

Bethany Rittle-Johnson
December 2009

Assistant Professor
Psychology and Human Development
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AREA OF SPECIALIZATION

My broad interests concern how people learn and how to improve their learning. My research focuses on learning of key concepts and problem-solving procedures in academic domains such as mathematics, with an emphasis on experiences that promote learning. I conduct this research in both laboratory and classroom contexts to better understand learning processes.

EDUCATION

1999 *Ph.D., Developmental Psychology*, Carnegie Mellon University, Pittsburgh, Pa.
1996 *M.S., Developmental Psychology*, Carnegie Mellon University, Pittsburgh, Pa.
1994 *B.A., Psychology (with Distinction)*, Biology minor, University of Virginia

PROFESSIONAL EXPERIENCE

Fall 2002 -	Assistant Professor Department of Psychology and Human Development Peabody College Vanderbilt University
Summer 1999 – Summer 2002	Post-Doctoral Research Associate Pittsburgh Advanced Cognitive Tutor (PACT) Center Human-Computer Interaction Institute Carnegie Mellon University
Fall 1999 – Spring 2000	Instructor Department of Psychology Carnegie Mellon University

HONORS AND AFFILIATIONS

German-USA Early Career Research Exchange for Research on Learning Technologies and Technology-Supported Education, National Science Foundation, 2001-2002
NIMH/NRSA Post-Doctoral Training Grant, National Institutes of Mental Health, 2000-2001

Graduate Fellowship (for tuition and stipend), National Science Foundation, 1995-1998
Graduate Research Scholarship in Psychology, American Psychological Foundation, 1998

Student Travel Award, Society for Research in Child Development, April 1999

Outstanding Student Paper Award, American Educational Research Association, Division C, April 1996

Affiliations: Learning Sciences Institute, Kennedy Center, ExPERT pre-doctoral training program

Member: Association for Psychological Science, Society for Research in Child Development, Cognitive Development Society, American Educational Research Association, National Council of Teachers of Mathematics.

PUBLICATIONS

BOOK CHAPTERS

Rittle-Johnson, B. & Siegler, R.S. (1998). The relation between conceptual and procedural knowledge in learning mathematics: A review. In C. Donlan (Ed.), *The development of mathematical skill* (pp. 75-110). Hove, UK: Psychology Press.

ARTICLES IN REFEREED JOURNALS

Star, J. R. Kenyon, M., Joiner, R. & **Rittle-Johnson, B.** (in press). Comparison helps students learn to solve equations flexibly and efficiently. *Mathematics Teacher*.

Star, J. R., Olzog, M., Wronski, R. & **Rittle-Johnson, B.** (in press). Comparison helps students learn to be better estimators. *Teaching Children Mathematics*.

Matthews, P. G. & **Rittle-Johnson, B.** (2009). In pursuit of knowledge: Comparing self-explanations, concepts, and procedures as pedagogical tools. *Journal of Experimental Child Psychology, 104*, 1-21.

Rittle-Johnson, B. & Koedinger, K.R. (2009). Iterating between lessons on concepts and procedures can improve mathematics knowledge. *British Journal of Educational Psychology, 79*, 483 – 500.

Rittle-Johnson, B. & Star, J. (2009). Compared to what? The effects of different comparisons on conceptual knowledge and procedural flexibility for equation solving. *Journal of Educational Psychology, 101*(3), 529-544.

Rittle-Johnson, B., Star, J. & Durkin, K. (2009). The importance of prior knowledge when comparing examples: Influences on conceptual and procedural knowledge of equation solving. *Journal of Educational Psychology, 101* (4), 836-852.

Star, J. R. & **Rittle-Johnson, B.** (2009). It pays to compare: An experimental study on computational estimation. *Journal of Experimental Child Psychology, 101*, 408-426.

Star, J. R., & **Rittle-Johnson, B.** (2009). Making algebra work: Instructional strategies that deepen student understanding, within and between algebraic representations. *ERS Spectrum, 27* (2), 11-18.

