

Patrick Shafto, PhD

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Erdős number = 5

Professional Positions

Henry Rutgers Term Chair in Data Science and Associate Professor of Mathematics and Computer Science, Rutgers University – Newark, 2015–present.
Associate Professor in Psychology, Rutgers Business School, and the Center for Molecular and Behavioral Neuroscience (by courtesy).
Associate Professor of Psychology, University of Louisville, 2013-2015.
Associate Professor of Computer Engineering & Computer Science (by courtesy).
Affiliated faculty, Program in Bioinformatics, University of Louisville, 2011-2015.
Assistant Professor of Psychology, University of Louisville, 2007-2013.
Assistant Professor of Computer Engineering & Computer Science (by courtesy), 2012-2013.
Postdoctoral Associate, Massachusetts Institute of Technology, 2004-2007.
Statistical Consultant, Department of Psychology, Northeastern University, 2003.
Instructor, Department of Psychology, Northeastern University, 2000, 2002, 2003.

Education

Ph.D., Experimental Psychology, Northeastern University, Boston, MA, 2004.
M.S., Experimental Psychology, Northeastern University, Boston, MA, 2002.
M.S., Physical Therapy, Northeastern University, Boston, MA, 1999.
B.S., Physical Therapy, Northeastern University, Boston, MA, 1998, with honors, *magna cum laude*.

Research Interests

Human learning: social cognitive development, inductive reasoning, pedagogical reasoning, epistemic trust, category/concept learning, Bayesian methods, theory learning/change.
Machine learning: cooperative inference, machine teaching, multi-view clustering, predictive databases, Bayesian nonparameterics, Algorithmic teaching.

Awards and Honors

Henry Rutgers Term Chair in Data Science, Rutgers University – Newark, 2015-present.
Fellow, Center for the Study of Language and Information (CSLI), Stanford University, Winter 2015.
Outstanding Scholarship, Research and Creative Activity Award in Basic and Applied Sciences, University of Louisville, College of Arts and Sciences, 2012-2013.
NSF Faculty Early Career Development (CAREER) award, 2012.
University of Louisville Faculty Favorite, 2012.
Best Student Paper, Honorable Mention, with Charles Kemp, Alison Berke & Josh Tenenbaum, 2006.

Travel Award to attend the annual meeting of the Cognitive Science Society, 2005.
Graduate Student Fellowship, Northeastern University, 1999-2004.
Phi Kappa Phi, 1998.
Carl S. Ell Scholarship, academic scholarship including full tuition, room, and board, 1993-1998.

Funding

Total external funding as PI or Co-PI: \$3,753,922.

CURRENT

- National Science Foundation, Integrative Strategies for Understanding Neural and Cognitive Systems Supplements (NSF:CHS) *An integrated system for storing and systematizing human visual experience*. Role: PI, Years: 2016-2017, Total Costs: \$99,956.
- National Science Foundation, Science of Learning Collaborative Networks (1640816). *SL-CN: Guiding guided learning: Developmental, educational and computational perspectives*. Role: PI (with Liz Bonawitz, Co-PI and Corriveau, Golinkoff, Hirsh-Pasek, and Xu), Years: 2016-2018, Total Costs: \$749,016.
- National Science Foundation, EAGER: MAKER (CISE-1623486). *EAGER: MAKER: The origins of making: A Data Science approach to investigating cognitive and affective basis of learning through constructing*. Role: Co-PI (with Liz Bonawitz and Vanessa LoBue), Years: 2016-2018, Total Costs: \$297,772.
- National Science Foundation, Trust worthy computing (CNS-1564034) *TWC SBE: Medium: Collaborative: Building a Privacy-Preserving Social Networking Platform from a Technological and Sociological Perspective*. Role: Co-PI (with Wei Jiang at Missouri University of Science and Technology and Jaideep Vaidya), Years: 2016-2019, Total costs: \$539,173.
- National Science Foundation, Cyber-human systems (CHS-1524888). *CHS: Small: Human visual perception as optimal, dynamically adaptive, information encoding*. Role: PI, Years: 2015-2018, Total costs: \$499,442.
- National Science Foundation, INSPIRE (IIS and SBE; NSF-1549981). *INSPIRE: Not unbiased: The implications of human algorithm interaction on algorithm performance and human learning*. Role: Co-PI (with Olfa Nasraoui at University of Louisville), Years: 2015-2018, Total costs to Shafto: \$399,972.
- Australian Research Council. *Learning from others: Inductive reasoning based on human-generated data*. (DP150103280). Role: Co-PI (with Amy Perfors at University of Adelaide), Years: 2015-2018, Total costs: \$301,300. Total costs to Shafto: \$0.
- National Science Foundation, CAREER. *A rational analysis of the implications of instruction for student learning*. (DRL-1149116). Role: PI, Years: 2012-2017, Total costs: \$625,835.
- Chancellor's Seed Grant Program. *A Data Science approach to investigating cognitive and affective basis of learning through constructing in the Newark Community*. Role: Co-PI (with Liz Bonawitz and Vanessa LoBue). Total costs: \$75,000.
- Chancellor's Seed Grant Program. *Creation of the Rutgers Cognitive Science Center (RCSC)*. Role: Co-PI (with Katalin Balog, Jennifer Austin, Elizabeth Bonawitz, Michael Cole, Raffaella De Rosa, William Graves, Kent Harber, and Stephen Jos Hanson). Total costs: \$50,000.

COMPLETED

- Amazon Education Research Grants. Role: PI. Date: 12/2015. 7500 credits.
- NVIDIA Corporation. *NVIDIA Hardware Grant: NVIDIA Tesla K40 active*. Requesters: Baxter Eaves & Patrick Shafto. Date: 8/2015. Approximate value: \$3,000.
- National Science Foundation, CAREER supplement. *A rational analysis of the implications of instruction for student learning*. (DRL-1149116). Role: PI, Years: 2014-2015, Total costs: \$77,291.

