



# Starting Early: Education from Prekindergarten to Third Grade

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# The Future of Children

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# Starting Early: Introducing the Issue

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*Jeanne Brooks-Gunn, Lisa Markman-Pithers, and  
Cecilia Elena Rouse*

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**A**cross the nation, more and more people want to see children receive quality education before kindergarten. Public opinion polls suggest that 70 percent of adults favor such programs, partly because of the irresistible idea that “starting early,” and ensuring that children arrive in school ready to learn, is the best way to generate happy, healthy, and productive adults.<sup>1</sup> The notion of starting early resonates. Head Start, the federally funded prekindergarten program for children from low-income homes, was a cornerstone of President Lyndon Johnson’s War on Poverty. Even then it was believed that students can’t fully benefit from an elementary education if they don’t arrive at kindergarten ready to learn. Presidents with views as disparate as those of George W. Bush and Barack Obama have called for strengthening early childhood education in their budgets and State of the Union addresses.

One reason for the strong support of early childhood education is the seemingly

compelling evidence that exposing children to educational experiences when they’re young can have profound effects on later educational, social, and adult outcomes. In fact, as Lynn Karoly points out in this issue, estimates based on some older pre-K programs suggest that every dollar invested in prekindergarten pays off \$3 to \$17 in terms of benefits, both to the adult individual and to society. That suggests prekindergarten is one of the most effective investments that we can make in children. Indeed, James Heckman of the University of Chicago, a Nobel laureate in economics, has argued that investments made in early childhood are more beneficial and also more cost-effective than those made in later childhood and adolescence.<sup>2</sup>

The idea that prekindergarten can enhance later learning and adult success is based on the premise that if pre-K programs provide enriching activities more intensively and more intentionally than parents can, then those programs have the potential to boost children’s learning and skill acquisition. In brief, quality pre-K experiences can teach

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children the skills that make it easier for them to learn new skills in early elementary school: that is, skills beget skills.

Differences in literacy and cognitive skills between children in low-income families and their better-off counterparts are already apparent by age three, or perhaps even earlier.<sup>3</sup> The pre-K education programs initiated in the 1960s and 1970s were designed to reduce those gaps by providing quality pre-K education to disadvantaged children, who were less likely to be ready for school. Few pre-K programs existed in the low-income neighborhoods where most disadvantaged children lived, and parents with little income and education were therefore less likely to send their children to prekindergarten than were parents with more resources. And when disadvantaged parents were able to find a pre-K program, it was likely to be of relatively low quality.<sup>4</sup>

Based on these observations, we would expect that children from disadvantaged environments would benefit the most from pre-K education; that high-quality programs would deliver the greatest benefits; and that children who received such education would benefit more than those who remained at home, cared for by parents, family, and friends. Comparisons between different pre-K programs, on the other hand, shouldn't show such a stark contrast. These assumptions imply that not all programs would show equal benefits in empirical evaluations. Scholars have called this heterogeneity in outcomes. Interpreting the research requires attention to many factors—family background, comparison group

composition, and programs' quality and intensity.

Scholars have extensively studied the efficacy of pre-K programs, especially those offered to four-year-olds. Of more than 100 evaluations of pre-K programs, the vast majority used random assignment of children to receive the preschool treatment or not.<sup>5</sup> Most of these experimental programs served children from low-resource families, in keeping with the premise that these children were less likely to have the skills needed for kindergarten and were therefore most likely to benefit. Consequently, we know the most about how preschool influences children from disadvantaged backgrounds. And because many of these evaluations were conducted before pre-K programs were widespread, children who didn't participate in a specific program (that is, those assigned to the control group) generally received no pre-K education at all.

As theory predicted, these programs were largely successful. They raised children's academic achievement in the short term, and subjects who were followed into early adulthood showed higher educational attainment, reduced crime, and more employment. More recent evaluations, especially those involving universal pre-K programs rather than those targeting children from disadvantaged backgrounds, also generally show short-term benefits overall. Evaluations that examined children from different backgrounds have revealed stronger effects among disadvantaged children, again in keeping with theory. These evaluations are too recent to have followed their children into adulthood.

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*This issue takes a fresh look at the evidence on prekindergarten's effectiveness and its role in setting the foundation for later academic learning.*

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The empirical evidence makes a good case for such early investments, but many questions remain. This issue takes a fresh look at the evidence on prekindergarten's effectiveness and its role in setting the foundation for later academic learning. We also review the evidence on other aspects of pre-K programs, such as teacher preparation and professional development, bilingual education, and parental and other supports for young children. And as much as possible, we address the integration of prekindergarten with the early elementary grades, specifically kindergarten through third grade (K–3). Public policy often doesn't focus on this integration, even though it's advocated by early childhood educators, developmental psychologists, and school districts. As pre-K programs become more widespread, the push for integration will be even more pronounced. The evidence for the effectiveness of pre-K education far surpasses the evidence for integrating it with K–3 education. This lack of evidence on the transition is reflected in many of the articles in this issue, which focus much more on prekindergarten

itself than on its integration with kindergarten through third grade.

### **What Is Prekindergarten?**

Many people use the term *prekindergarten* generically to refer to any educational program for children before elementary school. In fact, prekindergarten is a web of programs that vary by the ages of the children served, funding source, structures of administration, and mission.

Pre-K programs can generally be divided into four categories based on their main source of funding and administration. The first category encompasses state and city pre-K programs, which are usually universal but are sometimes targeted to low-income children. Typically, these programs fall under state and local education departments, though other entities may share responsibility for oversight.

The second category involves federally funded programs. The best known is Head Start, a means-tested program serving children whose parents earn less than the poverty threshold (with a set-aside of 10 percent for children with special needs). Head Start is administered by the federal Department of Health and Human Services, not the Department of Education; it focuses not just on education but on the whole child, allocating significant funds to health and social services.

The third category, which might be termed community programs, is less well defined. These are subsidized not-for-profit programs, although in some

cases parents pay a portion of the cost. The programs may receive funds from government child-care organizations (such as the Child Care Development Program Block Grants), city agencies, community groups, or private donors. Many different groups operate such programs, including community centers; social service, housing, or city agencies; and churches and other not-for-profit entities. Sometimes, a single center may have classrooms funded by different sources.

The fourth category is for-profit centers. These aren't discussed in this issue, as they haven't been involved in research to examine their effectiveness and aren't often included in studies of classroom quality. In the few general observational studies of pre-K centers within a particular geographic area, for-profit centers were found to be of lower quality on average than programs in the other three categories.<sup>6</sup> For-profit centers are also less likely to be influenced by state regulations for prekindergarten.<sup>7</sup>

Another important dimension of pre-K programs is the age of the children served. The vast majority of programs and evaluations have focused on four-year-olds; "prekindergarten" often refers to such programs run by a public school system. However, developmental research and program evaluations suggest that starting education even earlier than age four might enhance school achievement, attention, and engagement in learning. Consequently, some pre-K programs are enrolling children as young as three. For example, Head Start serves both three- and four-year-olds. Several early small programs in the 1960s and '70s also tested the efficacy of prekindergarten for both age groups. Therefore, some of the pre-K initiatives

described in this issue include both three-year-olds and four-year-olds. We anticipate that in the coming decade, an increasing number of three-year-olds will be included in pre-K programs. In fact, as more states and cities offer universal prekindergarten for four-year-olds—sometimes called *pre-K for all*—and integrate these programs with elementary schools, it's likely that Head Start will have more slots to offer three-year-olds.

In this issue, we use the term prekindergarten fairly generically—that is, to refer to all programs. But whenever possible, we do make an attempt to be more precise—for example, by specifying state or local prekindergarten.

How many children attend pre-K programs? The most up-to-date information comes from the National Household Education Surveys Program (NHES) and the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K:2012).<sup>8</sup> The estimates are based on parents' reports of what, if any, early childhood education their children received in the year before entering kindergarten (including four-year-olds and any five-year-olds not yet in kindergarten). In 2012, according to NHES data, 58 percent of these children were enrolled in pre-K programs; an additional 2 percent were in multiple-care arrangements that might or might not include prekindergarten. We see disparities by race and ethnicity in the percentages of children enrolled: 53 percent of Hispanic-American children, 59 percent of white children, 65 percent of African-American children, and 67 percent of Asian-American children. Attendance also varied by family income: the children who attended prekindergarten included 49 percent of



children whose family incomes were below the poverty threshold (about the lowest 20 percent of the income distribution), 51 percent of those whose family incomes were in about the next 20 percent (often termed the near poor), and 65 percent of those whose parents were neither poor nor near poor. In 2012, 71 percent of children whose mothers had a bachelor's degree were enrolled in pre-K programs, compared with 46 percent of those whose mothers hadn't completed high school.

## **Major Pre-K Evaluations**

Much of the debate regarding prekindergarten's effectiveness is based on a series of studies mentioned in many of this issue's articles. To avoid repetition, we'll briefly describe the studies that are mentioned most often.

### **Perry Preschool and Abecedarian**

The Perry Preschool Program and the Abecedarian Program are the best-known small-scale pre-K experiments. Both have demonstrated important positive impacts into adulthood for the participants.<sup>9</sup> From 1962 to 1967, the Perry Preschool Program enrolled three- and four-year-olds in Ypsilanti, MI. Children participated for one or two years, receiving half-day center-based care and weekly home visits for 30 weeks per year. The children were African-American, lived in low-income families, and had low cognitive competencies. The teachers were highly qualified; their curriculum was the precursor to the Creative Curriculum, now used by a third of all Head Start centers. The 123 children in the evaluation were randomly assigned to receive either treatment or no intervention. So far the subjects have been followed into their 40s; the study will continue until they're in their 60s.

The Abecedarian Program was conducted in Chapel Hill, NC, from 1972 to 1982; the participants were 111 low-income African-American families.<sup>10</sup> Children were enrolled in the program or assigned to a control group in the first three months of life; participating children received full-day center-based care for 50 weeks per year until kindergarten. A curriculum called Learning Games was developed and implemented (and is still used in programs today). When the children entered kindergarten, the two groups were randomized again. Half of them received services in elementary school (unlike the preschool intervention, this aspect of the program produced no effects on the measured outcomes). The Abecedarian children have been followed into their 40s. Because the program began in the first year of life, it isn't included in the article on prekindergarten's efficacy by Hirokazu Yoshikawa, Christina Weiland, and Jeanne Brooks-Gunn. But because it's one of the few evaluations to have followed its subjects into adulthood, Karoly discusses it in her article on benefit-cost analyses.

### **Head Start**

Unlike state and city pre-K programs that focus solely on school achievement and behavior, the federal Head Start program takes a whole-child approach, providing education, nutrition, health, and family support services. Though it was founded in 1965, its first multi-site randomized evaluation—the Head Start Impact Study—didn't begin until 2002; it followed children through 2008.<sup>11</sup> Participants were chosen from 383 Head Start centers (which themselves were randomly selected from among 84 randomly selected grantees and delegate agencies). A total of 4,442

children were randomly assigned to treatment or control groups in two age categories, three-year-olds and four-year-olds. All were eligible for Head Start either because their family income was below the poverty threshold or because they had special needs. In each group, about one-third of the children were Hispanic, one-third were African-American, and one-third were white. About one-quarter of the sample were English language learners. The study assessed the children's academic achievement, behavior problems, health, and approaches to learning. Few effects were sustained into the middle of elementary school. Because the children weren't followed past elementary school, no benefit-cost analyses were undertaken.

Researchers have also attempted to estimate the long-term effects of Head Start through several other types of analyses. One type of study compares siblings, one of whom attended Head Start and one of whom did not. Because the children live in the same families, these studies by definition control for many background family characteristics that might influence the measured outcomes.<sup>12</sup> Another approach examines long-term outcomes of children who were affected differently by Head Start's eligibility rules.<sup>13</sup> One such study took advantage of the fact that when Head Start began in the 1960s, some programs in high-poverty counties got help obtaining funds for their children, while programs in adjacent counties did not. Significant long-term effects have been reported in both of these types of evaluations. A recent study in Tulsa, OK, used matching techniques to compare children who received a high-quality Head Start experience with children who did not, evaluating eighth-grade achievement test

scores gathered by area school districts; it reported significant positive impacts.<sup>14</sup>

### The Tulsa, Boston, and Tennessee Pre-K Programs

When it comes to state- or city-level pre-K programs, three evaluations are often cited. The first is from Oklahoma, a leader in state pre-K programs for four-year-olds. Oklahoma's program for disadvantaged four-year-olds began in the 1990s; the state initiated a universal program in 1998–99 that continues today. Oklahoma pre-K teachers are paid the same as kindergarten teachers and must meet the same educational requirements. Across the state, programs can last half a day or a full day, and curricula vary. The evaluators compared Tulsa children who just made the pre-K age cutoff with those who just missed it and had to wait a year to attend.<sup>15</sup> This so-called *regression discontinuity* research design accounts for demographic differences between the two groups, since birth date is assumed to be random. Children were followed through their kindergarten year, and the study found positive impacts.

The second evaluation involves the pre-K program in Boston Public Schools. Children were eligible if their fourth birthday occurred by September 1. An estimated 34 to 43 percent of the city's eligible children enrolled in the program.<sup>16</sup> The full-day program used two major curricula—Opening the World of Learning (OWL) and Building Blocks. All teachers had at least a bachelor's degree. Coaches worked with the teachers, an unusual step for such programs.<sup>17</sup> The evaluation covered more than 2,000 four-year-olds in 69 elementary schools that had pre-K classrooms in 2008–09. Again, the evaluators used a regression

discontinuity design, in which children who missed the cutoff for pre-K were compared with children who were eligible. Of the four-year-olds who were too young to enroll in Boston's pre-K program in 2008, 57 percent attended some form of center-based care, according to their mothers. Pre-K attendance was associated with higher achievement scores.

The third evaluation is from Tennessee, where cohorts from 2009–10 and 2010–11 are being evaluated.<sup>18</sup> Children were randomly assigned to prekindergarten or to a control group. Initial analyses found small short-term impacts and no (or negative) medium-term impacts. However, the empirical strategy was compromised—parents' consent to follow a subset of the children was requested only after the randomization, and a very high percentage of parents declined to participate in the follow-up, making it difficult to interpret the results. Researchers are still trying to understand how this problem affected the estimated impacts.

## What Have We Learned?

In this issue, the authors present the best available evidence concerning the success of pre-K programs in preparing children for kindergarten and beyond. The 10 articles examine:

- the efficacy of prekindergarten in both the short term and the long run;
- the economic benefits of pre-K programs into adolescence and adulthood, compared to their costs;
- the development and evaluation of curricula focusing on several areas of learning—literacy, mathematics and

science, and attention and behavioral regulation;

- the ingredients of a quality learning experience, and the education, training, and compensation of teachers;
- successful practices for teaching young children with special needs;
- how best to teach English language learners; and
- the effectiveness of integrating parenting programs into pre-K–3 education.

In this section we briefly explore some of the important questions that tie the articles together.

## Is Preschool Effective, and If So, for Whom?

In the issue's opening article, Yoshikawa, Weiland, and Brooks-Gunn review what we know about the effectiveness of pre-K programs, looking at short-, medium-, and long-term effects on health, literacy, mathematics, and social-emotional competencies. The article by Karoly examines the economic benefits of pre-K programs compared to their costs, using some of the same evaluations as Yoshikawa, Weiland, and Brooks-Gunn and focusing on long-term outcomes. Both articles highlight pre-K evaluations that have strong research designs, mostly because they randomly assigned children to a treatment group or a control group. Although dozens of researchers have conducted small-scale evaluations, far fewer have followed their subjects into adulthood, or even into late elementary school.<sup>19</sup>

At the end of most evaluated programs, researchers find effects on school

achievement, though these effects diminish over elementary school. When program effects are large, they tend to be maintained into elementary school, though they are smaller than the initial impacts. At the same time, we see long-term effects on adult outcomes—for example, a reduction in crime or the completion of more schooling. It's puzzling that during elementary school, the achievement-test scores of children who attended prekindergarten converge with the test scores of children who did not, a phenomenon commonly called *fadeout*. Studies document that those who participate in a pre-K program have a significant advantage in kindergarten in terms of educational achievement. But those assigned to the control group tend to catch up in the first through third grades; in most evaluations, more than half the difference between the two groups disappears by the end of first grade.

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Several theories have been put forth to explain the convergence. One is that the initial pre-K effects may not be sustained if primary school classrooms are of low quality. Another theory suggests that kindergarten and first-grade teachers may concentrate on students who are

performing poorly, focusing on the skills already acquired by children who attended prekindergarten. It may be that the early grades lack challenging curricula, failing to focus on what are called *unconstrained* skills—large domains acquired gradually, such as reading to learn. Or perhaps prekindergarten simply isn't effective at raising academic achievement in anything but the short term. The articles by Catherine Snow and Timothy Matthews; Robert Pianta, Jason Downer, and Bridget Hamre; and Douglas Clements and Julie Sarama all examine one or more of these ideas. We need more nuanced research on children's primary-grade experiences to understand which of these explanations is relevant.

Another problem is that the amount of time children spend in pre-K classrooms, often called the *dose*, isn't well documented in studies. Is it half a day or a full day, one year or two, a full year or nine months? Dose of intervention no doubt makes a difference in sustaining effects on achievement.

It's also possible that prekindergarten may improve competencies that don't necessarily boost test scores, such as behavioral regulation, persistence, motivation, and engagement in school. These so-called noncognitive or soft skills may be important for success later in life, but few evaluations have measured such outcomes in the primary or secondary grades, so we know little about the likelihood of effects on these competencies. Programs that focus explicitly on regulation and executive function are only now being implemented in pre-K programs; Cybele Raver and Clancy Blair review them in their article.

Family involvement may also influence sustained pre-K effects. Parents of children enrolled in pre-K programs might become more engaged in schooling during the primary school years. Such parental differences could possibly be traced to selection—that is, parents who enroll their children in pre-K programs may already be more engaged than those who don't. But the differences could also result from a change in parents' behavior produced by the pre-K experience. In their article, Katherine Magnuson and Holly Schindler suggest that at least for now, changes in parents' behavior are unlikely to play a large role in explaining prekindergarten's longer-run effects. Most interventions that have targeted parents as part of a pre-K program haven't been successful, and those that have had some success haven't been taken to scale.

### **What Distinguishes High-Quality Programs?**

The role of curricula and the quality of the classroom are important for understanding young children's academic growth. All three articles that examine aspects of curricula—literacy; science, technology, engineering, and mathematics (STEM); and executive function—conclude that young children are capable of learning more than we currently teach them. Such content can be delivered in many ways.

Basic research on literacy has a long history, as does the development of literacy curricula. Today, we'd be hard pressed to find a pre-K program that doesn't have both explicit materials for teaching literacy and procedures for training teachers to enhance literacy learning. In their article, Catherine Snow and Timothy Matthews describe the key components of literacy, which include

both constrained skills (such as phonemic awareness and letter knowledge) and unconstrained skills (such as knowledge of the world). Young children are typically taught constrained skills, which are associated with success until second or third grade. Beyond third grade, however, mastery of comprehension is associated much more with unconstrained skills. This distinction is captured by the phrase "learning to read versus reading to learn."

Snow and Matthews suggest that our pre-K–3 approaches to literacy too often ignore unconstrained skills, and this might be one reason that when US children reach eighth grade, their literacy scores drop in both the National Assessment for Education Progress and international comparisons. The authors maintain that teachers need professional development on how to teach unconstrained skills; they end with a description of various curricular and other training interventions that may help boost students' literacy.

Douglas Clements and Julie Sarama argue that STEM subjects, though currently absent from most pre-K experiences, are appropriate for early education because young children think in terms of science and math and are intrigued by these subjects. The good news is that there's increasing interest in STEM activities for young children, and we now have curricula and training approaches to encourage teachers to spend more time on STEM learning and use more effective techniques. Clements and Sarama also argue that teachers need professional development, concentrating on setting goals and using developmental progressions, to teach math and other STEM subjects.



