

Greg Duncan



I spent the first 25 years of my career at the University of Michigan working on and ultimately directing the Panel Study of Income Dynamics (PSID) data collection project. Since 1968, the PSID has collected economic, demographic, health, behavior and attainment data from a representative sample of U.S. individuals and the households in which they reside. With these and other data I have studied the economic mobility of the U.S. population, both within and across generations, with a particular focus on low-income families. More specifically, I have investigated the roles families, peers, neighborhoods and public policy play in affecting the life chances of children and adolescents.

My research has highlighted the importance of early childhood as a sensitive period for the damaging influences of economic deprivation as well as for the beneficial impacts of policy-induced income increases for working families. The focus of my more recent research has shifted from these environmental influences to the comparative importance of the skills and behaviors developed during childhood. In particular, I have sought to understand the relative importance of early academic skills, cognitive and emotional self-regulation, and health in promoting children's eventual success in school and the labor market.

I was elected president of the Population Association of America for 2008 and president of the Society for Research in Child Development for 2009-2011. I was elected to the American Academy of Arts and Sciences in 2001 and to the National Academy of Sciences in 2010. In 2013, I was awarded the Klaus J. Jacobs Research Prize.

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Priorities for Early Childhood Education

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What skills and behaviors matter most for success in school?

How best to structure early education to maximize school readiness?

Skills and Behaviors

Achievement

Engagement

Problem Behaviors

Description:

Concrete math and reading skills

Ability to control impulses and focus on tasks

i) Ability to get along with others

ii) Sound mental health

Example test areas or question wording:

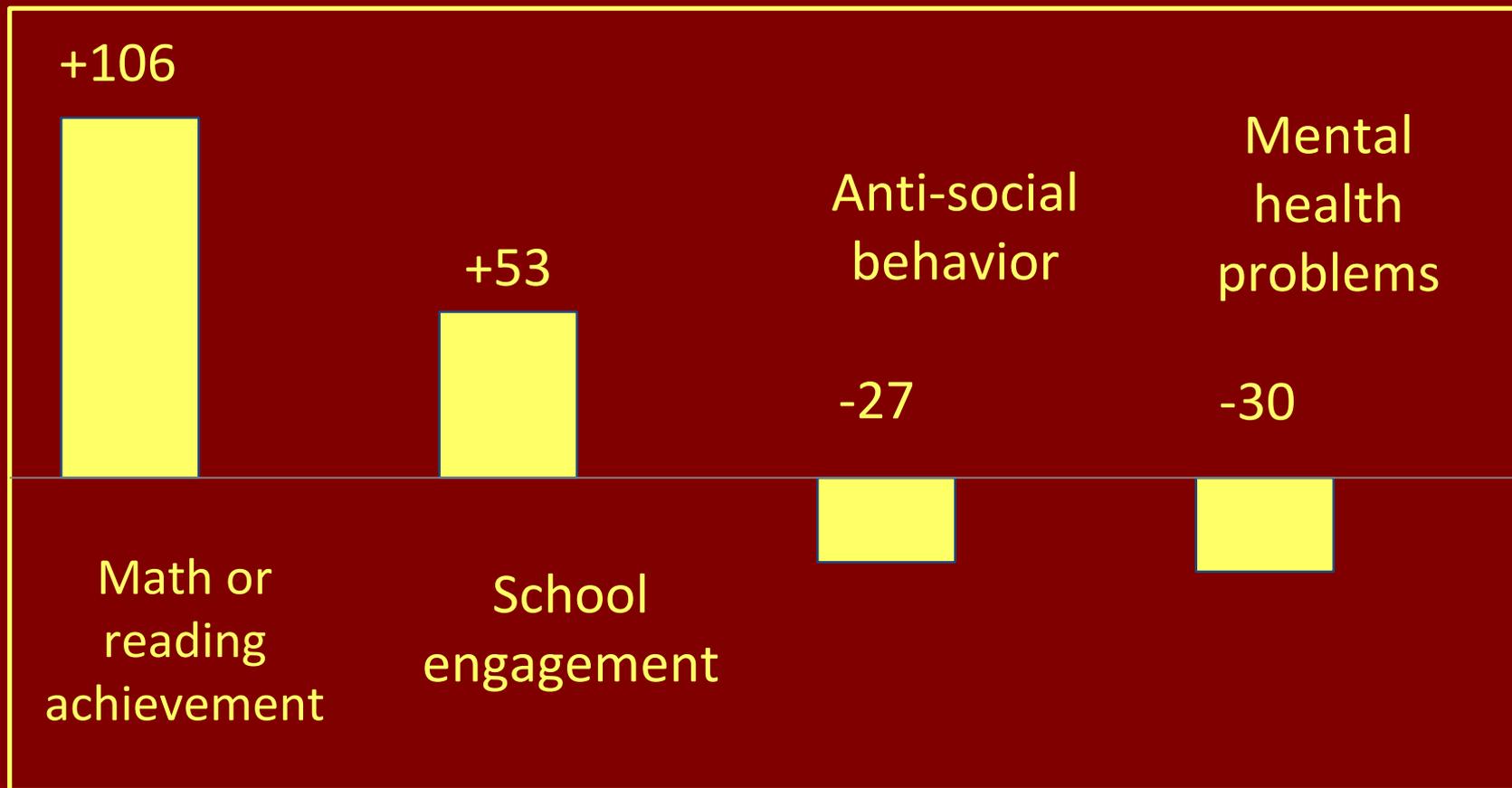
Knowing letters and numbers; beginning word sounds, word problems

Can't sit still; can't concentrate; score from a computer test of impulse control

i) Cheats or tells lies, bullies, is disobedient at school

ii) Is sad, moody

Skill and behavior gaps between high- and low-income kindergarteners

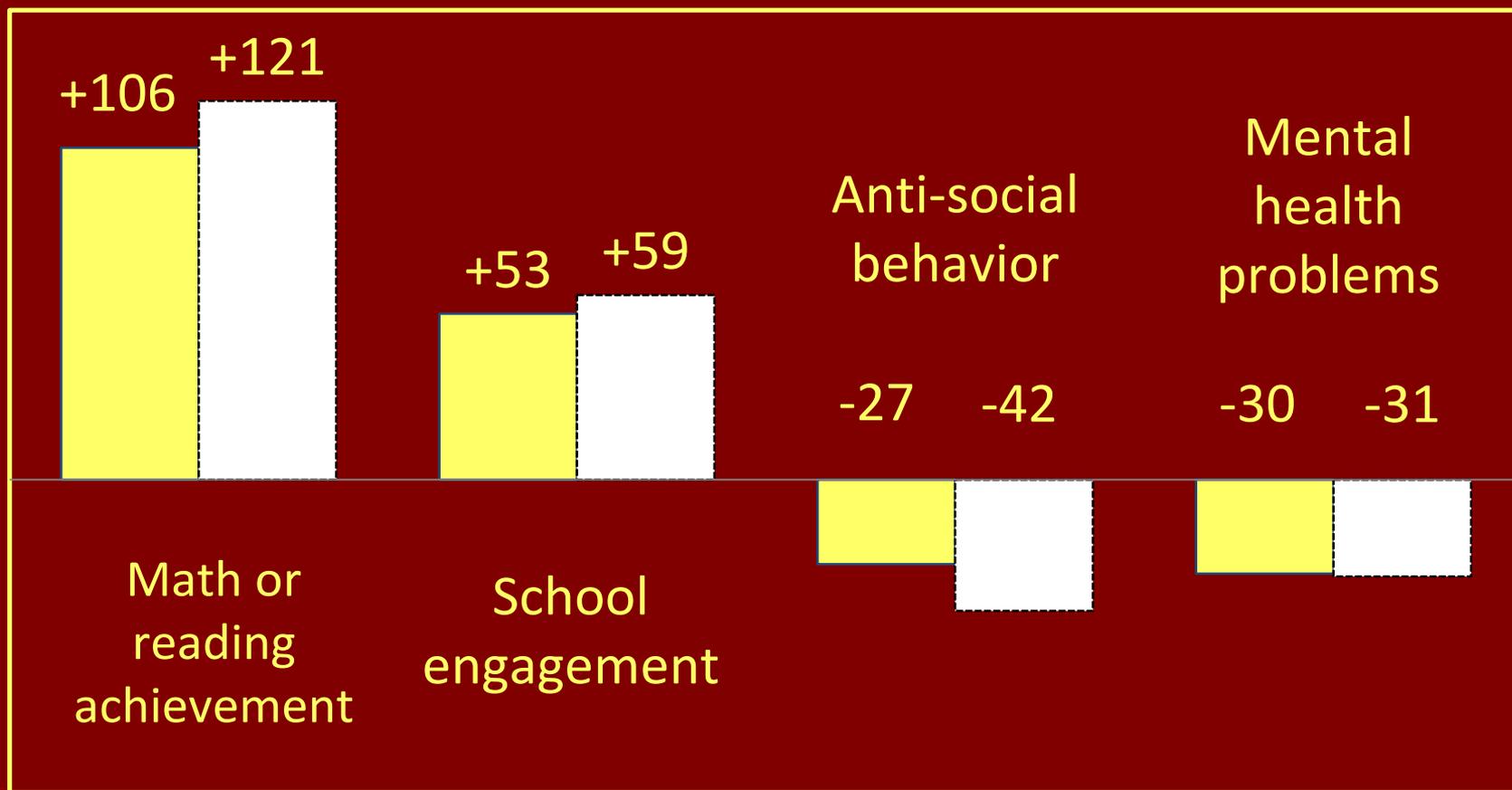


■ Kindergarten gap

■ 5th grade gap

Source: Early Childhood Longitudinal Study – Kindergarten cohort.

Skill and behavior gaps between high- and low-income kindergarteners and fifth graders



■ Kindergarten gap

■ 5th grade gap

Source: Early Childhood Longitudinal Study – Kindergarten cohort.