- Defense Advanced Research Projects Agency (DARPA), XDATA. *Automated Bayesian CrossCat (ABC) Family of Machine Learning Systems for XDATA*. Role: Co-PI (with SSCI and Vikash Mansinghka at MIT), Years: 2012-2015, Total costs to Shafto: \$219,646.
- National Science Foundation, Research Experiences for Undergraduates (REU). *Undergraduate Research Experiences in the Integrated Science of Learning*. Role: PI, Years: 2012-2013, Total costs: \$21,810.
- James S. McDonnell Foundation, Subcontract. *The role of experience in pedagogical reasoning*. Role: Subcontractor, Years: 2011, Total costs: \$8,397.
- University of Louisville, Intramural Research Incentive Grant. *Computational modeling of epistemic trust in causal learning*. Role: PI, Years: 2011, Total costs: \$3,600.
- University of Louisville, Intramural Research Incentive Grant. *Computational modeling of reasoning about knowledge and intent*. Role: PI, Years: 2010, Total costs: \$3,000.
- Cognitive Science Society, Tutorials and Workshop Program. *An interdisciplinary workshop on pedagogical reasoning*. Role: Organizer (with Co-organizer Noah Goodman), Years: 2009, Total costs: \$1,200.

Publications

^U indicates undergraduates, ^G graduate students, and ^P postdocs working in my lab.

¹ indicates joint first authorship. Note: I adopt last author position on papers coming out of my lab.

SUBMITTED MANUSCRIPTS

- S1. Nasraoui, O. & **Shafto, P.** (preprint). Human-Algorithm Interaction Biases in the Big Data Cycle: A Markov Chain Iterated Learning Framework. arXiv preprint arXiv:1608.07895.
- S2. Mansinghka, V., Tibbetts, R., Baxter, J., **Shafto, P.** & Eaves, B. (2015). BayesDB: A probabilistic programming system for querying the probable implications of data. arXiv preprint arXiv:1512.05006.
- S3. Yu, Y.^P, Bonawitz, L.B., & **Shafto, P.** (under review). Pedagogical questions in mother-child conversations.
- S4. Durkin, K.^P, Landrum, A.^P, Savage, P.^U & **Shafto, P.** (under review). Avoiding hasty conclusions: Manipulating informant expertise to influence belief revision.
- S5. Gweon, H., **Shafto, P.** & Schulz, L.E. (under review). Too much information? Prior knowledge and the cost of information in learning and teaching.
- S6. Lane, J. & **Shafto, P.** (under review). Preschoolers and toddlers attribute causal power to novel invisible entities.
- S7. Perfors, A., Navarro, D.J. & **Shafto, P.** (under revision). Stronger evidence isn't always better: The role of social inference in evidence selection and interpretation.
- S8. **Shafto, P.**¹, Bonawitz, E.B.¹, Gonzalez, A., Bridgers, S. & Gopnik, A. (under revision). Is that your final answer? Children rationally change their beliefs in response to neutral follow-up questions.

JOURNAL ARTICLES

1. Schweinhart, A.^P, **Shafto, P.** & Essock, E. (accepted pending minor revision) Distribution of content in recently-viewed scenes whitens perception. *Journal of Vision*.
2. Eaves, B.S.^P & **Shafto, P.** (in press). Parameterizing developmental changes in epistemic trust. *Psychonomic Bulletin and Review*.
3. McCrink, K., **Shafto, P.** & Barth, H. (in press). The relationship between non-symbolic multiplication and division in childhood. *Quarterly Journal of Experimental Psychology*.
4. Searcy, S.^G & **Shafto, P.** (2016). Cooperative inference: Features, objects, and collections. *Psychological Review*, 123(5), 510-533.

5. Eaves, B.S.^P, Feldman, N., Griffiths, T. & **Shafto, P.** (2016). Infant-directed speech is consistent with teaching. *Psychological Review*, 123(6),758-771.
6. Mansinghka, V., **Shafto, P.**, Jonas, E., Petschulat, C., Gasner, M. & Tenenbaum, J.B. (2016). CrossCat: A fully Bayesian nonparametric method for analyzing heterogenous, high dimensional data. *Journal of Machine Learning Research*, 17, 1-49.
7. Durkin, K.^P & **Shafto, P.** (2016). Epistemic trust and education: Effects of informant reliability on student learning of decimal concepts. *Child Development*, 84, 154-164.
8. Rafferty, A., Brunskill, E., Griffiths, T.L. & **Shafto, P.** (2015). Faster teaching via POMDP planning. *Cognitive Science*, 40(6), 1290-332. DOI: 10.1111/cogs.12290.
9. Rhodes, M., Bonawitz, E.B., **Shafto, P.**, Chen, A. & Calgar, L. (2015). Controlling the message: Preschoolers' use of evidence to teach and deceive others. *Frontiers in Psychology*, 6:867. doi: 10.3389/fpsyg.2015.00867.
10. Landrum, A.R.^P, Eaves, B.S.^G & **Shafto, P.** (2015). Trusting to learn and learning to trust: A theoretical framework. *Trends in Cognitive Sciences*, 19, 109-111.
11. **Shafto, P.**, Goodman, N.D. & Griffiths, T.L. (2014). A rational account of pedagogical reasoning: Teaching by, and learning from, examples. *Cognitive Psychology*, 71, 55-89.
12. **Shafto, P.**, Goodman, N.D. & Frank, M.C. (2012). Learning from others: The consequences of psychological reasoning for human learning. *Perspectives on Psychological Science*, 7, 341-351.
13. **Shafto, P.**, Eaves, B.^G, Perfors, A. & Navarro, D.J. (2012). Epistemic trust: Modeling children's reasoning about others' knowledge and intent. *Developmental Science*, 15, 436-447.
14. Kemp, C., **Shafto, P.** & Tenenbaum, J.B. (2012). An integrated account of generalization across objects and features. *Cognitive Psychology*, 64, 35-73.
15. **Shafto, P.**, Kemp, C., Mansinghka, V.K. & Tenenbaum, J.B. (2011). A probabilistic model of cross-categorization. *Cognition*, 120, 1-25.
16. Bonawitz, E.B.¹, **Shafto, P.**¹, Gweon, H., Goodman, N.D., Spelke, E. & Schulz, L. (2011). The double-edged sword of pedagogy: Instruction limits spontaneous exploration and discovery. *Cognition*, 120, 322-330.
17. Buchbaum, D., Griffiths, T.L., Gopnik, A. & **Shafto, P.** (2011). Children's imitation of causal action sequences is influenced by statistical and pedagogical evidence. *Cognition*, 120, 331-340.
18. Li, D.^G & **Shafto, P.** (2011). Bayesian hierarchical cross-clustering. *Proceedings of the Fourteenth International Conference on Artificial Intelligence and Statistics. JMLR W&CP*, 15, 443-451.
19. Rafferty, A., Brunskill, E., **Shafto, P.** & Griffiths, T.L. (2011). Faster teaching by POMDP planning. *Proceedings of the 15th international conference on Artificial Intelligence in Education (AIED). Lecture Notes in Artificial Intelligence*, 6738, 280-287.
20. **Shafto, P.**, Kemp, C., Bonawitz, E.B., Coley, J.D. & Tenenbaum, J.B. (2008). Inductive reasoning about causally transmitted properties. *Cognition*, 109, 175-192.
21. Feeney, A., **Shafto, P.** & Dunning, D. (2007). Who is susceptible to the conjunction fallacy in category-based induction? *Psychonomic Bulletin & Review*, 14, 884-889.
22. **Shafto, P.**, Coley, J.D. & Baldwin, D. (2007). Effects of time pressure on context-sensitive property induction. *Psychonomic Bulletin & Review*, 14, 890-894.
23. **Shafto, P.** & Coley, J.D. (2003). Development of categorization and reasoning in the natural world: Novices to experts, naïve similarity to ecological knowledge. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 29, 641-649.

