**“MU MATH STUDY”**

**MATHEMATICAL DEVELOPMENT IN LEARNING DISABLED CHILDREN**

Project Summary for Teachers, Principals, and other Educational Professionals

Spring 2006

**WHAT:** The National Institute of Child Health and Human Development is sponsoring a consortium of research groups across the country to study children’s mathematical learning and learning difficulties. Our mission is to explore the critical genetic, neurobiological, cognitive, linguistic, socio-cultural, and instructional factors that influence this learning. The Cognitive Development Lab in the Department of Psychological Sciences at the University of Missouri is one of a select few research centers funded under this program. We are now in the third year of at least a five-year study on mathematical development in learning disabled children.

**WHO:** Project Director: David C. Geary, PhD, Curators’ Professor; Senior Research Specialists: Mary Hoard, PhD, Lara Nugent, MA; Graduate Research Assistants: Jennifer Byrd-Craven, MS, Chatty Numtee, MEd.

**WHY:** To identify the basic cognitive systems (e.g., attentional control, memory) that underlie math learning and the core deficits that define and underlie learning disabilities in math. This research will lead to refined diagnostic techniques and the development of informed remediation tools for mathematical disabilities.

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**Initial Findings: Overview**

At the end of kindergarten, about 300 children from 12 elementary schools and their parents agreed to participate in the study, and now at the end of 2nd grade about 275 of these children are continuing in the study. The children are administered standard achievement tests in reading and math at the end of each academic year, and were administered cognitive ability tests in kindergarten and 1st grade, and an extensive battery of working memory tasks in 1st grade. The latter assess their ability to focus and control their attention, their ability to remember language-based and visuospatial information. In the fall of each year, the children are administered a series of experimental tasks that assess their conceptual understanding of counting and numbers, their ability to use a number line, and the strategies (e.g., finger counting or fact retrieval) used to solve simple (e.g., 4+8) and more complex (e.g., 18+6) addition problems.

**At risk children**

We classified children as at risk for a mathematical disability (MD) if they had standard math scores below the 15th national percentile in both kindergarten and 1st grade. Using these criteria, 5% of our sample was identified as at risk, and they had average math scores at the 7th and 6th percentile in kindergarten and 1st grade, respectively, consistent with previous studies suggesting 5% to 8% of children have a persistent math disability. We compared these children to groups of low-achieving (math scores > 15th and < 49th percentiles) and typically-achieving (math scores > 49th percentile) children.
Findings

The cognitive ability of the at risk children was average, but their ability to control their attention, inhibit distractions, and remember language-based and visuospatial information was significantly below that of both other groups. The low- and typically-achieving children did not differ on these working memory tests.

The at risk children understood basic counting concepts. They noticed counting mistakes, but had difficulty keeping mistakes in mind while monitoring their counting – this is related to poor self-correction of errors and frequent errors when using counting to solve arithmetic problems. These children also had a poor understanding of number sets (e.g., that 9 can be decomposed into 6 & 3), and difficulty placing numbers in the correct position on a number line. They used more finger counting and guessing to solve addition problems and rarely used the sophisticated decomposition strategy; e.g., 17+6 = 17+3+3.

Their working memory problems contributed to many of these difficulties, but in complicated ways. Their poor visuospatial memory interfered with learning the number line but was not related to their addition skills; their poor self-correction was related to attentional control, but not language or visuospatial memory. Their use of unsophisticated problem solving strategies and frequent counting errors (e.g., when finger counting) was related to their language memory and to their lack of understanding of number sets.

Follow-up

We don’t know if these memory and math difficulties are short-term or persistent, but will know by the end of the study. We will also have a very good understanding of how their math development proceeds and thus where, when, and how interventions might be targeted.

Implications

We cannot state with certainty at this time, but it appears that kindergarten children with math scores < 15th percentile may be at risk for a math disability, although only ½ or less of these children will actually develop such a disability. Nonetheless, this may be a good population to target for additional help.

For further information

If you have questions, please contact Dave Geary at (573) 882-6268, or Lara Nugent, Mary Hoard, or Jennifer Byrd-Craven at (573) 882-8529. Dr. Geary would be happy to present these results in more detail or answer further questions by meeting with you in person. You may also visit our Web site at: http://mumathstudy.missouri.edu.

THANK YOU!

We thank you for your help on this project and we appreciate your willingness to send your children to do math and reading activities with us twice per year. We hope to continue to learn much about the development of mathematical skills over the next few years as these students grow and learn. We couldn't do it without you! We will continue to do everything we can to minimize disruption of your teaching and the student's classroom activities.