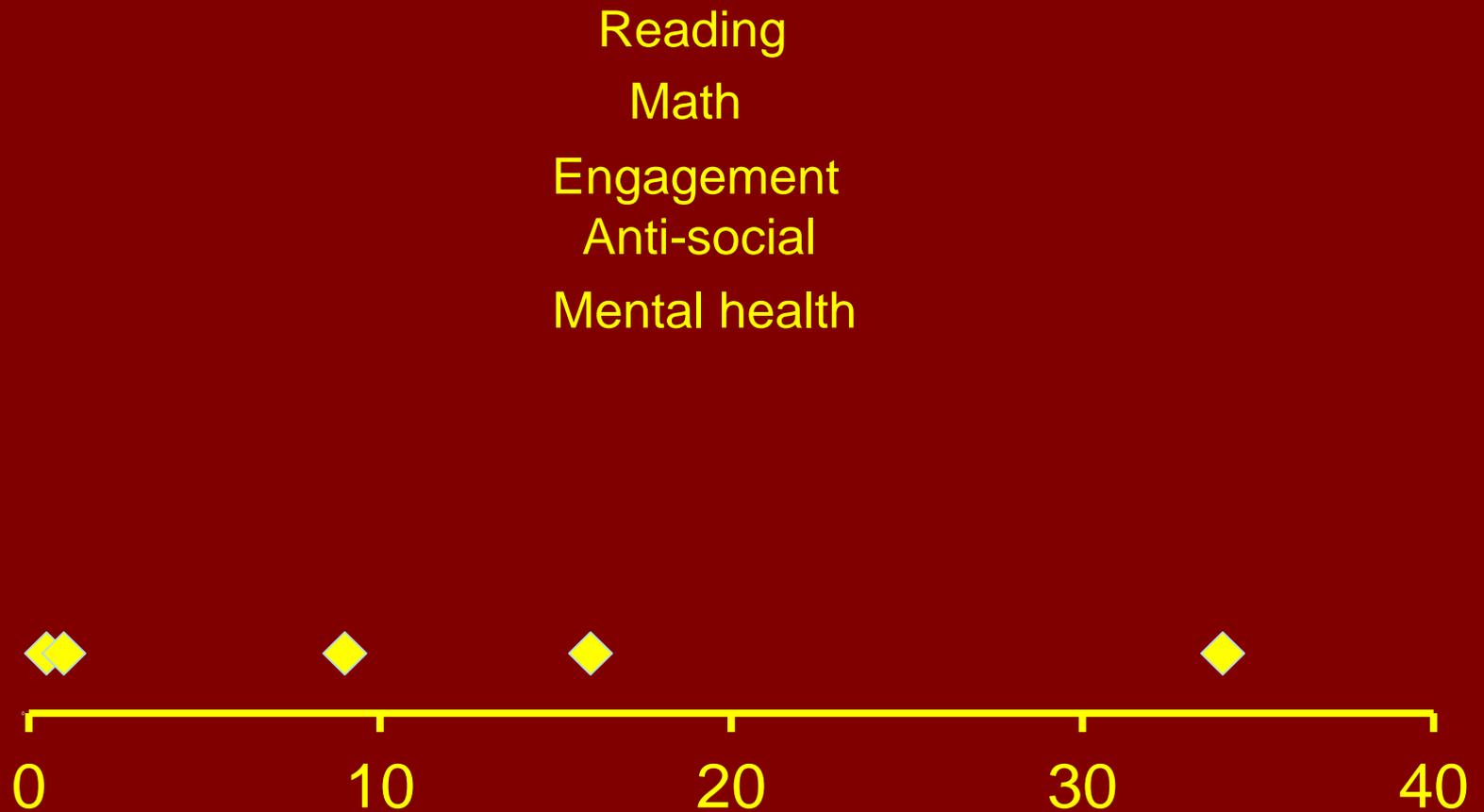


How important are school-entry academic skills and behavior for school achievement?

How important are K-5 academic skills and behavior for completed schooling?

How important are adolescent academic skills and behavior for labor market success?

Effects of school-entry skills and behaviors on later achievement



Effects of school-entry skills and behaviors on later achievement

Mental health

Anti-social

Engagement

Math



0

10

20

30

40



How important are school-entry academic skills and behavior for school achievement?



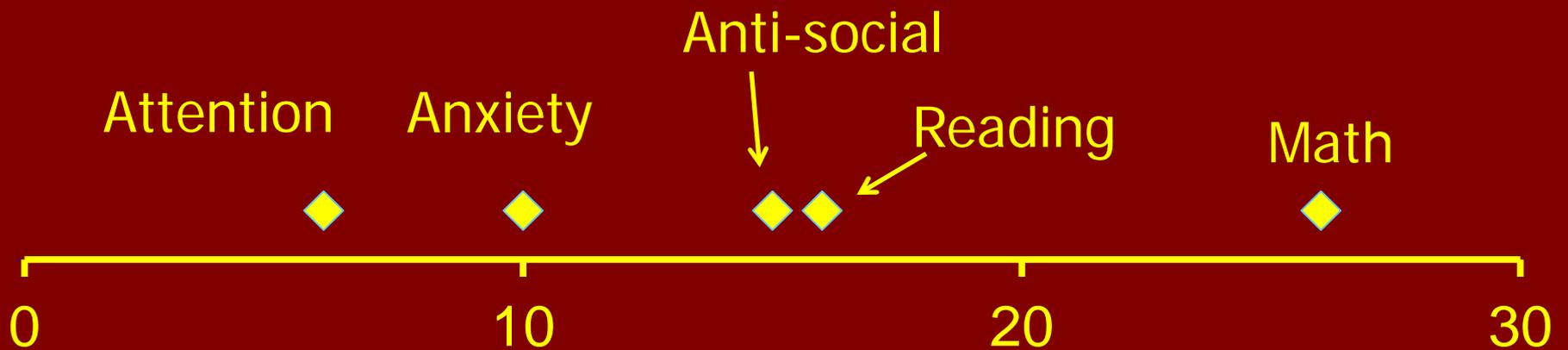
How important are K-5 academic skills and behavior for completed schooling?

How important are adolescent academic skills and behavior for labor market success?

Effects of K-5 skills and behaviors on completed schooling



Effects of K-5 skills and behaviors on completed schooling



How important are school-entry academic skills and behavior for school achievement?

How important are K-5 academic skills and behavior for completed schooling?

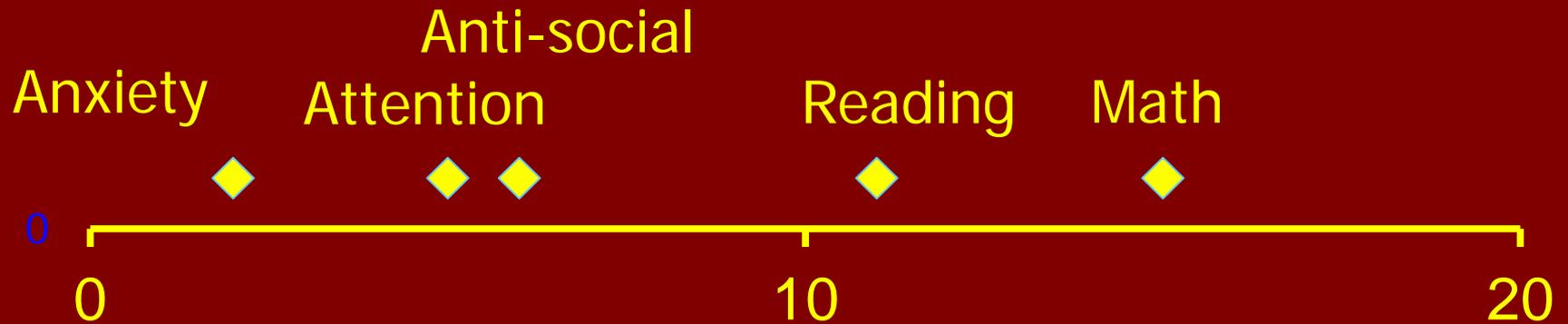


How important are adolescent academic skills and behavior for labor market success?

Effects of adolescent skills and behaviors on earnings



Effects of adolescent skills and behaviors on earnings



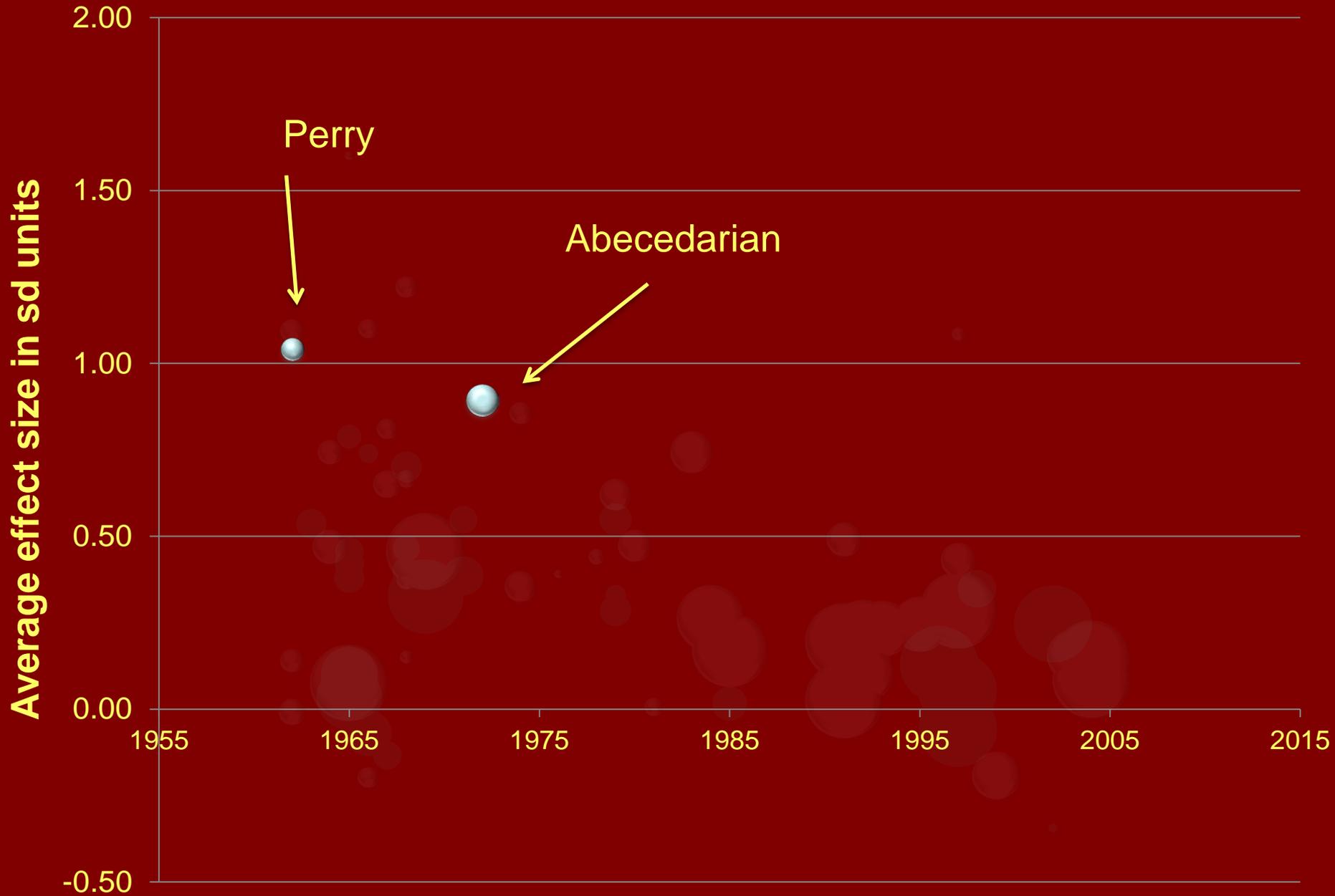
Bottom line

- Early academic skills are vital and we need to promote them in the home and in early education settings

