Lei Yuan

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Department of Psychology and Neuroscience
University of Colorado Boulder
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Academic Positions

2020-present	Assistant Professor Department of Psychology and Neuroscience. University of Colorado Boulder
2016-2020	NIH Postdoctoral Fellow Department of Psychological and Brain Sciences. Indiana University.
2010-2016	Graduate Research Assistant Department of Psychology. Northwestern University.

Education

2016	Northwestern University, USA. Ph.D. in Cognitive Psychology
2012	Northwestern University, USA. M.S. in Cognitive Psychology
2010	Beijing Linye University, China. B.A. in Psychology

Grants

2022-2025 (Awarded)	The National Science Foundation Discovery Research K-12: How multi-digit number names guide attention, memory, and place value learning. Role: P.I. [$449,850]
2022-2024 (Awarded)	CU Boulder Research & Innovation Seed Grant: Symbol grounding in humans and machines. Role: P.I. [$49,982]
2020-2021 (Awarded)	CU Boulder Outreach Award: Building Early Language and Math Together. Role: Co-P.I. [$23,500]

2017-2020 (Awarded)	Ruth L. Kirschstein National Research Service Award (NRSA) Individual Postdoctoral Fellowship, The National Institutes of Health, USA. Role: P.I. [$172,926]

Honors and Awards

2017, 2019	Provost's Travel Award for Women in Science, Indiana University, Bloomington, IN, USA
2010-2016	University Fellowship, Northwestern University, Evanston, IL, USA
2007	National Scholarship, Beijing Linye University, Beijing, China
2007-2010	University Scholarship, Beijing Linye University, Beijing, China

Publications

Under review / In prep

- **Yuan, L**., Byrge, L., Mix, K.S., & Smith, L. B. (Under review). From chaos to coherence: The emergence of compositional systems from local to rule-like generalization.
- **Yuan, L**., Zhu, L., Johns, E., Mix, K. S., & Smith, L. B. (In prep). Road to transfer and generalization: the role of knowledge "hub".
- Zhu, L. & **Yuan, L**. (in prep). Cross-linguistic differences without cross-culture confound: a computational modeling study.
- Mittra, T. & **Yuan, L**. (in prep). Modeling generative learning of a composition system using language-aided reinforcement learning.
- Hopkins, T. & **Yuan, L**. (in prep). What affects system alignment in statistical learning? A case study with musical notations

Published

- **Yuan, L.**, (2024). Beyond Learnability: Understanding Human Visual Development with DNNs. *Trends in Cognitive Sciences.*
- Bower, C. A., Mix, K. S., Hancock, G. R., **Yuan, L.,** & Smith, L. B. (2024). Smart errors in learning multidigit number meanings. *Journal of Cognition and Development.*
- **Yuan, L.**, Novack, M., Uttal, D., & Franconeri, S. (2024). Language systematizes attention: How relational language enhances relational representation by guiding attention. Cognition, 243, 105671.

- Mix, K. S., Bower, C. A., **Yuan, L**., Hancock, G. R., & Smith, L. B. (2023). Predictive relations between early place value understanding and multidigit calculation: approximate versus syntactic measures. Educational Psychology, 43(7), 795-813.

- Bower, C.A, Mix, K.S., **Yuan, L**., & Smith, L.B. (2022). A Network Analysis of Children's Emerging Place Value Concepts. *Psychological Science*

- Mix, K.S., Bower, C.A, Hancock, G., **Yuan, L**., & Smith, L.B. (2022). The development of place value concepts: approximation before principles. *Child Development.*

- **Yuan, L.,** Prather, R., Mix, K.S., & Smith, L.B. (2021). The first step to learning place value: A role for physical models? *Frontier in Education.*

- **Yuan, L**., Xiang, V., Crandall, D., & Smith, L. B. (2020) Learning the generative principles of a symbol system from limited examples. *Cognition*. http://doi.org/10.1016/j.cognition.2020.104243

- **Yuan, L**., Prather, R. W., Mix, K. S., & Smith, L. B. (2019) Number representations drive number-line estimates. *Child Development.* https://doi.org/10.1111/cdev.13333

- **Yuan, L.**, Prather, R. W., Mix, K. S., & Smith, L. B. (2019) Preschoolers and multi-digit numbers: A path to mathematics through the symbols themselves. *Cognition.* http://doi.org/10.1016/j.cognition.2019.03.013

- **Yuan, L.**, Xu, L., Yu, C., & Smith, L. B. (2018) Sustained visual attention is more than seeing—The dynamics of gaze during manual actions. *Journal of Experimental Child Psychology.* http://doi.org/10.1016/j.jecp.2018.11.020

