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EDUCATION & RESEARCH INTERESTS

2015 Ph.D. in Psychological Sciences, concentration in Developmental Science
Minor in Quantitative Methods
Vanderbilt University [GPA: 4.0]
Dissertation Advisor: Dr. Bethany Rittle-Johnson

2010 B.A. in Psychology and Sociology
University of Notre Dame [GPA: 4.0]
Undergraduate Thesis Advisor: Dr. Nicole McNeil

I study cognitive development and the central processes of learning and transfer with a focus on how children think, learn, and solve problems in mathematics.

PROFESSIONAL POSITIONS

2022-present ***Associate Professor***, Department of Psychological and Brain Sciences
Indiana University

2016-2022 ***Assistant Professor***, Department of Psychological and Brain Sciences
Indiana University

2015-2016 ***Postdoctoral Fellow***, Wisconsin Center for Education Research
University of Wisconsin-Madison
Postdoctoral Advisors: Dr. Martha Alibali & Dr. Mitchell Nathan

2015-2016 ***Postdoctoral Consultant***, SRI International, K-3 Formative Assessment Project

2015-2016 ***Postdoctoral Consultant***, James S. McDonnell Foundation, Study Panel on the Translation of Cognitive Science Research to Education Practice and Policies

HONORS, AWARDS, SCHOLARSHIPS, & FELLOWSHIPS

Post-PhD Honors and Awards

2023 Janet Taylor Spence Award for Transformative Early Career Contributions, Association for Psychological Science
2021 Trustees Teaching Award, Indiana University [$2,500]
2021 Outstanding Junior Scholar Award, Indiana University [$15,000]
2021 Early Career Award, American Educational Research Association (AERA), Division C on Learning and Instruction [$500]
2020 David and Cheryl Morley Early Career Award for Outstanding Teaching, College of Arts and Sciences, Indiana University [$4,000]
2020 Trustees Teaching Award, Indiana University
2019 Provost's Travel Award for Women in Science, Indiana University [$600]
2019 Trustees Teaching Award, Indiana University
2017 Rising Star Award, Association for Psychological Science
2017 Outstanding Dissertation Award, Society for Research in Child Development
2015 Postdoctoral Fellowship, Program in Mathematical Thinking, Learning, and Instruction, Institute of Education Sciences [Stipend]

Pre-PhD Honors and Awards

2014 P.E.O. Scholarship, Philanthropic Educational Organization [$15,000]
2013 Dissertation Research Grant, American Psychological Association [$1,000]
2013 Graduate Student Travel Award, Vanderbilt University [$300]
2012-2015 Graduate Research Fellowship, National Science Foundation [Tuition & Stipend]
2011 Poster Award Winner, Vanderbilt Kennedy Center Science Day [$250]
2010-2012 Pre-doctoral Fellowship, Experimental Education Research Training Program, Institute of Education Sciences [Tuition & Stipend]
2010-2015 University Graduate Fellowship, Vanderbilt University [Stipend]
2010 Valedictorian Candidate, University of Notre Dame
2010 Senior Honors Thesis, Department of Psychology, University of Notre Dame
2010 Phi Beta Kappa Honors Society, University of Notre Dame
2010 John F. Santos Award for Distinctive Achievement in Psychology, Department of Psychology, University of Notre Dame
2009 Alpha Kappa Delta Sociology Honors Society, University of Notre Dame
2006-2009 Raytheon Scholarship, Scholarship Management Services [$4,000]
2006-2010 Eli Lilly Scholarship, Adams County Community Foundation [Tuition & Fees]

GRANTS AND SPONSORED PROGRAMS

2020-2021 Reboot Foundation. "Improving Critical Thinking with a Categorization Practice Intervention." [$5,000]
Role: Co-PI with PI Ben Motz at Indiana University

2018-2024 James S. McDonnell Foundation, Human Cognition Scholar Award. "Understanding the Development of Early Mathematics Knowledge." [$600,000] Role: PI

2016-2019 Institute of Education Sciences, U.S. Department of Education, R305A160132. "Exploring the Roles of Pattern and Spatial Skills in Early Math Development." Role: Consultant for PI Bethany Rittle-Johnson at Vanderbilt University

2012-2015 Graduate Research Fellowship, National Science Foundation [$94,000]

2010-2015 Graduate Student Research Grants, Vanderbilt University [2 totaling $1300]

2008-2010 Undergraduate Research Grants, University of Notre Dame [3 totaling $7615]

PEER-REVIEWED JOURNAL PUBLICATIONS

[G] graduate student author; [U] undergraduate student author; [R] research assistant author; [P] postdoctoral author

1. [P]Borriello, G. A., [P]Grenell, A., [R]Vest, N., [U]Moore, K., & **Fyfe, E. R.** (in press). Links between repeating and growing pattern knowledge and math outcomes in children and adults. *Child Development*. doi:10.1111/cdev.13882

2. **Fyfe, E. R.,** [P]Borriello, G. A., & [G]Merrick, M. (in press). A developmental perspective on feedback: How corrective feedback influences children's literacy, mathematics, and problem solving. *Educational Psychologist*. doi:10.1080/00461520.2022.2108426

3. Motz, B. A., **Fyfe, E. R.,** & [U]Guba, T. P. (in press). Categorization training improves critical thinking performance. *Journal of Applied Research in Memory and Cognition*. doi:10.1037/mac0000053

4. Donovan, A. M., & **Fyfe, E. R.** (2022). Connecting concrete objects and abstract symbols promotes children's place value knowledge. *Educational Psychology, 42,* 1008-1026, doi:10.1080/01443410.2022.2077915

5. **Fyfe, E. R.**, [R]Byers, C., & [G]Nelson, L, J., & (2022). The benefits of a metacognitive lesson on children's understanding of mathematical equivalence, arithmetic, and place value. *Journal of Educational Psychology, 114, 1292-1306*. doi:10.1037/edu0000715

6. [R]Vest, N. A., [P]Fagan, S. E., & **Fyfe, E. R.** (2022). The role of gesture and mimicry for children's pattern learning. *Cognitive Development, 63, 101196*. doi:10.1016/j.cogdev.2022.101196

7. [P]Grenell, A., [U]Gardner, B., [G]Nelson, L. J., & **Fyfe, E. R.** (2022). Children's confidence using incorrect strategies on mathematical equivalence problems. *Cognitive Development, 62,* 101167, doi:10.1016/j.cogdev.2022.101167.