The article by Cybele Raver and Clancy Blair explores how executive function affects a child's learning outcomes. Executive function includes such abilities as attention, working memory, and inhibitory control—all of which are associated with cognitive and behavioral outcomes for both children and adults. Raver and Blair offer research to show that the development of executive function before children enter elementary school predicts their early math and reading skills. The authors also review promising individual and classroom interventions to improve executive function. Research on how to integrate the learning of memory, attention, and planning into the classroom is just beginning. So far, the results from several evaluations of executive function programs are largely positive. However, we need to learn more about effective curricular approaches and how to teach these skills throughout the school day. Some approaches might be difficult to incorporate into professional training, which suggests that we must pay more attention to the design of professional development for executive function.

One innovative line of work involves the cross-fertilization of curricula promoting literacy, STEM, and executive function. Some evidence suggests that incorporating high-quality STEM curricula into the classroom not only promotes STEM learning but also enhances literacy. Similar links are emerging between STEM and executive function. We might envision a classroom of the future where literacy, STEM, and executive function skills are seamlessly taught throughout the day, rather than in separate time slots. After all, that's how learning generally occurs outside the classroom.

Another issue that cuts across the literacy, STEM, and executive function articles is the possible disconnect between the content of curricula and teachers' competency in delivering that content. The article by Deborah Phillips, Lea Austin, and Marcy Whitebook considers the preschool and early elementary workforce. Somewhat surprisingly, we know little about how teachers are trained in the use of specific curricula or how effective such training is. The articles on STEM and executive functioning present exemplars of curricular training approaches. And a few recent pre-K evaluations, most notably the one in Boston, provide detailed information on teacher training and continued feedback to teachers. We hope to see more research in this area.

In their article, Robert Pianta, Jason Downer, and Bridget Hamre discuss overall classroom quality. Definitions of quality vary widely. The lack of agreement on how to define and measure quality makes it difficult to compare quality across classrooms, programs, or states. But a consensus is emerging on the dimensions of quality that are important and ought to be measured; these include structural elements, classroom environment, and teacher-child interactions. The authors note that certain structural elements—smaller class size, longer duration of a program, and teachers' degrees and certifications—are associated with positive learning outcomes. But even when all the structural quality indicators are met, low scores on teacher-child interaction predict smaller gains in learning in pre-K–3 classrooms. The implication is that we must pay much more attention to such interactions in measuring classroom quality, in implementing curricula, and in teacher training. Variation in the effectiveness of pre-K programs may be due in large part to differences in how teachers interact with their children. So ensuring that the structural

elements are in place—for example, that all pre-K teachers have a degree plus early childhood education certification—isn't enough to guarantee positive impacts on learning.

Another question is the continuity of quality. If quality is high in a pre-K program but not in the K–3 classrooms that a child later attends, it stands to reason that sustained achievement gains will likely be low. Pianta's group, at the University of Virginia, has been studying quality across the pre-K–3 range, with a special focus on teacher-child interactions. It's possible that efforts to integrate prekindergarten into the K–3 system will lead to higher quality across the board. We hope to see more such efforts in the coming years.

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Finally, in their article on how best to teach young English language learners, Lisa Barrow and Lisa Markman-Pithers offer evidence that ensuring high-quality classrooms in general may be at least as important as the language of instruction for ensuring academic success.

### **How Do We Prepare Teachers and Parents?**

Phillips, Austin, and Whitebook review what we know about the pre-K workforce and,

to a lesser extent, about K–3 teachers. The proportion of pre-K teachers who have a bachelor's degree and certification for teaching early childhood education has increased over the past 15 years. Still, far fewer pre-K teachers than kindergarten teachers are college graduates, owing to differences in requirements. State and city pre-K programs usually require teachers to hold a bachelor's degree, which has led to disparities between pre-K teachers in programs administered by public school systems and those in Head Start and community programs. Wage differentials are also high. Indeed, many pre-K teachers experience financial hardship and lack health insurance. Several systems are trying to enhance education and wages; in the section on integration below, we discuss an example of innovative policies to advance the status of pre-K teachers in North Carolina.

We know too little about how teachers are educated and trained. Phillips, Austin, and Whitebook find tremendous variation in preparation programs, as well as inconsistency across states regarding what preschool teachers are required to know. So it's not surprising that links between classroom quality and education and training are difficult to ascertain. And even among teachers who have received the required training, the quality of teacher-student interactions varies widely (see the Pianta, Downer, and Hamre article). Until we pay more attention to the links between training and classroom interactions, we can't evaluate the efficacy of current training and education programs. The same is true for implementing curricula in the classroom. How well do current training approaches prepare teachers to use the curricula they encounter? The lack of information on such

issues is somewhat shocking. In essence, we still don't know the best way to prepare teachers to deliver high-quality interactions and learning in their classrooms.

One of the goals of Head Start and other pre-K programs is to provide support, information, and even instruction to parents in the context of prekindergarten. In fact, being in favor of involving parents in their children's pre-K programs seems much like supporting motherhood and apple pie. But even though everyone believes such involvement is necessary, we know little about whether it makes the programs more effective. In fact, Katherine Magnuson and Holly Schindler report that when parenting programs attached to pre-K programs have been evaluated, many have proven to be ineffective. But programs that target specific competencies are more likely to have benefits, especially those that help parents deal with their children's behavior problems. Also, a few programs targeting mothers' literacy and reading have been effective. Clearly, it's time to develop and test new approaches to parental involvement rather than simply assuming that it's beneficial. One promising approach involves using technology to remind parents about reading, math, and language activities. We imagine that many technological applications will be developed in the coming years, and we hope to learn about their impact.<sup>20</sup>

### **How to Help English Language Learners Succeed in School**

What's the most effective way to teach English language learners? The answer depends on the ultimate goal. Is it to help English learner students become truly bilingual? Or is it to help them become proficient in the English language as quickly

as possible? Although the debate is often framed as a binary of total immersion in English versus dual-language instruction, the article by Barrow and Markman-Pithers describes a number of approaches for teaching English language learners. According to the authors, some evidence suggests that teaching pre-K children in English *and* in their native language might help them retain their native language without slowing their English acquisition. But if English proficiency is the primary goal, other models (namely English immersion) may be equally effective. We need to learn much more about exactly how students are being taught, what combinations of approaches are effective, and how classrooms with children speaking multiple languages can integrate language instruction.

### **What Works Best for Children with Special Needs?**

For decades, Head Start has reserved 10 percent of its slots for children with special needs. Yet experimental evidence on the impact of such inclusion is sparse, because children with special needs can't be randomly assigned to receive a pre-K program or not. Rather, services are mandated for these children, although the services don't necessarily include prekindergarten. For the same reason, we also know little about how including special-needs children in a classroom affects children without special needs. Rather than inclusion, research has focused more on the integration of services as well as the types of services offered to children with various special needs.

In their article, Kathleen Hebbeler and Donna Spiker review the landscape of



education for young children with special needs. They discuss the challenges of identifying such children, such as the difficulty in assessing young children and the variations in state eligibility guidelines. In general, they write, special education has moved away from looking at disability as a condition that resides in the child and toward the idea that disability is an interaction between the child and the environment. This social model recognizes that adapting the environment can either help or impede a child's development. Hebbeler and Spiker highlight effective interventions, such as multi-tiered systems of support that use data to monitor students' progress and to determine the help they need as they move through tiers of instruction. The authors also discuss the challenges faced by children with special needs in making transitions as they move from prekindergarten through third grade.

### **How Well Are Pre-K and K–3 Education Integrated?**

One issue cuts across all these articles: the fact that pre-K and K–3 programs seem to exist in separate silos. Prekindergarten programs are fragmented in terms of funding, approaches to learning, and the state regulatory agencies responsible for them. Sharon Lynn Kagan of Columbia University has written that because the pre-K landscape is a polyglot, it's hard to integrate prekindergarten with early elementary school.<sup>21</sup> Below we present two case studies, one of a county-level effort and another of a state effort, to build a system that ensures continuity in learning approaches from prekindergarten through third grade.

Maryland's Montgomery County, on the outskirts of Washington, DC, has changed most aspects of its approach to pre-K–3 education. The school district set the goal of having 80 percent of high school seniors ready for college, and worked backward from there to come up with goals for prekindergarten to third grade. Many of the district's extensive series of initiatives are proposed in this issue. For example, prekindergarten was provided for all four-year-olds, prekindergarten and kindergarten became full-day programs, and student-teacher ratios were limited to 15 to 1 for all K–3 classrooms.

Moreover, pre-K teachers were required to hold a bachelor's degree and be certified to teach early childhood education. Pre-K teachers were also categorized as elementary school teachers, making their compensation similar to that of K–3 teachers. Parents received programs in English as a second language and family literacy, and children received after-school and summer programs. Math and literacy curricula were aligned across grades, and kindergarten curriculum guidebooks and welcome packages were offered to parents in six languages. Basically, Montgomery County implemented most of the changes recommended by scholars of early childhood education. This comprehensive approach doubled the proportion of children who were reading at grade level.<sup>22</sup> The effects were sustained in elementary school, showing that the answer to the question of whether prekindergarten can have lasting impacts might be yes—as long as early elementary school classrooms and services are also improved.

North Carolina offers a state-level example of integration.<sup>23</sup> In conjunction

with More at Four—the state’s pre-K program—a series of policies seek to enhance pre-K teachers’ education and wages. Several programs encourage early childhood teachers to earn credentials or enroll in a two- or four-year college program. Teachers receive scholarships, and are then required to teach an additional year in prekindergarten. In 2009, 5,400 teachers were awarded these scholarships. Also, when college students who major in early childhood education go on to teach at-risk preschoolers for a year, their college loans are forgiven. The state’s community colleges all offer degrees in early childhood education and have a common course catalog so that credits can be easily transferred. One four-year college has coordinated with the community college coursework so that early childhood education credits all transfer for the bachelor’s degree.

North Carolina has also enhanced compensation. The Child Care WAGES® salary supplement, which is linked to education, has increased the pay of teachers in Head Start and other community programs, who are among the lowest-paid pre-K teachers. Also, subsidies are offered for health insurance. These initiatives have been shown to reduce turnover of early childhood teachers to about 12 percent annually, similar to that of elementary school teachers. Nationally, early childhood education programs report that about two-fifths of their teachers leave each year. The article by Phillips, Austin, and Whitebook provides more information on teacher turnover in early childhood education.

Unlike the evidence for pre-K’s effectiveness, evidence about integration generally isn’t based on rigorous evaluation

methods like random assignment. Indeed, Montgomery County is among the few entities to have evaluated their system-wide initiatives in any way. We need studies of such initiatives that include detailed information on individual students over time; which elements of the systems changed; and how many students, teachers, or classrooms received a particular element. Only through careful data collection and analysis can we understand what works—and doesn’t work—in designing integrated systems.

## Conclusions

Although some policymakers still question the value of pre-K education, we believe the weight of the evidence, as reflected in the articles in this issue, indicates that high-quality pre-K programs can indeed play an important role in improving later outcomes, particularly for children from more disadvantaged families. At the same time, significant questions remain. Why do we see a convergence in test scores in elementary school and yet potentially large impacts on other outcomes in the long term? What produces the variation in impacts seen among more recent programs? What’s the best way to train teachers to be effective in the classroom? What are the key components of a high-quality program? These questions highlight the need for sound research that attempts to get inside the black box of a pre-K education.

We also need a better understanding of how to take high-quality programs to scale—the most relevant example being the rollout of city- and state-level pre-K programs. And we must start considering the education of young children to be part

of the educational system, and integrating it with elementary and secondary education. Because learning is cumulative, our educational system—including prekindergarten—will be most effective only when each level builds seamlessly on the previous one.

Current estimates suggest that the social payoff to high-quality pre-K education could place it among the most cost-beneficial investments we as a society can make. The challenge is to design an effective system that gets all children off to a strong start.

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# When Does Preschool Matter?

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*Hirokazu Yoshikawa, Christina Weiland, and  
Jeanne Brooks-Gunn*

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## Summary

We have many reasons to invest in preschool programs, including persistent gaps in school readiness between children from poorer and wealthier families, large increases in maternal employment over the past several decades, and the rapid brain development that preschool-age children experience. But what do we know about preschool education's effectiveness?

In this article, Hirokazu Yoshikawa, Christina Weiland, and Jeanne Brooks-Gunn report strong evidence that preschool boosts children's language, literacy, and math skills in the short term; it may also reduce problem behaviors such as aggression. Over the elementary school years, however, test scores of children who were exposed to preschool tend to converge with the scores of children who were not. Many factors may explain this convergence. For example, kindergarten or first-grade teachers may focus on helping children with lower levels of skills get up to speed, or children may lose ground when they transition from high-quality preschools into poor-quality elementary programs. Taking a longer view, some studies have found that attending preschool boosts children's high school graduation rates and makes them less likely to engage in criminal behavior. Overall, higher-quality preschool programs are associated with larger effects.

How might preschools produce larger effects that last longer? Developmentally focused curricula, combined with intensive in-service training or coaching for teachers, have been shown to improve the quality of preschool instruction. Focusing on fundamental skills that both predict long-term outcomes and are less likely to be gained in the first years of school might also produce longer-lasting effects. And improving instructional quality in early elementary school and better aligning the preschool and elementary curricula may be another way to sustain the boost that quality preschool education can provide. Above all, the authors write, if we want to see sustained improvements in children's development and learning, we need to increase the quality of—not just access to—preschool education.

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Several factors together present a strong rationale for investing in children's learning before age five, when children enter primary school in the United States. First, family income–based gaps in cognitive skills are already large when children enter school. These gaps don't grow substantially as schooling goes on, suggesting that to reduce achievement gaps, we may need to intervene before children begin school.<sup>1</sup>

Second, during early childhood, the brain is especially sensitive to environmental enrichment. Early experiences in children's homes, in other care settings, and in their communities interact with their genes to shape their brains. Their neuronal systems undergo very rapid growth and then pruning, based on environmental inputs such as activities, language, and other people's responsiveness. Environmentally influenced brain development supports a range of early skills, including cognitive skills (language, literacy, and math), social skills (understanding others' behaviors and motivations, prosocial behaviors, and understanding and display of emotions), and self-regulation and executive function (voluntary control of attention and behavior).

Third, large increases in maternal employment over the past several decades, especially among lower-income families, mean that more children experience care by others besides parents early in life. Finally, the majority of US parents prefer preschool to home-based care for their three- and four-year old children. Polling suggests that 70 percent of Americans support legislation to make preschool available to all young children.<sup>2</sup>

The rationale for preschool education involves both preparing children to be

ready for elementary school and reducing achievement and behavior gaps between children whose parents have more and less education or higher and lower income. Underlying the focus on all preschoolers is the assumption that children will get more out of K–12 education if they master a number of skills before they start. These skills include knowledge of letters and phonemic properties; early language skills such as expanded vocabulary and oral comprehension; early numeracy, geometry, and problem solving; and the ability to pay attention, interact cooperatively with peers, and adjust behavior when experiencing strong emotions or conflict. Though children acquire these skills in their homes to some degree, high-quality preschool education can enhance them. Underlying the focus on gaps is the assumption that children in poorer families or those who have less-educated parents tend to have fewer of the types of opportunities that promote early learning and development. Disparities certainly exist vis-à-vis perinatal health; health conditions in the first years of life; access to books and other cognitively stimulating materials; and neighborhood exposure to violence and environmental toxins, to name a few. Many preschool programs were developed to offset these disparities by enhancing the development of children from specific backgrounds.

According to one study, in 2010 about 70 percent of US four-year-olds were enrolled in preschool. The Census Bureau's Current Population Survey, which defines preschool somewhat more restrictively, found that in 2013 about 66 percent of four-year-olds and 43 percent of three-year-olds were enrolled.<sup>3</sup> Children from lower-income families were less likely to be enrolled than were children from higher-income families. Enrollment



rates also varied by racial/ethnic group. As of 2010, Latino children showed the lowest enrollment levels—18 percentage points lower than those of whites.

In the following sections, we summarize what research shows about preschool education's effectiveness across a number of developmental domains. We look at effects across three time frames: immediately after preschool, during elementary and middle school, and during adolescence and adulthood. We describe how effects vary according to how intensive the preschool programs are and how long they last, family and child characteristics, and program quality. Finally, we highlight the strongest findings and discuss what we still need to know to help both policy makers and educators.

For the most part, evaluations of preschool education have used *randomized* designs, meaning that children whose parents have agreed to let them be considered for admission to a particular preschool program are assigned (randomized) to either a treatment group that participates in the program or a control group that does not. Children and families are assessed at this point to make sure that the groups are equivalent before the intervention begins. A random assignment study can provide strong evidence for a preschool program's effects. Another well-regarded design is called *regression discontinuity*. Here, children who miss the cutoff age for admission into a program (typically one that is universal or being offered to a large proportion of a particular population) are compared to those who just made the cutoff, on the assumption that these two groups of children are similar in most ways. Regression discontinuity has been used to evaluate public prekindergarten

programs. In this article, we review evidence mostly from studies that use one of these two designs. On occasion, we refer to studies that compare siblings who had different child-care experiences. Another approach is to attempt to match groups of children receiving different types of child care; this approach is limited by the fact that it's difficult to identify all possible differences among the groups of interest.

## Short-Term Effects

### Cognitive Outcomes

A recent meta-analysis quantitatively synthesized several decades of preschool evaluations that had strong causal research designs. One year of preschool education had an average impact on cognitive skills that represented three months of additional learning beyond the normal levels of skill acquisition that occur among four-year-olds without access to preschool.<sup>4</sup> The studies covered in the meta-analysis looked mostly at early language, preliteracy (spelling and letter-word identification) and math outcomes. Among language and literacy outcomes, preschool's effects were strongest on print concepts (for readers familiar with statistical analysis, the average effect size was .54, or roughly one half year of additional learning) and early reading (average effect size .44), and weaker on more broadband skills such as vocabulary (average effect size .22).<sup>5</sup>

Rigorous evaluations of preschool education have mostly been conducted on small-scale programs (the best known being the Perry Preschool and Abecedarian programs). Recently, several large-scale public prekindergarten programs have been evaluated using regression-discontinuity designs. These studies show a pattern of

impacts consistent with the meta-analytic study.<sup>6</sup> The large-scale programs produced the largest effects on narrowly defined skills such as those in the literacy domain, with statistically significant effects in seven out of eight states or cities that were studied (effect sizes ranged from 0.32 to 1.10, with an average effect of 0.63, or roughly two-thirds of a year of additional learning). Four out of seven programs showed effects on broader skills such as vocabulary (across all seven, effects ranged from -0.13 to 0.44, an average effect of 0.18) and math (ranging from 0.06 to 0.59, with an average effect of 0.34). Higher-quality programs tended to produce larger effects. Programs in Boston, MA, and Tulsa, OK, showed particularly strong results, with effect sizes in the medium to large range. The instructional quality of these two large-scale programs was considerably higher than what we typically see (for example, in large-scale Head Start and public prekindergarten studies, levels of instructional quality are in the low range).<sup>7</sup> (See the article in this issue by Robert Pianta, Jason Downer, and Bridget Hamre for a detailed look at preschool classroom quality.)

### **Socioemotional, Self-Regulation, and Executive Function Outcomes**

Relatively few causal evaluation studies of general preschool (that is, preschool that lacks a specific behavior-focused component) have measured socioemotional outcomes, which include positive behaviors that show empathy, cooperation, or a prosocial orientation, as well as problem behaviors that show antisocial, aggressive, hyperactive, impulsive, withdrawn, depressed, or anxious tendencies. Compared to measures of achievement, language, and cognition, socioemotional

measures are more varied in the content they cover and the quality of measurement.

