

The Importance of Academic Skills for PreK-3<sup>rd</sup>

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There is little agreement about what skills and behaviors best serve children in the PreKindergarten to Third Grade transition. Asked to identify factors associated with a difficult transition to school, Kindergarten teachers most frequently mentioned difficulty in following directions, working independently and in groups and lack of academic skills (Rimm-Kaufman, Pianta, & Cox, 2000). Supporting the teachers' emphasis on the importance of socioemotional skills is the "Neurons to Neighborhoods" report of the National Research Council and Institute on Medicine, which argued that "the elements of early intervention programs that enhance social and emotional development are just as important as the components that enhance linguistic and cognitive competence" (Shonkoff and Phillips 2000: 398-99).

In contrast, George W. Bush endorsed academic-oriented Head Start reforms in 2002, observing that "[o]n the first day of school, children need to know letters and numbers. They need a strong vocabulary...These are the building blocks of learning, and this nation must provide them."<sup>1</sup> Supporting the Bush position is a report from the National Research Council's Committee on the Prevention of Reading Difficulties in Young Children, which argued for the importance of the acquisition of certain pre-literacy skills before Kindergarten and urged that all children be provided access to early childhood environments that promote language and literacy growth (National Research Council 1998). Similarly, a recent joint position statement of the National Association for the Education of Young Children and the National Council of Teachers of Mathematics encourages high-quality mathematics education for children ages 3-6.<sup>2</sup>

These two views have emerged in the current debate about what constitutes school readiness, particularly what skills predict school achievement. Many early education programs, including Head Start, are designed to enhance children's physical, intellectual, and social competencies on the grounds that each domain contributes to a child's overall developmental competence and readiness for school. However, if early acquisition of specific academic skills or learning-enhancing behaviors forecasts later achievement, it may be beneficial to add domain-

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<sup>1</sup> <http://www.edweek.org/ew/newstory.cfm?slug=30bush.h21>

<sup>2</sup> <http://www.naeyc.org/about/positions/pdf/psmath.pdf>

specific early skills to the definition of school readiness and to encourage interventions aimed at promoting these skills prior to elementary school. Thus, understanding which skills are linked to children's academic achievement has important implications for early education programs.

We review recent evidence on this issue and conclude that PreKindergarten curricula promoting concrete literacy and, especially, numeracy skills are the best bets for boosting children's chances of school success than curricula that focus solely on promoting social and emotional development. Effective programs that address persistent anti-social behavior problems during primary school may also enhance children's life chances.

We are *not* arguing that socioemotional behaviors are inconsequential for a child's healthy development. Quite the contrary: Emotional development is wired into the architecture of young children's brains in ways that are highly interactive with circuits associated with judgment and decision – so-called “executive functions” that underlie problem-solving skills during the PreKindergarten years (Posner and Rothbart, 2000, National Scientific Council on the Developing Child, 2008). And we know that the toxic stress of abusive and neglectful interactions with caregivers can impart lifelong impairments to cognitive functioning (Glaser, 2000).

This brief addresses a much narrower question: For a PreKindergarten choosing between curricula focused on cognitive and academic skills and others focused on mental health and emotional development, which is likely to be better able to promote a child's future school success?

*The evidence.* Some experimental intervention programs have targeted individual problem behaviors such as self-regulation or anti-social behavior. Here the problem is that their evaluations typically assess impacts only on their targeted behavior and fail to relate experimentally induced improvements in behavior to outcomes such as school achievement. One noteworthy exception is the Barnett et al. (2008) test of the “Tools of the Mind” PreKindergarten curriculum, which is designed to promote cognitive self-regulation skills through a comprehensive system of activities. The study's control condition was a school district-developed literacy curriculum. As did Diamond et al. (2007), Barnett et al. (2008) document marked improvements in children's cognitive self-regulation and even bigger reductions in behavior problems. However, Tools children scored significantly better than controls on only one of seven tests of achievement and cognitive ability – hardly proving that boosting attention skills

is a better strategy for improving school success than more direct instructional approaches in PreKindergarten.

Another exception is Dolan et al. (1993), who report results from a behavioral intervention targeted to both aggressive and shy behaviors among First Graders. Their random-assignment evaluation showed short-run impacts on both teacher and peer reports of aggressive and shy behavior, but no crossover impacts on reading achievement. A third is Tremblay et al. (1995), who randomly assigned disruptive Kindergarten boys to a two-year treatment consisting of both school-based social skills training and home-based parent training in effective child rearing. Treatment/control differences in delinquency were evident through age 15, but initially favorable impacts on placement into regular classroom had disappeared by the end of primary school.

What light can nonexperimental studies shed on links between elements of school readiness and later school success? Many longitudinal studies correlate early socioemotional skills with later achievement, but most of them fail to estimate models that control well for family and child background factors and concurrent achievement. So while correlations between, say, school-entry anti-social behavior and later school success are invariably negative, studies rarely ask whether these correlations can be attributed to the fact that children entering school with behavior problems also often lack foundational literacy and numeracy skills as well. Perhaps these academic skills, rather than the anti-social behaviors, are the key determinants of future school success.