- Star, J. R., **Rittle-Johnson**, B., Lynch, K. & Perova, N. (2009). The role of prior knowledge in the development of strategy flexibility: The case of computational estimation. *ZDM – The International Journal on Mathematics Education*, 41, 569-579.
- Rittle-Johnson**, B. & Kmicikewycz, A. O. (2008). When generating answers benefits arithmetic skill: The importance of prior knowledge. *Journal of Experimental Child Psychology*, 101, 75-81.
- Rittle-Johnson**, B, Saylor, M. & Swygart, K. (2008). Learning from explaining: Does it matter if mom is listening? *Journal of Experimental Child Psychology*, 100(3), 215-224.
- Star, J. & **Rittle-Johnson**, B. (2008). Flexibility in problem solving: The Case of equation solving. *Learning and Instruction*, 18, 565-579.
- Rittle-Johnson**, B. & Star, J. (2007). Does comparing solution methods facilitate conceptual and procedural knowledge? An experimental study on learning to solve equations. *Journal of Educational Psychology*. 99(3), 561-574.
- Rittle-Johnson**, B. (2006). Promoting transfer: Effects of self-explanation and direct instruction. *Child Development*, 77(1), 1-15.
- Rittle-Johnson**, B. & Koedinger, K.R. (2005). Designing knowledge scaffolds to support mathematical problem solving. *Cognition and Instruction*, 23(3), 313-349.
- Rittle-Johnson**, B., Siegler, R.S. & Alibali, M.W. (2001). Developing conceptual understanding and procedural skill in mathematics: An iterative process. *Journal of Educational Psychology*, 93, 346-362.
- Rittle-Johnson**, B. & Alibali, M.W. (1999). Conceptual and procedural knowledge of mathematics: Does one lead to the other? *Journal of Educational Psychology*, 91, 1-16.
- Rittle-Johnson**, B. & Siegler, R.S. (1999). Learning to spell: Variability, choice, and change in children's strategy use. *Child Development*, 70, 332-348.

MANUSCRIPTS UNDER REVIEW

- Durkin, K. & **Rittle-Johnson**, B. (under review). The effectiveness of comparing correct and incorrect examples for learning about decimal magnitude.
- McNeil, N. M., **Rittle-Johnson**, B., Hattikudur, S. & Peterson, L. A. (under review). Continuity in representations between children and adults: Arithmetic practice hinders undergraduates' algebraic problem solving.
- Rittle-Johnson**, B., Taylor, R., Matthews, P.G., & McEldoon, K. (under review). Assessing Knowledge of Mathematical Equivalence: A Construct Modeling Approach.

Schneider, M., **Rittle-Johnson, B.**, & Star, J. (in preparation). Relations between Conceptual Knowledge, Procedural Knowledge, and Procedural Flexibility in Two Samples Differing in Prior Knowledge.

MANUSCRIPTS IN PREPARATION

Rittle-Johnson, B., Star, J., & Durkin, K. (in preparation). Developing procedural flexibility: When and how should multiple solution methods be introduced?

CONFERENCE PROCEEDINGS (Peer Reviewed)

Star, J. & Rittle-Johnson, B. (2009, September). The role of prior knowledge in the development of strategy flexibility: The case of computational estimation. *Proceedings of the 2009 annual meeting of the North American Chapters of the International Group for the Psychology of Mathematics Education*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Rittle-Johnson, B. & Star, J. (2007, August). Compared to what? How different types of comparison facilitate transfer in mathematics. Part of the symposium "Fostering transfer of knowledge in education settings." In D. S. McNamara & G. Trafton (Eds.), *Proceedings of the 29th Meeting of the Cognitive Science Society*. (pp. 21-22). Austin, TX; Cognitive Science Society.

Matthews, P., & Rittle-Johnson, B. (2007, August). To teach by concept or by procedure? Making the most of self-explanations. In D. S. McNamara & G. Trafton (Eds.), *Proceedings of the 29th Meeting of the Cognitive Science Society*. (pp. 1283-1288). Austin, TX; Cognitive Science Society.

Rittle-Johnson, B. (2005, August). Promoting flexible problem-solving: The effects of direct instruction and self-explaining. In K. Forbus, D. Genter & T. Regier (Eds.), *Proceedings of the Twenty-Sixth Annual Conference of the Cognitive Science Society* (pp. 1161-1166). Mahwah, NJ: Erlbaum.