Evaluations that include this domain most often focus on aggressive, antisocial, and hyperactive behaviors. The Perry Preschool program, for example, was found to reduce acting out and aggressive behaviors once participating children reached elementary school.<sup>8</sup> More recently, the National Head Start Impact Study found that one year of Head Start reduced acting-out behaviors for the full sample and hyperactivity among three-year-olds.<sup>9</sup> However, a national study using matching methods to approximate the conditions of a randomized experiment found that children who attended Head Start programs had greater social competence and fewer outward-directed problem behaviors than did children who attended other center-based care programs.<sup>10</sup> In Tulsa, an evaluation found that children who attended prekindergarten were less timid and more attentive than children who attended neither prekindergarten nor Head Start, suggesting greater engagement in the classroom. However, no differences were seen in aggressive or hyperactive behavior.<sup>11</sup> Preschool programs may need to pay explicit attention to this domain of behavior. A meta-analysis that summarized preschool's effects on aggression found small reductions in children's aggressive behavior (effect size -.10), but only among programs that made improving children's behavior a clear-cut goal.<sup>12</sup>

Several recent experiments have examined whether targeted curricula can improve the three principal dimensions of executive function in early childhood: cognitive flexibility, or the ability to switch focus and attention across different kinds of tasks; inhibitory control, or the ability to substitute a desired behavior for a more automatic type of response; and working memory, or the

ability to hold information in short-term memory and recall or manipulate it). The Tools of the Mind program, which targets these skills with a variety of activities, has shown mixed results. One evaluation found medium-sized increases in executive function skills, but three others showed no effects.<sup>13</sup> A kindergarten version of the program has shown positive effects on a variety of measures of executive function, as well as on reading and math skills.<sup>14</sup>

Math curricula may be another pathway for improving executive function, not to mention language skills. Arithmetic problems, for example, can build working memory and cognitive flexibility.<sup>15</sup> The Building Blocks curriculum—in which children express their mathematical ideas and thinking through language—has shown positive impacts on executive function skills both in small-scale experiments and in one larger-scale regression-discontinuity study (see Julie Sarama and Douglas Clements’s article in this issue). Finally, social-cognitive approaches to behavior management, which train children to substitute prosocial responses for impulsive or antisocial behaviors, may also increase executive function.<sup>16</sup> (See the article in this issue by Cybele Raver and Clancy Blair for a detailed look at executive function.)

## **Health Outcomes**

Preschool’s effects on children’s health have been rigorously investigated only in the Head Start program—possibly because Head Start, unlike most preschool programs, directly targets children’s health outcomes. The program includes preventive dental care, comprehensive health screening, tracking of well-child visits and required immunizations, and assistance with finding a regular medical

provider. During Head Start’s early years, a regression-discontinuity study showed that the program reduced child mortality—in particular, it reduced deaths from causes related to Head Start’s immunization and screening services (such as measles, whooping cough, and respiratory problems).<sup>17</sup> More recently, the national Head Start Impact Study found somewhat mixed effects on children’s health between the end of the program and the end of first grade. At some but not all post-program time points, Head Start had small positive impacts on some indicators of physical health and health care use, such as getting dental care, having health insurance, and parents’ reports of children being in good health. On the other hand, at the end of first grade Head Start had no impact on whether children had received care for an injury within the last month or whether they needed ongoing care.

## **Medium-Term and Long-Term Effects**

Evaluations of preschool’s medium-term effects (during elementary and middle school) most often measure achievement test scores, special education placement, and grade retention. Researchers have examined a smattering of other outcomes, but here we focus on those three.

### **Medium-Term Effects**

Test scores of children who were exposed to preschool and of children who were not tend to converge over the elementary school years. Preschool’s effects on test scores diminish every year (at a rate of .02 effect sizes per year), but the decline is steepest in the first two years after a preschool program ends—in other words, during the first years of primary schooling.<sup>18</sup> Most recently, an evaluation of Tennessee’s prekindergarten

program found that preschool attendance led to small *negative* effects on children's academic achievement at the end of third grade, concentrated among English language learners.<sup>19</sup> A follow-up evaluation of the Tulsa CAP Head Start program into eighth grade showed positive effects on math achievement using a similar matching approach.

Experimental evaluations have also shown that preschool exposure reduces grade retention and special education placement in the K–12 years. A recent meta-analysis showed average reductions in the available studies of 0.04 standard deviations or 6.0 percentage points for grade retention rates and 0.33 standard deviations or 7.5 percentage points for special education placement.<sup>20</sup>

### Long-Term Effects

Only a few studies have examined preschool's effects in late adolescence and adulthood. A recent meta-analysis found an 11.7 percentage-point increase in high school graduation rates, on average.<sup>21</sup> A few small-scale experiments (the Perry Preschool program being the most well-known), as well as national sibling studies that followed children from the same family who did and did not attend Head Start, have observed reductions in juvenile or adult crime. One of these national studies found that Head Start had an effect of .23 standard deviations on an index of young-adult outcomes comprising high school graduation, college attendance, joblessness, crime, teen parenthood, and health.<sup>22</sup>

The long-term experimental evaluations of Perry Preschool and the Abecedarian Project examined health outcomes in adulthood. Adults who participated in either program as children were less likely to use

drugs, tobacco, and alcohol. Abecedarian participants also had fewer depressive symptoms. When members of Abecedarian's research sample reached their mid-30s, those in the treatment group has lower rates of metabolic syndrome than those in the control group.<sup>23</sup> Descriptive analyses examining how these long-term effects come about suggest that higher educational attainment may play a mediating role.<sup>24</sup>

### Variation in Effects

How do preschool education's effects vary according to policy and demographic factors? We consider three major categories: dosage (how much time children spend in preschool); characteristics of children or their families; and program quality. We also review findings from an emerging area of research on how impacts vary across preschool centers and what factors predict that variation.

### Dosage and Duration

Only a few studies have examined whether preschool education has larger effects if it lasts for two years instead of one. The evidence isn't strong (none of these studies randomly assigned children to one versus two years of preschool), and the findings aren't clear. Focusing on disadvantaged children, the studies find that children who experience more years of preschool see larger gains. But the added gains of an additional year are often smaller than the gains that four-year-olds typically experience from one year of participation.<sup>25</sup> Why would an additional year generally produce smaller gains? For one thing, children who attend an additional year of preschool may experience the same curriculum across the two years rather than a sequenced two-year curriculum. Mixed-age classrooms (of three- and four-year olds) may magnify this problem.

Another measure of dosage is whether children spend a full day or a half day in preschool. Two recent studies, one experimental and one quasi-experimental, found that full-day preschool programs produced stronger cognitive and socioemotional outcomes than did half-day programs.<sup>26</sup> An experimental study that examined full-day versus half-day kindergarten (but not preschool) found better literacy outcomes from full-day exposure (effect size .31).<sup>27</sup>

### **Family and Child Characteristics**

It's difficult to estimate how preschool affects poor and better-off children differently, because virtually all preschool evaluations over the past decades have focused on poor families. Two recent evaluations are exceptions. Evaluations of the Tulsa and Boston prekindergarten programs, which were made available to all families, showed larger positive short-term effects on literacy and math skills (and in Boston on vocabulary) for poor children—although better-off children also saw small to large positive effects on these outcomes (a range of 0.30 to 0.75 standard deviations).<sup>28</sup> The Boston evaluation also found small positive impacts overall on executive function skills and the ability to recognize emotion, but among poor children, the executive function effects were larger than they were among better-off children.

What about differences by children's gender? Overall, we see no clear pattern. A study of three demonstration projects (Perry Preschool, Abecedarian, and the Early Training Project) suggested that long-term effects on a variety of outcomes pertained largely to girls rather than boys.<sup>29</sup> However,

a meta-analytic study found that this pattern didn't hold true for the larger set of rigorous preschool evaluations over the past several decades.<sup>30</sup>

Turning to other characteristics, few studies have had samples diverse enough to let researchers examine preschool programs' effects by race/ethnicity or by English language learner or immigration status. The samples in many of the landmark studies with long-term follow-up comprised nearly 100 percent low-income black children. More recent studies have analyzed more diverse samples, using regression-discontinuity approaches. For example, the Tulsa and Boston evaluations examined differences by race/ethnicity. The Boston study found larger impacts on language, literacy, early mathematics, executive function, and emotional skills among Asian, black, and Hispanic children than among white children (although the white children did show small gains in all those domains except emotional skills). In the Tulsa study, effects on children's literacy and mathematics skills were larger for Hispanic and Native American children than for white children, although whites also saw positive effects. Impacts were similar for white and black children in Tulsa on one test of early literacy, larger for whites on a different early literacy test, and larger for blacks for early mathematics. In both Boston and Tulsa, positive effects were strongest for Hispanic children (versus whites) and for English language learners (versus monolingual English speakers; the assessments were conducted only in English).<sup>31</sup>

Similarly, the Head Start Impact Study showed significantly larger effects on cognitive outcomes among Latino and English language learner children (who were



from Spanish-speaking households).<sup>32</sup> A second analysis of Head Start Impact Study data found that language and mathematics benefits were concentrated among English language learners who had the lowest skills when they entered the program.<sup>33</sup> A recent evaluation of Tennessee's prekindergarten program also found much larger short-term cognitive impacts for English language learners than for monolingual English speakers; the effects were particularly pronounced for English language learner children whose mothers had less than a high school degree.<sup>34</sup>

Three large-scale studies examined preschool's effects among children with disabilities. In studies of Head Start and the Tulsa and Boston prekindergarten programs, children with disabilities experienced positive short-term effects on cognitive skills. Although Head Start had no effects on their socioemotional skills, the Tulsa program reduced attention-seeking behavior and problem behaviors in interactions with peers for children with disabilities that attended prekindergarten. The Boston program strongly enhanced the impulse control of children with disabilities.<sup>35</sup> It's likely that the children identified in these studies had mild to moderate disabilities, rather than severe ones (children with severe disabilities are most often placed in specialized programs not included in these evaluations; see the article in this issue by Kathleen Hebbeler and Donna Spiker).

## Quality of Programs

For research purposes, preschool quality falls into two broad categories—structure and process. Structural quality includes features such as teacher education, group size, and staff-child ratio. Process quality

refers to children's interactions primarily with teachers, though also with other children. Structural quality sets the stage for higher-quality interactions to occur, although it doesn't guarantee that they will. Nationally, structural quality tends to be moderate, emotional support quality is good, and instructional quality is quite low.<sup>36</sup>

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*Higher quality appears to be associated with larger gains in children's skills.*

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Higher quality appears to be associated with larger gains in children's skills. The weight of nonexperimental evidence suggests that children make stronger gains in school readiness skills when they attend higher-quality preschool programs.<sup>37</sup> Moreover, particularly successful programs, like those in Boston and Tulsa, demonstrate higher instructional quality than typical US programs do.<sup>38</sup> In a recent set of 14 randomized trials, preschool curricula that focus on specific child developmental skills, that have a specific scope and sequence, and that were supported by high-quality teacher professional development such as in-classroom coaching have increased classroom quality and improved targeted child outcomes.<sup>39</sup> Combining focused curricula with supports for teachers in this way may help to raise the relatively low instructional quality of many large-scale preschool systems.

Preschool's effects on children's development depend not just on the quality of the preschool program they attend but also on the quality of alternatives to which a

preschool program is compared. A high-quality preschool program will show larger effects if we compare it to a low-quality setting, and smaller or no impacts if we compare it to another high-quality program. Empirically, several studies have found that Head Start has larger effects on children's cognitive outcomes when the alternative is parental or relative care, versus an alternative of another center-based preschool program.<sup>40</sup>

### **Variation across Preschool Centers**

Using data from the national Head Start Impact Study, two recent studies looked for statistically significant variation in impacts across Head Start centers.<sup>41</sup> Both found substantial variation. Some Head Start centers were much less effective than their local alternatives, and some were much more effective. One of the studies found that Head Start centers varied in their effects on language, literacy, self-regulation, and acting-out behaviors, but not their effects on math.<sup>42</sup> It may be that preschool teachers feel less comfortable teaching math than teaching language or literacy; spend less time teaching math than teaching other topics; or limit their math instruction to simple skills such as counting and recognizing shapes or numerals.

In nonexperimental analyses, centers produced larger effects on cognitive skills if they offered full-day rather than half-day care or served a larger percentage of English language learners with low baseline vocabulary skills. And centers that offered more than three home visits a year showed stronger positive impacts on a socioemotional skills composite than did centers that offered fewer visits. On the other hand, factors such as having a teacher

with a BA or teaching license, the center director's experience level, and the child-teacher ratio weren't related to variation in the size of a center's impacts.<sup>43</sup>

### **Why Do Long-Term Effects Vary?**

What might explain preschool programs' long-term effects on adult outcomes such as educational attainment, health, crime, and earnings? One puzzle we need to solve concerns the role of achievement effects, which tend to dissipate in the medium term, with the most rapid drops in the early elementary school years.<sup>44</sup>

Several factors may help explain the circumstances under which this convergence occurs, or those under which long-term effects occur.

First, the quality of the early elementary schooling that follows preschool may explain whether short-term effects are sustained. One study using matching methods found that when children transitioned to higher-quality schools, effects of preschool were more likely to be sustained. When children attended lower-quality schools, effects disappeared more quickly.<sup>45</sup>

Second, kindergarten or first-grade teachers may focus on helping children with lower levels of skills get up to speed; among such children, those who didn't attend preschool may be overrepresented. The no-preschool children may thereby catch up to their preschool-exposed peers, so that the relative benefits of preschool fall rapidly across the early primary grades. However, we don't have enough data to support or reject this hypothesis.

Third, aligning instructional content in the early elementary grades with that of

preschool may also be important. One study found that the boost in early math skills that children get from an early childhood mathematics curriculum lasted into early elementary school only when kindergarten instruction was aligned with preschool instruction. The study achieved alignment by bringing together preschool, kindergarten, and first-grade teachers to discuss what students learn in each grade, with the goal of minimizing repeated content.<sup>46</sup>

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*If preschool education doesn't affect more fundamental or broad-based skills such as vocabulary, we may not see differences later in important domains such as reading comprehension.*

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Fourth, if preschool targets skills that children would develop anyway later in schooling, it wouldn't be surprising if comparison groups catch up during the elementary grades. For example, by third grade children almost universally achieve language decoding skills such as alphabet recognition. If preschool education doesn't affect more fundamental or broad-based skills such as vocabulary, we may not see differences later in important achievement domains such as reading comprehension. Similarly, by the end of elementary school, almost all children master the skills that many preschool math curricula focus on—number recognition, relative magnitude, and basic arithmetic and geometry. We don't have enough evidence to say whether math

skills taught in preschool are related to later skills that help children achieve higher math skills such as algebra in middle school and high school. We may need to learn which fundamental aspects are causally related to long-term outcomes and then teach those skills in early childhood, rather than focus on the elementary math skills that virtually all children achieve in the first years of primary school.<sup>47</sup> It's also possible that some of the roots of long-term impacts lie in areas of development that achievement tests in middle childhood don't typically capture. In the Perry Preschool evaluation, for example, the degree to which children exhibited acting-out behaviors appeared to play the strongest explanatory role in middle childhood.<sup>48</sup>

Fifth, if the control (or no-preschool) group is particularly deprived of basic instruction and access to learning the skills taught in preschool, then preschool's effects may be longer-lasting. That may be why more recent studies show slightly smaller effects on average than older studies do.<sup>49</sup> In evaluations of preschool education experienced in the 1960s and '70s, members of control groups were likely to remain at home rather than attend other center-based care or preschools. Three recent studies show that the cognitive effects of Head Start are larger when Head Start children are compared to children staying at home, rather than to children in other centers.<sup>50</sup> That finding implies that any given preschool program's effects would get smaller over the decades, as more children began attending preschool. However, other aspects of the control group have also changed over time. The National Assessment of Educational Progress shows that third-grade math and reading scores increased substantially between 1978 and 2008 (the equivalent of



two years' worth of typical learning in math, and one year's worth of learning in reading). On the home front, the best available national data show that between 1998 and 2010, parents increased their investments in home educational resources and children were more often involved in enriching activities at home.<sup>51</sup> These increases occurred among families of all income levels, but they were particularly pronounced for low-income families. Across the same time span, national data also show increases in children's literacy and mathematics skills when they entered kindergarten, particularly among children from low-income and black families.<sup>52</sup> We don't yet know what best explains the pattern of convergence after preschool—changes over time in preschool or early primary-grade instruction, in parenting quality, or in parents' investments in children's learning.

## **Conclusions**

The evidence suggests that preschool education produces consistent and positive short-term effects on early language, literacy, and math skills. Short-term effects on socioemotional outcomes such as aggressive behaviors are less consistent, but they appear to be positive (for example, lower aggression) when preschools use behaviorally oriented curricula and programming. In the medium term, we find evidence of small reductions in grade retention and use of special education—6 to 8 percentage points, on average. Some studies have found long-term positive effects on high school graduation and criminality, though only in the context of very high-quality, small-scale programs, or of large-scale programs implemented in the 1960s, '70s and '80s, when comparison

groups had less access to other centers or preschools than they do today. The jury is still out on long-term effects of more recent large-scale programs, because we simply haven't had enough time to assess their impacts.

Overall, higher quality is associated with larger effects. In the United States, the quality of emotional support in preschool classrooms appears relatively strong when compared to the quality of instructional support. Recent experimental studies showed that efforts to improve instructional support through developmentally focused curricula, combined with intensive in-service training or coaching, can lead to small to large increases in targeted domains of child learning (amounting to roughly a couple of months to half a year of additional learning beyond business-as-usual preschool).

What factors might produce effects that are both larger and more sustained? Our review indicates several possibilities, although evidence is limited. First, we find relatively strong support for combining focused curricula with onsite help for teachers. Second, preschool's effects may last longer if we focus on fundamental skills that both predict long-term outcomes and are less likely to be gained in the first years of school. Third, better instructional quality and curricular alignment in early primary school may sustain the boost that quality preschool education can provide. All of these approaches suggest that if we want to see sustained improvements in children's development and learning, we need to increase the quality of—not just access to—preschool education.

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# The Economic Returns to Early Childhood Education

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## Summary

One way to assess the value of preschool education programs is to compare their upfront costs with the economic benefits they produce, measured by such outcomes as less need for special education services, improved high school graduation rates, higher earnings and less criminal activity in adulthood, and so on. What do such benefit-cost analyses tell us about the wisdom of investing in greater access to preschool? In this article, Lynn Karoly carefully reviews the evidence.

First, she identifies the biggest challenges in measuring the economic returns from preschool programs. Then she summarizes the range of estimates from various benefit-cost analyses and some of the methodological differences that can account for the differences among them. Last, she explores the implications of the research for using benefit-cost analysis results to make policy decisions about preschool education.

One key challenge: Although many preschool programs have been evaluated for their educational effectiveness, few have been subject to economic evaluations. Most predictive studies of preschool education's long-term economic benefits rely on benefit-cost analyses of programs that were implemented decades ago, when a far smaller proportion of children attended preschool at all, and that followed their subjects well into adult life. Although analyses of those programs suggest returns from preschool as high as \$17 for every dollar invested, Karoly concludes that in today's context, it may be more realistic to expect returns in the range of \$3 to \$4.

In the end, Karoly writes, we need to improve the quality and usefulness of economic evaluations of preschool, particularly by calculating the true economic value of preschool programs' short-term and medium-term effects in areas such as cognitive, social-emotional, and behavioral development. We could then more easily evaluate the economic benefits of a preschool program without having to wait until the participating children grow to adulthood.

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The case for investing in publicly funded preschool programs rests on a foundation of rigorous program evaluations that demonstrate favorable short- and longer-term effects from high-quality early learning programs.<sup>1</sup> That evidence is reinforced by economic evaluations—particularly benefit-cost analyses—that quantify the positive economic returns from such investments to the public sector and to society as a whole.<sup>2</sup> Both types of evidence—program evaluations and economic evaluations—have gained currency in a policy climate that stresses results-based accountability at all levels of government and prioritizes spending for evidence-based programs.<sup>3</sup> Policy makers want evidence that resources invested in early childhood programs and other areas of social policy can produce downstream benefits for students, the public sector, and society as a whole that can pay back the cost of the investment.

As a decision-making tool, benefit-cost analysis allows policy makers in the public and private sectors to compare the economic value of the resources invested in a high-quality preschool program with the economic value associated with that program's effects on children's outcomes. Among these outcomes are school readiness, use of special education, rates of grade repetition, likelihood of high school graduation, employment rates, and earnings. Other outcomes include levels of social and economic problems in adolescence and adulthood, such as delinquency and crime, teenage pregnancy, and dependence on welfare.

Researchers have applied benefit-cost analysis and other related economic evaluation methods (such as

cost-effectiveness analysis) to preschool programs for more than 40 years. When the age-19 follow-up results from the Perry Preschool Project were published in 1984, evaluators made a case that the program's two-year price tag—\$9,289 per child, measured in 1981 dollars—was more than offset by the \$33,058 per child in benefits to society (where future benefits were discounted). Thus, the estimated return to society was nearly \$4 for every dollar spent on the program. According to the results, Perry Preschool reduced the cost of K–12 education, raised lifetime earnings, lowered lifetime welfare use, and reduced lifetime costs from crime and delinquency.<sup>4</sup> (See the introductory article in this issue for a description of Perry Preschool and other programs discussed here.)