*Early skills and later achievement.* The University of Michigan-based Center for the Analysis of Pathways from Childhood to Adulthood provided the infrastructure for a much more comprehensive assessment of the comparative importance of school-entry achievement, attention and behavior problems for later school achievement. Duncan et al. (2007) identified six population-based data sets including measures of reading and math achievement, attention skills, pro-social behavior and anti-social and internalizing behavior problems, taken around the time of school entry, and measures of reading and math achievement taken later in the primary or middle school years. Most of the achievement outcomes came from tests administered between first and eighth grade, although results were similar when we used teacher-reported achievement data. Most of the school-entry reports of socioemotional behaviors were provided by teachers; the rest came from parents. School-entry reading and math skills were measured using tests. One of the

data sets provided a computer-based test of attention skills; the rest relied on teacher and parent reports.

Elementary school reading and mathematics achievement measures were related to Kindergarten-entry measures of reading and math achievement, attention, anti-social behavior and internalizing behavior problems (Duncan et al., 2007). The most complete models controlled for the child's cognitive skills, behavior and temperament measured prior to the point of Kindergarten entry as well as for family background factors.

Average effect sizes from the regressions involving math and reading outcomes are presented in Table 1. The “.09” and “.24” numbers in the first row indicate that – controlling for prior IQ, family background and concurrent attention skills and behaviors – a one-standard-deviation increase in school-entry reading skills is associated with a .09-standard-deviation increase in later math achievement and nearly a quarter-standard-deviation increase in later reading achievement. Both of these estimates of average effects are statistically significant.

A broader look at the results in Table 1 reveals that only three of the six sets of school-entry skill and behavior measures are predictive of subsequent school achievement: reading, math, and attention, with early math skills being consistently most predictive. Behavior problems and social skills were not associated with later achievement in models in which achievement and child and family characteristics were held constant.<sup>2</sup> Indeed, none had a standardized coefficient that averaged more than .01 in absolute value. These patterns generally held both across studies and within each of the six data sets they examined.

Not surprisingly, reading skills were stronger predictors of later reading achievement than of later math achievement. Less expected was that early math skills (adjusting for prior cognitive skills in five of the six studies) were as predictive of later reading achievement as were early reading skills. Children's attention skills appeared to be equally important (and several dimensions of socioemotional behaviors uniformly unimportant) for reading and math achievement.

All in all, the Duncan et al. (2007) analysis provides a clear answer to one question about the relative role of school-entry skills and behavior: For later school *achievement*, early academic skills appear to be the strongest predictor, even after adjusting for differences due to the fact that early achievers score higher on tests of cognitive ability and come from more advantaged families. Early math skills are more consistently predictive of later achievement than early

reading skills. A student's school-entry ability to pay attention and stay on task is modestly predictive of later achievement, while early problem behavior and other dimensions of social skills and mental health problems are not at all predictive.<sup>3</sup> If school readiness is defined as the skills and behaviors that best predict later academic achievement, concrete numeracy and literacy skills are decidedly more important than socioemotional behaviors.

*Early skills, high school completion and college attendance.* It is far from clear whether early academic skills matter as much and early behaviors as little for adolescent and early-adult school attainment as they do for middle-childhood reading and math proficiency. Finishing high school likely requires a combination of achievement, engagement and perseverance. Anti-social behaviors in primary school may lead only to inconsequential trips to the principal's office, while such behaviors in middle or high school may result in suspension, expulsion or even criminal prosecution.

In a second nonexperimental study, Duncan and Magnuson (2009) used two data sets to study links between both school-entry and persistent academic and behavior problems during primary school and high school completion. Prior research has suggested that a student's trajectory of behavior problems may be more important than his or her level of behavior problems at any single age in predicting later educational attainment (Kokko et al., 2006). This may also be true for achievement trajectories.

Duncan and Magnuson (2009) first related high school completion to the same set of school-entry achievement, attention and behavior problems measures used in the Duncan et al. (2007) study. Early math and reading skills had small, positive effects that were at best at the margin of statistical significance. Interestingly, school-entry anti-social behavior also had modest but significant (negative) effects. School-entry attention and internalizing behavior problems were not predictive.

More powerful relationships between some of these skills and behaviors and educational attainment emerged during the school years themselves. In their most revealing analysis, Duncan and Magnuson (2009) tested the impacts of *persistent* academic, attention, and behavior problems on high school completion and college attendance. They formed three groups – *never*, *intermittent* and *persistent* – depending on whether the child never, sometime or always had problems for the three assessment periods taken during elementary school. Table 2 shows

differences in the probabilities of graduating from high school and attending college for children with persistent as opposed to no problems.

