021). Visual communication of object concepts at different levels of

abstraction. Proceedings of the 43rd Annual Meeting of the Cognitive Science Society.

- McCarthy, W., Holdaway, C., Hawkins, R., and **Fan, J.** (2020). Emergence of compositional abstractions in human collaborative assembly. *NeurIPS Workshop on Object Representations for Learning and Reasoning*.
- McCarthy, W., and **Fan, J.** (2020). Rapid policy updating in human physical construction. *ICML Workshop on Object-Oriented Learning: Perception, Representation, and Reasoning.*
- Wang, H., and **Fan, J.** (2020). Library learning for structured object concepts. *ICML Workshop on Object-Oriented Learning: Perception, Representation, and Reasoning.*
- McCarthy W., Kirsh D., & Fan J. (2020). Learning to build physical structures better over time. Proceedings of the 42nd Annual Meeting of the Cognitive Science Society.
- **Fan J.**, Wammes J., Gunn J., Yamins D., Norman K., Turk-Browne N. (2020). Relating visual production and recognition of objects in human visual cortex. *Journal of Neuroscience*.
- Xu T., Fan J., & Dow S. (2020). Schema and metadata guide the collective generation of relevant and diverse insights. Proceedings of the 8th AAAI Conference on Human Computation and Crowdsourcing.
- Fan J., Hawkins R., Wu M., & Goodman N. (2020). Pragmatic inference and visual abstraction enable contextual flexibility during visual communication. *Computational Brain & Behavior.*
- Achlioptas, P., **Fan J.**, Hawkins R., Guibas L., & Goodman N. (2019). ShapeGlot: Learning language for shape differentiation. *International Conference on Computer Vision (ICCV)*.
- Hawkins R.*, Sano, M.*, Goodman N., & **Fan J.** (2019). Graphical convention formation during visual communication. *Proceedings of the 41st Annual Meeting of the Cognitive Science Society.*
- Mukherjee K., Hawkins R., & Fan J. (2019). Communicating semantic part information in drawings. Proceedings of the 41st Annual Meeting of the Cognitive Science Society.
- Long B., **Fan J.**, Chai R., & Frank M. (2019). Developmental changes in the ability to draw distinctive features of object categories. *Proceedings of the 41st Annual Meeting of the Cognitive Science Society.*
- Fan J., Dinculescu M., & Ha D. (2019). Collabdraw: An environment for collaborative sketching with an artificial agent. *Proceedings of the 2019 ACM SIGCHI Conference on Creativity and Cognition*.
- Cullen S., **Fan J.**, van der Brugge E., & Elga A. (2018). Improving analytical reasoning and argument understanding: A quasi-experimental field study of argument visualization. *npj Science of Learning*.
- Fan J., Yamins D., & Turk-Browne, N. (2018) Common object representations for visual production and recognition. *Cognitive Science*.
- Long, B., **Fan J.**, & Frank M. (2018) Drawing as a window into developmental changes in object representations. *Proceedings of the 40th Annual Conference of the Cognitive Science Society.*
- Fan J., Hutchinson, J., and Turk-Browne, N. (2016) When past is present: Substitutions of long-term memory for sensory evidence in perceptual judgments. *Journal of Vision.* 16(8), 1-12.
- Fan J. and Turk-Browne, N. (2016) Incidental biasing of attention from long-term memory. Journal of Experimental Psychology: Learning, Memory, & Cognition. 42(6), 970-977.

Fan J., Turk-Browne, N., & Taylor, J. (2016) Error-driven learning in statistical summary 2016 perception. Journal of Experimental Psychology: Human Perception and Performance, 42(2), 266-280. Fan J., Yamins D., & Turk-Browne, N. (2015) Common object representations for visual recog-2015 nition and production. Proceedings of the 37th Annual Meeting of the Cognitive Science Society. Fan J. (2015) Drawing to learn: how producing graphical representations enhances scientific 2015 thinking. Translational Issues in Psychological Science. 1(2), 170-181. Fan J. and Suchow, J. (2014) The crowd is self-aware. Behavioral and Brain Sciences, 37(1), 2014 81-82. Fan J. and Turk-Browne, N. (2013) Internal attention to features in visual short-term memory 2013 guides object learning. Cognition, 129(2), 292-308. Fan J., Turk-Browne, N., & Taylor, J. (2013) Feedback-driven tuning of statistical summary 2013 representations. Visual Cognition, 21(6), 685-689. Fan J. (2013) Can ideas about food inspire real social change? The case of Peruvian gastron-2013 omy. Gastronomica, 13(2), 31-42. Strange B., Kroes M., Fan J., & Dolan R. (2010) Emotion causes targeted forgetting of estab-2010 lished memories. Frontiers in Behavioral Neuroscience. 4, 1-13. Sharot T., Shiner T. Brown A., Fan J., & Dolan, R. (2009) Dopamine enhances expectation of 2009 pleasure in humans. Current Biology, 24(19), 2077-1080.