8. De Leeuw, J. R., Motz, B., **Fyfe, E. R.,** Carvalho, P. F., & Goldstone, R. (2022). Generalizability, transferability, and the practice-to-practice gap. Commentary in response to T. Yarkoni, The Generalizability Crisis. *Behavioral and Brain Sciences, 45,* E11. doi:10.1017/S0140525X21000406

9. [P]Borriello, G. A., [U]Flynn, M. E., & **Fyfe, E. R.** (2022). Developmental differences in children's and adults' strategies on a repeating pattern task. *Early Childhood Research Quarterly, 59*, 300-310. doi:10.1016/j.ecresq.2021.12.012

10. **Fyfe, E. R.,** de Leeuw, J. R., Carvalho, P. F., Goldstone, R. L., Sherman, J., … & Motz, B. (2021). ManyClasses 1: Assessing the generalizable effect of immediate versus delayed feedback across many college classes. *Advances in Methods and Practices in Psychological Science, 4,* 1-24. doi:10.1177/25152459211027575

11. [R]Vest, N. A., **Fyfe, E. R.,** Nathan, M. J., & Alibali, M. W. (2020). Learning from an avatar video instructor: The role of gesture mimicry. *Gesture, 19,* 128-155. doi:10.1075/gest.18019.ves

12. **Fyfe, E. R.,** Matthews, P. G., & Amsel, E. (2020). College developmental math students' knowledge of the equal sign. *Educational Studies in Mathematics, 104,* 65-85. doi:10.1007/s10649-020-09947-2.

13. **Fyfe, E. R.,** & Brown, S. A. (2020). This is easy, you can do it! Feedback during mathematics problem solving is more beneficial when students expect to succeed. *Instructional Science, 48,* 23-44. doi:10.1007/s11251-019-09501-5

14. [U]Flynn, M. E., [U]Guba, T. P., & **Fyfe, E. R.** (2020). ABBABB or 1212: Abstract language facilitates children's early patterning skills. *Journal of Experimental Child Psychology*, *193,* 104791. doi:10.1016/j.jecp.2019.104791

15. [G]Nelson, L. J., & **Fyfe, E. R.** (2019). Metacognitive monitoring and help-seeking decisions on mathematical equivalence problems. *Metacognition and Learning, 14*, 167-187. doi:10.1007/s11409-019-09203-w

16. **Fyfe, E. R.,** Matz, L., Hunt, K., & Alibali, M. W. (2019). Mathematical thinking in children with Developmental Language Disorder: The roles of pattern skills and verbal working memory. *Journal of Communication Disorders, 77,* 17-30. doi:10.1016/j.jcomdis.2018.11.001

17. **Fyfe, E. R.,** Rittle-Johnson, & Farran, D. C. (2019). Predicting success on high-stakes math tests from preschool math measures among children from low-income homes. *Journal of Educational Psychology, 111,* 402-413. doi:10.1037/edu0000298

18. **Fyfe, E. R.,** & Nathan, M. J. (2019). Making "concreteness fading" more concrete as a theory of instruction for promoting transfer. *Educational Review, 71,* 403-422. doi:10.1080/00131911.2018.1424116

19. Fyfe, E. R., & Brown, S. A. (2018). Feedback influences children's reasoning about math equivalence: A meta-analytic review. *Thinking and Reasoning, 24,* 157-178. doi:10.1080/13546783.2017.1359208

20. Fyfe, E. R., Matthews, P. G., Amsel, E., McEldoon, K. L., & McNeil, N. M. (2018). Assessing formal knowledge of math equivalence among algebra and pre-algebra students. *Journal of Educational Psychology, 110,* 87-101. doi:10.1037/edu0000208

21. Fyfe, E. R., Evans, J. L, Matz, L., Hunt, K., & Alibali, M. W. (2017). Relations between patterning skill and differing aspects of early mathematics knowledge. *Cognitive Development, 44,* 1-11. doi:10.1016/j.cogdev.2017.07.003

22. Fyfe, E. R., & Rittle-Johnson, B. (2017). Mathematics problem solving without feedback: A desirable difficulty in a classroom setting. *Instructional Science, 45,* 177-194. doi:10.1007/s11251-016-9401-1

23. Rittle-Johnson, B., **Fyfe, E. R.,** Hofer, K. G., & Farran, D. C. (2017). Early math trajectories: Low-income children's mathematics knowledge from age 4 to 11. *Child Development, 88,* 1727-1742. doi:10.1111/cdev.12662

24. Chu, J., Rittle-Johnson, B., & **Fyfe, E. R.** (2017). Diagrams benefit symbolic problem solving. *British Journal of Educational Psychology, 87,* 273-287. doi:10.1111/bjep.12149

25. Fyfe, E. R. (2016). Providing feedback on computer-based algebra homework in middle-school classrooms. *Computers in Human Behavior, 63,* 568-574. doi:10.1016.j.chb.2016.05.082

26. Fyfe, E. R., & Rittle-Johnson, B. (2016a). Feedback both helps and hinders learning: The causal role of prior knowledge. *Journal of Educational Psychology, 108,* 82-97. doi:10.1037/edu0000053

