

New School Readiness Indicators

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This study found that a combination of a child's early ability to control and sustain attention, fine motor skills, and general knowledge are much stronger overall predictors of that child's later math, reading, and science achievement than are either early math or reading scores alone.

Background

Recent research has presented new methods for identifying children's school readiness factors and quantifying their importance by examining which of children's developing skills measured at their entrance into kindergarten would predict reading and math achievement in late elementary school. They found that early math and reading skills and the ability to control and sustain attention were all significant predictors of later math and reading achievement. Early math scores actually predicted both later math and later reading scores. Although early math and reading scores predicted later reading scores about equally, early reading skills did not predict later math scores.

A new study, conducted by researchers from the Center for Advanced Study of Teaching and Learning at the University of Virginia, further analyzed some existing data on children to determine whether additional predictors of school achievement could be discovered. They analyzed data from three large data sets that included thousands of children: The Early Childhood Longitudinal Survey–Kindergarten Cohort (ECLS-K), National Longitudinal Survey of Youth, and the British Birth Cohort Study (see sidebar).

Results

The new data analysis found two new skills that were predictive of children's later achievement, in addition to early attention, math, and reading skills: These new skills were fine motor skills and general knowledge. Fine motor skills and general knowledge, when combined with attention, added significant additional predictive power for fifth-grade scores compared to early math and reading scores alone.

Fine motor skills—which most often refer to the movements of the hands, wrists, fingers, feet, toes, lips, and tongue—were a very strong and consistent predictor of later achievement. These skills were measured at kindergarten entrance using activities such as replicating a model with building blocks, copying figures on paper, and drawing human figures in full or in profile.

As the researchers considered the meaning of this finding, they noted that a number of learning-related activities require fine motor skills, such as writing (hand control and hand-eye coordination) and speaking (controlled production of sound).

However, the developmental and neuroscience literature indicates that the connection between early motor skills and later cognitive development (the ability to think, reason, and remember) may be more inextricably linked. Evidence suggests that as children develop cognitively, the neural (nervous system) infrastructure built during motor development is called into action. This neural infrastructure includes highly specialized capacities in the brain's basal ganglia and cerebellum that are used in specific types of learning, and sophisticated adaptive control capacity may be essential to both motor and cognitive learning. In other words, some of the neural infrastructure linkages built to control the learning process during motor development are also used to control learning in cognitive development.

Some researchers have suggested that during motor development we learn how to learn. Thus, the sophistication of cognitive capacity that a child builds during motor development may depend on the challenges a child encounters during that development. If diverse and more challenging motor environments vary for children, the cognitive capacity they bring to kindergarten may also vary.

The second skill discovered from previously unreported ECLS-K data was general knowledge. General knowledge was the strongest predictor of later reading and science test scores and, along with earlier math, was a strong predictor of later math achievement. The data was based on measures of children's early comprehension of physical and social science facts at kindergarten entrance. While the early math and reading tests focused mainly on procedural knowledge, the general knowledge test focused mainly on children's elementary knowledge or comprehension of the external world.

General knowledge measured at kindergarten entrance may reflect early comprehension skills that become necessary when reading transitions from a more procedural task in the early grades (when students are learning to read) to a task requiring more comprehension around third through fifth grades (when students are reading to learn).

Attention and motor skills also predicted science scores with about equal predictive strength, but they more strongly predicted later math achievement. Skills linked to early observation and comprehension of the social and physical world appear to be as important as early math and reading skills and likely should be included as an important kindergarten readiness indicator.

Implications

The results of this research would certainly support improving early math and reading instruction, because these early skills are strongly predictive of later math and reading scores. The results also suggest, however, that schools may need to shift emphasis from increasing or improving direct math and reading instruction to building better foundational skills of attention and fine motor skills and a better understanding of the world outside schools. Building attention and fine motor skills may rely more on subjects and curricula such as the arts, music, dance, physical education, and free play. Each of these subjects may need to be redesigned to focus on building foundational skills in the same way that math and reading have been redesigned in recent years.

Building stronger knowledge of the external world also suggests that improving early science and social studies curricula are important. Paradoxically, higher long-term achievement in math and reading may require reduced direct emphasis on math and reading and more time and stronger curricula outside math and reading.

This brief is based on the following published study:

Grissmer, D., Grimm, K.J., Aiyer, S. M., Murrell, W. M., & Steele, J.S. (2010). Fine Motor Skills and Early Comprehension of the World: Two New School Readiness Indicators. *Developmental Psychology, 46*, 1008-1017.

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The Data

The Early Childhood Longitudinal Survey-Kindergarten Cohort (ECLS-K), which follows a nationally representative sample of 21,260 children who were in kindergarten in 1998-1999. Researchers in this study used data from kindergarten entrance to the end of fifth grade. Data were collected from multiple sources, including direct achievement tests of children and surveys of parents, teachers, and school administrators. The battery of achievement tests given as part of the ECLS-K kindergarten and first-grade assessments covered three subject areas: language and literacy, mathematical thinking, and general knowledge. For fifth grade, the achievement tests included mathematics, reading, and science.

The children of the **National Longitudinal Survey of Youth (NLSY)**. The sample used in this analysis consists of 1,756 children whose academic achievement was tracked from age 7-8 to age 13-14 and whose achievement and behavior was assessed at age 5-6. The sample comprises children who were age 5 or 6 in 1986, 1988, 1990, or 1992. The age 13-14 achievement and behavior of these children were assessed in the respective 1994, 1996, 1998, and 2000 interviews. School readiness measures, including math and reading test scores and maternal reports of children's behavior problems were collected at age 5 or age 6. Academic achievement outcome measures were collected biennially for children between the ages of 5 and 14.

The 1970 **British Birth Cohort Study (BCS)** is a nationally representative longitudinal study, which has followed into adulthood a cohort of children born in Great Britain during 1 week in 1970. School readiness measures include vocabulary and copying skills tests, and maternal reports of attention, externalizing behavior, and internalizing behavior were collected when the children were 5 years of age. Reading and mathematics achievement tests were administered at age 10.

As described by Duncan et al. (2007). School readiness and later achievement. Developmental Psychology, 43, 1428-1446.