24. Ahn, W., Kalish, C., Gelman, S.A., Medin, D.L., Luhmann, C., Atran, S., Coley, J.D. & **Shafto, P.** (2001). Why essences are essential in the psychology of concepts. *Cognition*, 82, 59-69.

PEER-REVIEWED CONFERENCE PROCEEDINGS

25. **Shafto, P.** & Nasraoui, O. (2016). Human-recommender systems: From benchmark data to benchmark cognitive models. *Proceedings of the 10th ACM Conference on Recommender Systems (RecSys 2016)*, 127-130.
26. Yu, Y., Bonawitz, E.B. & **Shafto, P.** (2016). Questions in informal teaching: A study of mother-child conversations. *Proceedings of the 38th annual conference of the Cognitive Science Society*.
27. Durkin, K.^P, Caglar, L.R., Bonawitz, E.B. & **Shafto, P.** (2015). Explaining choice behavior: The intentional selection assumption. *Proceedings of the 37th annual conference of the Cognitive Science Society*.
28. Landrum, A.R.^P, Cloudy, J.^U & **Shafto, P.** (2015). More than true: Developmental changes in use of inductive strength for selective trust. *Proceedings of the 37th annual conference of the Cognitive Science Society*.
29. Noles, N.S., Danovitch, J.H. & **Shafto, P.** (2015). Children's learning from technological and human sources. *Proceedings of the 37th annual conference of the Cognitive Science Society*.
30. Danovitch, J.H., Noles, N.S. & **Shafto, P.** (2015) How children seek out information from technological and human informants. *EuroAsianPacific Joint Conference on Cognitive Science*.
31. Gweon, H., **Shafto, P.** & Schulz, L.E. (2014). Children consider prior knowledge and the cost of information both in learning from and teaching others. *Proceedings of the 36th annual conference of the Cognitive Science Society*.
32. Eaves, B.^G & **Shafto, P.** (2014). Order effects in learning relational structures. *Proceedings of the 36th annual conference of the Cognitive Science Society*.
33. Searcy, N.^G & **Shafto, P.** (2014). Learning biases for teaching boolean concepts. *Proceedings of the 36th annual conference of the Cognitive Science Society*.
34. Rhodes, M., Bonawitz, E.B., **Shafto, P.** & Chen, A. (2014) Controlling the message: Preschoolers' use of evidence to teach and deceive others. *Proceedings of the 36th annual conference of the Cognitive Science Society*.
35. **Shafto, P.**, Gweon, H., Fargen, C.^U & Schulz, L.E. (2012). Enough is enough: Inductive sufficiency guides learners' ratings of informant helpfulness. *Proceedings of the 34th annual conference of the Cognitive Science Society*.
36. Gonzalez, A., **Shafto, P.**, Bonawitz, E.B. & Gopnik, A. (2012). Is that your final answer? The effects of neutral queries on children's choices. *Proceedings of the 34th annual conference of the Cognitive Science Society*.
37. Warner, R.^G, Stoess, T.^U & **Shafto, P.** (2011). Reasoning about teaching and misleading situations. *Proceedings of the 33rd annual conference of the Cognitive Science Society*.
38. Montague, R.^G, Navarro, D.J., Perfors, A., Warner, R.^G & **Shafto, P.** (2011). To catch a liar: The effects of truthful and deceptive testimony on inferential learning. *Proceedings of the 33rd annual conference of the Cognitive Science Society*.
39. Smith, N.A.^G & **Shafto, P.** (2011). The role of cross-cutting systems of categories in category-based induction. *Proceedings of the 33rd annual conference of the Cognitive Science Society*.
40. **Shafto, P.**, Goodman, N.D., Gerstle, B.^U & Ladusaw, F.^U (2010). Prior expectations in pedagogical situations. *Proceedings of the 32nd annual conference of the Cognitive Science Society*.