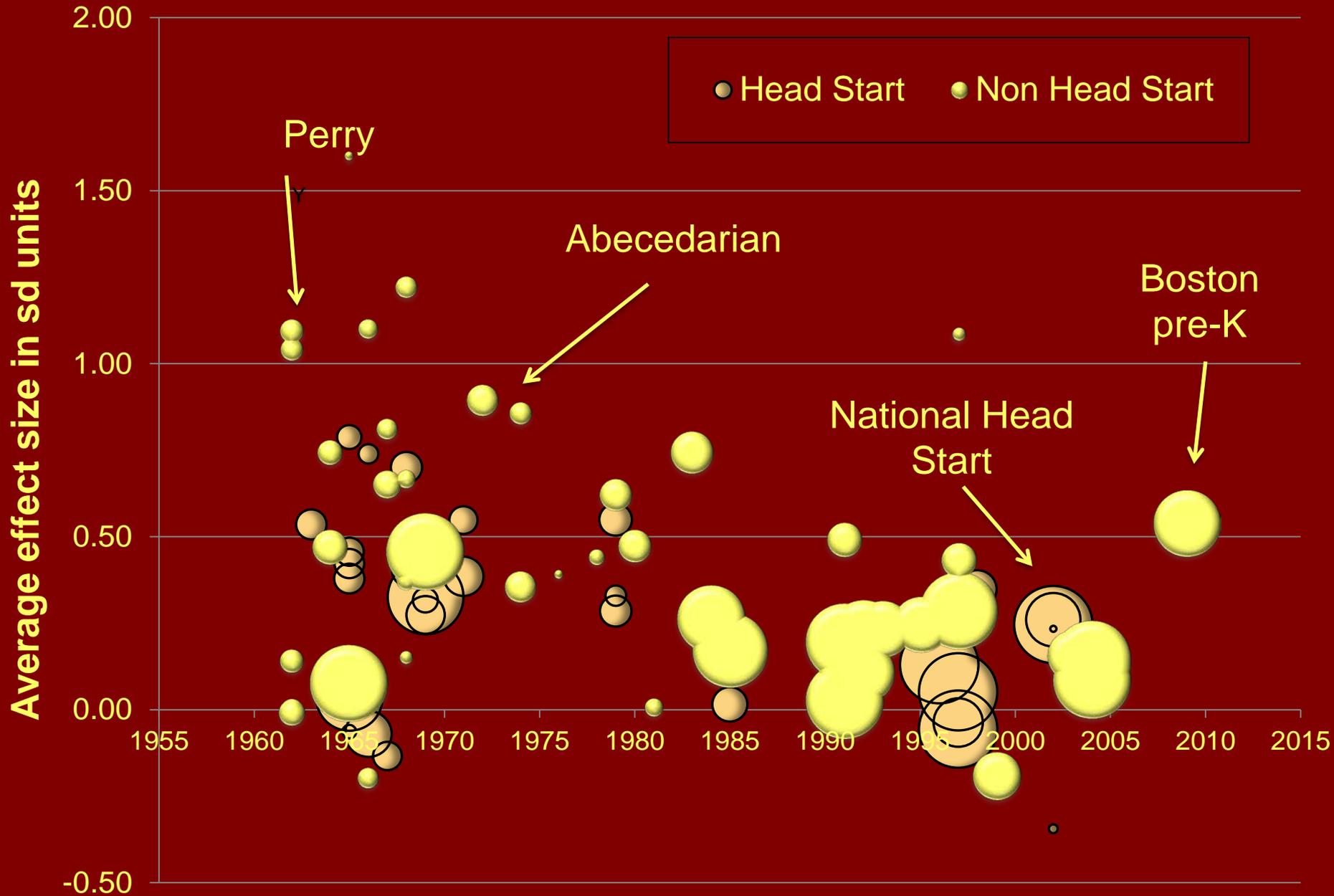
How well do ECE programs promote these skills?

- Evidence from 1960-2007

Average cognitive impact at end of treatment



Average cognitive impact at end of treatment



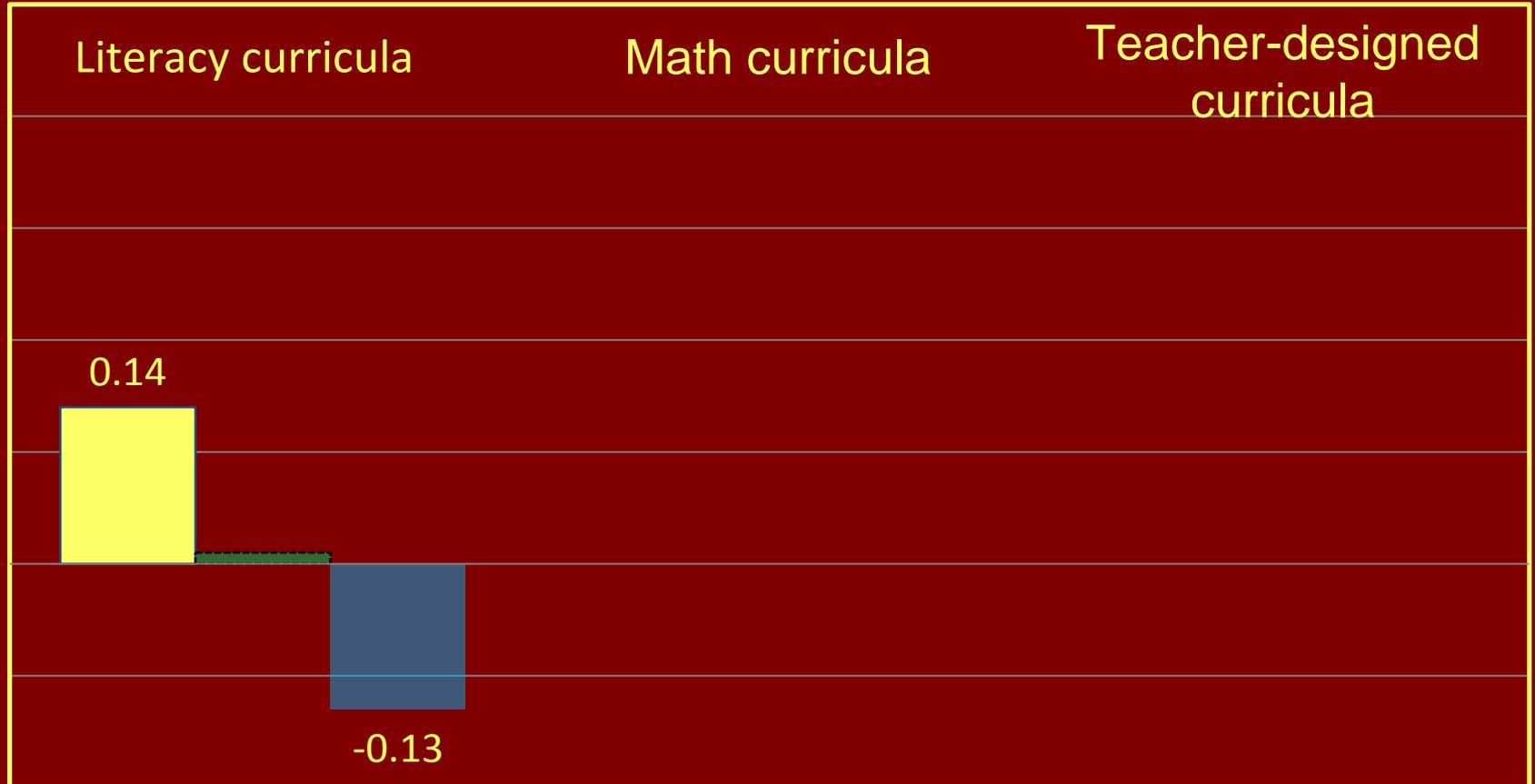
Bottom line

- Perry and Abecedarian are truly exceptional but ECE can make a difference

Does curriculum matter?

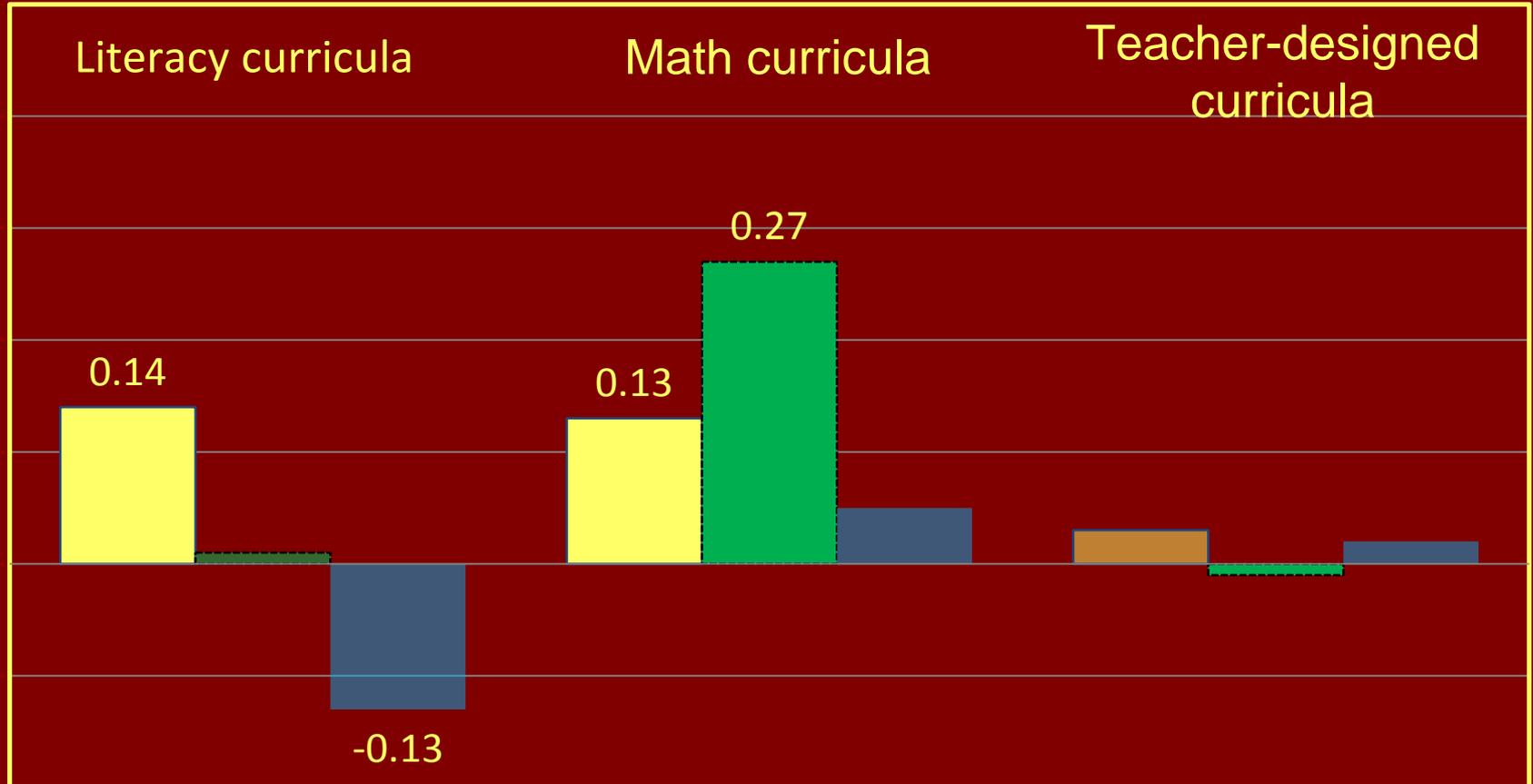
- Most Head Start centers use “global curricula” – Creative Curriculum & High Scope
- Can other curricula do better?
- PCER study comparisons (preliminary)