- **Yuan, L**., Haroz, S., & Franconeri, S. L. (2018) Perceptual proxies for extracting averages in data visualizations. *Psychonomic Bulletin & Review*. https://doi.org/ 10.3758/s13423-018-1525-7

- **Yuan, L**., Uttal, D. H., & Gentner, D. (2017) Analogical reasoning in children's understanding of spatial representations. *Developmental Psychology.* https://doi.org/10.1037/dev0000302

- **Yuan, L.,** Xu, L., Yu, C., & Smith, L. B. (2017) Seeing is not enough for sustained visual attention. In the proceedings of *the 39th Annual Conference of the Cognitive Science Society,* London, UK.

- **Yuan, L**., Uttal, D. H. (2017) Analogy lays the foundation for two crucial aspects of symbolic development: intention and correspondence. *Topics in Cognitive Science*. https://doi.org/10.1111/tops.12273

- **Yuan, L**., Uttal, D. H., & Franconeri, S. L. (2016) Are spatial relations encoded by shifting visual attention between objects? *PloS one*, 11(10), e0163141. https://doi.org/10.1371/journal.pone.0163141

- Uttal, D. H., & **Yuan, L.** (2014) Using symbols: Developmental perspectives. *Wiley Interdisciplinary Reviews: Cognitive Science*. http://doi.org/10.1002/wcs.1280

Organized Conference Symposium

- Learning Before School. *Biannual Meeting of the Society for Research in Child Development,* Baltimore, MD, March 2019

Conference and Invited Talks

- Bower, C. A., Mix, K. S., **Yuan, L.,** Hancock, G. R., & Smith, L. B. (2024, June). Beyond task accuracy: How kindergartners' 'smart' errors in place value tasks predict later multidigit calculation performance. In H. P. Osana & K. S. Mix (co-Chairs), *Investigating children's knowledge of Base-Ten Numeration*. Symposium presentation at the Mathematical Cognition and Learning Society Conference. Washington, DC.

- **Yuan, L.** (2023) Language Transforms Cognition via System Alignment. CU Boulder CS Colloquium. December 2023.

- **Yuan, L**., Prather, R., Mix, K., & Smith, L. B. (2023) It is not Symbol-Grounding; it is Analogy! Whether and How Physical Models Promote Number Learning. *Biannual Meeting of the Society for Research in Child Development,* Salk Lake City, UT, March 2023.

- **Yuan, L.** (2021) We are what we attend to: Attention-driven learning and implications for design. CU Boulder ATLAS Colloquium. October 2021.

- **Yuan, L**., Prather, R., Mix, K., & Smith, L. B. (2021) When and how Physical Models Benefit the Learning of Symbolic Multi-digit Numbers. *Biannual Meeting of the Society for Research in Child Development,* Baltimore, MD, April 2021.

- **Yuan, L.** (2021) How are systems of knowledge built? CU Boulder ICS Virtual Colloquium. March 2021

- **Yuan, L**., Xiang, V., Crandall, D., & Smith, L.B. (2021) Learning the generative principles of a linguistic system from limited examples. *The 34th Annual CUNY Conference on Human Sentence Processing.* March 2021.

- **Yuan, L**. (2021) Fast and far generalization from sparse data. *The Institute of Cognitive Science Colloquium Series. The University of Colorado Boulder.*

- **Yuan, L.** (2020) Fast and far generalization from sparse data. *Stanford University.*

- **Yuan, L.** (2020) Fast and far generalization from sparse data. The *University of Colorado Boulder.*

- **Yuan, L.** (2020) Fast and far generalization from sparse data. *Carnegie Mellon University.*

- **Yuan, L.** (2020) Fast and far generalization from sparse data. The *University of Wisconsin Madison.*

- **Yuan, L.** (2020) Fast and far generalization from sparse data. *Syracuse University.*

- **Yuan, L.** (2019) Fast and far generalization from sparse data. The *University of Texas Dallas.*

- **Yuan, L.** (2019) Fast and far generalization from sparse data. The *University of Kentucky.*

- **Yuan, L.**, Smith, L. B., & Mix, K. S. (2019) Learning numbers as a system of symbols and their relations. *Biannual Meeting of the Cognitive Development Society,* Louisville, KY, October 2019.

- **Yuan, L.** & Smith, L. B. (2019) Big numbers and small kids: Preschoolers' learning of multi-digit numbers. *Biannual Meeting of the Society for Research in Child Development,* Baltimore, MD, March 2019.