41. Li, D.^G, Rouchka, E. & **Shafto, P.** (2010). Phylogenomic analysis using Bayesian congruence measuring. *Proceedings of the 2nd International Conference on Bioinformatics and Computation (BICoB)*, 30-37.
42. Mansinghka, V.K., Jonas, E., Petschulat, C., Cronin, B., **Shafto, P.** & Tenenbaum, J.B. (2009). Cross-categorization: A method for discovering multiple overlapping clusterings. In *Nonparametric Bayes workshop at NIPS*.
43. Bonawitz, E.B.¹, **Shafto, P.**¹, Gweon, H., Chang, I., Katz, S. & Schulz, L. (2009). The double-edged sword of pedagogy: Modeling the effect of pedagogical contexts on preschoolers' exploratory play. *Proceedings of the 31st annual conference of the Cognitive Science Society*.
44. Warner, R.^G, **Shafto, P.**, Baker, C.L. & Tenenbaum, J.B. (2009). Abstract knowledge guides search and prediction in novel situations. *Proceedings of the 31st annual conference of the Cognitive Science Society*.
45. **Shafto, P.** & Goodman, N. (2008). Teaching games: Statistical sampling assumptions for learning in pedagogical situations. *Proceedings of the 30th annual conference of the Cognitive Science Society*.
46. Kemp, C., **Shafto, P.**, Berke, A. & Tenenbaum, J.B. (2006). Combining causal and similarity-based reasoning. *Advances in Neural Information Processing Systems (NIPS)*.
47. **Shafto, P.**, Kemp, C., Mansinghka, V.K., Gordon, M. & Tenenbaum, J.B. (2006). Learning cross-cutting systems of categories. *Proceedings of the 28th annual conference of the Cognitive Science Society*.
48. **Shafto, P.**, Kemp, C., Baraff, E., Coley, J.D. & Tenenbaum, J.B. (2005). Context-sensitive induction. *Proceedings of the 27th annual conference of the Cognitive Science Society*.

CHAPTERS IN EDITED VOLUMES

49. Bonawitz, E.B. & **Shafto, P.** (2016). Computational models of development, Social influences. *Current Opinion in Behavioral Sciences*, 7, 95-100.
50. Eaves, B.S.^P, Schweinhart, A.^P & **Shafto, P.** (2016). Tractable Bayesian teaching. In Jones, M. (Ed.) *Big Data in Cognitive Science*, New York, NY: Psychology Press.
51. **Shafto, P.** & Bonawitz, L.B. (2015). Choice from among intentionally selected options. In Ross, B. (Ed.) *Psychology of Learning and Motivation Volume 63*, San Diego: Elsevier.
52. Eaves, B.^G & **Shafto, P.** (2012). Unifying pedagogical reasoning and epistemic trust. In Xu, F. and Kushnir, T. (Eds.) *Advances in Child Development and Behavior*, 43, 295-319. San Diego, CA: Elsevier.
53. Tenenbaum, J.B., Kemp, C. & **Shafto, P.** (2007). Theory-based Bayesian models of inductive reasoning. In Feeney, A. & Heit, E. (Eds.), *Induction*. Cambridge, U.K.: Cambridge University Press.
54. **Shafto, P.**, Vitkin, A. & Coley, J.D. (2007). Availability in category-based induction. In Feeney, A. & Heit, E. (Eds.), *Induction*. Cambridge, U.K.: Cambridge University Press.
55. Coley, J.D., **Shafto, P.**, Stepanova, O. & Baraff, E. (2005). Knowledge and category-based induction. In Ahn, W., Goldstone, R.L., Love, B.C., Markman, A.B. & Wolff, P. (Eds.), *Categorization inside and outside the laboratory: Essays in honor of Douglas L. Medin*. Washington, DC: American Psychological Association.
56. Coley, J.D., Solomon, G.E.A. & **Shafto, P.** (2002). The development of folkbiology: A cognitive science perspective on children's understanding of the biological world. In Kahn, P. & Kellert, S. (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (65-91). Cambridge, MA: MIT Press.

PEER-REVIEWED PAPERS IN WORKSHOPS

57. Schweinhart, A.^P, Eaves, B.S.^P, & **Shafto, P.** (2016). Automating the recoding, analysis, and interpretation pipeline using naturalistic visual scenes. *IJCAI 2016 workshop on Closing the Cognitive Loop: Third Workshop on Knowledge, Data, and Systems for Cognitive Computing*.
58. Eaves, B.S.^P & **Shafto, P.** (2016). Toward a general, scalable framework for Bayesian teaching with applications to topic models. *IJCAI 2016 workshop on Interactive Machine Learning: Connecting Humans and Machines*.
59. Mansinghka, V.K., **Shafto, P.**, Baxter, J. & Eaves, B.S. (2014) BQL and BayesDB: a probabilistic DSL and runtime system for data analysis and predictive analytics. *NIPS Probabilistic Programming Workshop*.
60. Mansinghka, V.K., Jonas, E., Petschulat, C., Cronin, B., **Shafto, P.** & Tenenbaum, J.B. (2009). Cross-categorization: a method for discovering multiple overlapping clusterings. *NIPS 2009 Workshop on Nonparametric Bayesian Statistics*.

SOFTWARE

61. Baxter, J., Lovell, D., Eaves, B.^G, **Shafto, P.** & Mansinghka, V.K. (2013). [BayesDB](#).
62. Lovell, D., Baxter, J., Eaves, B.^G, **Shafto, P.** & Mansinghka, V.K. (2013). [CrossCat](#).