Impacts of literacy, math and teacher-designed curricula, relative to High Scope/Creative Curriculum



■ Literacy ■ Math ■ Behavior

Impacts of literacy, math and teacher-designed curricula, relative to High Scope/Creative Curriculum



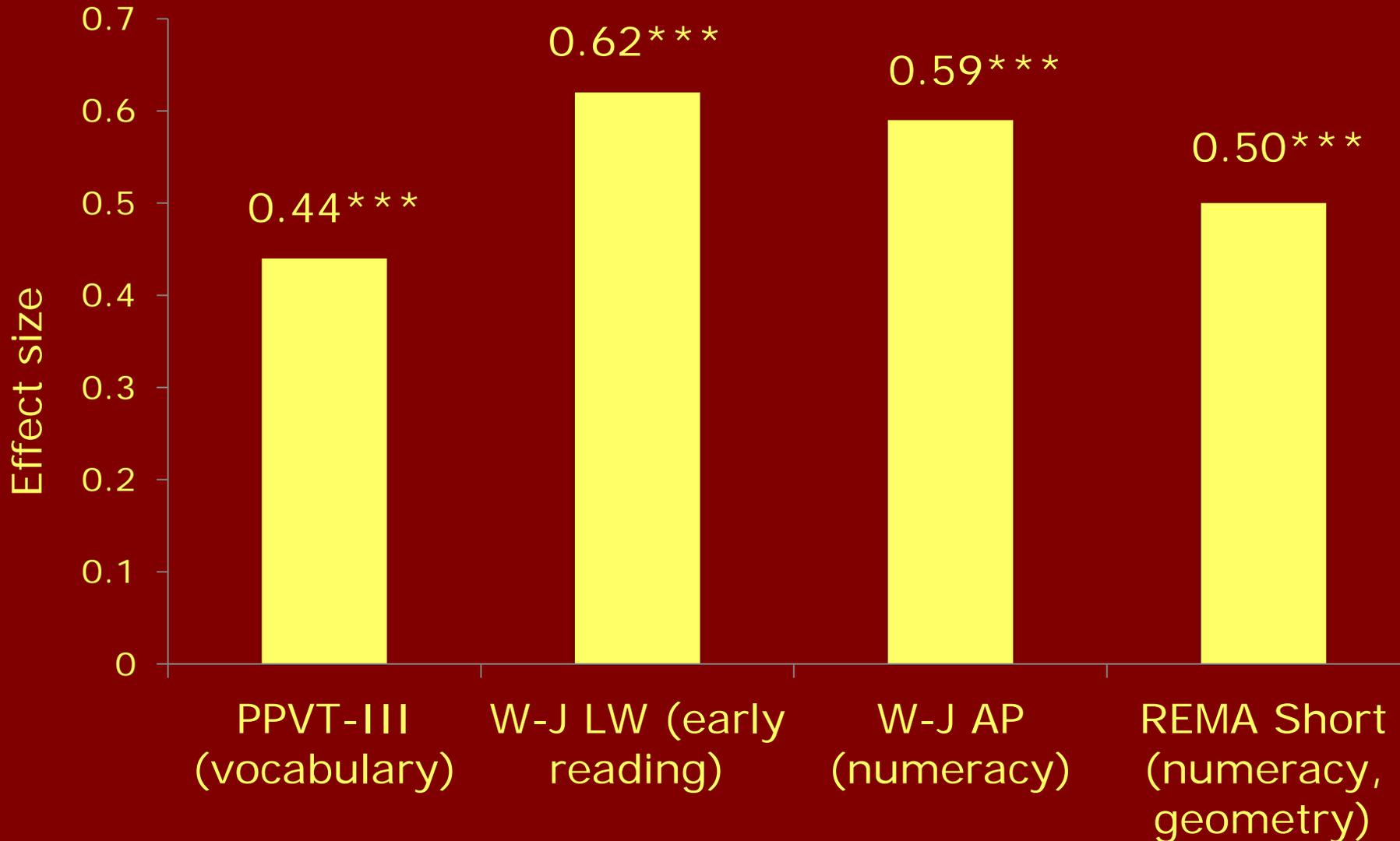
■ Literacy ■ Math ■ Behavior

Boston pre-K as a model?

- Curriculum combined proven math & literacy and behavioral curricula
- Strong professional development, including coaching
- Big impacts, but \$12K per child

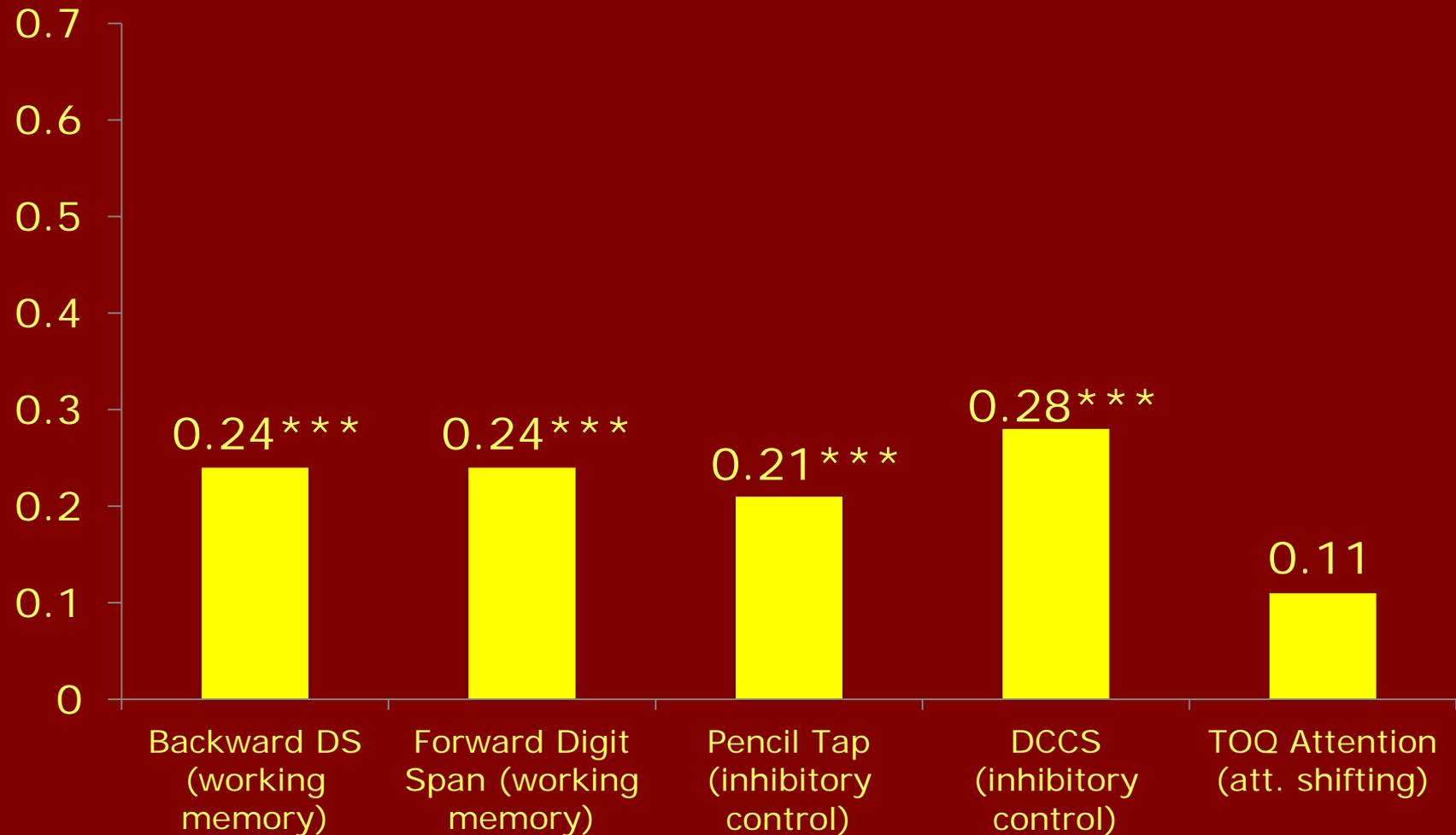
Boston pre-K

Weiland & Yoshikawa, 2013 *Child Development*



Positive “Spillover” Effects on All Three Dimensions of Executive Function Skills

Weiland & Yoshikawa, Nov / Dec 2013 issue, *Child Development*



What does Boston pre-K
look like?

6-minute video from
restoringopportunity.com

RESTORING OPPORTUNITY

The Crisis of Inequality and the
Challenge for American Education



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A revised version of this chapter appears in: Greg J. Duncan and Richard Murnane (2014) *Restoring Opportunity: The Crisis of Inequality and the Challenge for American Education*, Harvard Education Press and Russell Sage Foundation.