Rittle-Johnson, B. & Koedinger, K. (2002, October). Comparing instructional strategies for integrating conceptual and procedural knowledge. In Mewborn, D.S., Sztajin, P., White, D.Y., Wiegel, H.G., Bryant, R.L. & Nooney, K. (Ed.) *Proceedings of the twenty-fourth annual meeting of the North American Chapters of the International Group for the Psychology of Mathematics Education*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education, (pp. 969-978)

Rittle-Johnson, B., Kalchman, M., Czarnocha, B., & Baker, W. (2002, October). An integrated approach to the procedural/conceptual debate. In Mewborn, D.S., Sztajin, P., White, D.Y., Wiegel, H.G., Bryant, R.L. & Nooney, K. (Ed.) *Proceedings of the twenty-fourth annual meeting of the North American Chapters of the International Group for the Psychology of Mathematics Education*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education, (pp. 167-180).

Rittle-Johnson, B. & Koedinger, K. (2001, August). Using cognitive models to guide instructional design: The case of fraction division. In J. Moore & K. Stenning (Ed.), *Proceedings of the 23rd Annual Conference of the Cognitive Science Society*, (pp. 857-862). Mahwah, NJ, Erlbaum.

CURRICULA

Clark, E., Koedinger, K.R. & **Rittle-Johnson**, B. (2002). *Cognitive Tutor Math 6*. Carnegie Learning Co., Pittsburgh, PA. (Intelligent tutoring component that I authored is now being made available on the web. See <http://webmathtutor.org>)

PUBLIC MEDIA

“Moms Who Listen” news video was produced by ScienCentral and aired on over 10 ABC affiliate TV stations across the country (available at: http://www.sciencentral.com/articles/view.php3?article_id=218393102&cat=1_5) . The related press release “Kids learn more when mom is listening” was covered on WPLN-FM Nashville radio and printed in Fort Worth Star Telegram and over 50 on-line sites such as Science Daily and Education Week. I was also asked to write an article on the importance of explanation for the internationally distributed newsletter “Pediatrics for Parents: The Children’s Medical Journal for Parents” (www.pedsforparents.com). The article “Kids learn more when mom listens” was printed in May/June 2009 issue (Vol. 25, No. 5 & 6, p. 31)

“Calculators okay in math class, if students know the facts first” news release was included on over 50 on-line sites such as Science Daily.

“It pays to compare: Comparison helps children grasp math concepts” and “You do the math: Explaining basic concepts behind math problems improves children’s learning” news releases were each included on over 20 on-line sites such as Science Daily in the first 2 weeks of its release.

RESEARCH GRANTS

Principle Investigator, “CAREER: Developing conceptual and procedural knowledge: The roles of self- and instructional explanations,” National Science Foundation Faculty Early Career Development Program, 7/2008 – 6/2013. \$567,000.

Co-Principle Investigator with Jon Star (PI) and Kristie Newton. “Helping teachers to use and students to learn from contrasting examples: A scale-up study in Algebra I” National Science Foundation Research & Evaluation on Education in Science & Engineering (REESE), 10/2008 – 9/2013, \$1,999,987 (\$171,508 to Vanderbilt).

Co-Principle Investigator with Paul Cobb (PI), Guatam Biswas and Thomas Smith. “Postdoctoral Training: Rigorous Research Methods in the Learning Sciences” U.S. Dept. of Education Institute of Education Sciences, 6/08 – 5/12. \$864,447.

Joint Co-Principle Investigator with Jon Star. “Using contrasting examples to support procedural flexibility and conceptual understanding in mathematics” U.S. Dept. of

Education Institute of Education Sciences, 8/05 - 8/09. \$1,014,175 (\$560,566 to Vanderbilt).

Principle Investigator, "Validating measures of conceptual and procedural knowledge of mathematical equivalence" Peabody Small Research Grant, 1/08-12/08, \$6900.

Principle Investigator, "Promoting integration of conceptual and procedural knowledge in mathematics: The effects of students inventing procedures and self-explaining" Peabody Small Research Grant, 6/03-5/04. \$6850.

