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# SES differences in young children's metacognition in the context of mathematical problem solving

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**Abstract**

This investigation examines socioeconomic (SES) differences in young children's development of key aspects of metacognition and related language. The participants were 102 children ranging in age from 4 years 0 months to 5 years 11 months in five daycare centers located in New York City. Metacognitive abilities and language were observed as children engaged in an individually administered clinical interview concerning mathematical problem solving. The results indicate that the ability to describe thinking and explain ideas is stronger in the upper-SES group than the middle- or lower-SES groups. The findings also indicate that all the SES groups, and children of both ages, show little awareness of mistakes and adaptability without adult assistance. The capacity to express thinking was found to increase with age during early childhood. The results suggest that young children begin to employ rudimentary forms of metacognition before the onset of formal schooling. Implications for education are discussed.


*Keywords:* Metacognition; Children; Age; Socioeconomic status

This study focuses primarily on potential socioeconomic status (SES) differences in metacognition during the course of young children's mathematical problem solving. The study also aims to shed light on the development of metacognition in 4- and 5-year-olds.

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## 1. SES differences in metacognition

One of the most tragic but persistent facts of American education is that lower-SES children — a group comprised of a disproportionate number of African-Americans and Latinos (National Center for Children in Poverty, 1996) — show lower average levels of academic achievement than do their middle- and upper-SES peers (Natriello, McDill, & Pallas, 1990).

A possible contributor to SES differences in mathematics achievement is metacognition, the awareness of thinking and its uses (Kuhn, 2000). Metacognition can be conceptualized as involving three major components, namely recognition of mistakes, adaptability, and awareness and expression of thought. *Recognition of mistakes* (Garafalo & Lester, 1985) refers to children's ability to monitor their work in order to produce accurate results. For example, children learn to see when numbers have been added incorrectly. *Adaptability* (Shrager & Siegler, 1998) refers to the selection of strategies appropriate for solving specific problems. For example, children learn that counting individual objects is an effective yet cumbersome strategy when solving a problem like $25 + 12$, and adapt by selecting an alternative method like counting from the larger number. A third component of metacognition is *awareness and expression* of thought (Carr & Jessup, 1995). For instance, children gradually become aware of the fact that the answer to $5 + 2$ was determined by counting on their fingers, and learn to describe the process in a reasonably coherent fashion.

Metacognition has been shown to affect school performance. As early as first grade, children possessing metastrategic knowledge about why, when, where, and how to use different strategies are more successful in mathematics than students not possessing this knowledge (Carr & Jessup, 1995, 1997). Metacognitive skill is related to the ability to correctly represent and solve mathematical problems (Peterson, Swing, Braverman, & Buss, 1982; Schoenfeld, 1987). Students unable to evaluate the efficacy of strategies often perform poorly in mathematics (Garafalo & Lester, 1985; Peterson, 1988).

This study investigates the hypothesis that lower-SES children's metacognition, particularly their awareness and expression of thinking, is less advanced than that of their middle- and upper-SES peers. To our knowledge, no research directly involving 4- and 5-year-olds investigates this issue. Yet related evidence suggests that SES differences in metacognitive ability, particularly with respect to the expression of thinking, may exist in young children. Language competence appears to be weaker in lower-SES than middle-SES children: lower-SES children have a smaller vocabulary than do middle-SES children (Hart & Risley, 1995). Weak language may affect mathematical performance by detracting from the metacognitive ability to describe one's thinking.

Weak language may also interfere with comprehension of the problem and the demands of the task. Although middle-SES children perform better on verbal addition and subtraction tasks, there are no differences between these groups' ability to solve non-verbal problems (Jordan, Huttenlocher, & Levine, 1992). Similarly,