A [6-minute video](#) of the Boston pre-K system and transcripts of interviews with people involved in the program can be found on restoringopportunity.com

Chapter 5 Pre-kindergarten Programs that Provide Strong Foundations

It is altogether fitting that we start our exploration of promising education policies at the first free public elementary school in North America—Mather Elementary School in Boston’s Dorchester neighborhood. It’s 10 a.m. on an unseasonably warm day in November. Karla Settles, a young African-American teacher, finishes reading *The Little Red Hen Makes a Pizza* to the twenty-two African-American and Hispanic children sitting on a rug in her classroom. Ms. Settles’s four-year olds comprise one of three pre-kindergarten (pre-K) classes at Mather.

The book introduces the children to new words related to food—mozzarella cheese, mushrooms, anchovies, and even delicatessen. It also describes concepts relevant to mathematical thinking, such as flattening a ball of dough to make a circle and folding it into other shapes. Ms. Settles announces that the class will now be working on activities based on the book. As she calls out letters of the alphabet, the children whose first names begin with each letter move excitedly to the activity area of their choice.

Some children choose a table in the middle of the room, where they use rolling pins to roll out play dough into the shape of the pizza pans. Others choose the cooking corner, where they put plastic versions of vegetables on the pizza dough, as a teacher’s aide asks them to name the vegetables. This helps them place the new vocabulary words in context. Other children move to easels where they use water colors to paint pictures of pizzas loaded with the vegetables they have just learned about. Still others go to the sink at the side of the room to wash the different-shaped pots and pans and pizza-making utensils.

As the children work together at their tasks, Ms. Settles and the teacher’s aide move from group to group, asking questions to help the children understand the steps in the pizza-making process and the meanings of the new words in the story. When children want to move to a different activity center, they are expected to ask the children at that center when they will be finished, which reinforces the communication, self-regulation, and negotiation skills that Ms. Settles has been teaching since the first day of school.

The Little Red Hen Makes a Pizza is one module in a rich curriculum that the Boston Public Schools’ Department of Early Childhood (DEC) expects all pre-K teachers in the district to use. So that they can teach the curriculum effectively, DEC provides manuals detailing the range and sequence of topics to be covered in preparing lessons. DEC also offers extensive coaching to the pre-K teachers, aimed at helping them implement the curriculum well and learn the classroom management skills for keeping groups of four year-olds productively and happily engaged.

As we will explain in greater detail, the Boston Pre-K program is showing success at preparing children for school and reducing skill and behavior gaps between children in middle-

class and low-income families. In this chapter we explore why investments in such programs are critical to improving the life chances of children growing up in low-income families.

THE IMPORTANCE OF EARLY CHILDHOOD INVESTMENTS

Emerging evidence from neuroscience shows that early childhood is a critical period in the development of the brain “architecture” underlying cognitive, social, emotional, and health outcomes.¹ Infants and young children benefit from environments that provide sensitive, responsive caregiving and a variety of language-rich learning opportunities that are tailored to individual children’s capabilities and needs. Research on the malleability (plasticity) of cognitive and language abilities finds these skills to be highly responsive to environmental enrichment during the early childhood period.²

How might early childhood education programs take advantage of these opportunities and what kinds of children stand to benefit the most from them? One compelling view centers on the interactive nature of skill building and investments from families, preschools and schools.³ It posits that children’s skills developed in earlier stages of childhood bolster the development of skills in later stages. Moreover, a productive synergy exists between the skills children bring into an early education setting and how much they profit from it. These two components combine to produce the hypothesis that “skill begets skill.” One implication of this approach is that the children who stand to benefit the most from K-12 schooling are the ones who enter school with a solid set of school readiness skills.

What kinds of skills and behaviors matter the most for school success? Children who enter kindergarten with literacy and numeracy skills, including knowing letters, numbers, shapes and beginning and ending word sounds, are most likely to be successful students.⁴ Also important is a combination of skills involving focusing attention, filtering out distractions, and keeping in mind several pieces of information at the same time. This combination is called “executive functioning” and is viewed as like the job of an air traffic controller.⁵ It, too, is broadly predictive of academic achievement, as learning in classroom environments requires self-regulation and concentration.

The *Little Red Hen Makes a Pizza* module in Ms. Settles’s classroom was designed to promote all of these skills. Reading the story stimulates interest in story books, introduces vocabulary about food, numbers, and shapes, and reinforces the rewards to paying attention. The many follow-on activities enable children to channel their abundant energy to enjoyable tasks that promote creativity, fine motor skills, turn-taking, and— through the continuing interaction with Ms. Settles and the teacher’s aide—comprehension of the vocabulary used in the book. Some educators and parents worry that attempting to build academic skills before kindergarten will mean replacing playtime with flash cards, worksheets, and desk time. Yet in Ms. Settle’s classroom, children are having a lot of fun while learning important skills.

Indeed, all of the pre-kindergarten teachers in Boston integrate playful activities into the school day. Marina Boni, who helps Boston’s pre-K teachers improve their teaching and classroom management, puts it this way: “I’m a huge fan of play,..[of] building joyfulness in a climate for learning. [T]hree, four, five-year-olds – they’ve got to be happy learners. . . .”

Although pre-K programs like the Mather’s are a fairly recent development, early childhood education programs have been around for more than half a century, and rigorous evaluations have shown many of them to be effective. Most of the evidence on the long-run

consequences of enrolling children in early childhood education programs comes from a handful of programs designed and run by child development experts. Most famous are the Perry Preschool Program and the Abecedarian Project, both of which served several dozen young African-American children from low-income families.⁶ While the programs differed in some respects (Abecedarian enrolled younger children and worked with them longer than Perry did), both were designed to develop children's language skills and provide the cognitive and socioemotional skills needed to succeed in school. The programs proved successful in improving the lives of participating children. Perry and Abecedarian children were less likely than similar children who did not participate in these programs to be placed in costly special education classes, and they completed more schooling. Longer-term, Perry also enhanced youths' later employment opportunities and reduced their rates of incarceration.

These findings affirm the predictions of neuroscientists regarding the malleability of brain development during the early childhood years by demonstrating the remarkable potential of preschool programs to improve the life chances of children from low-income families. However, these programs were very small and expensive, and the visionary child development experts who founded them monitored their implementation closely. What are the chances that a large school district like Boston's could afford them and implement them at the level of quality their developers insisted upon?

In assessing the effects of the model programs, it is also important to consider the services available to the comparison group. To identify the benefits of Perry and Abecedarian, researchers compared the outcomes of children who won and lost lotteries for admission.⁷ When these programs began decades ago, parents of comparison-group children faced much more limited child care options than they do today.⁸ Moreover, the education levels of low-income mothers were much lower then than now, so they probably devoted less time to home enrichment activities. If the experiences of the comparison group failed to enhance school-readiness and success, or perhaps even inhibited children's development, then they set a low bar for measuring improvements achieved by Perry and Abecedarian.

A second body of evidence comes from evaluations of Head Start, a national preschool program introduced in 1965 as part of Lyndon Johnson's Great Society initiative.⁹ Today, Head Start provides educational, nutritional, health and social services to more than 900,000 children from low-income families, at an average cost of \$9,000 per child.¹⁰ Head Start centers are run by about 1,600 local agencies, all of which have considerable discretion in the design and operation of their programs. As a result, Head Start services vary widely across sites, as do the length of the program and the educational backgrounds and training of Head Start teachers and aides. Head Start centers can choose their curricula, and most lack the resources to ensure that those curricula are implemented successfully.¹¹

Evidence on the impacts of Head Start programs is less than clear-cut. Children who attended Head Start centers twenty to twenty-five years ago appear to have done considerably better than their siblings who were not part of the program.¹² However, a more recent and rigorous study found only short-term gains from attending Head Start; almost none of the academic and behavioral gains persisted to the end of first grade.¹³ Although Head Start continues to have a strong national constituency, mixed findings on its effectiveness raise the question of whether a more highly structured program implemented by better educated and better trained teachers would yield more favorable results.¹⁴

States and a number of large urban school districts have introduced pre-K programs that are quite different from traditional Head Start programs. Teacher qualification requirements tend to be higher, and there is a stronger emphasis on academic curricula.¹⁵ While costs and quality vary widely across states,¹⁶ a recent evaluation of these kinds of programs in five states found generally positive effects on children's literacy and numeracy skills, although the magnitude of these effects varied.¹⁷ Another study of a high-quality, full-day pre-K program in Tulsa found quite large positive effects.¹⁸ The program was offered to children from both low- and higher-income families. Although this increased costs, it also increased support for the program. Moreover, developers believe that this mix of children from different backgrounds contributed to the program's success because low-income children were exposed to children with larger vocabularies and other advantages of growing up in more affluent homes.

PRESCHOOL EDUCATION IN THE BOSTON PUBLIC SCHOOLS

The Boston Public Schools (BPS) face the same challenges as other urban districts in the United States. Three-quarters of the 57,000 students attending the district's public schools come from low-income families. Nearly half speak a first language other than English. As four-year-olds, the children from low-income families have academic skills that lag far behind those of the relatively few children from more affluent families who attend BPS schools.¹⁹ These factors pose significant handicaps as low-income children seek to meet academic standards and pass the high school exit examinations that are required for graduation in Massachusetts. The achievement gaps present at age four go a long way in explaining why the on-time high school graduation rate of BPS students from low-income families is nine percentage points lower than that of non-poor BPS students.²⁰

As part of its strategy to close achievement gaps, Boston began to provide full-day pre-K education programs for four-year-olds with special needs and a modest number of other four-year-olds who won places through a lottery. In the 2004–2005 school year, BPS had 38 classrooms serving 750 four-year-olds. At the urging of Mayor Thomas Menino, BPS almost doubled the number of pre-K classes in the 2005–2006 school year, enabling it to serve approximately one-quarter of the four-year-olds whose parents applied for admission. As is common in districts that dramatically increase the supply of preschool education, BPS had difficulty finding enough suitable classrooms and trained teachers.