INVITED PRESENTATIONS

Rittle-Johnson, B. (2008, November). Mathematical problem solving: Bridging between cognitive science and education. Invited presentation at Problem Solving Workshop, sponsored by Purdue University and U.S. Air Force.

Rittle-Johnson, B. & Star, J. (2008, June). It pays to compare: Effectively using comparison to support student learning of algebra. Invited talk for the Institute for Education Sciences Research Conference, Washington, D.C.

Star, J. & Rittle-Johnson, B. (2007, August). Contrasting cases in mathematics lessons support procedural flexibility. Invited talk presented at the 12th Biennial conference of the European Association for Research on Learning and Instruction (EARLI), Budapest, Hungary.

Rittle-Johnson, B. (2002, March). Developing conceptual understanding and procedural skill: Moving beyond the dichotomy. Invited presentation at University of Michigan.

CONFERENCE PRESENTATIONS

Matthews, P. G., Rittle-Johnson, B., Taylor, R. S., McEldoon, K. (2010, March). Understanding the Equals Sign as a Gateway to Algebraic Thinking. Paper to be presented at the 2010 Society for Research on Educational Effectiveness conference, Washington DC.

Rittle-Johnson, B., Star, J.R., & Durkin, K. (2009, October). Pathways to Flexibility: Leveraging Comparison and Prior Knowledge. Paper to be presented in symposium I organized "Understanding Knowledge Change: Investigations on How Children Learn Mathematics and Literacy Skills" at the biennial meeting of the Cognitive Development Society, San Antonio, TX.

Rittle-Johnson, B., Star, J.R., & Durkin, K. (2009, August). Using Comparison to Support Flexibility in Mathematics: The Effects of Different Comparison Types and Prior Knowledge. Paper to be presented at the 13th Biennial conference of the European Association for Research on Learning and Instruction, Amsterdam, Netherlands.

Rittle-Johnson, B. (2009, August). Discussant and co-organizer of symposium "Acquiring Mathematical Competence: The Roles of Conceptual and Procedural

Knowledge." 13th Biennial conference of the European Association for Research on Learning and Instruction, Amsterdam, Netherlands.

Schneider, M., Rittle-Johnson, B., & Star, J.R. (2009, August). Conceptual Knowledge, Procedural Knowledge and Procedural Flexibility in Mathematics: The Need for Valid Measures. Paper to be presented at the 13th Biennial conference of the European Association for Research on Learning and Instruction, Amsterdam, Netherlands.

Star, J. & Rittle-Johnson, B. (2009, August). The Role of Prior Knowledge in the Development of Strategy Flexibility: The Case of Computational Estimation. Paper to be presented at the 13th Biennial conference of the European Association for Research on Learning and Instruction, Amsterdam, Netherlands.

Rittle-Johnson, B., Star, J.R., & Durkin, K. (2009, June) Prior Knowledge Matters: An Aptitude x Treatment Interaction When Learning Mathematics from Comparison. Poster to be presented at the Institute for Education Sciences Research Conference, Washington, D.C.

Durkin, K. & Rittle-Johnson, B. (2009, April). Comparison of correct and incorrect examples when learning decimal fractions. Poster presented at the Biennial meeting of the Society for Research in Child Development, Denver, CO.

Matthews, P. & Rittle-Johnson, B. (2009, April). Dual dimensions for concreteness? Paper presented at the Biennial meeting of the Society for Research in Child Development, Denver, CO.

Rittle-Johnson, B., Matthews, P. G., & Saylor, M. (2009, April). Promoting explanations to support mathematics learning. Paper presented at the Biennial meeting of the Society for Research in Child Development, Denver, CO.

Taylor, R., Rittle-Johnson, B., Matthews, P., & McEldoon, K., (2009, March). Mapping children's understanding of mathematical equivalence. Paper presented at the 2009 Society for Research on Educational Effectiveness conference, Washington DC.

Star, J. R. & Rittle-Johnson, B. (2008, March). The Role of Comparison in the Development of Flexible Knowledge of Computational Estimation. Paper presented at the annual meeting of the American Educational Research Association, New York, New York.