In reports that support expanded access to high-quality preschool and other early care and education programs, especially for children from low-income backgrounds who otherwise lack access to such programs, leaders in business and the military have cited benefit-cost analyses that suggest returns as high as \$17 for every dollar invested.<sup>5</sup> During his 2013 State of the Union address, President Obama called for making high-quality preschool available to every child in the United States, citing an expected return of more than seven to one from his proposed federal investment.<sup>6</sup>

In this article, I focus on evidence from benefit-cost analyses of preschool programs. I define these as part- or full-day early learning programs that serve children in center-based settings, delivered by public or private providers for one or two years before the children enter kindergarten. This scope includes both universal programs and those targeting at-risk children. The programs



may be implemented on a national scale (such as Head Start), within a state or locality (for example, Oklahoma’s universal preschool program), or as a small-scale demonstration program like Perry Preschool.

I also consider preschool programs that extend to the elementary grades, known as P–3 programs—for example, the Chicago Child-Parent Centers (CPC) program. And I reference findings from an economic analysis of the Abecedarian program—which was not strictly a preschool program, but rather an early intervention program serving low-income children from birth to age five with full-day year-round care and early learning. In addition to economic evaluations of existing programs, I also consider evidence from *prospective* benefit-cost analyses, which predict future economic returns from implementing targeted or universal programs on a larger scale.

To make this type of economic evidence more useful as part of the preschool policy debate, I set three goals: first, to identify the key challenges in measuring the economic returns from preschool programs; second, to summarize the range of estimates available from various benefit-cost analyses and some of the methodological differences that can account for the differences among them; and third, to explore the implications of the research on preschool-program impacts and economic returns, both for future research and for using benefit-cost analysis results to make policy decisions.

## Challenges in Measuring Economic Returns for Preschool Programs

Performing a benefit-cost analysis of a preschool program can be complex. However, some of the requirements are relatively straightforward. We need:

1. A well-defined program and clearly specified counterfactual condition (that is, what the preschool program is being compared to).
2. A comprehensive estimate of the program’s cost relative to the counterfactual condition.
3. An evaluation that provides estimates of the program’s causal impact, in the short term and possibly in the longer run, on outcomes for the participating children (and perhaps other beneficiaries, such as parents) relative to the counterfactual condition.
4. An economic value—a market price or, if that’s not available, a shadow price that captures the economic value—to attach to each affected outcome, representing what society is willing to pay for that outcome.

Several other parameters must be established for a benefit-cost analysis, such as the time period over which costs and benefits will be measured, and the rate for discounting costs and benefits that occur in the future into present-value dollars.<sup>7</sup> The analysis is typically performed from a societal perspective, which means that all costs and benefits are accounted for. That would include costs and benefits that accrue both to the public sector (federal, state, and local government) and to the program participants themselves, as well as any private benefits that flow to the rest of society (for example, the private gains from crime reduction).

With these elements in place, the analyst calculates the present discounted value (PDV) of the program costs and the PDV of the stream of outcomes that occur over time, with outcomes valued in dollars using market or shadow prices. The PDV of the outcomes

(benefits) minus the PDV of the program costs gives us the net present value (NPV). If the NPV exceeds zero, or if the benefit-cost ratio (PDV benefits divided by PDV cost) exceeds one, then the program has a positive return. (The PDV of a stream of dollar values to be realized in the future is calculated using a discount rate to convert future dollars into current dollars, recognizing that a dollar will be worth less in the future than a dollar today. A typical discount rate for benefit-cost analyses of social programs falls in the range of 3 to 4 percent. If, for example, a preschool program delivered in 2016 saves \$1,000 in special education costs 10 years in the future, that benefit is valued, using a 3 percent discount rate, at \$744 in 2016 dollars. This is the equivalent of compound interest in reverse.)

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*It's hard to put a price on many of the outcomes we measure.*

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Researchers face a number of challenges when using benefit-cost analysis to evaluate a preschool program. Four issues stand out. The first is that it's hard to put a price on many of the outcomes we measure. The short-term outcomes typically measured in preschool evaluations capture children's developmental readiness in various domains: pre-reading skills, language and literacy skills, pre-math skills, and social and emotional skills, among others. These outcomes don't have a clear dollar value, a fact that may preclude conducting a benefit-cost analysis of a program that hasn't followed the participants (and nonparticipants) past the point when they entered school.

If the program evaluation does extend the follow-up period into the elementary grades (through surveys or direct observation, or by linking to school records), we can measure other outcomes such as grade repetition and use of special education. These may be valued in the benefit-cost analysis based on their cost to the education system. But again, it's hard to put a dollar value on measured impacts on student achievement (for example, test scores or grades).

Extending the evaluation period beyond the elementary grades may capture outcomes during the adolescent years, such as crime, delinquency, and eventually dropping out of high school versus graduating. It's easier to put a price on those kinds of outcomes. And when we follow participants into the adult years, we can evaluate behavior in the labor market, health behaviors, and other economic and social behaviors (such as financial savings and home ownership, substance use, marriage and childbearing, welfare use, and so on). The bottom line is that benefit-cost analysis for preschool programs, like analyses of other early childhood interventions, works best with long-term follow-up. That way, the evaluators can measure and place dollar values on outcomes in adolescence and beyond.

A second challenge is related to the fact that preschool programs are expected to affect outcomes throughout the life course. Thus a full accounting of potential benefits would require projecting outcomes from preschool participation into the future, beyond the point of the last follow-up. To connect outcomes measured at younger ages with expected outcomes at older ages, we need to make assumptions about the causal relationships through time. As we'll see in the next section, benefit-cost

analyses of preschool programs that make such linkages typically do so to project how educational attainment may affect future earnings, or how crime and delinquency in the adolescent years may affect criminal behavior in adulthood. More recently, benefit-cost analyses of preschool programs have made assumptions about links between achievement test scores at younger ages and educational attainment or future earnings. In essence, connecting early outcomes with later outcomes is one way to place an economic value on an early outcome that would otherwise not be valued in monetary terms.

The third challenge we face is that spillover benefits to other parties—such as parents, siblings, and participants’ own children—may not be captured at all by evaluations of preschool programs. Most preschool evaluations to date haven’t measured these spillover effects directly. And although such effects have been hypothesized, they generally haven’t been incorporated into the benefit-cost analyses I review in the next section. An exception is a benefit-cost analysis for the Abecedarian program, which did incorporate projected benefits for participants’ children.<sup>8</sup>

These three challenges together make it hard to capture the full economic value of favorable effects from a high-quality preschool program. Thus, benefit-cost analyses may underestimate a program’s benefits. And then there’s the fourth problem: it’s often impossible to calculate the incremental benefits and costs of a preschool program against a counterfactual condition of the absence of preschool participation. For evaluations of preschool programs conducted in the 1960s and 1970s, the counterfactual condition was effectively no program, because back then relatively few

children participated in formal early learning programs. By 2014, however, 52 percent of three- to five-year-olds who weren’t in kindergarten were enrolled in some sort of prekindergarten, preschool, or nursery school program.<sup>9</sup>

Today, then, the counterfactual condition to which we must compare any preschool program includes a high proportion of preschool-age children who are enrolled in some other program. For example, in the National Head Start Impact Study, 60 percent of the children in the 2002–03 program year who were randomly assigned to the control group attended an alternative preschool program. For 18 percent of four-year-olds, the alternative was another Head Start program.<sup>10</sup> The fact that most children now attend some sort of preschool program means that we must be careful when comparing benefit-cost analyses conducted in the past with those conducted more recently. In particular, we can expect the impacts and associated economic benefits found in more recent preschool program evaluations to be relatively more modest than those found in programs implemented and evaluated decades ago, when most children didn’t attend preschool at all.<sup>11</sup>

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*The evidence for economic returns from high-quality preschool programs contains few apples-to-apples comparisons.*

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In the face of these and other challenges, anyone conducting a benefit-cost analysis

for a preschool program must choose such features as which shadow prices to use, which discount rate to employ, and how to project outcomes into the future. Consequently, the findings from a benefit-cost analysis for one preschool program can't necessarily be compared to the findings from another. Even when researchers use the same set of methods—for example, the benefit-cost model developed by the Washington State Institute for Public Policy (WSIPP), which provides economic evidence to guide state legislature investments in such policy areas as early childhood, K–12 education, and crime prevention—the results from the benefit-cost analysis for one preschool program won't necessarily be comparable to the results for another, because the analyses often measure different outcomes and have different follow-up periods.<sup>12</sup> For this reason, the evidence for economic returns from high-quality preschool programs contains few apples-to-apples comparisons.

## **Evidence of Economic Returns to Preschool Programs**

Although numerous high-quality preschool programs have been rigorously evaluated, far fewer have been subjected to a comprehensive benefit-cost analysis, in part because of the challenges I've just outlined. Benefit-cost analyses for the category of preschool programs defined at the outset of this article range from back-of-the-envelope calculations to formal analyses that include a thorough cost analysis, evidence of a program's causal impact, and valuation of the measured outcomes.<sup>13</sup> I'll begin this section by reviewing the approaches and findings of benefit-cost analyses conducted for preschool programs that have already been implemented and evaluated. Then

I'll consider findings from several economic evaluations that estimate the potential returns from expanded preschool programs that have yet to be implemented. This group includes prospective estimates of economic returns using a benefit-cost analysis framework, as well as several studies that estimate economy-wide impacts as preschool becomes available to new cohorts of children over time.

## **Economic Evaluations of Implemented Programs**

Table 1 lists preschool programs implemented and evaluated in the United States that have undergone one or more formal benefit-cost analyses. The table includes two targeted part-day programs serving children one or two years before kindergarten entry: one is a demonstration program—Perry Preschool—the other a program operated by the Chicago public school district—Chicago CPC. The third distinct program is Oklahoma's publicly funded universal preschool program serving children part-day or full-day one year before kindergarten entry, with an evaluation of the program as implemented in the Tulsa school district—Tulsa UPK.

The other two entries in table 1 are programs that WSIPP subjected to benefit-cost analyses based on a meta-analysis of program impacts and program costs and valuation of outcomes specific to Washington state (a meta-analysis is a statistical approach for combining findings across multiple studies of the same program or similar programs). The studies included in the WSIPP meta-analysis cover 12 evaluations of the Head Start program and 17 evaluations of publicly funded state- and district-administered preschool programs, including Chicago CPC and Tulsa UPK. The programs in table 1 vary in terms of other features that are markers for preschool program quality,

**Table 1.** Features of Preschool Program Benefit-Cost Analyses

	Impacts from Single Program Evaluations					Impacts from Meta-Analysis	
	Perry Preschool	Perry Preschool	Perry Preschool	Chicago CPC	Tulsa UPK	Head Start	State and district programs
Follow-up age for BCAs	19, 27, 40	27	40	21, 26	5	Varies	Varies
Outcomes valued							
Child abuse and neglect	–	–	–	O, P	–		
Achievement tests	X	X	X	X	L	L	L
K–12 net savings	O	O	O	O	–	O	O
Postsecondary net savings	O	O	O	O	–	–	–
High school graduation	X	X	X	X	–	L	L
Earnings (and taxes)	O, P	O, P	O, P	O, P	–	–	–
Crime—tangible	O, P	O, P	O, P	O, P	–	O, P	O, P
Crime—intangible	O, P	X	O, P	O, P	–	O, P	O, P
Welfare use	O, P	O, P	O, P	–	–	–	–
Depression	–	–	–	O, P	–	–	–
Smoking	–	–	–	O, P	–	–	–
Substance abuse	–	–	–	O, P	–	–	–
Teen birth	–	–	–	–	–	O	–
Mortality	O	–	–	–	–	–	–

*Abbreviations:* L = outcome linked to monetizable earnings; O = observed outcomes; P = projected outcomes; X = measured but excluded from valuation; – = not measured or no significant effect.

*Sources:* For Perry Preschool column one: Berrueta-Clement et al. (1984); Barnett (1996); Barnett, Belfield, and Nores (2005); for Perry Preschool column two: Karoly et al. (1998); for Perry Preschool column three: Heckman et al. (2010); for Chicago CPC: Reynolds et al. (2002, 2011); for Tulsa UPK: Bartik, Gormley, and Adelstein (2012); for Head Start and state and district programs: WSIPP (2014). See endnotes for full citations.

*Note:* For programs with multiple benefit-cost analyses, outcomes valued are based on the most recent benefit-cost analysis.

such as group size, teacher-child ratio, teacher education and training, curriculum, and the nature of teacher-child interactions.

The programs listed in table 1 were evaluated in one of two ways. The Perry Preschool evaluation and one of the Head

Start evaluations in the meta-analysis used an experimental design—that is, one in which children were randomly assigned to the program (treatment) or to no program (control). Other evaluations used quasi-experimental designs, rigorous methods

that are viewed as a valid alternative to an experimental design. The most common quasi-experimental design used to evaluate larger-scale public preschool programs, including those of the Tulsa UPK and most of the state and district programs, is a regression discontinuity design, which is considered to be one of the best methods when an experimental design isn't possible.<sup>14</sup>

The Chicago CPC evaluation uses a nonrandom comparison group with pre-test data collected retrospectively to demonstrate baseline equivalence, an approach that some researchers view as a weaker evaluation design.<sup>15</sup> I nevertheless include the study because it's one of the few with long-term follow-up and a careful benefit-cost analysis. In addition, the findings from Chicago CPC are often used to forecast the potential impacts and economic returns of expanding access to high-quality preschool (for example, by instituting universal preschool).

The years covered by the evaluations range from the early 1960s for Perry Preschool to 2005 for Tulsa UPK. (The meta-analysis findings fall within the same range.) Because of this long time span, the counterfactual condition isn't consistent. Perry Preschool and Chicago CPC were evaluated when few children in the control or comparison group had access to a formal early learning program. For Tulsa UPK and many of the evaluations that underlie the meta-analyses of Head Start and state and district public preschool, up to 60 percent of children in the comparison group participated in some form of center-based preschool program.

These evaluations provide the basis for the benefit-cost analyses, using the methods summarized in table 1. The Perry Preschool program has been the subject of at least

five benefit-cost analyses. Three were associated with the evaluation conducted by the HighScope Educational Research Foundation, which implemented the Perry Preschool program, and were based on follow-ups at ages 19, 27, and 40.<sup>16</sup> Scholars from the RAND Corporation conducted a benefit-cost analysis based on the age 27 follow-up findings, and another group of researchers conducted an analysis using the age 40 findings.<sup>17</sup> Likewise, the Chicago CPC has undergone benefit-cost analyses based on follow-up results at ages 21 and 26.<sup>18</sup>

Given the long-term follow-up available with the Perry Preschool and Chicago CPC programs, the benefit-cost analyses have valued a wide range of outcomes. In all cases, the benefit-cost analyses captured observed net savings to the K–12 education system from fewer grade repetitions and less need for special education. They also captured net savings or costs to the higher education and adult education system (these actually turned out to be net costs, because children in the programs tended to complete more years of schooling). All of the benefit-cost analyses value both observed and projected earnings gains, along with observed and projected savings from reduced crime and lower welfare use. The Chicago CPC benefit-cost analysis further incorporated observed and projected benefits from favorable effects on child abuse and neglect, depression, smoking, and substance abuse.

Both Perry Preschool and Chicago CPC produced favorable effects on test scores that continued past the early elementary grades, as well as favorable effects on the rate of high school graduation. But the benefit-cost analyses didn't value these outcomes directly or link them to other



outcomes because the long-term follow-ups provided direct evidence of the programs' impact on such outcomes as earnings, crime, and welfare use. The RAND study (second column, Perry Preschool at age 27) was the only benefit-cost analysis to omit the intangible benefits from reduced crime.

In contrast, the Tulsa UPK benefit-cost analysis was more limited than those of Perry Preschool and Chicago CPC in that it was based on measured impacts on reading and math skills when children entered kindergarten.<sup>19</sup> To estimate partial economic returns in terms of future earnings, the Tulsa UPK study used the findings from an experimental evaluation of Tennessee Project STAR (Student/Teacher Achievement Ratio). That study was designed to test the relationship between class sizes in kindergarten and the early elementary grades and student outcomes. Based on long-term follow-up of the Project STAR treatment and control-group children, Stanford University economist Raj Chetty and colleagues provided a causal estimate of the relationship between early test scores and adult earnings.<sup>20</sup>

In particular, the Project STAR long-term follow-up data indicate that a one percentage-point increase in achievement scores among kindergarteners leads to a \$78.71 increase in annual earnings at ages 25–27 in 2009 dollars. Other researchers used this estimate and the age-earnings profile for workers in the Tulsa metro area to estimate that a one percentage point increase in test scores leads to an increase of \$1,502 in lifetime earnings (after discounting to present value and converting to 2005–06 dollars). The evaluation of Tulsa UPK showed an increase in test scores, on average, of 8.8 to 20.2 percentage points, depending on the

children's family income and whether they attended part-day or full-day preschool.

Combining these estimates indicates a projected increase in present-value lifetime earnings per child from participation in Tulsa UPK of \$13,200 to \$30,400. Notably, when the Tennessee STAR estimate of the relationship between early test scores and lifetime earnings is used to forecast the future earnings gains for the participants in Perry Preschool and Chicago CPC (two studies with earnings measured in adulthood), the forecast either slightly underpredicts the measured earnings gains (Perry Preschool) or provides a close estimate (Chicago CPC), thus supporting the projection approach.<sup>21</sup>

As a final step, we compare the estimate of the lifetime earnings benefits per child from Tulsa UPK participation in a part-day or full-day program with the associated cost of participation—about \$4,400 for a part-day program and \$8,800 for a full-day. That gives us an estimate of NPV benefits (that is, PDV benefits minus PDV costs) or a benefit-cost ratio (PDV benefits divided by PDV costs). The WSIPP meta-analysis for Head Start and state and district preschool programs similarly links test scores and earnings; it also values and projects some of the same outcomes captured in the Perry Preschool and Chicago CPC benefit-cost analyses.<sup>22</sup>

The results of the benefit-cost analyses for the programs listed in table 1, all calculated from a societal perspective, are summarized in table 2. The benefit-cost analysis of the Tulsa UPK program produced separate results for children in three income groups: those eligible for free lunches (family income below 130 percent of the federal

**Table 2.** Benefit-Cost Analysis Results for US Preschool Programs

Program (Follow-Up Age)	Per Child (in 2014 dollars)			
	PDV Costs	PDV Benefits	NPV Benefits	Benefit-Cost Ratio
Perry Preschool (age 19)	24,192	86,095	61,903	3.56
Perry Preschool (age 27)	18,329	75,399	57,070	4.11 <sup>a,b,c</sup>
Perry Preschool (age 27)	20,850	182,238	161,389	8.74
Perry Preschool (age 40)	20,850	355,912	335,063	17.07
Perry Preschool (age 40)	–	–	–	7.1–12.2 <sup>d</sup>
Chicago CPC (age 21)	9,719	69,364	59,644	7.14 <sup>a</sup>
Chicago CPC (age 26)	9,719	105,294	95,575	10.83
Tulsa part-day program (age 5)				
Free lunch students	5,170	21,084	15,914	4.08 <sup>e</sup>
Reduced-price lunch students	5,170	15,462	10,291	2.99 <sup>e</sup>
Full-price lunch students	5,170	17,775	12,605	3.44 <sup>e</sup>
Tulsa full-day program (age 5)				
Free lunch students	10,341	31,990	21,649	3.09 <sup>e</sup>
Reduced-price lunch students	10,341	35,703	25,362	3.45 <sup>e</sup>
Full-price lunch students	10,341	29,197	18,857	2.82 <sup>e</sup>
Head Start (varies)	8,830	23,150	14,320	2.63
State and district preschool programs for low-income 3- and 4-year-olds (varies)	7,191	30,119	22,928	4.20

<sup>a</sup>Excludes value of reduced intangible crime victim costs.

<sup>b</sup>Discount rate is 4 percent.

<sup>c</sup>Discounted to age 0.