Conference Presentations

1. Schweinhart, A.^P, Eaves, B.S.^P, & **Shafto, P.** (2016). Automating the recoding, analysis, and interpretation pipeline using naturalistic visual scenes. *IJCAI 2016 workshop on Closing the Cognitive Loop: Third Workshop on Knowledge, Data, and Systems for Cognitive Computing*.
2. Eaves, B.S.^P & **Shafto, P.** (2016). Toward a general, scalable framework for Bayesian teaching with applications to topic models. *IJCAI 2016 workshop on Interactive Machine Learning: Connecting Humans and Machines*.
3. Danovitch, J.H., Noles, N.S., & **Shafto, P.** (2016). The development of trust in internet search engines. *2016 SRCSD Special Topic Meeting: Technology and Media in Children's Development*.
4. Searcy, N. & **Shafto, P.** (2016). Cooperative inference: Features, objects, and collections. *2016 meeting of the Society for Philosophy and Psychology (SPP)*.
5. Searcy, N., Lane, J., Rodriguez, F. & **Shafto, P.** (2016). Cause and Affect. Annual meeting of the *Mathematical Psychology Society*.
6. Yu, Y., Bonawitz, E.B. & Shafto, P. (2016). Questions in informal teaching: A study of mother-child conversations. Poster presented at the *38th annual conference of the Cognitive Science Society*.
7. **Shafto, P.**, Bonawitz, E.B., Landrum, A. & Yue, Y. (2016). Questioning supports effective transmission of knowledge and increased exploratory learning in pre-kindergarden children. *International Conference on Thinking 2016*.
8. Schweinhart, A.M., Eaves, B.S. & **Shafto, P.** (2016). Exploring scene categorization based on the orientation distribution of natural images. Poster presented at the *Vision Sciences Society*.
9. **Shafto, P.** (2016). Computational models of teaching, learning, and epistemic trust. Paper presented at the annual meeting of the *Eastern Psychological Society*.
10. **Shafto, P.** & Searcy, N. (2015). Cooperative inference: Features, objects, and collections. Paper presented at the annual International Conference on *Biologically Inspired Cognitive Architectures (BICA)*. *Plenary
11. Eaves, B.S., Feldman, N., Griffiths, T.L. & **Shafto, P.** (2015). Infant-directed speech is consistent with teaching. Paper presented at the *40th annual Boston University Conference on Language Development (BUCLD)*.

12. Messmer, J., Noles, N., Danovitch, J. & **Shafto, P.** (2015) What can the Internet tell you about Pangolins?: Childrens Questions for Internet and Human Sources. Poster presented at the biennial meeting of the *Cognitive Development Society*.
13. Landrum, A.R., Bamforth, A. & **Shafto, P.** (2015). Ways of knowing: Investigating the epistemic aspect of selective trust. Poster presented at the biennial meeting of the *Cognitive Development Society*.
14. Noles, N., Danovitch, J. & **Shafto, P.** (2015) Developmental changes in learning from the internet. Poster presented at the *Annual meeting of the Association for Psychological Science*.
15. **Shafto, P.** (2015) Teaching, learning and trust: Computational models and behavioral results. Poster presented at *Mechanisms of learning in social contexts, workshop at ICDL*.
16. Durkin, K., Caglar, L.R., Bonawitz, E.B. & **Shafto, P.** (2015). Explaining choice behavior: The intentional selection assumption. Poster presented at the *37th annual conference of the Cognitive Science Society*.
17. Landrum, A.R., Cloudy, J. & **Shafto, P.** (2015). More than true: Developmental changes in use of inductive strength for selective trust. Poster presented at the *37th annual conference of the Cognitive Science Society*.
18. Noles, N.S., Danovitch, J.H. & **Shafto, P.** (2015). Children’s learning from technological and human sources. Poster presented at the *37th annual conference of the Cognitive Science Society*.
19. Durkin, K. & **Shafto, P.** (2015). Epistemic trust and education: Informant reliability affects learning of decimal concepts. Paper presented at the *45th annual meeting of the Jean Piaget Society*.
20. Schweinhart, A.M., **Shafto, P.** & Essock, E.A. (2015). Effects of recent exposure to atypical environmental statistics on orientation perception: Analyzing the plasticity of the horizontal effect. Poster presented at the *Vision Sciences Society*.
21. Noles, N., Danovitch, J. & **Shafto, P.** (2015). Is it better to ask a friend or ask Google? Children’s trust in people and the internet. Poster presented at the biennial meeting of the *Society for Research in Child Development*.
22. Durkin, K., Landrum, A.R., Savage, P., Eglian, M. & **Shafto, P.** (2015). Avoiding hasty conclusions: Manipulating informant expertise to avoid conceptual entrenchment. Poster presented at the biennial meeting of the *Society for Research in Child Development*.
23. Landrum, A.R., Bonawitz, E.B., Omar, F. & **Shafto, P.** (2015). Teaching through questioning: Examining how pedagogical questions elicit learning. Paper presented at the biennial meeting of the *Society for Research in Child Development*.
24. Durkin, K. & **Shafto, P.** (2015). Epistemic trust and education: Effects of informant reliability on student learning of decimal concepts. Poster presented at the annual meeting of the *American Educational Research Association*.
25. Mansinghka, V.K., **Shafto, P.**, Baxter, J. & Eaves, B.S. (2014) BQL and BayesDB: a probabilistic DSL and runtime system for data analysis and predictive analytics. Poster presented at the *NIPS Probabilistic Programming Workshop*.
26. Gweon, H., **Shafto, P.** & Schulz, L.E. (2014). Children consider prior knowledge and the cost of information both in learning from and teaching others. Paper presented at the *36th annual conference of the Cognitive Science Society*.
27. Eaves, B.^G & **Shafto, P.** (2014). Order effects in learning relational structures. Paper presented at the *36th annual conference of the Cognitive Science Society*.
28. Searcy, N.^G & **Shafto, P.** (2014). Learning biases for teaching boolean concepts. Paper presented at the *36th annual conference of the Cognitive Science Society*.