27. Fyfe, E. R., & Rittle-Johnson, B. (2016b). The benefits of computer-generated feedback for mathematics problem solving. *Journal of Experimental Child Psychology, 147,* 140-151. doi:10.1016/j.jecp.2016.03.009

28. Rittle-Johnson, B., **Fyfe, E. R.,** & Loehr, A. L. (2016). Improving conceptual and procedural knowledge: The impact of instructional content within a mathematics lesson. *British Journal of Educational Psychology, 86,* 576-591. doi:10.1111/bjep.12124

29. Miller, M. R., Rittle-Johnson, B., Loehr, A. L., & **Fyfe, E. R.** (2016). The influence of relational knowledge and executive function on preschoolers' repeating pattern knowledge. *Journal of Cognition and Development, 17*(1)*,* 85-104. doi:10.1080/15248372.2015.1023307

30. Fyfe, E. R., McNeil, N. M., & Rittle-Johnson, B. (2015). Easy as ABCABC: Abstract language facilitates performance on a concrete patterning task. *Child Development, 86,* 927-935. doi:10.1111/cdev.12331

31. Fyfe, E. R., DeCaro, M. S., & Rittle-Johnson, B. (2015). When feedback is cognitively-demanding: The importance of working memory capacity. *Instructional Science, 43*(1), 73-91. doi:10.1007/s11251-014-9323-8

32. Fyfe, E. R., McNeil, N. M, & Borjas, S. (2015). Benefits of "concreteness fading" for children's mathematics understanding. *Learning and Instruction, 35,* 104-120. doi:10.1016/j.learninstruc.2014.10.004

33. McNeil, N. M., **Fyfe, E. R.,** & Dunwiddie, A. E. (2015). Arithmetic practice can be modified to promote understanding of mathematical equivalence. *Journal of Educational Psychology, 107,* 423-436. doi:10.1037/a0037687

34. Rittle-Johnson, B., **Fyfe, E. R.,** Loehr, A. L., & Miller, M. R. (2015). Beyond numeracy in preschool: Adding patterns to the equation. *Early Childhood Research Quarterly, 31,* 101-112. doi:10.1016/j.ecresq.2015.01.005.

35. Fyfe, E. R., DeCaro, M. S., & Rittle-Johnson, B. (2014). An alternative time for telling: When conceptual instruction prior to problem solving improves mathematical knowledge. *British Journal of Educational Psychology, 84*, 502-519. doi:10.1111/bjep.12035

36. Fyfe, E. R., McNeil, N. M., Son, J. Y., & Goldstone, R. L. (2014). Concreteness fading in mathematics and science instruction: A systematic review. *Educational Psychology Review, 26*(1), 9-25. doi:10.1007/s10648-014-9249-3

37. Loehr, A. L., **Fyfe, E. R.,** & Rittle-Johnson, B. (2014). Wait for it…Delaying instruction improves mathematics problem solving: A classroom study. *The Journal of Problem Solving, 7,* 36-49. doi:10.7771/1932-6246.1166

38. Chesney, D. L., McNeil, N. M., Matthews P. G., Byrd, C. E., Petersen, L. A., Wheeler, M. C., **Fyfe, E. R.,** & Dunwiddie, A. E. (2014). Organization matters: Mental organization of addition knowledge relates to understanding math equivalence in symbolic form. *Cognitive Development, 30,* 30-46. doi:10.1016/j.cogdev.2014.01.001

39. Rittle-Johnson, B., **Fyfe, E. R.**, McLean, L. E., & McEldoon, K. L. (2013). Emerging understanding of patterning in four-year-olds. *Journal of Cognition and Development, 14*(3), 376-396. doi:10.1080/15248372.2012.689897

40. Fyfe, E. R., Rittle-Johnson, B., & DeCaro, M. S. (2012). The effects of feedback during exploratory mathematics problem solving: Prior knowledge matters. *Journal of Educational Psychology, 104*(4), 1094-1108. doi:10.1037/a0028389

41. McNeil, N. M., & **Fyfe, E. R.** (2012). "Concreteness fading" promotes transfer of mathematical knowledge. *Learning and Instruction, 22,* 440-448. doi:10.1016/j.learninstruc.2012.05.001

42. McNeil, N. M., Chesney, D. L., Matthews, P. G., **Fyfe, E. R.,** Petersen, L. A., & Dunwiddie, A. E. (2012). It pays to be organized: Organizing arithmetic practice around equivalent values facilitates understanding of math equivalence. *Journal of Educational Psychology, 104*(4), 1109-1121. doi:10.1037/a0028997

43. McNeil, N. M., **Fyfe, E. R.,** Petersen, L. A., Dunwiddie, A. E., & Brletic-Shipley, H. (2011). Benefits of practicing 4 = 2 + 2: Nontraditional problem formats facilitate children's understanding of mathematical equivalence. *Child Development, 82*(5), 1620-1633. doi:10.1111/j.1467-8624.2011.01622.x

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ARTICLES UNDER REVIEW OR IN PREPARATION

1. Grenell, A., Hine, E., & Fyfe, E. R. (under review). Informing the controversy: The prevalence of repeating and growing patterns in early mathematics textbooks.

2. Merrick, M., & Fyfe, E. R. (under review). How the source of feedback shapes performance and motivation for children learning mathematics.

3. Zhang, T., & Fyfe, E. R. (under review). High variability in learning materials enhances young children's pattern learning.

4. Merrick, M., & Fyfe, E. R. (under review). Feelings on feedback: Children's emotional responses during mathematics problem solving.