- **Yuan, L.,** Xu, L., Yu, C., & Smith, L. B. (2017) Seeing is not enough for sustained visual attention. Talk given at *the 39th Annual Conference of the Cognitive Science Society,* London, UK.

- **Yuan, L.** (2016) Relational representation from spatial symbols. *Indiana University, Developmental Seminar,* 2016.

- **Yuan, L.**, Franconeri, S. L., & Uttal, D. H. (2015) Guiding attention to children's graph comprehension. *University of Chicago, Developmental Psychology Brownbag,* 2015.

- **Yuan**, **L.**, Uttal, D. H., & Gentner, D. (2012) Analogy facilitates children's map learning. *Midwestern Psychological Association Annual Meeting,* Chicago, IL, May 2012.

- **Yuan**, **L.**, Uttal, D. H., & Gentner, D. (2012) The effect of analogy and relational language on young children's map learning. *International Conference on Spatial Cognition,* Rome, Italy, August 2012.

- **Yuan, L.**, Uttal, D. H., & Gentner, D. (2012) The effect of analogy and relational language on young children's map learning. *Spatial Cognition,* Munich, Germany, August 2012.

- **Yuan**, **L.,** Uttal, D. H., & Gentner, D. (2012) Analogy facilitates children's map learning. *NSF's Annual Inter-Science of Learning Center Conference,* San Diego, CA, 2012.

Conference Posters

- Vleugels, L. & **Yuan, L.** (2024, July). Finding Structure in Real Time: Statistical Learning of Multiple Regularities Simultaneously-An Eye-Tracking Study. *46th Annual Conference of the Cognitive Science Society*, Rotterdam, the Netherlands, July, 2024.

- Vleugels, L., & **Yuan, L.** Finding Structure in Time: Statistical Learning of Multiple Regularities Simultaneously—An Eye-Tracking Study. 2024 RMPA (Rocky Mountain Psychology Association) Convention. Denver, CO, April 2024.

- Vleugels, L. & **Yuan, L.** (2024). Finding Structure in Real Time: Statistical Learning of Multiple Regularities Simultaneously-An Eye-Tracking Study. *43rd Annual Ekstrand Memorial Mini-Convention*, Boulder, Colorado, April, 2024

- Bower, C. A., Mix, K. S., **Yuan, L.** & Smith, L. B. (2023, March). Kindergartners' 'smart' errors in syntactic and approximate place value tasks predict their second-grade multidigit calculation performance. *Biennial Meeting of the Society for Research in Child Development*. Salt Lake City, UT. March 2023

- Ybarra, A, Novack, M., Uttal, D. H., & Franconeri, S. L. & **Yuan, L**. A Sustained Effect of Language on Thought: Relational Language Enhances Spatial Representations via Visual Attention. *Biannual Meeting of the Society for Research in Child Development,* Salk Lake City, UT, March 2023.

- **Yuan, L.,** & Smith, L. B. Staggering individual differences in preschoolers' multi-digit number knowledge. *Biannual Meeting of the Society for Research in Child Development,* Baltimore, MD, March 2019.

- Novack, M., **Yuan, L**., Uttal, D. H., & Franconeri, S. L. How relational language promotes relational representation: The role of visual attention. *Biannual Meeting of the Society for Research in Child Development,* Baltimore, MD, March 2019.

- **Yuan, L.,** & Smith, L. B. Rapid generalization from statistical learning. *Interdisciplinary Advances in Statistical Learning,* Bilbao, Spain, June 2017.

- **Yuan, L.,** & Smith, L. B. The Generalizability of Statistical Learning. *Biannual Meeting of the Society for Research in Child Development,* Austin, TX, April 2017.

- **Yuan, L.**, Franconeri, S. L., & Uttal, D. H. Guiding attention to children's graph comprehension. *Biannual Meeting of the Society for Research in Child Development,* Philadelphia, PA, March 2015.

- **Yuan, L.**, Uttal, D. H., & Gentner, D. The effect of analogy and iconicity on young children's map learning. *Biannual Meeting of the Cognitive Development Society,* Memphis, TN, October 2013.

- **Yuan, L**., Uttal, D. H., & Franconeri, S. L. Low capacity for visual spatial relation memory. *Annual Meeting of the Vision Science Society,* Naples, FL, May 2013.

- **Yuan, L.**, Sauter, M., Uttal, D. H., & Gentner, D. Map in a snap: Can comparison facilitate preschoolers' understanding of maps? *The 33rd Annual Conference of the Cognitive Science Society,* Boston, MA, July 2011.