29. Rhodes, M., Bonawitz, E.B., **Shafto, P.** & Chen, A. (2014). Controlling the message: Preschoolers' use of evidence to teach and deceive others. Paper presented at the *36th annual conference of the Cognitive Science Society*.
30. Gweon, H., **Shafto, P.**, Chu, V. & Schulz, L.E. (2014). To give a fish or to teach how to fish? Children weigh costs and benefits to decide what and how much information to transmit. Poster presented at the *40th annual meeting of the Society for Philosophy and Psychology*.
31. **Shafto, P.** (2014). Direct instruction: More than meets the eye. Paper presented at the annual meeting of the *American Educational Research Association*.
32. Eaves, B., Feldman, N., Griffiths, T.L. & **Shafto, P.** (2013). Infant directed speech as statistically optimal input. Paper presented at the biennial meeting of the *Cognitive Development Society*.
33. **Shafto, P.**, Gonzalez, A., Bonawitz, E.B. & Gopnik, A. (2013). Is that your final answer? The effects of neutral queries on children's choices. Paper presented at the biennial meeting of the *Society for Research in Child Development*.
34. **Shafto, P.**, Gweon, H., Fargen, C. & Schulz, L. (2012). Enough is enough: Inductive sufficiency guides learners' ratings of informant helpfulness. Paper presented at the *34th annual conference of the Cognitive Science Society*.
35. Gonzalez, A., **Shafto, P.**, Bonawitz, E.B. & Gopnik, A. (2012). Is that your final answer? The effects of neutral queries on children's choices. Poster presented at the *34th annual conference of the Cognitive Science Society*.
36. Gweon, H., **Shafto, P.**, Tenenbaum, J.B. & Schulz, L.E. (2012). Children's sensitivity to informant's inductive efficiency and learner's epistemic states in pedagogical contexts. Poster presented at the *34th annual conference of the Cognitive Science Society*.
37. **Shafto, P.** & Eaves, B. (2012). Epistemic trust: Modeling children's reasoning about others' knowledge and intent. Paper presented at the *42nd annual meeting of the Jean Piaget Society*.
38. Rafferty, A., Brunskill, E., **Shafto, P.** & Griffiths, T.L. (2011). Faster teaching by POMDP planning. Poster presented at the *44th annual meeting of the Society for Mathematical Psychology*.
39. Warner, R., Stoess, T. & **Shafto, P.** (2011). Reasoning about teaching and misleading situations. Paper presented at the *33rd annual conference of the Cognitive Science Society*.
40. Montague, R., Navarro, D.J., Perfors, A., Warner, R. & **Shafto, P.** (2011). To catch a liar: The effects of truthful and deceptive testimony on inferential learning. Paper presented at the *33rd annual conference of the Cognitive Science Society*.
41. Smith, N.A. & **Shafto, P.** (2011). The role of cross-cutting systems of categories in category-based induction. Paper presented at the *33rd annual conference of the Cognitive Science Society*.
42. Li, D. & **Shafto, P.** (2011). Bayesian hierarchical cross-clustering. Poster presented at the *14th international conference on Artificial Intelligence and Statistics (AISTATS)*.
43. **Shafto, P.**, Bonawitz, E.B., Gweon, H., Goodman, N.D. & Schulz, L. (2011). Vicarious pedagogical learning: When overheard instruction affects exploration and discovery. Paper presented at the biennial meeting of the *Society for Research in Child Development*.
44. Eaves, B. & **Shafto, P.** (2011). Modeling epistemic trust and implications for learning. Poster presented at the biennial meeting of the *Society for Research in Child Development*.
45. Buchbaum, D., Griffiths, T.L., Gopnik, A. & **Shafto, P.** (2011). Children's imitation of causal action sequences is influenced by statistical and pedagogical evidence. Paper presented at the biennial meeting of the *Society for Research in Child Development*.
46. Warner, R., Stoess, T. & **Shafto, P.** (2010). Reasoning in pedagogical versus deceptive situations. Poster presented at the *32nd annual conference of the Cognitive Science Society*.

47. **Shafto, P.**, Goodman, N.D., Gerstle, B. & Ladusaw, F. (2010). Prior expectations in pedagogical situations. Poster presented at the *32nd annual conference of the Cognitive Science Society*.
48. Li, D., Rouchka, E. & **Shafto, P.** (2010). Phylogenomic analysis using Bayesian congruence measuring. Paper presented at the *2nd International Conference on Bioinformatics and Computation (BICoB)*.
49. **Shafto, P.**, Bonawitz, E.B., Gweon, H. & Schulz, L. (2010). Modeling the effects of pedagogy on preschoolers' exploratory play and discovery. Poster presented at the opening conference of the *Cognitive Development Center at Central European University*.
50. Mansinghka, V., Jonas, E., Petschulat, C., Cronin, B., **Shafto, P.** & Tenenbaum, J.B. (2009). Cross-categorization: A method for discovering multiple overlapping clusterings. Paper presented at the *NIPS workshop on nonparametric Bayes*.
51. Buchbaum, D., Griffiths, T.L., Gopnik, A. & **Shafto, P.** (2009). The influence of statistical and pedagogical cues on children's imitation of causal action sequences. Poster presented at the annual meeting of the *Cognitive Development Society*.
52. **Shafto, P.** (2009). Causal reasoning in pedagogical settings. Poster presented at the *50th Annual Meeting of the Psychonomics Society*.
53. Bonawitz, E.B., **Shafto, P.**, Gweon, H., Chang, I., Katz, S. & Schulz, L. (2009). The double-edged sword: Modeling the effect of pedagogy on preschoolers' exploratory play. Poster presented at the *31st annual conference of the Cognitive Science Society*.
54. Warner, R., **Shafto, P.**, Baker, C.L. & Tenenbaum, J.B. (2009). Abstract knowledge guides prediction and search in novel settings. Poster presented at the *31st annual conference of the Cognitive Science Society*.
55. **Shafto, P.** & Goodman, N.D. (2009). Intuitive pedagogical reasoning: Computational model and experimental investigations. Paper presented at the biennial meeting of the *Society for Research in Child Development*.
56. **Shafto, P.** & Goodman, N.D. (2008). Bayesian pedagogical reasoning. Poster presented at *NIPS workshop on human and machine intelligence*.
57. **Shafto, P.** & Goodman, N.D. (2008). A Bayesian model of pedagogical reasoning. Paper presented at the *AAAI Fall symposium*.
58. **Shafto, P.** & Goodman, N.D. (2008). Inductive learning based on communicative intent. Paper presented at the *6th International Conference on Thinking*.
59. Feeney, A., Crisp, A. & **Shafto, P.** (2008). Dual processes and category-based conjunction fallacies. Paper presented at the *6th International Conference on Thinking*.
60. **Shafto, P.** & Goodman, N.D. (2008). Teaching games: Statistical sampling assumptions for learning in pedagogical situations. Poster presented at the *30th annual conference of the Cognitive Science Society*.
61. **Shafto, P.** & Goodman, N.D. (2008). Intuitive pedagogy and causal learning. Paper presented at the annual meeting of the *Eastern Psychological Association*.
62. Kemp, C., **Shafto, P.**, Berke, A. & Tenenbaum, J.B. (2006). Combining causal and similarity-based reasoning. Paper presented at *NIPS*.
63. Coley, J.D., **Shafto, P.** & Baldwin, D. (2006). Availability and context-sensitive inductive reasoning. Poster presented at the *47th Annual Meeting of the Psychonomics Society*.
64. **Shafto, P.**, Kemp, C., Mansingka, V. & Tenenbaum, J.B. (2006). Learning cross-cutting systems of categories. Poster presented at the *47th Annual Meeting of the Psychonomics Society*.
65. Kemp, C., **Shafto, P.** & Tenenbaum, J.B. (2006). Combining causal and similarity-based reasoning. Poster presented at the *47th Annual Meeting of the Psychonomics Society*.