OTHER PUBLICATIONS

1. **Fyfe, E. R.** (2020). RE: Impact of COVID-19 on academic mothers. *Science E-Letter* (15 May 2020). https://science.sciencemag.org/content/368/6492/724.1/tab-e-letters

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CONFERENCE PROCEEDINGS

1. Merrick, M. V., & **Fyfe, E. R.** (2022). The source and type of feedback influence children's mathematics performance. In J. Culbertson, A. Perfors, H. Rabagliati, & V. Ramenzoni T. (Eds.), *Proceedings of the 44th Annual Conference of the Cognitive Science Society* (pp. 1403). Toronto, Canada: Cognitive Science Society.

2. Gok, S., & **Fyfe, E. R.** (2022). Learning from failure with self vs. task focused feedback. In J. Culbertson, A. Perfors, H. Rabagliati, & V. Ramenzoni T. (Eds.), *Proceedings of the*

44th Annual Conference of the Cognitive Science Society (pp. 2236-2241). Toronto, Canada: Cognitive Science Society.

3. Guba, T. P., & **Fyfe, E. R.** (2022). Attentional momentum effects on addition verification. In J. Culbertson, A. Perfors, H. Rabagliati, & V. Ramenzoni T. (Eds.), *Proceedings of the 44th Annual Conference of the Cognitive Science Society* (pp. 3743). Toronto, Canada: Cognitive Science Society.

4. **Fyfe, E. R.** & Macchione, A. L. (2019). Children's errors on a repeating pattern task and their associations with formal numeracy knowledge. In S. Otten, A. G. Candela, Z. de Araujo, C. Haines, & C. Munter (Eds.), *Proceedings of the 41st Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 196-200). St. Louis, MO: University of Missouri.

5. **Fyfe, E. R.** & Alibali, M. W. (2018). Seeing the math in patterns: Children's attention to numerical information in a repeating pattern task. In T. E. Hodges, G. J. Roy, & A. M. Tyminski, (Eds.), *Proceedings of the 40th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 229). Greenville, SC: University of South Carolina & Clemson University.

6. Ottmar, E. R., Melcer, E., Abrahamson, D., Nathan, M. J., **Fyfe, E. R.,** & Smith, C. (2018). Embodied mathematical imagination and cognition (EMIC) working group. In T. E. Hodges, G. J. Roy, & A. M. Tyminski, (Eds.), *Proceedings of the 40th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 229). Greenville, SC: University of South Carolina & Clemson University.

7. **Fyfe, E. R.** & Brown, S. A. (2018). Task expectations influence learning from feedback. In T. Rogers, M. Rau, X. Zhu, & C. W. Kalish (Eds.), *Proceedings of the 40th Annual Conference of the Cognitive Science Society* (pp. 396-401). Madison, WI: Cognitive Science Society.

8. **Fyfe, E. R.,** Matthews, P. G., & Amsel, E. (2017). College students' knowledge of the equal sign and its relation to solving equations. In E. Galindo & J. Newton (Eds.), *Proceedings of the 39th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 279-282). Indianapolis, IN: Hoosier Association of Mathematics Teacher Educators.

9. **Fyfe, E. R.,** Alibali, M. W., & Nathan, M. J. (2017). The promise and pitfalls of making connections in mathematics. In E. Galindo & J. Newton (Eds.), *Proceedings of the 39th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 717-724). Indianapolis, IN: Hoosier Association of Mathematics Teacher Educators.

10. **Fyfe, E. R.,** (2016). The benefits of feedback on computer-based algebra homework. In M. B. Wood, E. E. Turner, M. Civil, & J.A. Eli (Eds.), *Proceedings of the 38th Annual*

Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 581-588). Tucson, AZ: University of Arizona.

11. Fyfe, E. R. & Rittle-Johnson, B. (2016). Longitudinal predictions of sixth-grade geometry knowledge. In M. B. Wood, E. E. Turner, M. Civil, & J.A. Eli (Eds.), *Proceedings of the 38th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 270-273). Tucson, AZ: University of Arizona.

12. Chu, J., **Fyfe, E. R.,** & Rittle-Johnson, B. (2015). Diagrams benefit symbolic problem solving. In D. Noelle, R. Dale, A. Warlaumont, J. Yoshimi, T. Matlock, C. Jennings, & P. Maglio (Eds.), *Proceedings of the 37th Annual Conference of the Cognitive Science Society* (pp. 381-386). Pasadena, CA: Cognitive Science Society.

13. Fyfe, E. R., & Rittle-Johnson, B. (2012). The effects of feedback during exploration depend on prior knowledge. In N. Miyake, D. Peebles, & R. P. Cooper (Eds.), *Proceedings of the 34th Annual Conference of the Cognitive Science Society* (pp. 348-354). Sapporo, Japan: Cognitive Science Society.

CONFERENCE ORAL PRESENTATIONS

1. Grenell, A., & **Fyfe, E. R.** (2022, April). Children's overconfidence in the effectiveness of incorrect strategies for mathematical equivalence problems. Paper presented at the American Educational Research Association (AERA), San Diego, CA.

2. Borriello, G., Grenell, A., & **Fyfe, E. R.** (2022, April). Investigating links between repeating and growing pattern knowledge and mathematics achievement in children and adults. Paper presented at the American Educational Research Association (AERA), San Diego, CA.

3. Fyfe, E. R., de Leeuw, J. R., Carvalho, P. F., Goldstone, R. L., Sherman, J., & Motz, B. A. (2021, April). Large-scale collaborative science: The ManyClasses approach to experimental educational research. In S. J. Peters (chair), *Actions for increasing the credibility of educational research*. Symposium presented at the American Educational Research Association (AERA), Virtual Version.

4. Borriello, G., & **Fyfe, E. R.** (2021, April). Developmental differences in children's strategies and errors on a repeating pattern task. In G. Borriello (chair), *Beyond accuracy: Children's correct and incorrect strategies on early STEM tasks*. Symposium presented at the Biennial Meeting of the Society for Research in Child Development (SRCD).