Rittle-Johnson, B. & Star, J.R. (2007, October). When it pays to compare. The benefits of comparison in mathematics classrooms. Paper presented at the biennial meeting of the Cognitive Development Society, Santa Fe, NM.

Star, J.R., Rittle-Johnson, B., Lee, K., Samson, J., & Chang, K. (2007, June). When it pays to compare: Experimental evidence for when and how comparison facilitates mathematics learning. Poster presented at the Institute for Education Sciences Research Conference, Washington, D.C.

- Star, J. & Rittle-Johnson, B. (2007, April). Does Comparison Support Transfer of Knowledge? Investigating Student Learning of Algebra. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Star, J., Chang, K.L., & Rittle-Johnson, B. (2007, April) The Benefits of Comparison in Learning to Solve Equations. Poster presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Star, J. Glaser, H. & Rittle-Johnson, B. (2007, April) Investigating student thinking about estimation: What makes a good estimate? Paper to be presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Matthews, P. & Rittle-Johnson, B. (2007, March). Concepts or Procedures? Optimizing the Use of Self-Explanations to Correct Misconceptions. Paper presented at the Biennial meeting of the Society for Research in Child Development, Atlanta, GA.
- Rittle-Johnson, B., Star, J., Glasser, H. & Lee, K. (2006, June). Does using contrasting cases increase problem solving, flexibility and conceptual knowledge? An experimental study on early algebra learning. Poster presented at the Institute of Education Sciences 2006 Research Conference, Washington, D.C.
- Rittle-Johnson, B. & Star, J. (2006, April). Explaining contrasting solution procedures supports problem-solving flexibility and transfer. Paper presented at the Symposium I organized titled "How to support explanation in the classroom: The role of teachers and tasks". Annual meeting of the American Educational Research Association, San Francisco, CA.
- Rittle-Johnson, B. (2005, October). Contrasting examples in mathematics lessons support flexible and transferable knowledge. Paper presented at the biennial meeting of the Cognitive Development Society, San Diego, CA.
- Swygert, K.E., Rittle-Johnson, B. & Saylor, M. (2005, April). Learning from explaining: Does it matter if mom is listening? Poster presented at the Biennial meeting of the Society for Research in Child Development, Atlanta.
- Rittle-Johnson B. & McMullen, P. (2004, April). Using real-world contexts during mathematical problem solving. When it helps and when it doesn't. Paper presented in the symposium I organized titled "Finding Balance: Re-visiting the relations between conceptual and procedural knowledge." Annual meeting of the American Educational Research Association, San Diego, CA.
- Rittle-Johnson, B. & McMullen, P. (2003, October). When less is more: Using multiple representations to support learning about algebraic symbols. Poster presented at the biennial meeting of the Cognitive Development Society, Park City, UT.
- Rittle-Johnson, B. & Koedinger, K. (2001, April). Concepts, Procedures & Context: Difficulty factors for learning fraction arithmetic. Poster presented at the Biennial meeting of the Society for Research in Child Development, Minneapolis, MN.

- Rittle-Johnson, B., Alibali, M.W., & Siegler, R.S. (2000, April). Supporting correct representation promotes learning: Evidence from decimal fractions. Poster presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Rittle-Johnson, B. (1999, April). How does change occur? Integrating multiple influences on mathematics learning. Poster presented at the Biennial meeting of the Society for Research in Child Development, Albuquerque, NM.
- Rittle-Johnson, B. & Russo, S.R. (1999, April). Learning from explaining: Does it matter if anyone is listening? Poster presented at the Biennial meeting of the Society for Research in Child Development, Albuquerque, NM
- Rittle-Johnson, B. & Alibali, M.W. (1998, June). Knowing why and knowing how: Learning about mathematical equivalence. Paper presented at the 28th Annual Symposium of the Jean Piaget Society, Chicago.
- Rittle-Johnson, B. & Alibali, M.W. (1997, April). Mutual interaction between conceptual and procedural knowledge in children learning mathematical equivalence. Poster presented at the Biennial meeting of the Society for Research in Child Development, Washington DC.
- Rittle-Johnson, B. (1997, April). Rehearsing to remember: Preschoolers' memory strategy use on a serial recall task. Poster presented at the Biennial meeting of the Society for Research in Child Development, Washington DC.
- Rittle-Johnson, B. & Siegler, R.S. (1996, April). Learning to spell: Variability and change in strategy use. Paper presented at annual meeting of the American Educational Research Association, NYC. Awarded outstanding student paper for Division C.