Aware of the need for leadership of its preschool program, Superintendent Thomas Payzant recruited Dr. Jason Sachs to head a newly-formed Department of Early Childhood. With a background in research and evaluation and several years of experience in coordinating preschool programs for the Massachusetts State Department of Education, Sachs recognized the importance of program quality. This led him to commission an independent research group, the Wellesley Centers for Women, to conduct an assessment of the quality of Boston's existing pre-K program. The report, delivered in August 2006, was sobering. As summarized in the Boston Globe:

*Boston's public preschool and kindergarten programs are hobbled by mediocre instruction, unsanitary classrooms, and dangerous schoolyards, according to a first-ever study of the programs... Three-quarters of teachers reported that they lacked classroom materials, including books. In many classrooms, children spent a lot of their day sitting at desks while teachers lectured, a style frowned upon in early childhood education. As a result, half of the teachers missed signs that children were struggling, the study found.*²¹

According to Sachs, the Boston Globe article could have cost him his job. It did not, he believes, because the district's interim superintendent, Michael Contompasis, explained to the school committee and city council that evidence on quality was a precondition for improving quality. Sachs was able to make the case to the BPS leadership and to outside funders that instead of greatly expanding the number of pre-K classrooms, the district should slow the rate of expansion and devote significant resources to improving program quality. Only by doing so, he argued, could pre-K education in Boston contribute meaningfully to closing achievement gaps.

During the next four years, Sachs and his colleagues in the Department of Early Childhood led the effort to improve pre-K education in Boston by providing teachers and principals with the kinds of educational supports we described in Chapter 4. A critical first step was to choose strong curricula for use in all BPS pre-K classrooms. Only by mandating common curricula could DEC provide the instructional materials, scope and sequencing manuals, and most important, the coaching and professional development teachers would need to provide a consistently high-quality preschool experience for Boston four-year-olds. Moreover, research indicated that consistent implementation of strong reading and mathematics curricula could create positive "spillover" effects on children's emotional development and executive functioning skills. In Sachs' words, "A strong, engaging [academic] curriculum is a compelling way to deal with many social and emotional issues, in part, because the kids are really learning and are deeply engaged in their work. ...Early childhood classrooms are designed to create social interactions and negotiations and to help children make appropriate choices."²²

After examining curricula already in use in BPS Early Childhood Learning Centers and assessing the evidence on their efficacy, Sachs and his colleagues chose the Opening the World of Learning (OWL) literacy curriculum and the Building Blocks mathematics curriculum. The OWL focuses on developing children's early language and literacy skills and includes a social skills component within each study unit. The Building Blocks curriculum develops children's knowledge of simple arithmetic, geometry, measurement, and spatial relationships. The pedagogical approach expands children's language skills by asking them to explain their mathematical reasoning. Strengths of both curricula include a focus on concept development, the use of multiple methods and materials to promote children's learning, and a variety of activities to encourage analysis, reasoning, and problem-solving.²³ Both curricula specify that children should spend considerable time at activity centers, like those in Ms. Settles's classroom, playing in groups at activities designed to teach critical skills. The DEC team further enriched the curriculum by adding a "Building Communities" component aimed at teaching children the negotiation skills essential for constructive play and learning.

Recognizing that implementing these curricula well would pose a substantial challenge for most BPS pre-K teachers and require significant preparation for each lesson, DEC embarked on a multiyear strategy to increase the quality and consistency of instruction in pre-K classrooms. A first step was to provide teachers with manuals on how to prepare for and teach each of the many daily lessons in the curriculum. The manuals, which teachers could access online, described the goals of each lesson, provided a list of needed materials, offered guidelines about sequencing large- and small-group components, included a list of activities for small-group time, and offered suggestions for engaging children in thought processes that would increase their vocabulary and conceptual knowledge. For example, the scope and sequencing manual indicated that teachers should introduce *The Little Red Hen makes a Pizza* in early November. It also specified the materials that should be present at the art table, the sand and water tables, and

other centers, and it provided the activities that the teacher and her aide should offer at each center.

Each pre-K teacher received the educational supports she needed to implement the curriculum fully. This meant working with the facilities department to place a sink with running water in each pre-K classroom and to provide carpeting for the blocks corner to muffle the noise of falling structures. Sachs and his colleagues also provided all teachers with kits containing all of the materials they needed to carry out the full set of activities prescribed for each lesson. For example, the kit contained the play dough and plastic replicas of vegetables needed for the pizza-making activities. Without these materials, some teachers would skip the small-group play that the Early Childhood group recognized as critical to children's learning.

A third element of the quality improvement strategy was to provide the staffing necessary to implement the curriculum appropriately. This required building understanding and trust with principals, some of whom were inclined to assign their weakest teachers to pre-K classes. Over time, Sachs countered this tendency through a variety of actions. He organized and led professional development for school principals, explaining why the early childhood period is so important and what good teacher practice in early childhood classrooms looks like. He presented evidence that children who experienced a strong pre-K program fared better in the primary grades than those who had either no pre-K or a poor pre-K experience. Sachs also recruited a former BPS principal, Ben Russell, which increased the credibility of DEC with principals and encouraged those with pre-K teaching vacancies to call the office for recommendations about promising candidates.

Also key was a full-time paraprofessional in each pre-K classroom to assist a licensed teacher. Without the paraprofessional, Sachs explained, teachers would be distracted by bathroom breaks and other interruptions and unable to teach the rich, time-intensive curriculum fully. Moreover, the paraprofessionals could improve the quality of children's learning experience by engaging children in vocabulary-rich conversations at one activity center while the teacher was doing the same thing with children at another center.

A fourth element of the improvement strategy was intense coaching and professional development aimed at providing all pre-K teachers and aides with the skills and knowledge to implement the demanding curricula. Part of the challenge was to convince teachers and aides that four-year-olds learn by doing, not by listening to teachers talk. Classroom management skills were also critical if children were to thrive in a cooperative learning setting. Yet another concern was to help teachers assess children's mastery of the skills and knowledge that provided the focus for the day's activities.

To achieve these objectives, DEC provided each pre-K teacher with professional development, including training over the summer in how to use the curricular materials. During the school year, the teachers spent several hours per month working with coaches to ensure that they were implementing the curriculum properly. The training was provided by a team of well educated, experienced, ethnically diverse coaches, some of whom had worked for BPS and some for community-based pre-K programs. Having a mix of backgrounds on the coaching team was important in providing each teacher with the specific help she needed, as revealed by the Wellesley Center's classroom evaluations.

Marina Boni is one of those coaches. It is quickly apparent that she gives careful thought to the structure of teaching and student activities. During our visit to Ms. Settles's classroom, the

class seemed very engaged with the story of *The Little Red Hen Makes a Pizza*. Little did we know that it was part of an elaborate plan, which is clear from Boni's description of what she looks for when she visits classrooms:

When I observe story time in a classroom, I should be able to tell whether it's the first, the second, or third, or a fourth read. During the first read the teacher is reading the book without interruptions, trying to give the children a full sense of the story and emphasizing specific vocabulary [words] that are key in order for the children to grasp the content of the story. For example, 'delicatessen' ...[is] a very unusual, complex word that the kids may not be . . . familiar with yet. The teachers might say something like, 'She went to a delicatessen. A delicatessen is a special kind of store where they sell foods like special cheeses and meats and it's not like a supermarket. It's usually a small store.'

During the second read the teachers help the children recollect the story by engaging them in telling what they remember is happening or what might be happening next.

During the third reading, the children are chiming in-- you would imagine they are pretty familiar with the pattern of the book so they are able to read along with the teacher

The fourth read is an opportunity for reenacting the story. [The Little Red Hen Makes a Pizza] is a perfect example because there are distinct characters, the text is pretty repetitive, and the kids love to play the parts while the teacher is reading or retelling the story. Some teachers seize this opportunity and make costumes with the children and design the set. [It] can be a really engaging experience for the children.

When we asked Boni how the teachers learn to teach the very detailed curriculum, she explained that the key to success was to tailor coaching to individual needs, since teachers had different experience and teaching styles. For some teachers, it took time to become comfortable sitting at eye level with the children and reading stories in an expressive manner that engaged children's attention. Others needed to learn to give the children the freedom to choose activities, and to encourage them to try new things. Still others had difficulty managing transitions, especially cleaning up. As Marina explained:

You have 22 kids, and seven or eight areas are open, blocks are everywhere, paints are everywhere. . . . How am I going to get [the kids] to clean up? Teachers really worry about the possibility that the children will not clean up but the idea would be to teach the children strategies that help them remember what they are supposed to do. You might be giving the kids cues or warnings, which let them know that it's about time to clean up.

I want to help teachers to think more intentionally about how the areas/centers are set up so that the children are using the materials more purposefully rather than making gigantic messes because they don't know what to do with blocks or paint.

Another element of the quality improvement strategy was ongoing, independent assessment of instruction and of children's skills. Sachs contracted with the Wellesley Centers for Women for biennial evaluations of the pre-K system. He also provided the pre-K teachers with the results of the classroom evaluations. The underlying principle was that in order to improve their instruction, teachers needed to understand what they were and were not doing well. The data from the evaluations also showed what district-level changes were needed, such as providing time for the early childhood teachers to collaborate on developing instructional plans. Beginning in 2008, Sachs also began measuring children's vocabulary and language skills in a

variety of ways. The DEC team needed regular updates on children's skills to know whether their efforts were achieving success.

A final, ongoing step in the effort to improve quality has been to seek accreditation from the National Association for the Education of Young Children (NAEYC). The NAEYC standards describe best practices for promoting children's intellectual growth and healthy development. The three-year accreditation process begins with a self-assessment aimed at identifying gaps between the school's current pre-K program and NAEYC benchmark standards. Action is then taken to correct deficiencies and improve the program until it meets the NAEYC standards. The accreditation process is expensive—\$80,900 per school, or roughly \$5,000 per classroom per year. However, Sachs believed it is worth the money because it provides a structured process for improvement, not only for pre-K classrooms, but also for kindergarten classrooms.

The value of the NAEYC accreditation process is borne out by evaluation data, which show that both the quality of the classroom learning environment and student outcomes improved in the schools that sought NAEYC accreditation. Sachs has been able to secure a grant from a local foundation to assist the growing number of BPS schools that request permission to go through the process. As of December 2011, BPS schools providing more than half of all early childhood classrooms have either received NAEYC accreditation for their pre-K programs or are currently working to achieve it.