5. Vest, N. A., & **Fyfe, E. R.** (2020, December). The effects of feedback in an evaluative online learning environment. In M. DeCaro (chair), *The science of learning*. Invited symposium presented at the annual meeting of the Southern Society for Philosophy and Psychology (SSPP), Virtual Conference.

6. Motz, B., Carvalho, P., & **Fyfe, E. R.** (2020). A preliminary taxonomy of A/B: Education experiments with different inferences and scopes. Paper presented at the Ritter et al. workshop on *Educational A/B Testing at Scale for the Learning @ Scale conference*.

7. Sherman, J., Motz, B. A., de Leeuw, J. R., Carvalho, P. F., Goldstone, R. L., & **Fyfe, E. R.** (2020, April). The time and technical issues of ManyClasses: A study of the generalizability of educational practices in authentic classrooms. In J. Sherman (chair), *The promises and pitfalls of conducing large-scale multi-site experimental science in educational settings*. Symposium accepted at the annual meeting of the Association for Psychological Science (APS), Chicago, IL. (Conference canceled).

8. Nelson, L. J., & **Fyfe, E. R.** (2019, August). Children's metacognitive skills on math equivalence problems. Paper presented at the 18th Biennial conference of the European Association for Research on Learning and Instruction (EARLI), Aachen, Germany.

9. Donovan, A. M., & **Fyfe, E. R**. (2019, June). Connecting manipulatives and symbols promotes mathematics learning. In H. Osana (chair), *Unpacking manipulatives: Recommendations for the Mathematics Classroom*. Symposium presented at the meeting of The Mathematical Cognition and Learning Society (MCLS), Ottawa, Canada.

10. Nelson, L. J., & **Fyfe, E. R.** (2019, April). The predictive power of metacognitive monitoring on math equivalence problems. Paper presented at the American Educational Research Association (AERA), Toronto, Canada.

11. **Fyfe, E. R.** (2019, April). The development of children's early patterning skills and implications for mathematics education. In T. Redick (chair), *The influence of math cognition on academic outcomes.* Invited symposium presented at the Annual Meeting of the Midwestern Psychological Association (MPA), Chicago, IL.

12. **Fyfe, E. R.,** & Donovan, A. M. (2019, March). Connecting manipulatives and symbols promotes mathematics learning. In P. Sidney (chair), *External representations in mathematical thinking and learning*. Symposium presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Baltimore, MD.

13. Motz, B., de Leeuw, J., Carvalho, P., **Fyfe, E. R.,** & Goldstone, R. (2018, July). ManyClasses: A model for abstracting generalizable research principles from different learning contexts. Presentation at *replicate.education: A Workshop on Large Scale Education Replication*. Buffalo, New York.

14. **Fyfe, E. R.,** & Rittle-Johnson, B. (2018, April). The Early Math Trajectories Model: Longitudinal predictors of middle school mathematics achievement. Paper presented at the American Educational Research Association (AERA), New York, NY.

15. Rittle-Johnson, B., **Fyfe, E. R.,** & Zippert, E. (2017, September). Patterning knowledge is foundational to math achievement. Paper presented at the Meeting of the European Association for Research on Learning and Instruction (EARLI), Tampere, Finland.

16. Fyfe, E. R. & Nathan, M. J. (2016, July). Connecting concrete and abstract representations: What is "concreteness fading" and how does it work? Paper presented at the Fourth Annual Midwest Meeting on Mathematical Thinking (M3T), Madison, WI.

17. Rittle-Johnson, B., **Fyfe, E. R.,** Loehr, A., & Miller, M. R. (2015, October). It's a pattern! The importance of early pattern knowledge for mathematics. In B. Rittle-Johnson (chair), *Development of number, shape, and pattern knowledge*. Symposium presented at the Biennial Meeting of the Cognitive Development Society (CDS), Columbus, OH.

18. Fyfe, E. R., Rittle-Johnson, B., Hofer, K., & Farran, D. (2015, August). Early pattern knowledge predicts fifth-grade math achievement. Paper presented at the Third Annual Midwest Meeting on Mathematical Thinking (M3T), Minneapolis, MN.

19. Fyfe, E. R., & Rittle-Johnson, B. (2015, March). The timing of feedback on mathematics problem solving in a classroom setting. Paper presented at the Society for Research on Educational Effectiveness (SREE), Washington, DC.

20. Fyfe, E. R., Loehr, A. L., Rittle-Johnson, B., Miller, M. R. (2014, April). Enhancing the quality of children's explanations to promote patterning knowledge. Paper presented at the American Educational Research Association Conference (AERA), Philadelphia, PA.

21. Fyfe, E. R., DeCaro, M. S., & Rittle-Johnson, B. (2014, April). The role of feedback type and working memory capacity during problem solving. Paper presented at the American Educational Research Association Conference (AERA), Philadelphia, PA.

22. Loehr, A. L., **Fyfe, E. R.,** Miller, M. R., & Rittle-Johnson, B. (2014, April). Learning from explanations: Does it matter who provides them? Paper presented at the American Educational Research Association Conference (AERA), Philadelphia, PA.

23. Rittle-Johnson, B., **Fyfe, E. R.,** Loehr, A. L., & DeCaro, M. S. (2014, April). Learning from explanation: The timing and source of explanations for learning early algebra. In B. Rittle-Johnson (chair), *Different perspectives on the role of explanation and exploration*. Symposium presented at the American Education Research Association Conference (AERA), Philadelphia, PA.

24. Fyfe, E. R., & McNeil, N. M. (2013, April). The benefits of "concreteness fading" generalize across task, age, and prior knowledge. In K. Mix (chair), *Learning from concrete models*. Symposium presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Seattle, WA.