Just as in the school-achievement analyses, math achievement emerged as the single most powerful predictor of educational attainment. Children persistently scoring in the bottom end of the math distribution were 13 percentage points less likely to graduate from high school and 29 percentage points less likely to attend college. But while school-entry reports of anti-social behavior problems were not predictive of later school achievement, Table 2 shows that persistent behavior problems were indeed correlated with lower attainment. Surprisingly, persistent early reading problems were *not* predictive, nor were persistent attention problems. A measure of persistent anxiety problems was marginally predictive of college attendance, but this result did not replicate in analyses of the second data set used by Duncan and Magnuson (2009). Patterns were broadly similar for different SES and race groups, although they did differ by gender – anti-social behavior was more predictive of schooling attainment for boys than for girls.

*Summary and implications for early childhood interventions.* Nonexperimental analyses of six data sets suggest that future school achievement is much less a function of a child's school-entry social and emotional development than concrete literacy and numeracy skills like knowing letters, word sounds, numbers and ordinality. Ability to pay attention and engage in school tasks occupies an intermediate position – consistently predicting future achievement, but not as powerfully as early reading and, especially, math skills.

Expanding our conception of school “success” to include not only doing well on achievement tests, but also completing high school and attending college changes the picture somewhat. School-entry achievement and anti-social behaviors were only very modestly predictive of these outcomes. More consequential was whether persistent learning or behavior problems were evident in primary school. Avoiding persistently low achievement mattered the most for positive school attainment, but children with persistent anti-social behavior problems across middle childhood were also at elevated risk of low attainment. Persistent attention and internalizing behavior problems were not predictive of high school completion once family background and concurrent achievement problems were taken into account.

As explained in the introduction, a number of targeted PreKindergarten curricula have successfully boosted early math, literacy, attention and behavior skills. Based on our nonexperimental analyses, the best bets for promoting later school achievement would appear to

be proven PreKindergarten math and literacy curricula, while longer-run educational attainments are most likely to be influenced by curricula or other programs that ensure that children avoid persistent achievement and anti-social behavior problems in primary school.

Policy actions should not be based only on “best bets,” however, but rather on convincing evidence from rigorous evaluations of scalable programs. Here the biggest problem is that evaluations of seemingly successful curriculum intervention programs rarely continue for more than a few months beyond the end of the programs and typically fail to measure outcomes other than those targeted by their intervention. “Cross-over” impacts of, say, improving attention skills on math or reading achievement are rarely estimated. Nor are follow-ups long enough to estimate impacts on general education attainment outcomes such as school dropout or college attendance. Sorely needed are longer-run follow-ups that measure impacts on a diverse set of skills and behaviors, school attainment, and economically significant school outcomes such as special education placement and grade failure.

One of our noteworthy results is that early math skills are the most powerful predictor of later achievement. It is important to discover why. Math is a combination of both conceptual and procedural competencies such as working memory; however, our data do not allow us to examine these competencies separately. Still, our findings provide compelling evidence that future research should be devoted to a close examination of efforts to improve math skills prior to school entry. Random-assignment evaluations of early math programs that focus on the development of particular mathematical skills and track children’s reading and math performance throughout the elementary school years could help to identify missing causal links between early skills and later achievement.

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Table 1: Effect sizes of School-entry Skills and Behaviors on Later Achievement; Meta-analysis of 236 coefficients

School-entry:		Grades 1 to 8:	
		Math achievement	Reading achievement
Reading		.09*	.24*
Math		.41*	.26*
Attention		.10*	.08*
Externalizing (- expected)		.01 ns	.01 ns
Internalizing (- expected)		.01 ns	-.01 ns
Social skills		-.00 ns	-.01 ns

\*  $p < .05$ ;  $n = 236$  estimated coefficients; Source: Duncan et al. (2007)  
 Estimates control for time to test, test/teacher outcome, study fixed effects;  
 coefficients are weighted by inverse of their variances

Table 2: Effect of Persistent vs. No Problems at Ages 6, 8 and 10 on the Probabilities of High School Graduation and College Attendance

Problem area:	HS completion	College attendance
Reading	-.05	-.06
Math	<b>-.13*</b>	<b>-.29**</b>
Anti-social behavior	<b>-.10†</b>	<b>-.24*</b>
Inattention	.01	-.05
Anxiety	-.03	<b>-.18†</b>

\*\* p<.01 \*p<.05 †p<.10; “problem” is defined as being in the worst quartile of distribution at a given age. Both regressions include all listed variables, plus child and family controls. Source: Magnuson et al. (2009).

## Endnotes

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<sup>1</sup> This paper draws extensively from Duncan and Magnuson (2009).

<sup>2</sup> It should be noted that bivariate associations across the studies were as one might expect.

Correlations between later achievement and school entry behaviors were: .21 for social skills, -.14 for externalizing behavior problems and -.10 for internalizing behavior problems.

<sup>3</sup> It is important to note that the Duncan et al. (2007) analysis was of population-based data sets that provided little to no ability to identify children with diagnosed conduct disorder, attention deficit or other behavioral conditions. It is best to think of their analyses as focusing on children with relatively high or low, but not clinical levels of learning, attention and behavior problems.