THE EVALUATION EVIDENCE

Evidence shows that the BPS pre-K program has been successful. In 2006, 2008, and 2010, the Wellesley Centers for Women research team observed almost 100 pre-K and kindergarten classrooms for three to four hours each, using established assessment tools to rate the quality of the environment, the curriculum, and instructional practices in the classes. In sharp contrast to 2006, almost two-thirds of BPS pre-K classrooms in 2010 met the "good" benchmark for environment, which means that they provided several well-resourced learning centers and opportunities for children to exercise choice and initiative. The research team also found that in more than one-half of BPS pre-K classrooms,

*[T]eachers supported children's oral language development, incorporated shared book reading and discussion of books daily, as well as provided informal opportunities for children to explore, read and hear books throughout the classroom and throughout the day. In these classrooms, teachers were regularly available to support and encourage all children's writing efforts, including dictation, writing group stories, and children's real and pretend writing.*²⁴

Of course, the critical question is whether four-year-olds enrolled in the BPS pre-K program are acquiring important skills and knowledge at a more rapid rate than they would have without the program. This question is particularly important in a period of tight school district budgets, given that the average annual cost of the Boston pre-K program is about \$12,000 per student, with much of the cost stemming from staffing each pre-K classroom with both a teacher and an aide, both paid according to the BPS salary schedule. The results show that the program is indeed making a difference. Children who had participated in the BPS pre-K program scored higher on the state language arts test in Grade 3 than nonparticipants. Furthermore, the black-white achievement gap was one-third smaller among pre-K participants than among nonparticipants.²⁵

Even more telling is an impact evaluation conducted by two Harvard researchers, Christina Weiland and Hiro Yoshikawa.²⁶ They found that the mathematics, literacy, and language skills of children who participated in the pre-K program were considerably more advanced than those of similarly-aged children who spent the year in other child care settings.²⁷ Moreover, the evaluation also found improvements in executive functioning.²⁸ All in all, the size of the pre-K impacts was sufficient to close more than half of the gap at kindergarten entry between the academic skills of children from low-income families and those from relatively affluent ones.

ONGOING CHALLENGES

In recent years, the Boston Public Schools have made significant progress toward the goal of a universally available, consistently high quality pre-K program. Yet many challenges remain. One is the prosaic, but often difficult problem of space. Pre-K classrooms need to be near bathrooms. They need running water. In addition, there should be at least two pre-K classrooms in any given school so each pre-K teacher has a colleague. Finding space to meet these requirements in Boston's many old elementary school buildings has been difficult.

Another challenge has been finding an adequate supply of teachers who understand how young children learn and who can quickly develop the skills needed to implement the curriculum. Sachs and his colleagues have found that effective teachers use a number of different approaches to promote children's learning, including developing concepts, connecting them to the real world, and encouraging children to experiment, brainstorm, and make predictions.

Coaching and ongoing professional development have helped many teachers master these complex teaching tasks, but implementation quality still varies across classrooms. It has not been easy to find excellent coaches like Marina Boni. As Sachs said, "I just don't know how to scale strong, diverse, inspiring coaches." DEC staff are trying to solve this problem by using technology to provide teachers with easy-to-access videos illustrating how to teach particular lessons effectively.

A final challenge has been to meet the logistical needs of parents' work schedules. Moving from a half-day to a full 9 a.m. to 3 p.m. schedule made the pre-K program attractive to many parents, but others have jobs that require before- or after-school care. Since most schools have been unable to extend the school day, many of these parents have not been able to enroll their children in the BPS pre-K program.

THE BIG PICTURE

As we documented in Chapter 3, large gaps between the academic skills of children from low- and higher-income families are present at the beginning of kindergarten. These gaps persist through elementary school and high school, undermining poor children's ability to succeed in school. And success in school is essential for escaping poverty as an adult.

One reason that these skill gaps are present at school entry is that enrollment in preschool programs remains highly unequal. For more than 40 years, enrollment rates in centers that provide some kind of developmental or educational focus have been 10 to 20 percentage points lower for children from families in the bottom half of the income distribution than for those whose families are in the top quarter.²⁹

Spurred by discoveries from neuroscientists about the importance of early childhood education, as well as evidence from small-scale programs such as Perry Preschool and the Abecedarian Program, a growing number of states have sought to improve access to early learning among low-income children by introducing public pre-kindergarten programs. As of 2011, 39 states funded preschool programs that collectively serve 28 percent of the nation's four-year-olds, up from 14 percent in 2002.³⁰ Quality has also improved over the last decade. In 2011, public pre-K programs in 20 states met at least 8 of 10 quality benchmarks.³¹

The Boston pre-K program shows that it is possible to develop and sustain a high quality public pre-K program in a large urban school district, and that providing a rich, research-based curricula and in coaching and professional development can help to close a substantial portion of the gap between poor and non-poor children in school readiness.

It's important to acknowledge a few caveats, however. One question is whether districts that are unable to muster the same kinds of resources will be able to replicate the impacts from the well-designed and well-run Boston pre-K program. Boston's program provides more in-depth training for its teachers than many other pre-K programs, costs considerably more, and devotes considerably more resources to the quality implementation of its proven literacy and math curricula. So it is not surprising that its impacts are somewhat larger than those found in evaluations of pre-K programs in other states.³²

Another key policy question is whether publicly-funded pre-K programs – whether they be Boston's top-of-the-line model or the less expensive versions implemented in most states –are worthy social investments in the sense of generating more benefits than costs. At this time, pre-K programs simply have not been around long enough to be able to determine long-term benefits. That said, the impressive evidence from Boston demonstrates that well designed and well implemented pre-K programs have the potential to be a vital component of a strategy to improve the life chances of children from low-income families.

From a policy perspective, it is especially important to note that the programs with the strongest evidence of impacts—Boston and Tulsa—are open to children from all backgrounds, irrespective of family income. This may have increased the quality of these two programs and boosted the school readiness for economically disadvantaged children more than is the case with income-based programs—even though this strategy may also increase costs. Universal access also expands the constituency for pre-K programs, which may provide a base of political and financial support. Given the difficult funding situation most urban school districts currently face, one policy worth considering is to establish a sliding scale of fees for universal pre-K programs, with very low fees for low-income families and higher fees for families with more income.

Developing a high-quality preschool program in Boston has required considerable resources and time and a relentless focus on quality improvement. As in other promising interventions featured in this book, the program involves a carefully planned system of supports combined with accountability. Key supports include a high quality curriculum, sufficiently high salaries to attract and retain well-educated teachers, extensive professional development and coaching, and the physical facilities and materials needed to engage children in the many learning activities that are part of the curriculum. Accountability for teachers was apparent in the periodic observation, evaluation and coaching from principals and coaches, from the classroom component of the biennial evaluations conducted by the Wellesley Center for Women and from Jason Sach's goal of securing NAEYC accreditation for all of the classrooms.

Evaluation evidence from the Boston program supports the conclusion that providing low-income children with this kind of pre-kindergarten experience will allow them enter kindergarten much better prepared to take advantage of what schools have to offer – potentially enabling schools to make a much bigger difference in setting these students up for success. The next challenge is to create elementary schools and high schools that can build on this foundation – and, even more difficult, meet the needs of children who have entered school at a disadvantage.

ENDNOTES

¹ Eric I. Knudsen and others, "Economic, Neurobiological, and Behavioral Perspectives on Building America's Future Workforce," *Proceedings of the National Academy of Sciences of the United States of America* 103 (2006): 10155-62.; Jack Shonkoff and Deborah Phillips, eds., *from Neurons to Neighborhoods: The Science of Early Childhood Development* (Washington, D.C.: National Academy Press, 2000).

² Charles Nelson and Margaret Sheridan (2011). Lessons from neuroscience research for understanding causal links between family and neighborhood characteristics and educational outcomes. Pp. 27-46 in G. Duncan and R. Murnane (eds.), *Whither Opportunity: Rising Inequality, Schools, and Children's Life Chances*, New York: Russell Sage.

³ Flavio Cunha and James J. Heckman. 2007. "The Technology of Skill Formation." *American Economic Review* 97 (2): 31-47.

⁴ Greg Duncan and others, "School Readiness and Later Achievement," *Developmental Psychology* 43, no. 8 (2007): 1428-46.

⁵ National Scientific Council on the Developing Child, "Building the Brain's "Air Traffic Control" System: How Early Experiences Shape the Development of Executive Function" (working paper no. 11, Center on the Developing Child, Harvard University, Cambridge MA, 2012),

http://developingchild.harvard.edu/index.php/resources/reports_and_working_papers/working_papers/wp11/.

⁶ See Lawrence J. Schweinhart and others, *Lifetime Effects: The High/Scope Perry Preschool Study through Age 40* (Ypsilanti, MI: High/Scope Press, 2005); James Heckman and others, "the Rate of Return to the High Scope/Perry Preschool Program" (working paper no. 15471, National Bureau of Economic Research, Cambridge, MA, 2009).; F. Ramey Campbell and others, "Early Childhood Education: Young Adult Outcomes from the Abecedarian Project" *Applied Developmental Science* 6, no. 1 (2002): 42-57.

⁷ Very few child care centers would have existed in the neighborhoods of Perry and Abecedarian children. In contrast, the recent National Head Start Impact Study found that nearly 50 percent of the four-year-old children who lost the lottery to enter their first-choice Head Start center attended some other kind of center-based child care. Mike Puma, Stephen Bell, Ronna Cook, Camilla Heid, Pam Broene, Frank Jenkins, Andrew Mashburn, and Jason Downer (2012). *Third Grade Follow-up to the Head Start Impact Study Final Report*, OPRE Report # 2012-45, Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

⁸ This and the maternal schooling point made below are documented in Greg J. Duncan and Katherine Magnuson, "Investing in Preschool Programs" *Journal of Economic Perspectives* 27, no. 2 (Spring, 2013): 109-132.

⁹ Jens Ludwig and Deborah Phillips, "The Benefits and Costs of Head Start." *Social Policy Report* 21 (2007): 3-20.

¹⁰ The per child cost estimate comes from Jens Ludwig and Deborah A. Phillips, "Long-Term Effects of Head Start on Low-Income Children," *Annals of the New York Academy of Science* 1136 (2008).

¹¹ In November 2011 President Obama announced new rules aimed at increasing the accountability of Head Start programs. Maggie Severns, "Long-Term Effects of Head Start on Low-Income Children," *Salon*, Nov 8, 2011, , http://www.salon.com/topic/head_start/.

¹² David Deming, "Early Childhood Intervention and Life-Cycle Skill Development: Evidence from Head Start," *American Economic Journal: Applied Economics* 1, no. 3 (July, 2009): 111-134 provides a recent look at these kinds of sibling differences. Another historical study finding long-term benefits is Jens Ludwig and Douglas L. Miller, "Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design," *Quarterly Journal of Economics* 122, no. 1 (February, 2007): 159-208.

¹³ Puma and others, *Third Grade Follow-up to the Head Start Impact Study Final Report*.

¹⁴ For an interesting discussion of alternative explanations of the findings from recent evaluations of Head Start, see Chloe Gibbs, Jens Ludwig and Douglas L. Miller, *Does Head Start do any Lasting Good?* (Cambridge, MA: NBER Working Paper 17452,[2011]).

