

Fine Motor Skills and Executive Function Both Contribute to Kindergarten Achievement¹

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This study examined the role of fine motor skills and executive function in early achievement in a sample of 213 middle-class kindergarteners. Controlling for executive function, children who had higher levels of fine motor skills, specifically the ability to copy a design, had higher achievement at kindergarten entry. Children with strong fine motor skills also improved more from fall to spring compared to kindergarteners with lower levels of fine motor skills.

Young children need many different skills to be ready for school. Early readiness assessments often focus on whether entering kindergarteners know basic skills, such as letters and numbers.

In addition, researchers have found that children also need to be able to exercise a set of complex behaviors related to self-control, attention, and task completion, collectively known as executive function. Although these complex self-regulatory skills are not often explicitly taught in school, they are especially important for children as they try to organize and control their behavior in the classroom.

Both research and popular media reports have explored the importance of executive function and other similar skills, which are not measured on achievement tests but nonetheless are crucial for children's healthy development. In a recent story in "This American Life," Ira Glass explored the importance of skills beyond achievement and implications for the educational system (Glass, 2012, September 14)¹.

The present study found that in addition to executive function, another complex skill set – how well children could perform fine motor tasks – explained their achievement at kindergarten entry and how much they learned over the school year.

Fine motor skills are a prominent part of what

kindergarten teachers ask children to do, but wide variation has been observed in students' experiences with motor activities. What is more, gaps in motor skill can be traced to social or demographic factors such as gender, ethnicity, and socioeconomic status. This means that while some children enter the kindergarten classroom well prepared to do motor tasks, others do not.

Notably, this study found that how well children could copy designs such as shapes was as important as their executive function for explaining their achievement in early literacy and comprehension. Researchers from the Center for Advanced Study of Teaching and Learning at the University of Virginia, the College of Charleston, and the University of Michigan used two different activity-based assessments to measure children's executive function and fine motor skills.

Before they began kindergarten, a sample of 213 middle-class children from the Midwest completed a series of fine motor tasks, including building with blocks, copying designs, and drawing a picture of a person. Early in their kindergarten year, children also played an executive function game called Head-Toes-Knees-Shoulders (HTKS) where they had to remember several rules, such as touch their head when told to

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Motor Skills

Fine and gross motor skills were assessed with the Early Screening Inventory-Revised (ESI-R). Fine motor items included building a tower, bridge, and gate with blocks (blocks); using a pencil to copy shapes pictured on cards such as a square or circle (design copy); and using a pencil and paper to draw a person from memory (draw-a-person).

Executive Function

The Head-Toes-Knees-Shoulders (HTKS) structured observation of behavioral self-regulation was used to measure Executive Function (see "**more information**").

The assessment is conducted in two phases of commands. Children were first told to follow the examiner's commands (e.g., touch your head) but then told to "be silly and do the opposite. If I say 'touch your head,' touch your toes instead."

The task requires children to pay attention to instructions, remember which body part goes with which for four different rules, and control their automatic tendency to touch the named part and instead touch a different part.

touch their toes.

In the fall and spring of kindergarten, researchers measured individual children's achievement with six tests: early letter-word knowledge, early reading comprehension, knowledge of the sounds in language (known as phonological awareness), knowledge of the world, math, and vocabulary.

Of the three fine motor tasks (building with blocks, copying designs, and drawing a person), copying designs was found to be the most important for explaining achievement in letter-word knowledge, early reading comprehension, and phonological awareness. This pattern held for fall achievement as well as for the improvement in children's learning from fall to spring. Being good at copying designs was also associated with higher mathematics scores, but this finding was not as strong.

Currently in education, the term "fine motor" is a catch-all label for a variety of different skills. But these findings suggest researchers need to better understand the different cognitive processes that fall under the general label "fine motor skills."

Interestingly, in the 1970s and 1980s, after years

of testing interventions that were found to have no effects, reading researchers decided against fine motor interventions as a way to improve children's achievement. However, these previous studies examined broad aspects of fine motor and perceptual skills in children with learning disabilities. They did not focus specifically on children's skill at copying designs and there were few studies with large numbers of typically developing children.

It is possible that children with good copying skills have developed another underlying cognitive process that allows them to achieve at higher levels. For example, a child with strong fine motor and copying skills may have better "automaticity," which means he or she can easily perform basic motor tasks like getting ready to write letters on a piece of paper. If so, this might free up cognitive resources for learning more complex skills, like reading whole words, and writing.

Overall, findings highlight fine motor competence as a unique skill associated with improved kindergarten entry performance and learning over the year in a variety of academic domains. Increasing children's opportunities for fine motor learning experiences with elements of copying designs may be one direction for curriculum supplements in early childhood.

These results are especially important to consider given the increasing focus in early childhood programming on performance on achievement tests. This study emphasizes the importance fine motor and, specifically, design copying, skills in early school preparation.

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Footnote: ¹ Glass, I. (2012, September 14). Back to school [Audio podcast]. Retrieved from: <http://www.thisamericanlife.org/radio-archives/episode/474/back-to-school>; <http://www.thisamericanlife.org/radio-archives/episode/474/transcript>

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More Information: The HTKS predicts children's school readiness, academic achievement, and classroom behavior across cultures and has been translated into more than ten languages. It is currently available at no cost for use in research. Oregon State University professor Megan McClelland and Dr. Cameron are also working to develop the task for use as a school readiness assessment. For more information on the HTKS, please contact Claire Cameron at cecameron@virginia.edu.