25. Chesney, D. L., McNeil, N. M., Matthews, P. G., Byrd, C. E., Petersen, L. A., Wheeler, M. C., **Fyfe, E. R.,** & Dunwiddie, A. E. (2013, April). Organization matters: Children's

mental organization of arithmetic knowledge correlates with understanding of math equivalence. Paper presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Seattle, WA.

26. Fyfe, E. R., DeCaro, M. S., & Rittle-Johnson, B. (2013, March). An alternative time for telling: When conceptual instruction prior to exploration improves mathematical knowledge. Paper at the Society for Research on Educational Effectiveness (SREE), Washington, DC.

27. Rittle-Johnson, B., **Fyfe, E. R.,** McLean, L. E., & McEldoon, K. L. (2012, April). Algebra in preschool: Emerging understanding of patterns in four-year-olds. Paper presented at the American Educational Research Association Conference (AERA), Vancouver, Canada.

28. Fyfe, E. R., Rittle-Johnson, B., & DeCaro, M. S. (2011, September). The effects of feedback during exploratory math practice. Paper presented at the Society for Research on Educational Effectiveness (SREE), Washington, D.C.

CONFERENCE POSTER PRESENTATIONS

1. Zhang, T. & **Fyfe, E. R.** (2022, April). Variability's impact on children's pattern practice. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Madison, WI.

2. Merrick, M. & **Fyfe, E. R.** (2022, April). The effects of person vs. computer feedback on children's motivation in mathematics. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Madison, WI.

3. Byers, C., & **Fyfe, E. R.** (2021, April). The benefits of a metacognitive lesson on elementary school children's mathematics understanding. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD).

4. Vest, N., Borriello, G., & **Fyfe, E. R.** (2021, April). Mimicking speech and gesture during a lesson may not be beneficial for early learners. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD).

5. Borriello, G., **Fyfe, E. R.,** & Vest, N. (2021, April). Associations between novel patterning assessments and mathematics knowledge across childhood. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD).

6. Vest, N. A., & **Fyfe, E. R.** (2020, June). Don't copy me! How mimicking gestures influence children's patterning performance. Poster accepted at the meeting of The Mathematical Cognition and Learning Society (MCLS), Dublin, Ireland. (Conference canceled).

7. Byers, C., & **Fyfe, E. R.** (2020, May). Children's skills with repeating patterns and growing patterns correlate with arithmetic performance. Poster accepted at the annual meeting of the Association for Psychological Science (APS), Chicago, IL. (Conference canceled).

8. Vest, N. A., & **Fyfe, E. R.** (2020, April). A novel patterning assessment and its associations with numeracy knowledge. Poster accepted at the Annual Meeting of the Midwestern Psychological Association (MPA), Chicago, IL. (Conference canceled).

9. Flynn, M. E., Guba, T.P., & **Fyfe, E. R.** (2019, October). Using quantitative labels to promote children's patterning skills. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Louisville, KY.

10. Macchione, A. L., & **Fyfe, E. R.** (2019, May). The effects of feedback during problem solving in the context of stereotype threat. Poster presented at the annual meeting of the Association for Psychological Science (APS), Washington, DC.

11. Vest, N. A., & **Fyfe, E. R.** (2019, May). The effects of self-focused feedback on students' mathematics problem solving. Poster presented at the annual meeting of the Association for Psychological Science (APS), Washington, DC.

12. Macchione, A. L., Vest, N. A., & **Fyfe, E. R.** (2019, March). Point to those! Grouping gestures predict children's early patterning skills. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Baltimore, MD.

13. Vest, N. A., & **Fyfe, E. R.** (2018, November). Feedback hinders performance on women's mathematics problem solving. Poster presented at the annual meeting of the Psychonomic Society, New Orleans, LA.

14. Macchione, A. L. & **Fyfe, E. R.** (2018, November). Gender predicts performance on six-year-olds' knowledge of place value. Poster presented at the annual meeting of the Indiana Psychological Association. Noblesville, IN.

15. Vest, N. A., & **Fyfe, E. R.** (2018, May). Learning from an avatar video instructor: Gesture mimicry supports middle school students' algebra knowledge. Poster presented at the annual meeting of the Association for Psychological Science, San Francisco, CA.

16. Nelson, L. J., & **Fyfe, E. R.** (2018, May). Metacognitive monitoring on math equivalence problems. Poster presented at the Midwestern Cognitive Science Conference, Bloomington, IN.

17. Vest, N. A., & **Fyfe, E. R.** (2018, May). You are right! Feedback focused on the self enhances problem solving. Poster presented at the Midwestern Cognitive Science Conference, Bloomington, IN.

18. Fyfe, E. R., Evans, J. L., & Alibali, M.W. (2017, October). Relations between patterning, calculation skill, and key concepts in early math. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Portland, OR.

19. Donovan, A. M., & **Fyfe, E. R.** (2017, October). Making concrete connections in math. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Portland, OR.

20. Fyfe, E. R., Brown, S. A., & Alibali, M. W. (2017, April). The effects of feedback on equivalence understanding in 6- to 11-year-old children. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Austin, TX.

21. Rittle-Johnson, B., & **Fyfe, E. R.** (2017, April). Early math skills that predict low-income children's mathematics development from age 4 to 12. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Austin, TX.

22. Matthews, P. G., & **Fyfe, E. R.** (2017, April). Assessing knowledge of mathematical equivalence among algebra and pre-algebra students. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Austin, TX.

23. Rittle-Johnson, B., **Fyfe, E. R.,** & Farran, D. C. (2016, December). Predicting the future: Identifying early math skills that predict middle-school math achievement among low-income children. Poster presented at the Annual Research Conference of the Institute of Education Sciences (IES), Washington, DC.