<sup>d</sup>Reported range of estimates from Heckman et al. (2010) under alternative assumptions regarding the economic cost of crime.

<sup>e</sup>Discounted to age 4.

*Abbreviations:* PDV = present discounted value; NPV = net present value.

*Sources:* Perry Preschool (in order): Berrueta-Clement et al. (1984); Karoly et al. (1998); Barnett (1996); Barnett, Belfield, and Nores (2005); Heckman et al. (2010); Chicago CPC: Reynolds et al. (2002, 2011); Tulsa: Bartik, Gormley, and Adelstein (2012); Head Start and state and district programs: WSIPP (2014). See endnotes for full citations.

*Notes:* All dollar values were converted to 2014 dollars using the Consumer Price Index for All Urban Consumers. The benefit-cost ratios are the ratio of the present discounted value of total benefits to society as a whole (participants and the rest of society) divided by present discounted value of program costs. The discount rate is 3% and discounting is to age 3 unless otherwise noted. The value of reduced intangible-crime victim costs are included unless otherwise noted. – = not available.

poverty line), those eligible for reduced-price lunches (income between 130 percent and 185 percent of the poverty line), and those not eligible (income greater than 185 percent of the poverty line). For each income group, separate results are shown for the part-day and full-day programs. When available, the table lists the PDV costs and benefits per child for each study, along with the NPV benefits (PDV benefits minus PDV costs), all converted to 2014 dollars. The associated benefit-cost ratio is listed as well.

Several results stand out from this series of economic evaluations:

- Program costs range widely, from about \$5,200 per child for the one-year Tulsa UPK program to nearly \$21,000 for the two-year Perry Preschool program. These differences reflect the programs' duration and intensity, as well as variations in the type and quality of services provided.
- The level of net benefits varies considerably as well, in part because of the outcomes available in the evaluation that can be valued and their associated magnitudes. The age-40 Perry Preschool benefit-cost analysis, with an array of sizable impacts on high-value outcomes (such as earnings and crime) that are both observed and projected, shows estimated net benefits that exceed \$300,000 per child. Tulsa UPK (which values only projected lifetime earnings gains based on test scores) and Head Start (with smaller impact estimates) are at the lower end of the range, with estimated net benefits of \$10,000 to \$16,000 per child.
- The corresponding benefit-cost ratios extend from about \$3 to \$17 of benefits for every dollar of cost.<sup>23</sup> The highest benefit-cost ratios are associated with

Perry Preschool and Chicago CPC, the two targeted programs with long-term follow-up. Benefits exceed costs by a sizable margin in both the targeted programs in table 2 and in the one universal program (Tulsa UPK). Moreover, favorable returns are found for the Perry Preschool small-scale demonstration program and for the larger-scale programs implemented at the district level or beyond. But the estimated returns are clearly smaller in the scaled-up programs, even when long-term follow-up findings are available to include in the economic evaluation (as in Chicago CPC and Head Start).

- The multiple benefit-cost analyses available for Perry Preschool and Chicago CPC with each successive follow-up evaluation as the participants grew older show an increase in the estimated net benefits and benefit-cost ratio as outcomes are observed at older ages and the associated forecast period declines. This suggests that the forecasts applied at younger ages tended to understate the future benefits for such outcomes as earnings, crime, and welfare use.
- The Tulsa UPK findings indicate that a one-year part-day or full-day universal preschool program is likely to produce favorable returns for children across the income spectrum. The estimated returns are based solely on earnings projections from the program's impact on test scores, and are quite similar for the three income groups. The NPV benefits from participation in a full-day program are higher for each income group. On the other hand, except for the reduced-price lunch group, the benefit-cost ratio from

the full-day program is lower compared with the part-day program.

- The estimated returns shown in table 2 are based on the set of observed or projected outcomes from the preschool program evaluations. Although the evaluations consider a number of key short- and long-term impacts (see table 1), other potentially important benefits aren't accounted for because they typically haven't been measured. These include intermediate-term benefits to school systems from a reduced need for services for children with behavior problems beyond enrollment in special education classes (which is accounted for in several of the benefit-cost analyses), and lower teacher turnover because of fewer behavior problems. Spillover benefits to classroom peers also aren't assessed. If such outcomes could be demonstrated as part of preschool program evaluation, they would provide additional sources of economic benefits.

In sum, table 2 shows strong evidence that both targeted and universal preschool programs produce favorable economic returns, whether they're provided for one or two years before kindergarten. The evidence also shows that such returns can be realized for scaled-up programs. At the same time, although table 2 features multiple estimates from benefit-cost analyses, the findings rely on just a handful of program models and their associated evaluations. Only two preschool programs taken to scale—Chicago CPC and Tulsa UPK—have undergone individual economic evaluations, and Tulsa UPK's evaluation is based on projecting future earnings from age-five test scores. The meta-analysis for Head Start rests on several evaluations, but only one national

experimental evaluation and a handful of quasi-experimental evaluations provide estimates of the program's longer-term impacts. Likewise—with the exception of Chicago CPC, one of the included studies—the meta-analysis findings for state and district programs are based mostly on short-term follow-up.

## Forecasting Returns from Universal Preschool Programs

The evidence that targeted programs such as Perry Preschool and Chicago CPC produced favorable economic returns sparked an interest in projecting the potential economic returns from universal preschool programs. Motivated by policy proposals to expand preschool access at the state and federal levels, several studies have been conducted to provide such estimates. Table 3 summarizes the key features of five state studies, all conducted in the mid-2000s.

These studies all project the benefits from state-level universal preschool programs—in some cases for a one-year program, in other cases for a two-year program. The studies consider the effect of increasing access to high-quality preschool programs, relative to current enrollment levels. In most cases, they also consider the effect of increasing the quality of current programs. The first two studies, for California and Texas, take a societal perspective. They base their impact estimates on the Chicago CPC age 21 follow-up findings, and they assume that because universal programs serve more children who aren't disadvantaged, their effects will be somewhat more muted than those of targeted programs.<sup>24</sup> The studies that cover programs in Arkansas,

**Table 3.** Approach and Findings from Prospective Benefit-Cost Analyses of State-Specific Universal Preschool Programs

BCA Study	Preschool Program Type	Counterfactual	Assumed Outcomes and Sources	Perspective	Benefit-Cost Ratio
California	Universal, one-year part-day academic-year	Current enrollment levels	Based on Chicago CPC impacts (attenuated for scale-up)	Societal	2:1 to 4:1
Texas	Universal, two-year full-day academic-year	Current enrollment levels	Based on Chicago CPC impacts (attenuated for scale-up)	Societal	3.4:1
Ohio	Universal, two-year part-day academic-year	Current enrollment levels	Based on Chicago CPC and other study impacts	Government	1.4:1 to 1.9:1
Massachusetts, Ohio, Wisconsin	Universal, one- or two-year part-day academic-year	Current enrollment levels	Based on Chicago CPC and other study impacts	Government	1.2:1 to 1.6:1
Arkansas	Universal, two-year part-day academic-year	Current enrollment levels	Based on Chicago CPC and other study impacts	Government	1.6:1

Sources: California: Karoly and Bigelow (2005); Texas: Aguirre et al. (2006); Ohio: Belfield (2004); Massachusetts, Ohio, and Wisconsin: Belfield (2006); Arkansas: Belfield (2006). See endnotes for full citations.

Massachusetts, Ohio, and Wisconsin focus on savings to government, with impact estimates derived from multiple evaluations, including evaluations of Chicago CPC.<sup>25</sup>

Despite the differences among these studies, the findings are quite similar. From the societal perspective, they estimate that a one- or two-year universal preschool program would generate returns from \$2 to \$4 for every dollar invested—consistent with the earnings-based impacts for Tulsa UPK. Focusing on savings to government alone, the returns range from just above \$1 to nearly \$2 dollars in government savings for every dollar of program cost.

### Economy-Wide Projections of Preschool Expansion

Other studies have taken a different approach to forecasting the economic benefits to be derived by expanding access to high-quality preschool, but they too rely on narrow evidence. One group of researchers estimated the national-level effect on economic growth (projected to 2080) of a two-year universal preschool program, based on evidence of the known relationship between educational attainment, earnings, and economic growth.<sup>26</sup> They concluded that such a program would add \$2 trillion to the US gross domestic product (GDP), measured against \$59 billion in program cost (all in

2005 dollars). Another study estimated the societal costs and benefits at the national level, projected to 2050, of a one- or two-year preschool program that is either targeted or universal, with estimated returns of 12-to-1 for the targeted program and 8-to-1 for the universal program.<sup>27</sup> To forecast the impacts, the first study used estimates from evaluations of Perry Preschool, while the second based its estimates on findings from Chicago CPC. Given that both these studies relied on evaluations of the two programs with the highest estimated returns, it's not surprising that they predicted strong economy-wide benefits that would outweigh the costs of either a targeted or a universal program. In fact, the second study's estimated returns are even higher than those produced for the Chicago CPC program itself.

## Implications for Preschool Policy

My review demonstrates that although many preschool programs have undergone impact evaluations, few have been subject to economic evaluations. Benefit-cost analyses have been produced for the three programs with evidence of longer-term impact: Perry Preschool, Chicago CPC, and Head Start. Many of the other programs that have been evaluated, such as state-funded preschool programs, have generated estimated impacts on school readiness and perhaps some other outcomes in the early elementary years, but these outcomes are less readily converted to monetary values.

The Tulsa UPK benefit-cost analysis shows that early skills can be linked to long-term earnings, but for now the connection relies on estimates from a single study. The WSIPP model incorporates meta-analysis to link various outcomes such as school-age test

scores to later outcomes such as earnings, which may produce more credible findings. Further evidence of links between early and later outcomes will make it easier to perform benefit-cost analyses for preschool programs that haven't yet had time to generate evidence of longer-term impact.

Even if we can make such projections, however, the long-term benefits of preschool programs that have had only short-term follow-up may be underestimated because all the relevant impacts—those measured at older ages, for which linkages can't be made—won't be accounted for. Consider the fact that the benefit-cost analyses of Perry Preschool and Chicago CPC that were based on outcomes observed at younger ages produced smaller estimated returns than did the benefit-cost analyses that were based on outcomes at older ages. That finding suggests that the projections themselves may understate longer-run effects, especially when researchers use conservative assumptions. At the same time, the fact that preschool participants' short-term developmental or achievement test gains may not last (see the article in this issue by Hiro Yoshikawa, Christina Weiland, and Jeanne Brooks-Gunn) raises the question of whether we can use such short-term gains to forecast later outcomes.

My review also shows how benefit-cost analysis and related methods are used to estimate the future benefits—whether for children or for the economy as a whole—of expanding preschool programs to cover either more low-income children or all children. We must acknowledge that these predictive studies rely heavily on impact estimates from Perry Preschool or Chicago CPC, even if they assume some dilution



of impacts because of scale-up or broader population coverage. The multiplicity of such studies makes it appear that the results are replicated across multiple jurisdictions and by using varied methods, but the truth is that most of the studies assume that future programs will produce impacts on the same set of outcomes that Perry Preschool and Chicago CPC affected. Those two programs and their associated evaluations heavily influence any evidence that makes a case for the positive economic returns of investing in preschool.

Of course, findings from one study don't necessarily apply to other existing or proposed preschool programs. Evidence that some early childhood education programs, such as those shown in table 3, generate positive economic returns doesn't mean that all such programs will have benefits that exceed their costs. Programs at scale—even high-quality targeted programs—are unlikely to produce economic returns as large as those measured for Perry Preschool. Universal programs and those of lower quality are likely to produce smaller returns. Different jurisdictions may also see different results, based on demographic factors and the way the programs are implemented.

Pointing to Perry Preschool's \$17-to-\$1 returns, in fact, may be setting expectations too high. Rather, it may be more realistic to expect returns in the range of \$3 to \$4 for every dollar invested, which is consistent with the WSIPP estimate for state and district public preschool programs. Given that more recent cohorts of children already have high rates of preschool participation, we must recognize that creating higher-quality programs or expanding access to preschool would represent incremental investments.

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*It may be more realistic to expect returns in the range of \$3 to \$4 for every dollar invested.*

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We also need to acknowledge that it may take time for even high-quality targeted programs to reach the break-even point. Depending on the nature of a program's early impacts and whether we can put a price on them, we may not see substantial monetary savings from improved outcomes until preschool participants reach adolescence or even young adulthood. For example, the RAND analysis of Perry Preschool, based on the age 27 follow-up results, found that cumulative benefits didn't exceed cumulative costs until 15 years after the intervention ended. This profile of upfront costs and a long payback period makes it hard to convince public-sector decision makers to commit to further preschool investments. It may also deter private investors who are interested in mechanisms like social impact bonds, whereby the investors fund the upfront costs of a preschool program in return for future payments from the government if the program produces public-sector savings.<sup>28</sup>

Another challenge we face is that the downstream payoff from publicly funded preschool investments may not always accrue to the same level of government or government agency that made the initial investment—the so-called *wrong pocket* problem. Let's say a city raises taxes to pay for universal preschool, but some of the returns flow to the federal government in the form of increased income-tax revenue from higher earnings. Similarly, a preschool investment

might be made through an education department, but the eventual savings from reduced crime would benefit police departments, the courts, and the corrections system. The fact that some returns from high-quality preschool are private gains to the participating children and their families also means that the public sector doesn't realize all of the downstream benefits. This problem has been an impetus for using social impact bonds as an alternative financing mechanism for preschools and other social programs.<sup>29</sup>

The economic evaluations I've reviewed have strongly influenced policy discussions about devoting public resources to preschool programs. Yet the quality and usefulness of such studies could be improved. For example, policy makers often want to know how economic returns vary with preschool policy choices. What are the differences between part-day and full-day programs, a program that serves children for one year before kindergarten versus two years, targeted versus universal programs, or a prekindergarten program as opposed to one that extends into the early elementary grades? Answering these questions would require evaluation evidence that shows how preschool programs' design affects children's outcomes in both the short and long run. For the most part, such evidence is currently lacking.

We should also calculate the economic value of the many short- and medium-term outcomes affected by preschool programs. We need to measure cognitive, social, emotional, and behavioral development when children enter school, and student achievement in the elementary grades. That way, economic evaluations of preschool programs could offer evidence of impacts in the short term, instead of waiting until longer-term impacts could be assessed.

Meanwhile, initiatives are under way to make benefit-cost analysis and other economic evaluation methods more useful for early childhood programs and other areas of social policy. One of these initiatives is a 2016 report from an ad hoc National Academies Committee on the use of Economic Evidence to Inform Investments in Children, Youth, and Families.<sup>30</sup> Such progress indicates that we'll see more advanced research on the relationship between preschool program design features and the impacts of those programs. In addition, we'll have more standardization in the measures included in impact evaluations and in the methods used to conduct economic evaluations. As a result of these changes, decision makers in the public and private sectors will soon have better evidence to guide investments in preschool programs.

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# Reading and Language in the Early Grades

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*Catherine E. Snow and Timothy J. Matthews*

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## Summary

How does literacy develop in children's early years, and what programs or practices promote adequate literacy for all children? These are the questions Catherine Snow and Timothy Matthews tackle in this article.

Fundamental literacy skills can be grouped into two categories, Snow and Matthews write. The first category is *constrained* skills, which are readily teachable because they're finite: for example, the 26 letters of the alphabet, or a set of 20 to 30 common spelling rules. These skills have a ceiling; young children can and do achieve perfect performance.

As they grow older, though, children need to understand words rarely encountered in spoken language and to integrate new information they encounter with relevant background information. Vocabulary and background knowledge are examples of *unconstrained* skills—large domains of knowledge acquired gradually through experience. Unconstrained skills are particularly important for children's long-term literacy success (that is, success in outcomes measured after third grade). Compared to constrained skills, they're also more strongly predicted by children's social class or their parents' education, and more difficult to teach in the classroom. And because of their open-ended nature, unconstrained skills are also much harder to test for. Snow and Matthews write that a drop in literacy scores we see as US children move from elementary to middle school suggests that our schools may be focusing too much on constrained skills—and too little on unconstrained ones—in the early grades.

The authors review promising programs and practices for enhancing both constrained and unconstrained skills, ranging from comprehensive school-improvement programs to efforts to improve curricula and teachers' professional development—although they note that vast differences in programs' scope, cost, targets, and theories of change make comparing them difficult. Another challenge is that it's hard to maintain quality and consistency when implementing complex programs over time. Snow and Matthews suggest that to improve young children's success with literacy, it might be better to introduce and evaluate promising practices that can be mixed and matched, rather than complex programs that are implemented as a package.

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Children who don't develop age-appropriate literacy skills by the end of third grade are at high risk of school failure. Longitudinal research conducted over almost 40 years has confirmed that differences between high school dropouts and graduates can be identified as early as third grade.<sup>1</sup> Thus we need to understand how literacy develops in the early years and what programs or practices promote adequate literacy for all children. In this article, we summarize the key components of literacy, characterize how US children are performing in literacy, identify some features of excellent literacy instruction, and discuss why early literacy instruction isn't universally more effective.

## What Is Literacy in the Early Grades?

By the end of third grade, children in the English-speaking world are expected to have acquired the foundational literacy skills. Literacy, though, is a complex domain with many components, so it's important to clarify what those foundational skills are, how they relate to one another, and how or whether they predict longer-term literacy success (see table 1).

One set of skills consists of those that parents and preschool teachers value and actively promote: reciting the alphabet, recognizing and writing letters, writing one's own name, reading environmental print (signs and labels), and knowing how to hold a book upright and turn the pages. Another important skill is promoted less consciously, by exposing children to rhymes and phonological play: the recognition that words are made up of smaller units of sound, which can be manipulated independently, as in the

changes rung on "I Like to Eat Apples and Bananas" in the popular children's song (I like to eat eeples and beeneenees), or versions of familiar phrases with one sound replaced by another (Junkin Jonuts, Bunkin Bonuts, Funkin Fonuts). Recognizing that words are made up of sounds (called *phonemes*) is a key early literacy achievement, because children must learn to map those phonemes to letters or letter sequences (called *graphemes*) to read unfamiliar words (*decode*). Teachers in the first years of school focus on helping children learn and apply the basic principles for mapping sounds into print and vice versa. If the teaching is successful, children can read even unfamiliar words accurately and, after considerable practice, effortlessly. In English, because of its complex set of mapping principles from sound to spelling and vice versa, children may take two to three years to master this task (and to learn the one or two hundred common *sight words* that must be memorized because they deviate from decodable spelling patterns).

This relatively long list of fundamental literacy skills, however, is far from comprehensive. So far we've discussed *constrained* skills, meaning those that are directly teachable because the domain is finite: 26 letters, 44 phonemes, a set of 20 to 30 commonly taught spelling rules (for example, drop a final silent *e* before *-ing*), and 100-plus sight words. Constrained skills have a ceiling; the learner can achieve perfect performance. Within the domain of constrained skills, we see clear predictive relationships—for example, phonological awareness predicts the ability to decode and spell—that confirm the importance of mastery. But the time and the attention required for mastery are finite.

**Table 1.** Skills Children Acquire Starting in Preschool That Affect Literacy

Constrained skills		Unconstrained skills	
Print-related	Sound-related	Language	Knowledge
Letter recognition	Reciting the alphabet	Vocabulary	Topic-specific knowledge (science, geography, social structures)
Writing one’s own name	Rhyming	Grammar	Information seeking
Reading environmental print (signs, labels)	Segmenting initial phonemes (say frog without the fff)	Story structure	Requesting explanations
Book handling	Invented spelling	Telling narratives	
		Giving descriptions	
		Engaging in pretend play	

Once children master the constrained skills, they can accurately and automatically read most words, and thus successfully comprehend texts written at second- or third-grade level, because the words used and the topics covered are familiar to them. Beyond third grade, though, successful comprehension requires children to understand words rarely encountered in spoken language and to integrate new information encountered in the text with relevant background information. Vocabulary and background knowledge are *unconstrained* skills—large domains acquired gradually through varied experience, rather than through focused instruction. These domains become increasingly crucial to comprehension as the texts children encounter range more widely in topic and language complexity<sup>2</sup>.