66. Kemp, C., **Shafto, P.** & Tenenbaum, J.B. (2006). Combining causal and similarity-based reasoning. Paper presented at the *Annual Meeting of the Society for Mathematical Psychology*.
67. **Shafto, P.**, Kemp, C., Mansinghka, V., Gordon, M. & Tenenbaum, J.B. (2006). Learning cross-cutting systems of categories. Poster presented at the *28th Annual Conference of the Cognitive Science Society*.
68. **Shafto, P.**, Coley, J.D. & Baldwin, D. (2005). Availability in category-based reasoning. Poster presented at the *46th Annual Meeting of the Psychonomic Society*.
69. **Shafto, P.**, Kemp, C., Baraff, E., Coley, J.D. & Tenenbaum, J.B. (2005). Context-sensitive induction. Paper presented at the *27th Annual Conference of the Cognitive Science Society*.
70. **Shafto, P.**, Kemp, C., Baraff, E., Coley, J.D. & Tenenbaum, J.B. (2004). Inductive generalizations of novel diseases: Causal generalizations over food web relations. Paper presented at the *5th International Conference on Thinking*.
71. **Shafto, P.** & Coley, J.D. (2001). From the depths of the sea to you and me: Expertise and adult conceptual development. Poster presented at the biennial meeting of the *Society for Research in Child Development*.

Invited Presentations

Rutgers-New Jersey Medical School, December 2016.
 ConCats meeting, New York University, October 2016.
 Psychology Department, Princeton University, September 2016.
 IAS Nighttime Topology Seminar, Institute for the Advanced Study, April 2016.
 Distinguished Seminar, Computer & Information Sciences department, Florida International University, January, 2016.
 Earth and Environmental Sciences department, Rutgers-Newark, October, 2015.
 Advanced Analytic Lectures Series, Prudential Financial Services, October, 2015.
 Cognitive Brown bag, University of Pittsburgh, October, 2015.
 London Neuroscience Conference, University College London, April, 2015.
 Schwartz/Weiman/McCandliss group meeting, Stanford University, February, 2015.
 Center for the Study of Language and Information, Stanford University, February, 2015.
 Cognitive Science Program, Tufts University, February, 2015.
 Learning Sciences, Worcester Polytechnic Institute, January, 2015.
 I-DSLAI, Rutgers University–Newark, January, 2015.
 Psychology Department, Rutgers University–Newark, November, 2014.
 Psychology Department, Rutgers University–New Brunswick, November, 2014.
 ConCats Group Meeting, NYU, November, 2014.
 Spelke Lab, Harvard University, September, 2014.
 Draper Laboratory, Distinguished Speaker Series, September, 2014.
 Philosophy Department, University of Louisville, September, 2014.
 Educational Psychology Department, University of Illinois, Urbana-Champaign, December, 2013.
 Cognitive Development Society Pre-conference Workshop, Computational Models of Cognitive Development, October, 2013.
 Psychology Department, University of New South Wales, July, 2013.
 Teachers College, Columbia University, February, 2013.
 Computer Science Department, University of Louisville, October, 2012.
 Computer Science Department, University of Louisville, October, 2011.
 McDonnell Workshop, Stanford University, December, 2010.

Computer Science Department, University of Louisville, October, 2010.
McDonnell Workshop, Center for Human Growth and Development, University of Michigan, May, 2010.
Cognitive Development Center, Department of Philosophy, Central European University, March, 2010.
Probabilistic Models of Cognitive Development Workshop, Banff International Research Station, May, 2009.
Leuven Workshop on Learning Semantic Knowledge, Leuven, Belgium, June, 2008.
Grand Rounds, Department of Psychiatry, University of Louisville, May, 2008.
Computer Science Department, University of Louisville, April, 2008.
Spanning the Socio-Cognitive Modeling Gap: From Development to Social Simulation, ONR Workshop, February, 2008.
Statistics Research Group, University of Louisville, November, 2007.
CGeMM Computational Biology Meeting, University of Louisville, September, 2007.
Cognitive Science Department, Indiana University, Bloomington, September, 2007.
Cognitive Science Department, University of California, Irvine, January, 2007.
Department of Psychological and Brain Sciences, University of Louisville, January, 2007.
Psychology Department, University of Hawaii, January, 2007.
Language & Cognition Group, Northeastern University, January, 2007.
Categorization & Causality Workshop, Brown University, September, 2006.
Psychology Department, University College London, March, 2006.
Language & Cognition group, Northeastern University, February, 2006.
Psychology Department, University of Durham, January, 2006.
Culture & Cognition group, Northwestern University, March, 2004.
Sloman Lab, Brown University, February, 2004.