Teaching Experience

Instructor:

2024 Fall	Research Methods Proseminar, University of Colorado Boulder
2024 Spring	Advanced Cognitive Psychology, University of Colorado Boulder
2023 Fall	Research Methods Proseminar, University of Colorado Boulder
2023 Spring	Perception & Attention Proseminar, University of Colorado Boulder
2021 Spring & Fall	Advanced Cognitive Psychology, University of Colorado Boulder
2021 Fall	Research Methods Proseminar, University of Colorado Boulder
2017-2019	Supervised Research, Indiana University
2015 Summer	Developmental Psychology, Northwestern University

Guest Lecturer:

2017 - 2022	Grant Writing Course, Indiana University
2017 Fall	Statistical Consulting, Indiana University

2015 Spring	Cognitive Processes in Social Psychology, Northeastern University
2014 Fall	Cognitive Psychology, Northeastern University

Teaching Assistant:

2013 Fall	Statistics, Northwestern University
2012 Fall	Research Methods, Northwestern University
2011 Fall	Advanced Introduction to Psychology, Northwestern University
2011 Spring	Cognitive Science, Northwestern University
2010 Winter	Cognitive Psychology, Northwestern University

Research Mentees:

University of Colorado Boulder
Doctoral Students' Committees: Jennifer Weber, Chelsea Brown, Matt Hong (ATLAS institute), Torin Hopkins (ATLAS institute), Clara Elizabeth
Graduate student: Lucile Vleugels
Masters' student: Nitin Kumar, Medha Rudra, Spriha Awasthi, Tirthankar Mittra, Rohan Nalla
Undergraduate students: Gaia Kakkar, Ziqi Guo, Lilly Zhu (from John Hopkins)
Highschool student: Kai Parker (Boulder High)

Indiana University
Masters' student: Violet Xiang
Undergraduate students: Ivy Sullivan, Ella Tommer, Haley Meekhof, Kesha Kandoi, Emily Johns, Joseph Stoica, Hannah Hanscom, Olivia Long, Erin DeCocq, Kate Wood, Arianna Scott, Elizabeth Berquist, Cindy You, Oliver (Mel) Allen, William Belden, Alexandra Lucas.
High school students: Shaina Pennington, Anna Kim, Bria Ooley

Northwestern University
Undergraduate students: Thidar Khine, Stephanie Chang, T.J. Butler, Matt Hong, Ellen Reynolds

Quantitative Skills

Programming and statistical analysis software, e.g., R, Matlab, Python
Longitudinal and time-series data analysis
Eye-tracking (and multi-sensory tracking) data analysis and visualizations
Deep learning, e.g., Convolutional Neural Networks, Recurrent Neural Networks
Advanced statistical analysis, e.g., Linear Mixed Effect model (LMM), network analysis
Adaptive psychophysical methods

Ad-Hoc Reviewer

Cognition, PNAS, Cognitive Science, Developmental Psychology, Developmental Review, Child Development, Infancy, Psychonomic Bulletin & Review, Journal of Cognition and Development, Journal of Cognitive Psychology, British Journal of Developmental Psychology, Cognitive Research: Principles and Implications, The Annual Conference of the Cognitive Science Society, The Bi-annual Conference of the Cognitive Development Society.

Service and Outreach

2024	Department PUEC committee
2024	Organizer of the 43rd Annual Ekstrand Mini-Convention
2023 & 2024	CU Science Discovery community family STEAM outreach event
2021-2022	Organizer for the CU Boulder Department of Psychology & Neuroscience Undergraduate Research Day
2021-2022	CU Boulder Outreach Awards Project Lead
2021-2022	Departmental computational lab OIT liaison
2020-2022	CU Boulder Departmental Awards Committee
2019	Organizer and presenter at a site event for the #GIRLBOSS series for Girls Inc. Indiana University
2019	Recruiter at Child Fair event, Bloomington, Indiana
2018, 2019	Host and mentor for high school students for the STEM summer program, Indiana University
2017	Recruiter at Farmer's Market, Bloomington, Indiana
2015	Volunteer for the Schuler Scholar Program, Northwestern University
2014	Volunteer at the "Science of a Cocktail Party" event, Illinois Science Council
2013	Recruiter at Parent/child workshop event, Evanston Public Library
2012	Volunteer organizer at graduate students' recruitment events, Northwestern University

Past and Current Professional Affiliations

Society for Research in Child Development, Cognitive Development Society, Cognitive Science Society, Vision Science Society, American Educational Research Association