Unconstrained skills are particularly important in predicting long-term literacy outcomes (that is, outcomes measured after third grade). They’re also more strongly predicted by children’s social class or parental education, and more difficult to influence through classroom instruction, than constrained skills are. Unconstrained skills include language skills (vocabulary, grammar, and discourse skills) and general

knowledge of the world. As early as second grade, children with larger vocabularies read words more accurately, presumably because knowing a word supports correct pronunciation while decoding.<sup>3</sup> Even stronger relationships emerge in later grades, when students read more complex texts. Knowing what the words mean and having some background knowledge relevant to the text become the strongest predictors of successful comprehension among students who have acquired basic decoding skills.

Researchers and educators widely acknowledge that language skills and world knowledge are important for success with literacy. Yet many prekindergarten through third-grade classrooms, particularly those serving low-income children, still focus on constrained skills, which are easy to teach and easy to test. Ensuring that teachers pay appropriate attention to unconstrained skills in early childhood and primary classrooms is a serious challenge.

**Performance in Literacy**

In international comparisons from 2011, US fourth-graders performed fairly well on literacy assessments—higher than the international average of 53 education

systems participating in the Progress in International Reading Literacy Study (PIRLS), and among the top 13 of those systems.<sup>4</sup>

Though the international results are encouraging, the 2015 National Assessment of Educational Progress (NAEP), conducted in the United States alone, paints a less rosy picture.<sup>5</sup> Only 36 percent of fourth-graders scored at or above proficient, and children scoring at the 50th percentile achieved a score of 225 on a 500-point scale. The overall average of 36 percent proficient masks disparities associated with race (only 18 percent of blacks and 21 percent of Hispanics or Native Americans scored proficient), gender (only 33 percent of males), and location (only 32 percent of urban students). These percentages were unchanged from 2013.

How do we reconcile US students' satisfactory performance on the PIRLS with the disappointing NAEP results? First, we should note that *proficient* is a high standard. The National Assessment Governing Board, which oversees the NAEP Reading Framework, defines proficiency as the ability to infer characters' motivation, explain a theme, identify elements of an author's craft, find evidence to support an argument, distinguish fact from opinion, and draw conclusions. Basic-level reading in fourth grade consists of the ability to find information, make simple inferences, identify mood, find topic sentences, identify the author's explicitly stated purpose, and make simple inferences. Thus children who perform at the basic level are reading with some level of comprehension. Furthermore, in 2002 the NAEP tested a national sample of

fourth-graders on their oral reading fluency and accuracy. Three-quarters read a fourth-grade level text with 95 percent accuracy (no more than 5 percent of words missed or mispronounced), and 65 percent read more than 105 words per minute, the rate at which basic comprehension was achieved.

The NAEP fluency study, then, suggests that US schools are doing a fairly good job of teaching most students the basic skills of reading words accurately and relatively quickly. In contrast, most third-graders tested in Nigeria (81 to 88 percent) and Mozambique (63 to 67 percent) couldn't read a single word accurately on a test of oral reading fluency. These are children who have received schooling but evidently no effective instruction in literacy.<sup>6</sup>

Beginning in third grade, students across the United States are tested for progress on literacy using a patchwork of state and multistate assessments; the skills tested vary from assessment to assessment. It once seemed likely that the Partnership for Assessment of Readiness for College and Careers (PARCC) and Smarter Balanced tests, which were developed to align with the Common Core State Standards (CCSS), would lead to more standardization across states and a greater focus on making comprehension assessments more challenging. But intensifying public skepticism about the Common Core standards themselves, coupled with rejection or adaptation of the accompanying assessments, suggests that considerable variability from state to state will continue. Perhaps because of the lack of state-level accountability before third grade, comparatively fewer assessments are used to monitor the progress of preschool and early elementary students.

One nationally normed test for K–3 students is DIBELS Next, developed by Ruth Kaminski and Roland Good at the University of Oregon Center on Teaching and Learning and intended to be given at the beginning, middle, and end of a student’s school year.<sup>7</sup> In kindergarten, children are assessed on basic tasks such as accuracy and speed of naming letters, and identifying the first sound in a word. As children reach second and third grade, they are tested for oral reading fluency. Students who take the test receive a percentile rank that educators can compare to a national sample of children. DIBELS Next is useful and convenient, and it has undeniably led educators to pay more attention to children’s ability to read quickly and without undue struggles to decode. But it is more sensitive to constrained than to unconstrained skills.

Beyond DIBELS Next, school psychologists, reading specialists, and teachers certified in special education use a variety of assessments to identify struggling readers. Teachers, assistant teachers, and aides may also use their own informal assessments to gauge their children’s progress.

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*Our schools may be focusing too much on constrained skills—and too little on unconstrained ones—in the early grades.*

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Are US schools doing a good job of balancing their success in producing accurate and fluent readers with attention to producing linguistically sophisticated

students who will have the background knowledge needed to comprehend middle-grades texts? The drop in literacy scores by eighth grade, both on the NAEP and in international comparisons, suggests that our schools may be focusing too much on constrained skills—and too little on unconstrained ones—in the early grades.

## Reading First

Word reading accuracy and fluency was a specific goal of Reading First, a \$1 billion per year federal effort launched in 2002 to align reading instruction in eligible US schools—those that served a high percentage of low-income students—with what was understood to be scientifically based reading instruction. The theory behind Reading First was that poor reading outcomes could be explained by weaknesses in young students’ decoding and fluency. The National Reading Panel (NRP)—a 14-member committee formed in 1997 in response to a Congressional request that the National Institute of Child Health and Human Development and the US Department of Education identify an expert panel to determine how children should be taught to read—issued its recommendations in 2000. Its members—including educators, school administrators, and researchers—concluded from a review of rigorous research studies that there was strong support for five instructional practices: teaching phonological awareness, phonics, fluency, vocabulary, and comprehension strategies.<sup>8</sup> Districts that received Reading First grants were required to adopt one of an approved list of reading programs, all of which were judged to put sufficient emphasis on structured phonics instruction, and to commit at least 90 minutes a day to literacy instruction in first through third grade.

Abt Associates and MDRC, two research organizations that are often asked to review the impacts of national education and social policy initiatives, evaluated Reading First in 2008, comparing schools that received the funding to similar schools that hadn't.<sup>9</sup> Reading First teachers spent significantly more time teaching phonemic awareness, phonics, vocabulary, fluency, and comprehension in first and second grade. Reading First schools offered teachers more professional development focused on the five instructional practices, and offered more support for struggling readers. These large changes in practice translated into small improvements in first-grade decoding skills (for readers familiar with statistical analysis, less than one-fifth of a standard deviation, an effect considered small but educationally relevant), but no other impacts were seen. Strikingly, reading comprehension didn't improve at all.

These Reading First findings confirm two conclusions that have emerged from multiple studies. First, it's easier to improve classroom practices than the skills of children in those classrooms. Second, constrained skills are easier to improve than unconstrained skills.

Interventions (for example, new curricula or professional development) quite frequently show effects on what teachers do, how much time they spend on recommended activities, how they organize their classrooms, and other features of their practice.<sup>10</sup> These improvements in classroom practice may not be reflected in children's skills for several reasons: the improvements may be insufficiently robust or sustained; it may take a few years for teachers to get really good at them; or the students may be in the classroom too infrequently to benefit from

the improved teaching. In one study of a professional development intervention in prekindergarten classrooms, the children who were consistently present in the classroom showed positive effects, but 66 percent of the group were absent for more than 10 percent of the school year, and there were no significant effects for the group of children as a whole.<sup>11</sup>

Constrained skills are easier to improve for a number of reasons. They constitute well-defined goals, and we have proven approaches to teaching and to assessing them. Many techniques help four- to five-year-olds develop phoneme awareness. For example, teachers can ask such questions as:

- This is Bear Bertie. What color begins with same sound as Bear Bertie?
- This is Ferret Freddie. What would his name be without the fff?
- Which sounds more like log, cat or dog?  
Can you think other words that rhyme with log?

These brief phoneme awareness lessons are easy to carry out. The techniques for teaching new vocabulary are much more complicated: selecting the right words to teach, ensuring that children hear those words in rich semantic contexts, giving the words child-friendly definitions, exposing the children to the words many times, and creating contexts where the children can use the new words. Teachers need much more curricular support to do a good job when it comes to unconstrained domains like vocabulary. Furthermore, once children have mastered a constrained domain, they reliably display that skill on any test of the domain. In contrast, a child who has learned all the words in an effective vocabulary curriculum



is unlikely to encounter any of them on a standardized vocabulary test.

## **Classroom Challenges**

Early childhood and primary classrooms typically comprise children at many different levels of language and literacy development. These differences are larger in socioeconomically diverse classrooms, because we see substantial social class differences in literacy-related skills even before most children enter preschool.<sup>12</sup> These social class differences encompass both constrained and unconstrained skills, but the differences in unconstrained skills are greater and more persistent. Thus a comprehensive effort to promote good literacy outcomes for all children must incorporate not only preschool programs but also programs designed for children from birth to three years old and their families.

## **Promising Programs and Practices**

Efforts to improve children's literacy vary in many ways. Reading First, for example, used financial incentives for school districts that implemented the reading methods it endorsed to influence the mix of practices in classrooms, while Success for All is a comprehensive school-improvement program with a strong emphasis in its literacy component on phonological awareness and structured phonics. Other programs rely on curriculum or professional development. Some are designed for all students, whereas others target students who have trouble learning to read. Still others target very specific skills (notably, phonological awareness or vocabulary), on the theory that weaknesses in those skills constitute bottlenecks in literacy development. Given the variety we see in literacy programs' scope, cost, targets,

and theories of change, comparing them is difficult.

Reading First promoted a set of practices that small experimental studies had identified as effective. Unfortunately, those practices didn't add up to a comprehensive literacy program, in part because they were too often limited to the constrained skills reflected in third-grade assessments. Furthermore, expanding classroom time for these practices squeezed out activities—such as reading books aloud, science instruction, field trips, and discussion-based learning—that have been associated with the development of unconstrained skills. So, although adding specific proven practices into a comprehensive literacy program might well have been productive, substituting an exclusive focus on those practices for a well-rounded program was not. When we evaluate literacy interventions, we need to understand the larger context in which they're implemented. We turn now to consider large-scale efforts to improve outcomes for all participating students.

## **Success for All**

Success for All, surprisingly, wasn't one of the programs approved for funding under Reading First. Thus despite a record of successfully supporting literacy development in schools serving high-risk students, Success for All shrank significantly when Reading First was in its ascendancy. Success for All is also relentlessly empirical; if a review of research suggests that a practice (for example, grouping students by reading level or collaborative learning) is helpful, that practice is introduced into the program, which may thus best be characterized as a mosaic of practices rather than an approach driven by a particular theory. That mosaic

of practices includes systematic approaches to teaching reading to homogeneous groups, regular assessment and regrouping, and tutoring children who fall behind. Because Success for All provides its own recommended curricular resources, it offers greater scope for integrating newly identified, effective practices instead of replacing traditional approaches with new ones.

Robert Slavin, the Johns Hopkins professor who launched Success for All, collaborated with other researchers in a rigorous experimental study to evaluate the program's effectiveness in the primary grades.<sup>13</sup> Success for All students scored higher than the study's control group on three domains of literacy: decoding unfamiliar (nonsense) words, as well as decoding and comprehension. These effects (which ranged from 0.2 to 0.3 of a standard deviation) were equivalent to about a year's worth of learning, but they emerged only after children had been in Success for All for three years, presumably because it takes time for such a program to become well established and be carried out properly in any school, and because students benefit from lengthier exposure to the integrated and systematic curriculum.

A recurrent theme in evaluations of Success for All, though, is that the impacts were greatest for measures of phonological awareness but more modest for decoding and comprehension. Harvard researchers Lowry Hemphill and Terry Tivnan compared Success for All to three other literacy approaches that were less focused on phonics and were being tried in a single school district: Building Essential Literacy, Developing Literacy First, and Literacy Collaborative. Success for All scored better

than the others on decoding but below the other programs on promoting vocabulary, writing, or comprehension skills.<sup>14</sup>

Success for All's impact is also affected by how strictly educators follow its guidelines. In a series of interviews with teachers and observations in schools implementing Success for All, Johns Hopkins University researchers Amanda Datnow (now of the University of California at San Diego) and Marisa Castellano (now of the University of Illinois) found that educators often modified the program, despite the fact that the designers stressed that implementing it with fidelity was important for the program's success. However, teachers' personal level of support for Success for All didn't seem to affect how likely they were to carry out its practices with fidelity; rather, educators who took part in the study complained that the program constrained their creativity and autonomy.<sup>15</sup>

### **Publisher-Developed Curricula**

Reading curricula developed by textbook publishers are widely used in districts and schools across the United States. Accordingly, they substantially influence teachers' day-to-day instruction and students' learning. However, we have only limited evidence that such curricula are effective, or that picking one curriculum over another matters much for elementary children's literacy skills. For example, one district-level study of Pearson's kindergarten to sixth-grade curriculum, *Reading Street*, found no statistically significant improvements in third-grade reading outcomes compared to the curriculum used previously. In the same study, teachers reported that they were generally satisfied with the curriculum.<sup>16</sup>

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*Changing children's trajectories as they move from kindergarten through fourth grade often requires additional support for children who are struggling when they enter elementary school.*

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In the absence of curricular impacts, the role of the classroom environment in which students are immersed is paramount. One of the authors of this article, Catherine Snow, along with her colleagues Patton Tabors and David Dickinson, developed a road map for the kinds of interactions in early childhood—with parents, caregivers, or teachers—that prepare the ground for children to progress as readers.<sup>17</sup> Children who come from homes with few activities that fertilize the ground for reading success can be helped significantly by school environments where such experiences abound. Changing children's trajectories as they move from kindergarten through fourth grade often requires that we invest in additional support for children who are struggling when they enter elementary school. Some researchers who focus on implementing effective literacy instruction at the classroom level argue that we need assessments sufficient to paint a picture of students' individual, group, and aggregate needs; this would allow core instruction and targeted supports to be tailored for an individual classroom's or school's needs.<sup>18</sup> Moreover, writes Harvard researcher Paola Uccelli, although a generalized understanding of the needs of, for example, English language

learners might help guide instruction, it's also "necessary to remember that each child is unique and reflects diverse experiences not always easily classifiable as those of one discrete cultural group. Children vary enormously even within the same cultural group."<sup>19</sup>

### **Efforts That Focus on Constrained Skills**

Fifteen years ago, the NRP summarized 52 studies of phonemic awareness interventions published before 2000 and found generally large positive effects (ranging in size from half of a standard deviation to more than two standard deviations—students typically show growth of about a quarter of a standard deviation in one year).<sup>20</sup> Since 2002, dozens more studies have shown that phonemic awareness strongly predicts successful early literacy learning, a finding reinforced by a 2008 review of early literacy research carried out by the National Early Literacy Panel.<sup>21</sup>

Similarly, the NRP reported positive effects from interventions that offered structured phonics instruction—systematic instruction about the links between letters and sounds. However, many of the children in the studies that the panel examined were selected for intervention because they were having trouble learning to read from the regular classroom instruction that worked well for many of their classmates. Thus the strong emphasis on phonics instruction that emerged from the NRP and its elevation into policy through Reading First might be compared to prescribing a gluten-free diet for everyone because it helps people with celiac disease. It's clear, of course, that word-reading skills strongly predict ultimate reading outcomes—comprehension requires reading words, after all. But it's equally

clear that not all children need structured phonics instruction. The question is whether all children benefit from it or whether any suffer negative consequences. Since Harvard researcher Jeanne Chall's pioneering work, published in the early 1980s, scholars have hypothesized that children at risk of poor reading outcomes (whether because of reading disabilities, low family support for literacy, or other reasons) benefit most from well-sequenced phonics instruction.<sup>22</sup> No systematic large-scale tests of this hypothesis have been carried out. But Carol Connor, a reading researcher then at Florida State University, created an algorithm to match teaching emphasis to first graders' profiles of skills. In a carefully conducted experimental study, she found that some first-graders benefited from instructional activities with considerable teacher-led focus on the code (that is, phonological awareness and phonics), whereas others benefited more from student-led instructional activities that focused on meaning.<sup>23</sup> In other words, a focus on phonics helped children who needed it, but some children benefited more from self-selected reading or writing activities.

In 2013, a group of researchers at Columbia University's Teachers College undertook a cost-benefit analysis of seven early literacy interventions, all designed primarily for students struggling to reach grade-level standards.<sup>24</sup> The programs varied enormously in their cost per student (from \$27 to \$10,108), and the delivery method ranged from structured whole-class lessons to supplementary tutoring and computer-mediated support. All of the programs focused on alphabets (which encompasses phonemic and phonological awareness, letter identification, print awareness, and decoding/spelling), and all produced

improvements in alphabetic skills (with effect sizes ranging from one-fifth to four-fifths of a standard deviation). A couple of the programs also showed effects on fluency, and one (Sound Partners, an 18-week-long program for struggling kindergartners) improved reading comprehension, a skill that for kindergartners is largely determined by word reading. There was no relationship between cost of a program and size of the improvements it produced.

One of the programs included in this cost-benefit comparison is called Reading Recovery. It follows a constructivist approach to identifying struggling readers and giving the bottom 15 percent of students in each classroom additional support from a specially trained literacy teacher, starting in first grade (that is, *after* the first year of widespread schooling). This approach was developed by New Zealand educator Marie Clay, and has been widely implemented in the United States by teachers trained at The Ohio State University and Lesley University. The What Works Clearinghouse—an initiative of the Institute of Education Sciences at the US Department of Education dedicated to promulgating best practices gleaned from reviews of high-quality research—lists it as an effective program.

From the 1970s until the present, New Zealand's early literacy strategy has revolved around Reading Recovery, which was made into national policy by the Ministry of Education. William Tunmer, now at the University of Canterbury, and James Chapman of Massey University and their colleagues detail the story in a recently released report arguing that New Zealand's national literacy strategy has failed. Their critique focuses on the Reading Recovery protocol's resistance to evidence-based

modifications (for example, supplementing the instruction with some attention to phonics), and on the inefficiency of using the program with the poorest readers in every classroom. Tunmer and Chapman point out that in schools serving middle-class students, the worst readers read better than the best students in schools serving less privileged children, most of whom get no special help. The policy thus exacerbates differences within the country's racial and ethnic subgroups when children enter school.<sup>25</sup> Although Reading Recovery is used to some degree in Australia, Canada, the United Kingdom, and the United States, nowhere but in New Zealand has it been used so pervasively on a national basis.

The robust finding that targeted interventions can influence phonological awareness, word reading, and other alphabetic skills shows how important it is to make a distinction between constrained and unconstrained skills.<sup>26</sup> Are any programs effective at helping children develop unconstrained skills?

### **Efforts That Focus on Unconstrained Skills**

Vocabulary is the most widely studied unconstrained skill. A meta-analysis of programs designed to promote vocabulary learning in four- to eight-year-old children (from prekindergarten through third grade) showed that these programs had sizable effects (almost nine-tenths of a standard deviation). However, the programs didn't eliminate social class differences in vocabulary; in fact, better-off children were more likely to benefit than were poorer children.<sup>27</sup> And, as is often the case in vocabulary evaluations, assessments designed by researchers showed larger

gains than did standardized assessments. This recurrent finding reflects a challenge of teaching and testing unconstrained skills: the problem space (all the vocabulary in a language) is much larger than the training space (the 30 to 200 words actually taught), and there may be no way for children to generalize from trained to untrained items.

University of Michigan researcher Susan Neuman developed the World of Words, a vocabulary intervention for children in prekindergarten, precisely to promote generalization.<sup>28</sup> World of Words focuses on teaching words that fit together into conceptual structures; for example, words related to insects may be taught in science units about insects that also teach about the characteristics of insects that distinguish them from other organisms, and so on. When Head Start classrooms were randomly assigned to use the World of Words curriculum or not, children in classrooms that used the program learned more words and, to some extent, closed the vocabulary gap with better-off children. They were more likely to produce generalizations about the categories they learned and to make inductive inferences about novel words. Though it included no standardized assessments, this study nonetheless suggests that embedding the unconstrained domain of vocabulary inside another unconstrained domain, world knowledge, promotes learning of both.