TEACHING

Courses Taught

Psy 396 Science to the Classroom, Vanderbilt University (PhD seminar)
Psy 1630 Developmental Psychology, Vanderbilt University
Psy 2310 Educational Psychology, Vanderbilt University
Psy 334/Educ 3110 Psychological Foundations of Education, Vanderbilt University
Psy 2980 Directed Research: supervise 2-6 undergraduates in my lab each term
Principles of Child Development, Carnegie Mellon University
Research Methods in Developmental Psychology, Carnegie Mellon University

Undergraduate Advising

Advisor for Undergraduate Honors Thesis student Alexander Kmicikewycz (2006).
Faculty sponsor for 2 Vanderbilt University Summer Research Program (VUSRP) students: Kathryn Swygart (2004) and Adam Porter (2007).
Mentor for more than 25 undergraduate research assistants between Fall 2002 – Spring 2009.
Freshman advisor, 2003-2004; 2006-2007; 2008-2009
Academic advisor for 8 – 15 undergraduates each year.

Doctoral Student Advising

Major Professor for 4 Developmental Science students: Percival Matthews, Kelley Durkin, Jen Samson & Katie McEldoon.

Masters Committee Member for Manya Whitaker (Developmental Science) & Jeff Nyquist (Cognitive Psychology).

Dissertation Committee Member for Gabrielle Strouse (Developmental Science), Manya Whitaker (Developmental Science), Sarah Powell (Special Education), Robin Schumacher (Special Education), Maria Mendiburo (Leadership, Policy & Organization), Daryl Schneider (Cognitive Psychology), Sean Hurley (Cognitive Psychology), and Thomas Katzlberger (Computer Science).

Post-Doctoral Research Associate Advising

Roger Taylor & Marci DeCaro

PROFESSIONAL SERVICE

Grant Review Panel, US Dept. of Education Institute of Education Sciences, Cognition and Student Learning Panel, 2009.

Editorial Boards for *Journal of Educational Psychology* 2008-2011; *Journal of Experimental Child Psychology* 2009-2011; *Journal of Cognition and Development* 2009 – 2013.

Ad-hoc reviewer for *British Journal of Educational Psychology*, *Child Development*, *Cognition and Instruction*, *Cognitive Development*, *Developmental Psychology*, *Developmental Science*, *Journal of Experimental Psychology: General*, *Journal for Research in Mathematics Education*, *Mathematical Thinking and Learning*, the National Science Foundation, Netherlands Organisation for Scientific Research and Canadian Language and Literacy Research Network.

Consultant (PI is Bruce McLaren, Carnegie Mellon University), “AdaptErrEx: Exploring the Learning Benefits of Erroneous Examples and Their Dynamic Adaptations Within the Context of Middle School Mathematics” Institute of Education Sciences 9/09 – 8/12.

Consultant, “Fractions and Decimals” Software. Tom Snyder Productions, Scholastic Inc., 1/08 – 6/08.

UNIVERSITY, COLLEGE AND DEPARTMENTAL SERVICE

Service to University and Peabody College

Member, Peabody Endowed Chair Search committee, 2007-present

Member, Peabody Diversity committee, 2007-present

Graduate Faculty Delegate Assembly, 2006-2007; 2008-present

Freshman advisor, 2003-2004; 2006-2007; 2008-2009

Member, Peabody Technology Committee 2003-2005

Member, IRB Task Force 2003-2004

Member, Peabody Learning Course Committee 2002-2003

Service to the Department

Member, Developmental Psychology search committee 2003-2004; 2006-2007

Member, Graduate curriculum sub-committee, 2002-2003

Organizer, Graduate Student Psychology Day, 2006, 2007, 2009

Organizer, Psychological Sciences Graduate Student Recruitment Weekend, 2008