¹⁵ Deborah A. Phillips, William T. Gormley and A. E. Lowenstein, "Inside the Pre-Kindergarten Door: Classroom Climate and Instructional Time Allocation in Tulsa's Pre-K Program," *Early Childhood Research Quarterly* (in press).

¹⁶ The National Institute for Early Education Research at Rutgers University tracks the number and quality of these programs (<http://nieer.org/>)

¹⁷ Vivian C. Wong, "An Effectiveness-Based Evaluation of Five State Pre-Kindergarten Programs," *Journal of Policy Analysis and Management* 27, no. 1 (Jan, 2008): 122-154.

¹⁸ William T. Jr Gormley, Deborah Phillips and Ted Gayer, "Preschool Programs can Boost School Readiness," *Science* 320, no. 5884 (2008): 1723-1724 present the Tulsa results. In contrast to the lottery-based evaluations of the recent national evaluation of Head Start studies, these pre-K program evaluations rely on what is called a regression discontinuity design. To be eligible for most pre-K programs, a child must turn four years of age as of some date – in Boston's case September 1. In September of any given year, it is possible to measure the skills and knowledge of five-year-old children whose parents had enrolled them in the pre-K program in the previous school year. But at the same time one can measure those same skills and knowledge of children who had missed the age cutoff for last year's pre-K program. Focusing the analysis on the children with birthdays closest to the birthday cutoff point provide two very similar groups of children – one of which has just completed a year of pre-K and the other who were forced to opt for alternative care arrangements. As Gibbs, Ludwig and Miller, *Does Head Start do any Lasting Good?* explain, a limitation of the design of the Gormley, Phillips, and Gayer (2008) and Weiland and Yoshikawa (2013) studies is that it is not possible to examine the long-term effects of the pre-K programs. The reason is that the comparison group participates in the pre-K program the year after the treatment group does.

¹⁹ National data on these differences were documented in chapter 3.

²⁰ We calculated the nine percentage point figure using data available on the Boston Public Schools website.

²¹ Tracy Jan, "Boston Preschools Falling Far Short of Goals, Study Says," *Boston Globe*, sec. A, April 7, 2007.

²² Personal interview with Jason Sachs on November 9, 2011.

²³ The description of the Boston pre-K program draws heavily on Christina Weiland and Hirokazu Yoshikawa, "Impacts of a Prekindergarten Program on Children's Mathematics, Language, Literacy, Executive Function, and Emotional Skills," *Child Development* (2013).

²⁴ Nancy L. Marshall and Joanne Roberts, *Boston Public Schools Early Childhood Quality Study* (Wellesley, MA: Wellesley Centers for Women,[2010]).

²⁵ 43% of Pre-K participants scored at the proficient or advanced level on the grade 3 MCAS ELA examination compared to 34% of non-participants. The black-white gap in the percentage of 3rd graders who scored at the proficient or advanced level on the MCAS ELA examination was 14.3 percentage points compared to 22.9 percentage points among non-participants. The source of this information is a report Jason Sachs presented to the BPS School Committee in 2011. One limitation of this evidence is that the higher third-grade achievement of children who participated in the BPS pre-K program could stem, in part, from differences between the family environments of participants and non-participants.

²⁶ Weiland and Yoshikawa, *Impacts of a Prekindergarten Program on Children's Mathematics, Language, Literacy, Executive Function, and Emotional Skills* use the regression discontinuity design for their impact assessment. This method is described in an earlier endnote in this chapter. For a more detailed exposition of the method, see Richard J. Murnane and John B. Willett, *Methods Matter: Improving Causal Inference in Educational and Social Science Research* (New York: Oxford University Press, 2011).

²⁷ The differences amounted to between one-half to three-quarters of a standard deviation higher, which translates into 50 to 75 points on a test that employs an SAT-type scoring scale.

²⁸ One of the simplest tests for the impulse control element of executive functioning is the pencil tap test. In it, the tester gives a pencil to the child and instructs him or her to tap the pencil once is the tester taps twice, and to tap the pencil twice is the tester taps once. This requires the child to suppress the impulse to imitate what the tester does – a surprisingly difficult task for some four- and five-year-olds.

²⁹ Duncan and Magnuson, (2013) "Investing in Preschool Programs."

³⁰ This is on top of the Head Start program, which enrolled an additional 11% of four-year-olds in 2011. See W. Steven Barnett and others, *The State of Preschool 2011: State Preschool Yearbook* (New Brunswick, NJ: National Institute for Early Education Research,[2011]).

³¹ Ibid.

³² According to Christina Weiland and Hirokazu Yoshikawa (2013), the educational requirements and pay scales for Boston's pre-K teachers were identical to those of other public school teachers. In particular, the teachers must have at least a bachelor's degree and obtain a masters degree within five years. In the 2008-9 academic year, 78% of program teachers held

masters degrees and 75% had at least five years of teaching experience. According to W. Steven Barnett et al. (2011), 29 out of 39 states required a BA for teachers in state-funded prekindergarten programs. Boston's \$12,000 per student cost is more than twice as high as the \$4,847 per pupil cost reported in W. Steven Barnett et al. (2011). Impacts from five state pre-K program are given in Wong et al. (2008); see also Gormley, Phillips and Gayer (2008).

The Importance of Kindergarten-Entry Academic Skills¹

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(A revised version of this paper appeared as a chapter in The Preschool Education Debates: Current Issues and Controversies, Edward Zigler, Walter Gilliam and Steven Barnett (eds.), Baltimore: Brookes, 2011, pp. 89-93.)

I had the pleasure of serving on the National Research Council/Institute on Medicine committee that wrote the comprehensive review *From Neurons to Neighborhoods: The Science of Early Childhood Development* (Shonkoff & Phillips, 2000). One of its most striking conclusions regarding school readiness was 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” (pp. 398-99). In the ensuing decade, I have come to doubt the wisdom of this conclusion, concluding instead that preschool curricula that promote concrete literacy and, especially, numeracy skills are better 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.

It is important to note that I am *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 preschool 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).

In the spirit of the volume, this chapter addresses a much narrower question: For a preschool 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?

Although the socioemotional behaviors children exhibit when they begin school certainly have the *potential* to influence their future school success, the evidence supporting the National Research Council report’s conclusion is not strong. Consider first the findings of experimental studies. Model programs like Perry and Abecedarian² targeted high-risk preschoolers and produced impressive cognitive and academic achievement gains, long-term reductions in referrals for special education services, grade retention and school drop-out, as well as increases in adult educational attainment. But since most of these programs had broad curricula designed to enhance both academic and social skills, it is impossible to determine which of the academic, self-regulation and behavioral components of the program, taken individually or in combination, were responsible for the long-run school impacts that were observed.

Other experimental intervention programs, however, 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” preschool 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 preschool.

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.³ 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 Adulthood⁴ 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. An interdisciplinary team I co-headed with Chantelle Dowsett 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.

Using these data, we regressed the later reading and mathematics achievement measures on kindergarten-entry measures of reading and math achievement, attention, anti-social behavior and internalizing behavior problems (Duncan et al., 2007). Our 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. To establish comparability across studies, all achievement and behavior measures were standardized. All post-kindergarten reading and math achievement outcome measures available in the six data sets were treated as dependent variables in separate regressions.

To summarize our results, we conducted a formal meta-analysis of the standardized regression coefficients emerging from the individual study regressions. 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.⁵ 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.⁶

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.⁷ 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.⁸ 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. To do this, they categorized children according to their pattern of scores for reading and math achievement, attention skills, anti-social behavior and anxiety during the early school years (age 6, 8, 10). The 75th percentile was chosen as the threshold for a "high" level of behavior problems, while the 25th percentile was the upper limit for low achievement.

They then formed three groups – *never*, *intermittent* and *persistent* – depending on whether the child fell into the worst quarter of a given measure's distribution on zero, one or two, or all three measurement occasions. Table 2 shows differences in the probabilities of graduating from high school and attending college for children with persistent as opposed to no problems. As with Table 1, the two regressions control for child IQ and family backgrounds as well as concurrent problems in other areas.

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.

It is hazardous to draw policy implications from nonexperimental studies. Our estimates of the causal influence of early skills and behaviors may be biased. Even if unbiased, estimates of what is most important may point to skills or behaviors that are impossible or very costly to modify. The appropriate intervention policy test involves costs and benefits rather than correlations.

Fortunately, as explained in the introduction, quite a number of targeted preschool 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 preschool 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 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	-.13*	-.29**
Anti-social behavior	-.10†	-.24*
Inattention	.01	-.05
Anxiety	-.03	-.18†

** 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

¹ This paper draws extensively from Duncan and Magnuson (2009), was supported by the NSF-funded Center for the Analysis of Pathways from Childhood to Adulthood (Grant # 0322356) and benefited from comments from Katherine Magnuson.

² Schweinhart et al. (1993) and Schweinhart et al. (2008) report recent Perry follow-ups. Campbell et al. (2002) documents Abecedarian impacts. Other examples of model programs include Lazar & Darlington (1982), Royce et al. (1983) and Reynolds and Temple (1998).

³ Duncan et al. (2007) review some of this literature.

⁴ The school readiness collaborators were: Greg J. Duncan, Chantelle J. Dowsett, Amy Claessens, Katherine Magnuson, Aletha C. Huston, Pamela Klebanov, Linda Pagani, Leon Feinstein, Mimi Engel, Jeanne Brooks-Gunn, Holly Sexton, Kathryn Duckworth, and Crista Japel. Data sets included the Early Childhood Longitudinal Study – Kindergarten Cohort, the NICHD Study of Early Child Care and Youth Development, the National Longitudinal Survey of Youth Child Supplement, the Infant Health and Development Project, the Montreal Longitudinal-Experimental Preschool Study and the British Cohort Study (1970 Cohort).

⁵ 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.

⁶ These results were robust to a host of potential problems: (a) adjustments for error in measuring attention and socioemotional skills had little impact on the results; (b) maternal reports of attention and behavior were nearly as predictive as teacher reports of later academic achievement; (c) worries proved unfounded that the models may overcontrol for achievement-related impacts of attention and socioemotional skills; (d) bias from shared-method variance was not a concern because test scores were just as predictive of later teacher-reported as test-based achievement measures; (e) the relative importance of school-entry factors was similar for immediate (e.g., first grade) and later (e.g., fifth grade) measures of achievement; and (f) impacts of behavior problems were no larger for entering students with the most problems.

⁷ 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.

⁸ The two data sets used in this research were the National Longitudinal Study of Youth – Child Supplement and the Entwisle-Alexander Baltimore Beginning School Study (BSS). For ease of presentation, we focus on results from the NLSY. Persistent anti-social problems were somewhat less predictive of college attendance in the BSS than in the NLSY.