Symposia & Workshops

Organizer of “Pickin’ and grinnin’: Children’s ability to choose evidence for themselves and others”, Symposium at the biennial meeting of the *Society for Research in Child Development*, 2011.
Co-organizer of “Intuitive Pedagogical Reasoning: An Interdisciplinary Workshop”, Workshop at *31st annual meeting of the Cognitive Science Society*, 2009.
Organizer of “Inductive Reasoning: Categories and Properties”, Symposium at *6th International Conference on Thinking*, 2008.

Press (selected)

11/09/16 – [Research Shows Infants May Benefit From Baby Talk](#), NJTV.
07/05/16 – [Between the ears: Study tests the value of baby talk](#), Seattle Times.
02/16/15 – [What children think of the internet and why it matters](#), New York Times.
12/20/13 – [5 Q’s for the Creators of BayesDB, a Database Built for Data Science](#), Center for Data Innovation, 5 Q’s with a Data Innovator.
06/17/13 – [“What’s the most natural way to learn? It might surprise you”](#), The Washington Post.
07/07/11 – [“The educational value of creative disobedience”](#), Scientific American.
06/30/11 – [“Direct instruction can thwart independent exploration”](#) Science Daily.
05/26/11 – [“Now you know: When should you teach children, and when should you let them explore?”](#), The Economist.
03/16/11 – [“Why preschool shouldn’t be like school”](#), Slate Magazine.
01/18/11 – [“When teaching constrains discovery”](#), Discover Magazine.

Blogging

02/22/16 – [Why big tech companies are open-sourcing their AI systems](#), The Conversation.

Reviewing

Journals: *Consulting editor* for Child Development, 2015-present. *Ad-hoc reviewer* for Artificial Intelligence; Child Development; Cognition; Cognitive Psychology; Cognitive Development; Cognitive Science; Contemporary Perspectives in Early Childhood Education; Developmental Psychology; Developmental Science; Frontiers in Human Neuroscience; Frontiers in Psychology: Quantitative Psychology and Measurement; IEEE Transactions on Autonomous Mental Development; IEEE Transactions on Pattern Analysis and Machine Intelligence; Journal of Experimental Child Psychology; Journal of Experimental Psychology: General; Journal of Experimental Psychology: Learning, Memory & Cognition; Journal of Memory and Language; Learning & Instruction; Memory & Cognition; Nature Human Behavior; Perspectives on Psychological Science; PLoS Computational Biology; Psychological Science; Psychological Review; Psychonomic Bulletin & Review; Trends in Cognitive Sciences (TiCS); Quarterly Journal of Experimental Psychology; WIREs: Cognitive Science.

Grants: *Panel member* for National Defense Science and Engineering Graduate (NDSEG) Fellowship, National Science Foundation (NSF) Big Data in Education, National Science Foundation (NSF) Education Core Research (ECR), National Science Foundation (NSF) Fostering Interdisciplinary Research on Education (FIRE), Research and Evaluation on Education in Science and Engineering (REESE), and Graduate Research Fellowship Program (GRFP). *Ad-hoc reviewer* for the NSF Faculty Early Career Development (CAREER); Perception, Action, and Cognition; Methodology, Measurement, and Statistics (MMS); Research and Evaluation on Education in Science and Engineering (REESE); and the Decision, Risk and Management Science programs.

Conferences: Proceedings of the Cognitive Science Society (CogSci); Advances in Neural Information Processing Systems (NIPS); Society for Research in Child Development (SRCD), Society for Philosophy and Psychology (SPP).

Teaching

Graduate: Introduction to Data Science (2016); Computational Cognitive Science (2008, 2010-2015); Introduction to Computer Programming for Behavioral Science (2009-2011, 2013); Learning & Reasoning (2008).

Undergraduate: Introduction to Computer Programming for Behavioral Science (2009-2011, 2013-2014); Quantitative Methods (2007-2011); Research Methods (2003); Cognition (2001-2002).

Advising

Postdocs: Wai Keen Vong (2016-present); Lewis Baker (2016-present); Scott Cheng-Hsin Yang (2016-present); Yue Yu (2015-present); Baxter Eaves (2015-2016; currently Data Scientist with Monsanto); April Schweinhart (2015-present); Kelley Durkin (2013-2015; currently Research Scientist at Peabody Research Institute at Vanderbilt University); Asheley Landrum (2013-2015; currently Fellow at the UPenn Annenberg School of Journalism).

Graduate Students: Arash Givchi (Mathematics, PhD expected 2021); Sophie Searcy (Experimental Psychology, MS 2015; PhD expected 2017); Baxter Eaves (Experimental Psychology, MS, 2013; PhD 2014; currently Data Scientist with Monsanto), Russell Warner (Experimental Psychology, MS, 2010).

Dissertation Committees: *University of Louisville*: Masha Badami (CECS) Behnoush Abdollahi (CECS), April Schwienhart (Psych, 2015), Anand Kulkarni (ECE), Mike Godbey (Math, 2014, University of Louisville), Wael Emara (CECS, 2012), Dahzou Li (CECS, 2012), Scott Strother (Psych, 2011), Terry Kim (Psych, 2010), Andrew Haun (Psych, 2009).

Honors theses: 2015: Danielle McCarty 2014: Divine-Favour Anene; 2012: Landon Crunk; 2011: Baxter Eaves; 2010: Ben Gerstle; 2009: Ashley Wade, Ryan Derickson.

Last updated: November 10, 2016