World of Words' success may result from well-designed curricular materials that supported productive classroom talk. Researchers Christina Weiland of the University of Michigan and Hirokazu Yoshikawa of New York University showed in a 2013 study that when a public prekindergarten program coached teachers



in how to use a rich language and literacy curriculum called Opening the World of Learning, children's vocabulary (as well as emergent literacy, numeracy, and self-regulation skills) improved compared with children who were just shy of the cutoff age to enroll.<sup>29</sup> Because the children who missed the enrollment cutoff were exposed to a variety of other experiences, ranging from home care to alternate prekindergarten programs, we don't know precisely which aspects of Opening the World of Learning—the curriculum itself, children's exposure to qualified teachers, or their participation in structured daily activities with highly qualified teachers—were responsible for the gains.

A review of the effectiveness of early childhood curricula based on a What Works Clearinghouse report concluded that only one of 13 curricula—the Literacy Express Comprehensive Preschool Curriculum—had strong evidence of positive effects on oral language. Two others had some evidence of positive effects, one had some evidence of negative effects, and nine showed no effects.<sup>30</sup> An analysis of the content covered by Literacy Express and Opening the World of Learning might tell us more about the features of successful, well-designed early childhood language curricula.

One of the very few instructional practices shown to improve young children's language skills without introducing specific curricula or a focus on vocabulary is called Storytelling and Story Acting, invented by a fabled kindergarten teacher at the University of Chicago Lab School, Vivian Gussin Paley.<sup>31</sup> In this technique, children are encouraged to dictate stories to the teacher, then to select classmates to help

act out the stories while the teacher reads them aloud. After Paley described the practice, other early childhood educators adopted it based on her vivid depictions. Ageliki Nicolopoulou of Lehigh University and her colleagues decided to evaluate it by introducing it into six Head Start classrooms serving three- and four-year-olds and comparing the children with those in seven other classrooms.<sup>32</sup> Children who participated in Storytelling and Story Acting for one school year showed greater gains in storytelling and story comprehension, vocabulary, early literacy skills, and ability to pretend. Children who participated in telling and acting the most stories showed the greatest gains. Storytelling and Story Acting is powerful because it engages children and helps them develop language and literacy skills (as well as self-regulation and peer cooperation) within the normal pattern of preschool classrooms. Story dictation can take place at an activity center, and story acting (which takes only a few minutes) at circle time or pre-lunch meeting time. Storytelling and Story Acting requires no special curricular materials and is essentially free once teachers have received some basic professional development. (It was also implemented in the prekindergarten classrooms studied by Weiland and Yoshikawa.)

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*A good curriculum's effect on children may be produced not by the curriculum itself but by the teacher talk that results.*

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## **Language Environments in Early Childhood and Primary Classrooms**

Curricular support for teachers is a frequently noted feature of good early childhood programs, and a rich and logically sequenced curriculum is the backbone of well-structured primary literacy instruction. Although developing and promoting good curricula clearly offers valuable support to teachers, the effect on children may be produced not by the curriculum itself but by the teacher talk that results. Considerable evidence suggests that quality of teachers' talk influences students' opportunities to learn—in particular, to learn the unconstrained language and content skills relevant to literacy. Children whose preschool teachers use more sophisticated vocabulary, engage them more actively in talk about books, and use more complex syntax themselves show larger vocabularies, more complex grammar, and better reading skills even as late as fourth grade.<sup>33</sup> All the studies showing these relationships are correlational, and thus we don't have a strong basis for inferring causality. Nonetheless, the pattern is robust, and we should invent ways to promote more sophisticated teacher talk if we wish to test its effects on child outcomes.

High-quality teaching fosters a high-quality learning environment for children in prekindergarten and the early grades.<sup>34</sup> That learning environment, particularly in prekindergarten, relies on four components: explicit instruction; warmth and sensitivity to the needs of students; consistent feedback to and interaction with students; and verbal stimulation. These conclusions about early childhood-learning environments parallel those found in various studies of K–12 classrooms.<sup>35</sup>

However, we have less consistent evidence for the role of professional development and coaching programs in producing higher-quality academic outcomes for students, regardless of which curriculum or intervention is being implemented. Johns Hopkins's Slavin and colleagues found that interventions targeting teachers' own classroom practices were more successful than those that aimed to improve students' reading skills in the early grades.<sup>36</sup> Teachers need information about students' skills and the expected progressions of skill, as well as support for trying new ways of teaching and interacting with students.<sup>37</sup> Often the best support involves new curricular materials paired with guidance in using them. In one study, the University of Michigan's Neuman and Linda Cunningham of Brown University found that a combination of professional development and coaching fostered a more positive classroom environment in preschool.<sup>38</sup> However, they write, we don't know much about whether it's feasible to bring such efforts to scale—especially when we think about the diversity of early childhood-education programs.

## **Fostering Reading in Pediatric Care Settings**

Reach Out and Read is an intervention in which primary-care pediatricians talk with parents about why reading is important and share strategies for reading with their child; families, meanwhile, receive a new book to take home at every regular pediatric check-up, starting when the child is six months of age. A review of 11 studies of Reach Out and Read concluded that the intervention's quality was mixed.<sup>39</sup> Across the studies, Reach Out and Read's outcome was often more frequent book reading, rather than children's development or

specific language skills. One study of more general efforts to promote book reading through pediatric care suggests doing so can improve receptive and expressive vocabulary in older toddlers (from 18 to 25 months).<sup>40</sup> Showing parents brief videos of responsive parent-child interactions in pediatricians' offices—in an effort to enhance the effects of giving families a book—has also shown positive effects, both on children's language and on attention and imitative play.<sup>41</sup> But we need more research to understand the best way to use pediatric visits to promote more persistent gains in children's literacy skills.

## Conclusions

It's hard to neatly summarize what influences early literacy, because the target domain must be very broadly conceived and the sources of influence are many. The numerous skills listed in this article all constitute components of or precursors to success in school literacy tasks. These include constrained skills (such as phonemic awareness and letter knowledge) that are appropriately identified as outcomes at ages four to six, and unconstrained skills (such as vocabulary and world knowledge) that are harder to test in young children but are ultimately more relevant to long-term literacy success. Instructional and intervention programs in early childhood through third grade show greater success in influencing constrained skills, or directly targeted subdomains within the unconstrained skills (for example, the words actually taught in a vocabulary curriculum). But evidence of broader and longer-term impacts on reading comprehension is scarce.

The varying quality and consistency with

which classroom instructional programs are implemented in prekindergarten through third grade constitute a huge challenge in evaluating these programs' impacts. Whether because well-designed programs are inherently complicated, because professional development and coaching support is insufficient, because of teacher burnout, or because of teacher turnover and lack of mechanisms for effective induction of new personnel, maintaining successful implementation over long periods is challenging. Nonetheless, specific practices within the programs that show initial success may well be sustainable and valuable in promoting the desired impacts; rethinking comprehensive programs as collections of proven practices that could be mixed and matched, rather than implemented as a package, might be a route to generally more effective literacy instruction.

We also see strong hints in the research that certain kinds of curricular content, supplemented with guidance to teachers about implementation, can strongly support better early childhood outcomes. Curriculum in early childhood has generally been downplayed, seen as too academic and insufficiently responsive to children's interests and need to play. As a result, early childhood educators are left either working overtime to come up with curricular resources or seizing upon relatively banal topics (pumpkins in October, turkeys in November, snowflakes in December) that fail to expand children's vocabularies or world knowledge very much. Simply focusing on practices in professional development for early childhood educators (talk more, ask more open-ended questions, select interesting words from read-aloud texts to talk about) is demonstrably less effective than providing sets of books related

to a theme for reading aloud, identifying the words to be talked about and the questions to be asked, and providing guidance for center activities (act-outs, art, sandbox, or block corner) that echo and thus reinforce the theme of the books. Directly comparing the impacts of improved curricular resources with modest investment in professional development to much more extensive general-purpose professional development would provide some guidance about the most efficient route to improved outcomes.

It's worth noting, though, that many programs to improve literacy through

interventions in early childhood did show effects on aspects of classroom functioning, even in the absence of impacts on children. This juxtaposition suggests how difficult it is to influence literacy outcomes through formal education alone. Literacy skills are, ultimately, the product of everything a child has learned about language and about content expressed through language. The accumulated advantages that accrue to children who've been exposed to rich language and content from birth can't easily be matched in a few hours a day of instruction, however well-designed and implemented.

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# Math, Science, and Technology in the Early Grades

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*Douglas H. Clements and Julie Sarama*

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## Summary

Do young children naturally develop the foundations of science, technology, engineering, and math (STEM)? And if so, should we build on these foundations by using STEM curricula in preschools? In this article, Douglas Clements and Julie Sarama argue that the answer to both these questions is yes.

First, the authors show that young children possess a sophisticated informal knowledge of math, and that they frequently ask scientific questions, such as *why* questions. Preschoolers' free play involves substantial amounts of foundational math as they explore patterns, shapes, and spatial relations; compare magnitudes; and count objects.

Moreover, preschool and kindergarten children's knowledge of and interest in math and science predicts later success in STEM. And not only in STEM: the authors show that early math knowledge also predicts later reading achievement—even better than early literacy skills do. Thus mathematical thinking, Clements and Sarama say, may be cognitively foundational. That is, the thinking and reasoning inherent in math may contribute broadly to cognitive development.

Is teaching STEM subjects to preschool children effective? The authors review several successful programs. They emphasize that STEM learning for young children must encompass more than facts or simple skills; rather, the classroom should be infused with interesting, appropriate opportunities to engage in math and science. And instruction should follow research-based learning trajectories that include three components: a goal, a developmental progression, and instructional activities.

Clements and Sarama also discuss barriers to STEM teaching in preschool, such as the cultural belief in the United States that math achievement largely depends on native aptitude or ability, and inadequate professional development for teachers.

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Other articles in this issue make a strong case that early education is important. The issue we address here is whether early education should include substantial science, technology, engineering, and mathematics (STEM) content—which some educators view, often from ideological perspectives, as appropriate only for older students. To examine this question, we review research on the appropriateness, benefits, and effectiveness of various programs. Our findings are often surprising.

Many adults, including some researchers, believe that “open-ended free play” is good for preschoolers and kindergartners, but “lessons” are not. They don’t believe that the youngest children should be taught specific subjects, especially math, science, and technology. They may grudgingly accept math in the primary grades, but they believe that literacy is more important, more motivating, and more appropriate for children. In this article we show that research doesn’t support such thinking.

We begin by asking whether young children naturally develop the foundations of STEM. If so, should adults build on these foundations intentionally, for example by using STEM curricula in preschools? Will children enjoy such interactions and learning? Do curricula and intentional teaching produce substantial gains in STEM competencies? What teaching approaches are most effective through the primary grades? Does teaching STEM have other positive effects, such as supporting high-quality play and building executive function and language? If so, what kind of professional development will help teachers engage children in STEM from preschool through

third grade? (Note that because more research has focused on mathematics than on the other STEM subjects, our examples tend to favor math.)

## Young Children’s Surprising Competence in STEM

Especially when they’re given opportunities to learn, young children possess a surprisingly broad, complex, and sophisticated informal knowledge of math.<sup>1</sup> For example, they can invent solutions to arithmetic problems by using a variety of strategies. When asked what 75 added to 25 would be, a first-grader told us, “That’s like three quarters and one more quarter—so four quarters, a dollar... 100!” Young children also are remarkably successful with geometry tasks that go beyond what older students are usually asked to complete. A kindergartner in one of our studies was making rectangles by inputting a length and a width into a computer program called Logo. He entered 50 and 50, and said, “It’s a square! Sure, all sides the same—it’s a *square* rectangle.”

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*Young children possess a broad, complex, and sophisticated informal knowledge of math.*

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Another surprise is how early these competencies develop in all STEM subjects. Even before they begin school, young children possess foundational science and engineering concepts, at least at an implicit level.<sup>2</sup> For example, they ask whether cow babies come from eggs, they observe that people’s eyes are different colors (and generate explanations for that), and they

frequently ask questions that begin with “why.” Entering kindergartners possess knowledge of the natural world, including some understanding of things like cause and effect; the differences between animate and inanimate objects; the ways that people’s beliefs, goals, and desires affect their behavior; and substances and their properties. This knowledge includes concepts related to physics, biology, psychology, and chemistry—though admittedly, their intuitions aren’t always based on scientific theories, or on any theory at all.

Even infants show sensitivity to principles that adults would classify as physics, measurement, and other science topics. For example, infants as young as three or four months have an intuition that objects need support to keep them from falling. In the first year of life, infants understand that inanimate objects can’t move themselves and need to be propelled into action. In one experiment, five- to seven-month-olds watched a film that showed a hand approaching a doll, picking it up, and moving away with it. After seeing this repeatedly, the infants lost interest (called *habituation*). They remained uninterested even when the direction or pace of the movement changed. But when the film changed again to show both the hand and doll moving simultaneously and separately, without the hand touching the doll, the infants showed renewed interest by staring intently. Thus they’re sensitive to the fact that the lack of contact between the hand and doll violates the causal principles of physics.

Similarly, children show surprising competencies in mathematics that either are innate or develop in the first years of life. Consider a study in which five-month-old children were repeatedly shown four groups of two dots on a computer screen. Once

they were habituated to seeing those groups, they looked longer when shown two groups of four dots—they perceived the difference and were more interested. Other studies have demonstrated that nine-month-olds can distinguish sets of 10 from sets of 15, and that toddlers can use geometric information about the shape of their environment to find objects. Toddlers also show early competence in arithmetic, noticing when a small collection of things increases or decreases by one item. By 24 months, many children have learned number words and begun to count. If young children naturally think and learn about STEM content, then enhancing that learning clearly isn’t an imposition.

### Young Children’s Interest in STEM

In a similar vein, the scientific questions children ask, such as *why* questions, show that science is natural and motivating for young children, as are engineering and technology. Perhaps more surprisingly, this is also true for mathematics, regarding both what children can accomplish and what they’re interested in. For instance, preschoolers’ free play involves substantial amounts of foundational math. Regardless of their income level and gender, preschoolers explore patterns, shapes, and spatial relations; compare magnitudes; and count objects. As an example, Kyoung-Hye Seo and Herb Ginsburg of Columbia University watched a child putting away blocks by placing each one in a box that contained only other blocks of the same size and shape.<sup>3</sup> They saw three girls draw pictures of their families and discuss the number and ages of their siblings. It’s not surprising, then, that high-quality education can help children build on these nascent tendencies. Unfortunately, when such education doesn’t begin in preschool and continue through the early years, this

potential may be unrealized, leaving children trapped in a trajectory of failure.

## **The Value of Early Math and Science**

Preschool and kindergarten children's knowledge of and interest in math and science predicts later success in STEM.<sup>4</sup> For example, early math knowledge strongly predicts later math achievement, even after controlling for differences in other academic skills, attention, and personal and family characteristics.<sup>5</sup> This surprising result comes not from a single study, but from a meta-analysis that combined six studies, each involving large databases that had followed the same children over time. Essentially, math seems to be a fundamental component of thinking.

## **Measuring Early Competency in Math and Science**

Our methods for measuring early math and science knowledge are important, not only for researchers but also for teachers who wish to discover what their children know and how they can teach them better.<sup>6</sup> Whether we use quick screeners or long diagnostic tests, most assessments should cover skills, facts, concepts, and problem-solving strategies. In math, verbal (rote) counting is a simple skill, whereas problem-solving might be tested by showing children two groups of chips and asking them to count to determine which group has more chips. Posing an arithmetic word problem is another approach.

Assessments should also be age appropriate. Multiple-choice group tests may not be adequate. For teachers, a positive approach to assessing children's strengths and needs should include curriculum-embedded assessment (observing and taking notes

during small group instruction), documenting children's talk, and individual interviews. These strategies are more likely to illuminate children's background knowledge and emerging ideas, giving teachers the insight they need. The richer the instructional environment, the broader the range of evidence for assessing learning. Careful assessment is especially important for children with special needs or disabilities.

## **Teaching Math and Science in the Early Grades**

Based on children's foundational competencies and natural interest, learning math and science should be viewed as an appropriate and important educational goal. Teachers need to understand that these subjects encompass more than facts or simple skills.<sup>7</sup> Unfortunately, young children aren't given enough math and science experiences. Teachers spend less time in science learning centers (tables or areas stocked with books and other materials that promote exploration) than in other learning centers, and they rarely offer science-related activities in any context, either planned or spontaneous. Even well-regarded programs for young children tend to have a strong focus on language and social development but a weaker focus on math, and little or no focus on developing children's potential for scientific thinking.

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*Teachers rarely offer science-related activities in any context, either planned or spontaneous.*

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What's more, the small amount of science that children are taught isn't of high quality.

For example, Head Start children arrive at kindergarten with lower scores in science readiness than in any other area. Many teachers still retain a bias against computer technology, considering it inappropriate in classrooms for young children. With little appreciation for science, math, and technology (not just computer technology, but also the technology and engineering of everyday objects), most teachers are poorly prepared to help young children realize their potential for learning STEM content.

Similarly, most three- and four-year-olds have few or no experiences in mathematics. Teachers often believe they are “doing math” through puzzles, blocks, and songs. But even when such activities do include mathematics, it’s not the main focus; instead, the math is embedded in reading or a fine-motor activity. Evidence suggests that such an approach is ineffective.<sup>8</sup>

Too many primary-grade classrooms teach children simple facts and skills that they either already know or can learn relatively quickly, instead of more advanced math concepts. Learning such processes as arithmetic problem-solving and reasoning is arguably more important to their development over time.<sup>9</sup> Even later reading success requires such conceptually oriented science and math instruction.

Certain experiences can ameliorate such problems, however, especially for low-income children and those from minority racial and ethnic groups. But several traditional approaches, such as developmentally appropriate practice, haven’t been consistently successful. According to the National Association for the Education of Young Children, *developmentally appropriate practice* involves “meeting

young children where they are” and helping them reach goals that are both challenging and achievable. Unfortunately, it hasn’t been shown to increase children’s learning, perhaps because it’s too often restricted to the use of free play only.<sup>10</sup> To combat this lack of learning, we need to infuse the young child’s day with interesting, appropriate opportunities to engage in math and science, from preschool through the primary grades.

## Learning Better Mathematics

Recently, research-based standards have been developed to describe what should be taught and emphasized when it comes to math. For example, the Common Core State Standards—Mathematics followed research on how children learn as well as the structure of math. Just as important, all math curricula and standards should identify and support a few core ideas rather than many disconnected topics. The best way to achieve academic gains and understanding is to focus on these core concepts coherently, within and across age levels, rather than trying to teach a little of everything at every age.

Moreover, as President Bush’s National Mathematics Advisory Panel stated in a comprehensive research review published in 2008, “The curriculum must simultaneously develop conceptual understanding, computational fluency, and problem-solving skills.”<sup>11</sup> A study of second-graders shows the benefits of this approach.<sup>12</sup> One group was taught skills along with conceptual understanding, as well as how to flexibly apply multiple strategies. These students scored higher on math tests than did students in a traditional textbook program that focused only on mastering skills. The first group more often selected strategies related to the number properties of the problems, and



used strategies more adaptively. Even after months of instruction, the skills-only group didn't apply their skills flexibly. Students who have fluent and adaptive competencies can propose problems, make connections, and then work out solutions in ways that make the connections visible.

Rich learning in mathematics can support existing approaches to early education. For example, children given specific learning activities tend to engage in higher-quality social-dramatic play. That is, children in classrooms that strongly emphasize either literacy or math are more likely to display higher-quality social-dramatic play, while those in classrooms that emphasize *both* have the highest-quality play.<sup>13</sup> By contrast, the lowest gains in learning come from free-play-only classrooms, and even using so-called teachable moments during play is ineffective in these circumstances.<sup>14</sup>

Children also benefit from a related type of play, playing with mathematical ideas. Many researchers consider this the “child as scientist” approach: Children are motivated to explore science concepts while they interact with their environment.<sup>15</sup> As a mathematical example, just after her third birthday, our daughter Abby was playing with three of five identical toy train engines. Passing by, her mother asked, “Where are the other trains?” After her mother was out of sight, Abby was heard speaking to herself. “Oh, I have five. Ummm ... [pointing to each engine] you are one, two, three. I'm missing four and five—two are missing! [She played with the trains a few more seconds.] No, I changed my mind ... I have one, three, and five. I'm missing two and four. I gotta find them two.”

