Effects of First-Grade Number Knowledge Tutoring With Contrasting Forms of Practice

Lynn S. Fuchs
Vanderbilt University

Donald L. Compton and Douglas Fuchs
Vanderbilt University

Carol L. Hamlett, Jacqueline DeSelms,
Pamela M. Seethaler, Julie Wilson,
Caitlin F. Craddock, Joan D. Bryant,
and Kursin Luther
Vanderbilt University

David C. Geary
University of Missouri

Christopher Schatschneider
Florida State University

Paul Changas
Metropolitan-Nashville Public Schools

The purpose of this study was to investigate the effects of 1st-grade number knowledge tutoring with contrasting forms of practice. Tutoring occurred 3 times per week for 16 weeks. In each 30-min session, the major emphasis (25 min) was number knowledge; the other 5 min provided practice in 1 of 2 forms. Non-speeded practice reinforced relations and principles addressed in number knowledge tutoring. Speeded practice promoted quick responding and use of efficient counting procedures to generate many correct responses. At-risk students were randomly assigned to number knowledge tutoring with speeded practice (n = 195), number knowledge tutoring with non-speeded practice (n = 190), and control (no tutoring, n = 200). Each tutoring condition produced stronger learning than control on all 4 mathematics outcomes. Speeded practice produced stronger learning than non-speeded practice on arithmetic and 2-digit calculations, but effects were comparable on number knowledge and word problems. Effects of both practice conditions on arithmetic were partially mediated by increased reliance on retrieval, but only speeded practice helped at-risk children compensate for weak reasoning ability.

Keywords: mathematics, practice, fluency, arithmetic, word problems

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Large-scale studies in the United Kingdom indicate nearly one in four adults are without the mathematics competencies needed to take full advantage of employment opportunities and handle critical daily life activities (Bynum, 1997; Every Child a Chance Trust, 2009). This situation extends to the United States (Institute of Education Sciences, National Center for Education Statistics, 2009; National Mathematics Advisory Panel, 2008), and functional innumeracy is more common among adults than reading problems due in part to stronger early intervention for reading. In fact, children with lower performance than peers in basic quantitative knowledge early in school tend to remain behind throughout their schooling (Duncan et al., 2007). Skill in whole number addition at the start of first grade predicts mathematics learning through the end of fifth grade (Geary, 2011) and is an indicator of risk for long-term learning disabilities (Geary, Hoard, Nugent, & Bailey, 2012). The National Mathematics Advisory Panel (2008) concluded that early mastery of simple arithmetic is a critical step toward eventual mastery of high school algebra, a gateway for entry into mathematics-intensive fields. These factors point to the importance of early mathematics intervention and the need for a strong focus on arithmetic in that intervention.

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Lynn S. Fuchs, Department of Special Education, Vanderbilt University; David C. Geary, Department of Psychological Sciences, University of Missouri; Donald L. Compton and Douglas Fuchs, Department of Special Education, Vanderbilt University; Christopher Schatschneider, Department of Psychology, Florida State University; Carol L. Hamlett, Jacqueline DeSelms, Pamela M. Seethaler, Julie Wilson, Caitlin F. Craddock, Joan D. Bryant, and Kursin Luther, Department of Special Education, Vanderbilt University; Paul Changas, Department of Research, Assessment, and Evaluation, Metropolitan-Nashville Public Schools, Nashville, Tennessee.

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Correspondence concerning this article should be sent to Lynn S. Fuchs, Department of Special Education, 228 Peabody, Vanderbilt University, Nashville, TN 37203. E-mail: lynn.fuchs@vanderbilt.edu