



Cognitive Skills, Student Achievement Tests, and Schools

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Key Findings

We studied the relationships between schooling, cognitive skills, and academic achievement in eighth-grade students attending public schools in Boston. We examined how schools influenced both test scores, which measure academic knowledge such as vocabulary and arithmetic, and fluid cognitive skills, which include the ability to reason and solve problems in novel situations. We find that:

- Students with high test scores and large improvements in test scores also have high levels of fluid cognitive skills.
- Despite wide variation in test scores across schools, differences in fluid cognitive skills across schools were negligible after controlling for fourth grade test scores.
- Even schools that substantially increase students' academic achievement, as measured by test scores, still have no measurable effect on students' fluid cognitive skills.

Research Questions

We addressed three broad questions:

- Do fluid cognitive skills help explain how students perform on the grade 8 MCAS and how much they improve from grade 4 to grade 8?
- Do schools vary in their effect on fluid cognitive skills?
- Does attending a school that generates achievement gains on the MCAS also lead to similar gains in fluid cognitive skills?

Data

We administered fluid cognitive measures to a sample of 1,367 grade 8 students who attended 32 different traditional, exam, or charter public schools in Boston. Measured fluid cognitive skills included processing speed (how efficiently information can be processed), working memory capacity (how much information can be simultaneously processed and maintained in mind), and fluid reasoning (how well novel problem can be solved). We created a composite measure of general fluid cognitive ability by taking the average of the standardized values on the three measures. Data on test scores came from the students' grade 4 and grade 8 MCAS tests.



Research Methods

First, we estimated bivariate Pearson correlations among achievement scores, achievement gains, and fluid cognitive skills. Second, we conducted an analysis of variance to determine how much variance in these measures occurred within schools versus between schools. Finally, we conducted a quasi-experimental analysis of the effect of attending school for one year at one of five oversubscribed charter schools. Here we used the random offer of enrollment to these schools as an instrumental variable for charter school attendance in a two-stage least squares regression framework. This approach allows us to convincingly argue for a causal analysis of charter school attendance on achievement and fluid cognitive skills, not just a correlation.

Detailed Results

- The correlational analysis revealed significant and positive relationships between grade 8 achievement scores and fluid cognitive skills, with correlations for the composite measure of fluid cognitive skills at 0.57 for mathematics and 0.40 for English language arts.
- Fluid cognitive skills are also correlated with achievement *gains* in mathematics and English language arts, at 0.32 for mathematics and 0.18 for English language arts on the composite measure.
- Which school a student attended explained 24 percent of the variation in grade 8 English language arts scores and 34 percent in mathematics, but less than 3 percent of the variation on the composite measure of fluid cognitive skills.
- For students who attended five oversubscribed charter schools, each additional year of charter attendance was estimated to increase grade 8 mathematics scores by 0.13 standard deviations, with no statistically significant effects for English language arts (although a positive trend).
- Despite the increase in MCAS mathematics scores, we observed virtually no effect of oversubscribed charter school attendance on fluid cognitive skills.
- These findings suggest that schools that improve achievement test scores do so primarily through channels other than fluid cognitive skills.

Implications for Policy and Practice

Some schools raised MCAS test scores without raising the fluid cognitive skills that are usually highly correlated with achievement as measured by test scores. Evidence suggests that the types of skills measured on achievement tests predict greater educational attainment and life success. However, given the value of fluid cognitive skills, schools might do well to focus on those skills as well; such a focus might increase their success in improving student achievement, as well. Some early research shows promise that this may be possible through specialized programs, but no consensus has emerged regarding which programs are consistently effective in raising fluid cognitive skills. At this early stage, schools should focus on experimenting with different approaches to increasing these skills and scaling up programs where successful.