	Invited Colloquia
2021	Cognitive technologies for visual communication
	CogSci 2021 Workshop: Symbolic and sub-symbolic systems in people and machines, July 2021.
2021	Drawing games as a window into concepts, communication, and collaboration.
	CogSci 2021 Workshop: Using games to understand intelligence, July 2021.
2021	Cognitive technologies for making the invisible visible
	Diverse Intelligences Summer Institute, July 2021.
2021	Relating visual production and recognition in human visual cortex.
	Wellcome Trust Centre for Neuroimaging, June 2021.
2021	Cognitive tools for making the invisible visible.
	Workshop on Sketch-Oriented Deep Learning, CVPR, June 2021.
2021	Cognitive tools for learning and communication.

Nokia Bell Labs, February 2021.

2021 Cognitive tools for learning and communication.

2020

2020

 $Department\ of\ Cognitive,\ Linguistic\ \mathring{\sigma}\ Psychological\ Sciences,\ Brown\ University,\ February\ 2021.$

Cognitive tools for learning and communication.

Institute for Cognitive Science, University of Michigan, December 2020.

Cognitive tools for making the invisible visible.

Department of Philosophy, University of Southern California, June 2020.

2020	Emergence of graphical communication protocols. Robotics: Science & Systems Workshop: Emergent Behaviors in Human-Robot Systems, July 2020.
2020	Cognitive tools for making the invisible visible.
2020	ICLR Workshop on Bridging AI and Cognitive Science, Addis Ababa, Ethiopia, April 2020.
2010	Cognitive tools for learning and communication.
2019	Design @ Large, UC San Diego, La Jolla, CA, May 2019.
2010	Cognitive tools for learning and communication.
2019	Halicioğlu Data Science Institute, UC San Diego, La Jolla, CA, January 2019.
2018	Cognitive tools for learning and communication.
2010	Hult International Business School, San Francisco, CA, April 2018.
2018	Drawing as a window into the mind.
2010	Netflix, Los Gatos, CA, April 2018.
2018	Cognitive tools for learning and communication.
2010	University of California Berkeley, Berkeley, CA, February 2018.
2018	Cognitive tools for learning and communication.
2010	University of California San Diego, La Jolla, CA, January 2018.
2018	Cognitive tools for learning and communication.
2010	Indiana University, Bloomington, IN, January 2018.
2017	Drawing as a window into the mind.
2017	Rhode Island School of Design, Providence, RI, November 2017.
2017	Role of cognitive actions in learning.
2017	Annual Meeting of the Cognitive Science Society, London, UK, July 2017.
2016	Drawing as a window into the mind.
	Princeton University Art Museum, Princeton, NJ, October 2016.
2016	Drawing as cognitive technology.
	Drawing and the Brain Symposium, Indiana University Center for Art + Design, Bloomington,
	IN, April 2016.
2016	Drawing to learn: how visual production refines object representations.
	Indiana University in Bloomington, IN, April 2016.
2015	Drawing as a window into learning.
	Educational Testing Service, Princeton, NJ, October, 2015.
2015	Common object representations for visual recognition and production.
	University of British Columbia, Vancouver, BC, March, 2015.
2015	Drawing as a window into the mind.
	Smart Design, New York City, NY, March, 2015.
2013	Can ideas about food lead to real social change?
	Princeton Woodrow Wilson School Bernstein Gallery Art Exhibit on "Cooking for Change", Prince-
	ton, NJ, May 2013.
2011	Apégate a la causa! La gastronomía peruana como fenómeno social total.
	Faculty of Social Sciences, Pontificia Universidad Católica del Perú, Lima, Peru, July 2011.

