Kindergarten difficulties may predict academic achievement across primary grades

November 19 2018

Credit: CC0 Public Domain

Identifying factors that predict academic difficulties during elementary school should help inform efforts to help children who may be at risk. New Penn State research suggests that children's executive functions

may be a particularly important risk factor for such difficulties.

Preliminary findings from a three-year National Science Foundation-funded project, recently published in *Child Development*, show that executive functions in kindergarten predict children's mathematics, reading and science achievement, as well as their classroom behavior, in second grade. A second study from the project, recently published in Early Childhood Research Quarterly, finds that deficits in executive functions increase the risk for experiencing repeated academic difficulties in mathematics, reading and science from first to third grade. The NSF is also highlighting the findings in their Discovery News.

According to principal investigator Paul Morgan, Harry and Marion Eberly Fellow, professor of education and demography, and director of the Center for Educational Disparities, executive functions (EF) are a set of cognitive processes that facilitate children's abilities to plan, problem-solve, and control impulses. "Our research shows that deficits in EF increase the risk for repeated academic difficulties over time, suggesting these deficits may be an especially promising target of early intervention efforts."

This research is important because few previous studies have examined risk factors for repeated academic difficulties during elementary school.

"Of the few available longitudinal studies, most have focused on identifying risk factors for repeated difficulties in mathematics," said Morgan. "Risk factors for repeated difficulties in reading and science have been less clear, as has which specific types of EF are the strongest risk factors for such difficulties." Also unclear is whether the risks attributable to deficits in EF can be explained by other factors.

For the first study, Morgan and his research team analyzed a nationally representative and longitudinal cohort of about 9,000 kindergarten

children who were followed until the end of second grade.

The investigators found that kindergarten children with better EF displayed greater reading, mathematics and science achievement, as well as fewer externalizing and internalizing problem behaviors by second grade, even after controlling for prior achievement and behavior as well as socio-demographic factors such as gender, age, disability status and family economic status.

In the second study, researchers once again analyzed data from about 11,000 children who were followed from kindergarten to third grade.

"The first study looked at the relation between children's EF and academics and behavior more generally, while the second study focused more on children at risk," Morgan explained. "Specifically, in the second study we examined whether deficits in EF functioned as a type of 'bottleneck' for learning, as suggested by the increased risk for repeated academic difficulties for children with EF deficits and based on these observational data."

Despite controls for prior achievement, including across several domains as well as socio-demographic characteristics, having deficits in EF by kindergarten consistently increased the risk that children will experience repeated academic difficulties across elementary school.

The risks for working-memory deficits, or difficulties using and manipulating new information, were especially strong. The researchers found that the odds that kindergarten children with working-memory deficits experienced repeated academic difficulties were about three to five times greater than children without working-memory deficits, controlling for whether children had other types of deficits in EF, prior achievement and oral language ability, and socio-demographic characteristics, including the family's economic resources.

"Our study also provides suggestive evidence that repeated academic difficulties may be the result of underlying cognitive impairments, not just a lack of basic skills acquisition," said Morgan.

The findings could help inform the design and delivery of experimentally evaluated interventions, particularly for those who are at risk for academic difficulties during elementary school.

"Children who are already experiencing repeated academic difficulties during elementary school are likely to continue to struggle in school as they age. We should be doing all we can to assist these children early on in their school careers," Morgan said.

More information: Paul L. Morgan et al, Executive function deficits in kindergarten predict repeated academic difficulties across elementary school, *Early Childhood Research Quarterly* (2018). DOI: 10.1016/j.ecresq.2018.06.009

Provided by Pennsylvania State University