Contact (session chair) email: baroody@illinois.edu

Symposium Title: Implications of Three Training Experiments for Tailoring Instruction to Promote the Fluency of Specific Arithmetic Families

Conference section: Advances in Neuroscience/Alliance for Progress

Presenting Authors (in order), Affiliations, e-mail:
David J. Purpura, University of Illinois at Urbana-Champaign, dpurpura@illinois.edu
Arthur J. Baroody, University of Illinois at Urbana-Champaign, baroody@illinois.edu
Veena Paliwal, University of Illinois at Urbana-Champaign, paliwal2@illinois.edu

Non-presenting Author, Affiliation, e-mail:
Michael D. Eiland, University of Illinois at Urbana-Champaign, meiland@illinois.edu
Erin E. Reid, University of Illinois at Urbana-Champaign, erinreid@illinois.edu

Paper presentation order:

Introduction by Session Chair: Arthur J. Baroody

Paper 1: Fostering First-Graders’ Reasoning Strategies with the Most Basic Sums,
David J. Purpura, Arthur J. Baroody, Michael D. Eiland, and Erin E. Reid

Paper 2: Fostering First-Graders’ Fluency with Basic Addition and Subtraction Combinations,
Arthur J. Baroody, David J. Purpura, Michael D. Eiland, and Erin E. Reid

Paper 3: Young Children’s Use of a Shortcut to Solve Addition Problems,
Veena Paliwal, Erin E. Reid, Arthur J. Baroody, and David J. Purpura

Discussant: Russell Gersten, University of Oregon
Symposium Justification

Symposium Title: Issues in Assessment and Scoring of Early Numeracy Skills
Paper 1: Fostering First-Graders’ Reasoning Strategies with the Most Basic Sums
Paper 2: Fostering First-Graders’ Fluency with Basic Addition and Subtraction Combinations
Paper 3: Young Children’s Use of a Shortcut to Solve Addition Problems

Early math proficiency is linked to later academic success, both in math and other content areas (Aunola et al., 2004; Duncan et al., 2007; Jordan & Levine, 2009; Jordan et al., 2009; Mazzocco & Thompson, 2005; National Mathematics Advisory Panel [NMAP], 2008). Fluency with basic (single-digit) addition combinations and related subtraction items is a key aspect of this early competence and has long been a central goal of primary-grade instruction. Fluency entails quickly, accurately, appropriately, and flexibly generating the answer to a combination. Fluency with basic sums/differences, in particular, is critical because it facilitates learning more advanced math and applying numerous everyday skills. By freeing cognitive resources, it can expedite inductive reasoning, problem solving, estimating, and other aspects of arithmetic fluency (e.g., retrieval of related multiplication/division combinations, multi-digit mental or written computation, and computation with rational numbers).

Achieving fluency with basic sums/differences, however, is a serious stumbling block for many children (e.g., Henry & Brown, 2008), and a lack of fluency is a pervasive characteristic of those with mathematical learning difficulties (Geary, 1994; Jordan et al., 2003). Children at risk for academic failure (e.g., from low-income families), in particular, may not achieve fluency with even the most basic sums in a timely manner (Jordan et al., 2006). Well-designed computer programs and properly chosen computer games may be an effective and practical means of ensuring that all primary-level children achieve fluency with basic sums and differences (Clements & Sarama, 2012; National Research Council, 2009; Sarama & Clements, 2009).

The experimental computer program in the present studies focused on helping children learn and efficiently use reasoning strategies, which can serve as a bridge between using relatively inefficient counting strategies and efficient mental-arithmetic (e.g., Kilpatrick et al., 2001; NMAP, 2009). Almost no software exists to help children discover relations or invent reasoning strategies. Three studies were undertaken to evaluate the efficacy of such software and compare it with drill and practice software, which is prevalent and which can be more effective than regular classroom instruction/practice (Fuchs et al., 2005, 2006; Goldman & Pellegrino, 1986; Hasselbring et al., 1988; Lin et al., 1994; see review by Kulik & Kulik, 1991; but cf. Fuson & Brinko, 1985).

The research reported in Paper 1 evaluated whether structured or unstructured computer-assisted discovery effectively promoted the learning of the relatively salient add-1 rule (the sum of $n+1$ or $1+n$ is the number after $n$ in the counting sequence) and doubles (e.g., $4+4$). Past research has indicated that structured discovery can be a powerful tool but unstructured discovery is not effective (Alfieri et al., 2010). Paper-1 results indicated a more complicated picture. The research reported in paper 2 found that structured training on a subtraction-as-addition strategy indeed promoted greater transfer than unstructured practice or regular classroom instruction/practice. The research in paper 3 underscores the importance of using multiple tasks to evaluate an intervention’s efficacy. A computational shortcut task provided a different perspective on progress and, together with a fluency measure, provided a more accurate assessment of learning.
References