Selected Conference Presentations

McCarthy W., Kirsh D., & Fan J. (2021). Exploring the role of prototyping in physical con-2021 struction. Poster to be presented at the Society for Philosophy and Psychology Annual Meeting. McCarthy W., Kirsh D., & Fan J. (2020). Learning to build physical structures better over 2020 time. Talk presented at the 42nd Annual Meeting of the Cognitive Science Society. McCarthy, W., and Fan, J. (2020). Rapid policy updating in human physical construction. 2020 Spotlight talk presented at the ICML Workshop on Object-Oriented Learning: Perception, Representation, and Reasoning. Wang, H., and Fan, J. (2020). Library learning for structured object concepts. Poster presented 2020 at the ICML Workshop on Object-Oriented Learning: Perception, Representation, and Reasoning. Fan J. & Hawkins R. (2019). Visual content and social context jointly determine pictorial 2019 meaning. Poster presented at the Society for Philosophy and Psychology Annual Meeting. Fan J., Dinculescu M., & Ha D. (2019). collabdraw: an environment for collaborative sketching 2019 with an artificial agent. Poster presented at the 2019 ACM SIGCHI Conference on Creativity and Cognition. Hawkins R.*, Sano, M.*, Goodman N., Fan J. (2019). Graphical convention formation during 2019 visual communication. Talk presented at the 41st Annual Meeting of the Cognitive Science * equal contribution; Sayan Gul Travel Award Mukherjee K., Hawkins R., & Fan J. (2019). Communicating semantic part information in 2019 drawings. Poster presented at the 41st Annual Meeting of the Cognitive Science Society. Long B., Fan J., Chai R., & Frank M. (2019). Developmental changes in the ability to draw 2019 distinctive features of object categories. Talk presented at the 41st Annual Meeting of the Cognitive Science Society. Fan J., Hawkins R., Wu M., & Goodman, N. Modeling contextual flexibility in visual commu-2018 nication. Talk presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL May 2018. Long, B., Fan J., & Frank, M. Drawing as a window in the development of object category 2018 representations. Talk presented at the Cognitive Science Society Annual Meeting in Madison, WI July 2018. Long, B., Fan J., & Frank, M. Drawing as a window in the development of object category 2018 representations. Poster presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL May 2018. Wammes, J., Fan, J., Lee R., Gunn J., Yamins, D. Norman K., & Turk-Browne, N. Changing ob-2018 ject representations during visual production training. Poster presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL May 2018. Fan J., Yamins D., & Norman, K., & Turk-Browne, N. Consequences of visual production 2017 on object representations. Dynamic poster presented at the Society for Neuroscience Annual Meeting in Washington, DC, November, 2017. Fan J., Yamins D., & Turk-Browne, N. Visual production induces categorical perception. Poster 2017 presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL May 2017.

Fan J., Yamins D., & Turk-Browne, N. Dynamic visual feedback is sufficient to improve draw-2016 ing. Poster presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL May 2016. Fan J., Yamins D., & Turk-Browne, N. Common object representations for visual recognition 2015 and production. Talk given at Cognitive Science Society Annual Meeting in Pasadena, CA July * Computational Modeling Paper Prize in Perception & Action Fan J., Yamins D., & Turk-Browne, N. How drawing alters object representations. Poster 2015 presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL May 2015. Fan J., Yamins D., DiCarlo, J., & Turk-Browne, N. Mapping core similarity among visual ob-2014 jects across image modalities. Poster presented at ACM SIGGRAPH 2014 in Vancouver, BC, Canada, August 2014. Fan J. & Turk-Browne, N. Feature distributions constrain object perception. Poster presented 2014 at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL, May 2014. Everaert, J., Fan, J., Koster, E., & Turk-Browne, N. Attentional capture from emotional associ-2014 ations in long-term memory. Poster presented at the Vision Sciences Society Annual Meeting in St. Pete's Beach, FL, May 2014. Fan, J., Turk-Browne, N., & Taylor, J. Feedback-driven tuning of statistical summary repre-2013 sentations. Talk given at the Annual Meeting on Object Perception, Attention, and Memory in Toronto, Ontario, Canada, November 2013. * Student Travel Award Fan, J., Hutchinson, J., & Turk-Browne, N. Incidental expression of visual long-term memory 2013 in online perception. Poster presented at the Annual Meeting of the Psychonomic Society in Toronto, Ontario, Canada, November 2013. Fan, J. and Turk-Browne, N. Visual long-term memory for objects biases perceptual attention. 2013 Poster presented at the Vision Sciences Society Annual Meeting in Naples, FL, May 2013. Fan, J. and Turk-Browne, N. Accessing visual memory distorts object representations. Talk 2012 given at the Vision Sciences Society Annual Meeting in Naples, FL, May 2012. Advising **STUDENTS** UC San Diego Graduate Students **Haoliang Wang** 2019 -Holly Huey (co-advised by Caren Walker) 2019 -

Will McCarthy (co-advised by David Kirsh)

Sebastian Holt (co-advised by David Barner)

Tone Xu (co-advised by Steven Dow)

Felix Binder (co-advised by David Kirsh)

Cameron Holdaway (co-advised by Ed Vul)