24. Fyfe, E. R. & Alibali, M. W. (2016, July). Patterning predicts some, but not all, aspects of early math knowledge. Poster presented at the Fourth Annual Midwest Meeting on Mathematical Thinking (M3T), Madison, WI.

25. Fyfe, E. R. (2016, April). When does feedback help? The impact of human- versus computer-generated feedback on mathematics problem solving. Poster presented at the American Educational Research Association Conference (AERA), Washington DC.

26. Fyfe, E. R., Rittle-Johnson, B., Hofer, K., & Farran, D. (2015, October). Pattern knowledge, but not shape knowledge, predicts fifth-grade math outcomes. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Columbus, OH.

27. Fyfe, E. R., & Rittle-Johnson, B. (2015, March). Feedback both helps and hinders mathematics problem solving. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Philadelphia, PA.

28. Fyfe, E. R., McNeil, N. M., & Rittle-Johnson B. (2015, March). The effect of abstract versus concrete labels on children's relational reasoning. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Philadelphia, PA.

29. Rittle-Johnson, B., **Fyfe, E. R.,** & Loehr, A. L. (2015, March). Just tell me how to solve it. The impact of including procedural instruction in conjunction with conceptual instruction. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Philadelphia, PA.

30. Rittle-Johnson, B., Hofer, K., **Fyfe, E. R.,** & Farran, D. (2015, March). It's a pattern! The importance of early pattern knowledge for middle grade mathematics achievement. Poster presented at the Biennial Meeting of the Society for Research in Child Development (SRCD), Philadelphia, PA.

31. Miller, M. R., Rittle-Johnson, B., Loehr, A. L., & **Fyfe, E. R.** (2013, October). Importance of executive function for learning about patterns. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), Memphis, TN.

32. Miller, M. R., Loehr, A. L., **Fyfe, E. R.,** Rittle-Johnson, B., McLean, L. E., & McEldoon, K. L. (2013, May). Preschoolers' knowledge of repeating patterns over time. Poster presented at the 25th Association for Psychological Science (APS) Annual Convention, Washington, DC.

33. McNeil, N. M., Dunwiddie, A. E., Petersen, L. A., **Fyfe, E. R.,** & Brletic-Shipley, H. (2010, June). Arithmetic practice that promotes conceptual understanding and computational fluency: Year 3. Poster presented at the Annual Meeting of the Institute of Education Sciences (IES), National Harbor, MD.

34. Fyfe, E. R., McNeil, N. M. (2009, October). Benefits of "concreteness fading" for children with low knowledge of mathematical equivalence. Poster presented at the Biennial Meeting of the Cognitive Development Society (CDS), San Antonio, TX.

35. McNeil, N. M., Dunwiddie, A. E., Petersen, L. A., **Fyfe, E. R.,** & Brletic-Shipley, H. (2009, June). Arithmetic practice that promotes conceptual understanding and computational fluency. Poster presented at the Annual Meeting of the Institute of Education Sciences (IES), Washington, D.C.

INVITED TALKS AND ADDRESSES

2022	University of Chicago, Developmental Psychology Seminar. Talk title: *The controversial role of basic pattern skills in early mathematics learning.*
2022	Indiana University, Developmental Psychology Seminar. Talk title: *Pattern skills and mathematics education.*
2022	American Educational Research Association Conference, Division C Early Career Scholar Award. Talk title: *Children's foundational knowledge of mathematical equivalence: Past, present, and future directions.*
2022	Virginia Tech, Mathematics Education Seminar. Talk title: *Children's metacognition about mathematical equivalence understanding.*

2021	Maths Teaching Theme at the University Edinburgh, Scotland. Talk title: *The ManyClasses Project: A large-scale collaborative effort on experimental education across many college classes.*
2021	Indiana University, Social Psychology Seminar. Talk title: *The ManyClasses model to experimental education research.*
2020	Indiana University, Developmental Psychology Seminar. Talk title: *Children's metacognition across math topics and difficulty levels.*
2020	Indiana University, Developmental Psychology Seminar: Talk title: *ManyClasses method for testing the generalizability of evidence-based learning practices.*
2019	Indiana University, Developmental Psychology Seminar. Talk title: *The development of pattern skills and implications for mathematics education.*
2017	Purdue University, Department of Human Development and Family Studies Colloquia. Talk title: *Development of Pattern Knowledge*.
2017	Knox College, Faculty Workshop on Translating Cognitive Science to Pedagogy. Talk title: *Desirable Difficulties in the Classroom*.
2015	Michigan State University, Educational Psychology and Educational Technology Colloquia. Talk title: *Feedback can help or hinder mathematics problem solving.*
2015	University of Delaware, College of Education and Human Development Colloquia. Talk title: *The effects of feedback on mathematics problem solving.*
2015	University of Wisconsin-Madison, Educational Psychology Colloquia. Talk title: *The effects of feedback on mathematics problem solving.*

TEACHING EXPERIENCE

2016-2022	Instructor, Indiana University *P155: Introduction to Psychological and Brain Sciences* [2016-2023] *P315: Developmental Psychology* [2017-2023] *P660: The Teaching of Psychology* [2020-2023] *P457: The Translation of Theory to Practice* [2021]
2014-2015	Guest Lecturer, Vanderbilt University *Cognition in Infancy* *Cognitive Development* *Developmental Psychology* *Educational Psychology*
2013-2014	Academic Tutor, Stratton Foster Academic Center, Vanderbilt University
2013-2014	Graduate Teaching Assistant, Vanderbilt University

MENTORSHIP

Graduate Student Advising
Ambar Narwal (2022-present)
Tongyao Zhang (2021-present)
Megan Merrick (2020-present)

Lindsey Nelson (2017-2020)

Postdoctoral Fellow Advising
Amanda Grenell (2021-present)
Giulia Borriello (2019-present)