2019 -

2019 -

2020 -

2020 -

2020

2021 – Hannah Lloyd

Qualifying Exam Committee

Lauren Oey
Erik Brockbank
Mohan Gupta
Yang Wang

2021 Cameron Holdaway

James Qi

Dissertation Committee

Aubrey Lau
Helen Wang

Selected Undergraduates

Justin Yang, Honors: Chancellor's Research Scholarship, HDSI Research Scholarship

Xuanchen Lu, Honors: UCSD Psychology Research Perseverence During COVID Award

Julia Xu, Honors: HDSI Research Scholarship
 Sirui Tao, Honors: HDSI Research Scholarship

2020 – Zhe Huang, Honors: Triton Research & Experiential Learning Scholarships

Stanford

Renata Chai (Master's, Stanford, 2018-19), Xin Yuan (Master's, Tsinghua University, 2018-19), Kushin Mukherjee (undergraduate, Vassar, 2018-19), Megumi Sano (undergraduate, Stanford, 2018-19), Karl Mulligan (undergraduate, Rutgers, 2017)

Princeton

Laura Herman (undergraduate, Princeton, 2015-16), Jessica Ji (undergraduate, Princeton, 2016), Jordan Gunn (undergraduate, Princeton, 2015), Rachel Klebanov (undergraduate, Princeton, 2015), Ryan O'Connell (undergraduate, Princeton, 2013-14), Annie Chen (undergraduate, Carnegie Mellon, 2013), Max Luo (undergraduate, University of Pennsylvania, 2012–2013)

APPOINTMENTS

2017-2018	Stanford Center for the Study of Language & Information, Mentor
2012-2016	Princeton Wilson College, Resident Graduate Advisor
2015-2016	Princeton Cognitive Science Program Graduate Student Fellow
2013-2014	Princeton Psychology Senior Thesis Writing Group Leader

Teaching

UC SAN DIEGO

Instructor-of-Record

2022	PSYC 193L: Science of Learning Data Science, Instructor
2021	PSYC 230: Computational Approaches to Visual Abstraction, Instructor
2021	PSYC 60: Introduction to Statistics, Instructor
2021	PSYC 230: Computational Approaches to Visual Abstraction, Instructor
2020	PSYC 193: Perception & Computation, Instructor
2020	PSYC 60: Introduction to Statistics, Instructor
2019	PSYC 272: Computational Approaches to Visual Abstraction, Instructor

Guest Lectures

2021	PSYC 523b: Cognitive Psychology (Yale)
2021	PHIL 281: Non-Linguistic Representation (UCLA)
2020	NEU 200C: Basic Neuroscience
2020	PSYC 111A: Research Methods
2020	COGS 200: Faculty Research Seminar

Professional Service

SERVICE TO THE UNIVERSITY AND BROADER COMMUNITY

2020	Marshall College Commencement Representative
2020-	Pathways2AI Initiative, Co-Founder
2020-	Psychology Undergraduate Research Assistant Common Application Initiative, Co-Chair

Service to the Field

2022	Program Committee, Cognitive Computational Neuroscience Meeting
2021	Program Committee, Conference on the Theory and Application of Diagrams
2021	Program Committee, ACM Creativity and Cognition
2020	Mentor, Científico Latino Graduate Student Mentorship Initiative
2020	Program Committee, NeurIPS Object Representations for Learning and Reasoning Workshop
2020	Program Committee, ICML Object-Oriented Learning Workshop
2020	Awards Committee, Cognitive Science Society
2020	Program Committee, Cognitive Science Society

AD HOC REVIEWER OR PANELIST

Grants

NSF Integrative Strategies for Understanding Neural and Cognitive Systems (NCS) NSF Perception, Action $\mathring{\sigma}$ Cognition NSF Cognitive Neuroscience

Journals

Cognition

Cognitive Research: Principles and Implications

Cognitive Science Developmental Science

Gastronomica

Journal of Experimental Psychology: General

Journal of Experimental Psychology: Human Perception and Performance

MIT Handbook of Attention PLoS Computational Biology

Proceedings of the National Academy of Sciences

Psychonomic Bulletin & Review

Psychological Review

Quarterly Journal of Experimental Psychology

Translational Issues in Psychological Science

AFFILIATIONS

Association for Computing Machinery (2019–), Cognitive Science Society (2015–), Association for Psychological Science (2014–), American Psychological Association (2011–), Vision Sciences Society (2010–), Society for Neuroscience (2008–), American Association for the Advancement of Science (2008–)

Last updated: December 21, 2021 Typeset in X₂T_EX