Honors Theses, Masters, and Dissertation Committees
Taylor Guba (2021); Undergraduate Honors Thesis Committee Chair
Sebahat Gok (2020); PhD Advisory Committee
Anna Zhen (2020); Masters Advisory Committee
Lindsey Nelson (2020); Masters Advisory Committee Chair
Emily Merritt (2020); Undergraduate Honors Thesis Committee
Calvin Isch (2020); Undergraduate Honors Thesis Committee

External Committees
Helena Connolly (2022-present); Dissertation Defense Committee, Columbia University
Julie Shirah (2021-present); Masters Advisory Committee, University of Kentucky
Alicia Macchione (2020-present); PhD Advisory Committee, University of Southern Mississippi
John McGinty (2020-present); Masters Advisory Committee, University of Wisconsin-Madison
Emmanuelle Adrien (2020-2021); PhD Advisory Committee, Concordia University

Mentor Collective Initiative, Center of Excellence for Women and Technology
Ishee Pardeshi, (2022-present); Undergraduate Student, Indiana University
Asia Peters, (2022-present); Undergraduate Student, Indiana University
Hailey McCracken, (2022-present); Undergraduate Student, Indiana University
Tzu-l Chiang (2021-2022); Graduate Student, Indiana University
Kadzumi Komiyama (2021-2022); Undergraduate Student, Indiana University

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PROFESSIONAL SERVICE

Grant Reviewer

Standing Panel Member, *Institute of Education Sciences, Education Research Grants, Basic Processes Panel,* 2020-2025

Panel Member, *National Science Foundation, Education and Human Resources,* 2022
Panel Member, *National Science Foundation, Education and Human Resources,* 2020
Panel Member, *National Science Foundation, Education and Human Resources,* 2017

Associate Editor

Developmental Psychology, 2022 to present

Editorial Board Member

Journal of Cognition and Development, 2021 to present
Review of Educational Research, 2019 to present
Educational Psychology Review, 2018 to present

Journal of Educational Psychology, 2018 to present

Ad-hoc Manuscript Reviewer
Behavior Research Methods • British Journal of Educational Psychology • Child Development • Cognition and Instruction • Cognitive Development • Cognitive Psychology • Cognitive Science • Computers and Education • Computers in Human Behavior • Contemporary Educational Psychology • Developmental Science • Early Childhood Research Quarterly • Educational Psychology Review • Instructional Science • Journal of Applied Research in Memory and Cognition • Journal of Cognition and Development • Journal of Experimental Education • Journal of Educational Psychology • Journal of Experimental Child Psychology • Journal of Numerical Cognition • Journal of The Learning Sciences • Learning and Individual Differences • Learning and Instruction • Mathematical Thinking and Learning • Memory and Cognition • Neural Plasticity • Perspectives on Psychological Science • Review of Educational Research • School Psychology Quarterly

Conference Submission Reviewer
American Educational Research Association
Cognitive Development Society
Proceedings of the Cognitive Science Society
Proceedings of the Psychology of Mathematics Education – North American Chapter

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UNIVERSITY, COLLEGE, AND DEPARTMENTAL SERVICE

2023	Member, Psychological and Brain Sciences Search Committee for Senior Hire in Precision Developmental Science
2023	Member, Psychological and Brain Sciences Search Committee for Junior Hire
2022	Panel Member, Assistant Professor Bootcamp Discussion, Center of Excellence for Women and Technology
2021	Panel Member, New Faculty Orientation: Getting Your Feet on the Ground with IU Resources, Office of the Vice Provost for Faculty and Academic Affairs
2021	Member, Psychological and Brain Sciences Search Committee for Junior Hire
2021-present	Member, Committee on Use of Teaching Evaluations
2021-present	Mentor, Mentor Collective Initiative, Center of Excellence for Women & Technology
2021-present	Faculty Advisory Board, Center of Excellence for Women & Technology
2021-present	Member, Teaching and Dissemination Committee
2020	Member, Psychological and Brain Sciences Search Committee for Junior Hire
2019	Presenter, Advance College Project Seminar
2018	Member, Student Learning Outcomes for Research Methods Committee
2018-2019	Member, Space Committee
2018	Member, Psychological and Brain Sciences Search Committee for Senior Hire
2017-2018	Member, Student Awards Committee
2016-present	Member, Grant Support Faculty Committee
2016-present	Member, Undergraduate Program Committee
2016-2017	Chair, Student Learning Outcomes for Developmental Psychology Committee

OTHER SERVICE AND OUTREACH

2021-present	Reviewer, Reviewer Zero Program, Sponsored in part by the APA Commission on Ethnic Minority Recruitment, Retention, and Training.
2017-2018	Panel Member, Exhibit design for WonderLab Museum of Science
2017	Abstract Reviewer, Indiana Junior Academy of Sciences
2017	Mentor, Cox Scholar Interns, Indiana University
2017	Mentor, Service Learning Students at Bloomington High School North
2017	Mentor, Mentoring Program for Young Scholars, Cognitive Development Society
2013	Student Committee Member, ExpERT training program, Vanderbilt University
2012	Tutor, Martin Luther King Jr. Magnet School, Nashville TN
2011-2014	Volunteer, Hands on Nashville, Nashville TN
2011-2013	Volunteer, Graduate Student Council, Vanderbilt University
2008-2009	Health & Environmental Commissioner, Lyons Hall, University of Notre Dame
2008-2010	Volunteer, Logan's Center for People with Disabilities, South Bend, IN
2008-2010	Volunteer, Center for the Homeless, South Bend, IN

PROFESSIONAL AFFILIATIONS AND MEMBERSHIPS

American Educational Research Association
American Psychological Association
Association for Psychological Science
Cognitive Development Society
Cognitive Science Society
Society for Research in Child Development
Society for Research on Educational Effectiveness