When Abby first figured out how many she was missing, she was using mathematics in her

play. But when she decided that she would call the three engines she had one, three, and five, and call the missing engines two and four, she was playing with the notion that assigning numbers to a collection of objects is arbitrary. She was also counting not just objects but words. She counted the words “four and five” to see that two were missing, and then she figured out that counting the renumbered counting words “two” and “four” also yielded the result of “two.” She was playing with the idea that counting words themselves can be counted.

## Learning Mathematics Better

If developmentally appropriate practice classrooms don't support math learning, how do we ensure that a new approach remains appropriate to children's development?<sup>16</sup> The answer lies in seeing that learning progresses along research-based trajectories. A learning trajectory has three components: a goal, a developmental progression, and instructional activities.<sup>17</sup> To attain a certain competence in a given math topic (the goal), students progress through several levels of thinking (the developmental progression), aided by tasks and experiences (instructional activities) designed to build the mental actions-on-objects that enable thinking at each level.

For example, we might set a goal for young children to become competent counters. The developmental progression describes a typical path that children follow to achieve this. A child might start by learning simple verbal counting, then learn one-to-one correspondence between counting words and objects. The next step is understanding that the final counting word tells *how many*; after that, connecting the final number of the counting process to the cardinal quantity (*how many*) of a set. Finally, the



child acquires counting strategies for solving arithmetic problems (up to multidigit problems, for example,  $36 + 12$ : “I counted 36 . . . 46 . . . then 47, 48!”). Although learning trajectories share characteristics with other ways to sequence teaching, they’re based on a core of subject-specific knowledge, on cognitive science, and on educational research into how children learn that subject.<sup>18</sup> Most curricula, assessments, and professional development omit critical levels in the learning trajectory for counting and don’t recognize these research-based levels in such topics as measurement and geometry.

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*Teachers who know how to use and connect the three components of a learning trajectory—content, levels of thinking, and activities that are fine-tuned for their children’s level of thinking—are more effective professionals.*

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Teachers who know how to use and connect the three components of a learning trajectory—content, levels of thinking, and activities that are fine-tuned for their children’s level of thinking—are more effective professionals.<sup>19</sup> Without such knowledge, teachers often give young children tasks that are either too easy or too hard, and they don’t recognize the mismatch.<sup>20</sup> When teachers understand how levels of thinking progress along these paths, and are able to sequence and individualize activities that are based on

these levels, they can build effective math-learning environments. In this way, learning trajectories make it easier to provide appropriate and effective teaching for all children. Substantial work on standards, curricula, and professional development has been based on the concept of learning trajectories in one form or another.<sup>21</sup>

## **Developing Mathematically Rich Curricula**

Through our own program, Building Blocks, we illustrate how a curriculum can be based entirely on learning trajectories and use the kinds of assessment we discussed earlier. From 1998 to the present, we developed and evaluated Building Blocks according to a comprehensive research framework. Our basic approach was to find the mathematics in children’s everyday activities and develop math from there. Building Blocks helps children bring math into activities ranging from art and stories to puzzles and games.

We connected every aspect—including text, software, and professional development—to an explicit core of learning trajectories for each math topic. Multiple evaluations have documented that our approach has strong positive effects on children’s achievement, even when the curriculum was implemented at a large scale. (One study covered an entire school district, using a scale-up model called TRIAD—short for technology-enhanced, research-based instruction, assessment, and professional development.)<sup>22</sup>

Most groups of children who experienced this curriculum (for example, girls and boys, or children of different income levels) demonstrated equal learning gains, with one notable exception. Although African American children in the control group showed smaller gains than their peers in the

same group, African American children in the treatment group showed larger gains than their peers, thus narrowing the initial achievement gap. By providing learning trajectories that help teachers see what children can achieve and how they can be assisted to progress to higher levels, the TRIAD/Building Blocks intervention may be particularly effective in overcoming the negative effects that result from the low expectations some educators hold for African American children when it comes to math learning.<sup>23</sup>

An evaluation of Boston's prekindergarten program offers more evidence of Building Blocks' effectiveness.<sup>24</sup> This study used a different design and evaluated a literacy curriculum combined with Building Blocks. Children in the program scored higher on math, literacy, and language skills than other children, raising a child at the 50th percentile to the 69th to 73rd percentile. Furthermore, the children in the program scored significantly higher in multiple executive-function skills, such as attention-shifting, working memory, inhibitory control, and emotion recognition. (See the article in this issue by Cybele Raver and Clancy Blair for an examination of executive function in young children.) The program narrowed the school readiness gap in early math between poor and non-poor children and eliminated the gap between Latino and white children.

Changing teachers' perceptions of all children's abilities to be strong learners and thinkers about math topics may have substantial benefits. But the above results should be tempered by initial findings from a large evaluation of Building Blocks in New York City. In that study, gains seen at the beginning of prekindergarten were no longer statistically significant when prekindergarten

ended. Researchers are still analyzing several other anomalies, including the large amount of math taught in the control classrooms, the lack of high-quality instructional strategies (such as promoting dialogue and formative assessment) in intervention classrooms, and the finding that effects appeared to be greater for children who entered prekindergarten with strong receptive language skills. The evaluation is continuing into the children's kindergarten year.

Other preschool math curricula have shown positive results in high-quality evaluations, including Big Math for Little Kids and the Pre-K Mathematics Curriculum. Table 1 summarizes the main studies. We know of only one direct comparison of Building Blocks with another math curriculum. In that case, Building Blocks outperformed the other curriculum, Pre-K Mathematics, when all other factors were kept the same—that is, the amount of coverage, new materials, and professional development. Beyond this, there is little to tell us which curriculum would be a better choice for any particular context. All successful interventions appear to depend on raising the quality and quantity of specific mathematics teaching strategies. This has implications for policy and practice, as it suggests that although adopting a curriculum is an important step, other factors, such as professional development and coaching, are also critical.

Do positive effects last? Three types of long-term impact are important: sustainability, persistence, and diffusion. *Sustainability* is the continued and accurate use of an innovation such as a curriculum. *Persistence* means that the effects of an intervention on individual children's learning trajectories continue to be felt. *Diffusion* is the process by which an innovation spreads among the

**Table 1:** Evaluations of Early Mathematics Programs

Program/ Curriculum	Content	Age/ Grade	No. of Children	Design	Results
Building Blocks	Math	Pre-K	276	Random assignment to one of three groups: Building Blocks, Pre-K Mathematics Curriculum, or control	Building Blocks: large effect compared to control; medium effect compared to Pre-K Mathematics Curriculum
TRIAD/ Building Blocks	Math, Language	Pre-K	1,305	Random assignment of schools to one of three groups: TRIAD with follow-through (TRIAD-FT), TRIAD with no follow-through (TRIAD-NFT), and control	Large effect on math; small to medium effect on four of six language subtests
TRIAD follow-through (to Building Blocks)	Math	K	1,218	Random assignment to same three groups as in TRIAD/Building Blocks evaluation	Both TRIAD groups had a medium effect compared to control and were similar to each other.
TRIAD follow-through (to Building Blocks)	Math	1	1,079	Random assignment to same three groups as in TRIAD/Building Blocks evaluation	TRIAD-FT had a medium effect and TRIAD-NFT a small effect compared to control; FT had a small effect compared to NFT.
Building Blocks + OWL	Math Literacy, Executive Function, Emotions	Pre-K	2,018	Comparison of children just above and just below the age cutoff	Medium effect on language, literacy, numeracy, and mathematics skills; small effect on executive function and measure of emotion recognition
Big Math for Little Kids (BMLK)	Math	Pre-K and K	762	Randomly assigned child-care centers	Medium effect
Pre-K Mathematics Curriculum + Building Blocks (software)	Math	Pre-K	276	Classrooms randomly assigned to intervention or control	Moderate effect

*Note:* Many of these studies included control groups that used a variety of early childhood curricula, most often Creative Curriculum, but also Opening the World of Living, Where Bright Futures Begin, and curricula developed by districts and teachers. Thus we may be confident that business-as-usual curricula don't effectively develop children's potential for learning math.

*Sources:* Douglas H. Clements and Julie Sarama, "Experimental Evaluation of the Effects of a Research-Based Preschool Mathematics Curriculum," *American Educational Research Journal* 45 (2008): 443-94; Douglas H. Clements et al., "Mathematics Learned by Young Children in an Intervention Based on Learning Trajectories: A Large-Scale Cluster Randomized Trial," *Journal for Research in Mathematics Education* 42 (2011): 127-66; Julie Sarama et al., "The Impacts of an Early Mathematics Curriculum on Emerging Literacy and Language," *Early Childhood Research Quarterly* 27 (2012): 489-502; Julie Sarama et al., "Longitudinal Evaluation of a Scale-up Model for Teaching Mathematics with Trajectories and Technologies," *Journal of Research on Educational Effectiveness* 5 (2012): 105-35; Christina Weiland and Hirokazu Yoshikawa, "Impacts of a Prekindergarten Program on Children's Mathematics, Language, Literacy, Executive Function, and Emotional Skills," *Child Development* 84 (2013): 2112-30; Ashley Lewis Presser et al., "Big Math for Little Kids: The Effectiveness of a Preschool and Kindergarten Mathematics Curriculum," *Early Education and Development* 26 (2015): 399-426; Alice Klein et al., "Effects of a Pre-Kindergarten Mathematics Intervention: A Randomized Experiment," *Journal of Research on Educational Effectiveness* 1 (2008): 155-78; Preschool Curriculum Evaluation Research Consortium, *Effects of Preschool Curriculum Programs on School Readiness* (Washington, DC: Government Printing Office, 2008).

members of a social system—for example, wider dissemination of a curriculum.

Sustainability of implementation is especially important, given the importance of high-quality teaching for any curriculum and the short life of many reforms. Logically, we might expect to see decreasing fidelity after the external support and professional development provided by the intervention teachers have ceased. In the TRIAD/Building Blocks study, however, we saw the opposite: Teachers demonstrated increasing levels of fidelity years after support ended. It would appear that when teachers saw children gaining competence in math, they increased their efforts to carry out all of the intervention's components.

Persistence of effects may be a more important and complex issue than sustainability. Gains made in high-quality prekindergarten interventions often fade in the following few years. Policy makers have tried to promote persistence through alignment (for example, making connections between curricula and assessments within each grade) and continuity (making similar connections across grade levels). We have hints but little empirical evidence that lack of alignment and continuity is at least partially responsible for the fadeout of early gains. We also see some evidence that professional development can support curricular continuity that produces better induction experiences for new teachers, shared goals and instructional strategies, and increased student performance.

The TRIAD project promoted continuity between prekindergarten and the primary grades, testing the hypothesis that gains would appear to fade without follow-through in the primary school years. That

is, if children transition into a kindergarten curriculum that assumes little or no competence in math and thus emphasizes low-level skills, children who had a strong prekindergarten math experience would not continue their learning, whereas others might catch up. In the TRIAD evaluation, the effects from prekindergarten persisted when follow-through interventions took place in kindergarten and first grade; without follow-through, the effects were significantly smaller.

Interventions such as TRIAD are exceptions in US schools. Because the new trajectories are exceptions, many things may weaken their positive effects, such as programs that assume low levels of math knowledge and focus on lower-level skills, or a culture of low expectations for certain groups. Without continued support, children's nascent learning trajectories revert to their original, limited course. On the other hand, perhaps stronger prekindergarten interventions are necessary to counteract early disadvantage in children's school-readiness skills. But that approach may be unrealistic when children attend poor-quality schools, as African-American students are more likely to do. Just as experiencing consecutive years of high-quality teaching can have a cumulative positive effect, the opposite is also true.

*Diffusion* of the innovation is difficult to assess. However, reports have documented diffusion of the TRIAD/Building Blocks intervention in Boston. And New York City schools are adopting the curriculum and the TRIAD model for all prekindergarten classrooms.

Several successful interventions in the primary grades also apply some version of the learning trajectories idea. First-grade

teachers in Japan commonly move along multiple learning trajectories, culminating at the point when children develop an effective base-10 strategy to solve addition problems. For example, children solve  $8 + 6$  by thinking, “I take 2 from the 6 to make the 8 into 10, then have 4 left, so  $10 + 4 = 14$ .” Such interventions explicitly promote conceptual understanding by discussing and developing connections among concepts, facts, procedures, and processes. The interventions don’t practice basic facts for mastery until the children develop conceptual foundations and meaningful strategies. They challenge students to solve demanding math problems, helping them learn to think mathematically. Interventions like these may offer effective follow-through after prekindergarten programs, thus minimizing the fadeout effect. And they may be particularly successful if they use formative assessment—that is, continuous monitoring of student learning to guide instruction that’s based on the idea of learning trajectories.<sup>25</sup>

Three curricula implemented in first and second grade are among the other approaches to primary-grade math that have also been evaluated. One of these is consistent with the learning trajectories approach (Math Expressions), one is a more conventional textbook series, and the third emphasized procedural skills but did make some connections to concepts. All three outperformed a curriculum that was less structured and put more demands on teachers mathematically and pedagogically.<sup>26</sup>

### **Learning Better Science and Learning Science Better**

Like early math education, early science education should be more than a surface

treatment of traditional topics—describing the weather, for instance. Research has identified learning trajectories for key topics in science and engineering, such as physics and biology, and evidence shows that following these pathways is educationally effective. Admittedly, efforts to identify learning progressions and core concepts in science are not as far along as they are in math. We still need to identify a few core ideas and to plan standards, curricula, and teaching around those ideas.<sup>27</sup> But we do have a foundation on which to build.

### **Developing Scientifically Rich Curricula**

As with mathematics, high-quality science education that emphasizes richer and deeper content appears to be effective, although experimental and long-term studies have yet to be conducted for most curricula. Early results suggest that consistent science experiences can increase children’s vocabulary. They also promote the use of more complex grammatical structures, such as causal connectives: “It’s green *because* I mixed yellow and blue paint.” Such experiences may also close a science gender gap in motivation and interest.

Several science curricula encourage children as young as preschoolers to think about and work with science concepts (for example, the change in a plant’s height) for many weeks or months. Primary grade teachers also need access to all three components of learning trajectories, especially instructional activities that work when connected to their understanding of students’ scientific thinking and learning.<sup>28</sup> And our early elementary educators sorely need more professional development in science. Ideally,

that would involve multi-year efforts to focus on both subject-matter content and pedagogy.<sup>29</sup>

## Effects on Competencies beyond Math and Science

The time spent by primary-grade teachers on science and social studies instruction has decreased in the past 15 to 20 years, and the long-term negative effects on achievement may be substantial.<sup>30</sup> Math and science vocabulary and concepts are essential for reading comprehension, because early math and science instruction develops language within those subjects.<sup>31</sup> And the benefits may run deeper. In one study, children who experienced the Building Blocks curriculum in prekindergarten outperformed children in a control group on four oral language competencies when they were asked to retell a story: ability to recall key words, use of grammatically complex utterances, willingness to reproduce narratives independently, and inferential reasoning. This revealed transfer both in content and in time. That is, the children learned language skills that had not been directly taught in the math curriculum, and they maintained these skills into their kindergarten year.

Such transfer of learning may explain why early math knowledge not only predicts later mathematics achievement, but also predicts later reading achievement—even better than early literacy skills do. Mathematical thinking may be cognitively foundational.<sup>32</sup> That is, the thinking and reasoning inherent in math may contribute broadly to cognitive development. However, we still need to learn more about *how* STEM education supports later language and literacy learning. Would having interesting, sustained conversations on any topic be just as beneficial? We also

know little about how much time should be focused on literacy and STEM topics.

Research also suggests that high-quality implementation of math curricula in preschool can develop self-regulation skills (also called executive function skills).<sup>33</sup> These are the cognitive skills that allow people to control, supervise, or regulate their own thinking and behavior, such as the ability to shift attention or hold things in working memory. In math, consider the following problem: “There were six birds in a tree. Three birds already flew away. How many birds were there from the start?” Children must use the executive function of response inhibition to avoid the tempting (but incorrect) procedure of subtraction, engendered by the phrase “flew away.” Instead, they must calculate the sum through addition, counting on, or other strategies. In some experiments, the effects of high-quality math on executive function have been found even when they weren’t planned. For example, the combination of the Building Blocks math curriculum and the Opening the World of Learning literacy curriculum produced unplanned but positive, albeit small, statistically significant impacts on executive function.

Another study hypothesized that combining Building Blocks with Tools of the Mind, a curriculum designed to develop executive function through play, would produce better results in executive function and in math than a Building Blocks math curriculum alone would. The study further hypothesized that both the combined curriculum and Building Blocks alone would outperform the control group in math.<sup>34</sup> The results were surprising. The Building Blocks group had higher math scores than either of the other groups. Even more surprising was that the Building Blocks



group outperformed the others on two measures of executive function, including one that predicts later math achievement.

These and other studies suggest that high-quality math education may have the dual benefit of teaching an important content area and developing at least some executive function processes.<sup>35</sup> They also suggest that preschool curricula can successfully combine social-emotional learning, literacy, language, science, and math, all the while enhancing rather than competing with play-based approaches.<sup>36</sup> We need research on such efforts to see how they can benefit all domains of development.

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*High-quality math education may have the dual benefit of teaching an important content area and developing at least some executive function processes.*

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## **Barriers to Teaching Math and Science**

Widespread negative dispositions and beliefs about learning and teaching mathematics and about preservice training and professional development in STEM constitute substantial barriers to high-quality teaching.

### **Negative Dispositions and Beliefs**

One deeply embedded cultural belief in the United States is that math achievement largely depends on native aptitude or ability. In contrast, people in other countries, such as Japan, believe that achievement comes from effort. Research shows that the US

belief hurts teachers and students and, furthermore, that it just isn't true. Students who believe—or are helped to understand—that they can learn if they work diligently will perform better throughout their school careers than students who believe that a person either gets it or doesn't. That view often leads to failure and what we call “learned helplessness.” Similarly, students who have mastery-oriented goals (that is, students who try to learn and see that the point of school is to develop knowledge and skills) achieve more than students whose goals are directed toward high grades or outperforming others.

Early-childhood teachers often hold negative dispositions and beliefs about math and science, including dislike, trepidation, fear, and a doubt in their own efficacy. In one study, the strongest predictor of mathematics learning among preschoolers was their teachers' belief that math education was appropriate for that age group.

Children also need more positive beliefs and attitudes about STEM. As early as the primary grades, math anxiety hurts children's achievement in math. Primary-grade students who score high on working memory but also have math anxiety tend to perform more poorly in math, because their working memory capacity is co-opted by anxiety. Primary graders who feel panicky about math have increased activity in brain regions associated with fear, and decreased activity in brain regions involved in problem-solving. If we can identify and treat math anxieties early, we may be able to keep children with high potential from avoiding math courses.

Fortunately, most very young students have positive feelings about math; they're motivated to explore numbers and shapes.

But it takes just a couple of years in typical schools before they begin to believe that only some people have the ability to do math. We believe that students who experience math as a sense-making activity, rather than a series of timed tests, will build positive feelings about math throughout their school careers. Similarly, we can change teachers' negative dispositions and beliefs through high-quality preservice and professional development, a subject to which we now turn.

### **Professional Development Is Inadequate**

Even though children are eager to learn, many early childhood teachers aren't eager or prepared to engage children in rich experiences in domains other than literacy. Historically, teachers of young children haven't been prepared to teach subject-specific knowledge to young children. In-service professional development also tends not to emphasize math and science, despite learning standards and increased curricular attention to these subjects. Of 50 state-funded preschool programs, 41 require at least 15 hours of in-service training per year. But content decisions are made locally, and STEM is usually ignored. Professional development must help teachers explore content and pedagogy in depth. It must also confront the distaste for math that is widespread among teachers of young children—and directly related to girls' achievement in their classes.

Research on professional development for math teachers offers some guidance. For example, certification alone doesn't reliably predict high-quality teaching—probably because certification programs vary widely and too many are of low quality. On the other hand, direct measures of teachers' knowledge

of math and math pedagogy do predict the quality of their teaching.<sup>37</sup>

In general, research suggests that effective professional development in early STEM is continuous, intentional, reflective, goal-oriented, and focused on content knowledge and children's thinking; it's grounded in particular curriculum materials, and situated in the classroom. But all training needn't occur in the classroom. While research-based curricula can help teachers learn to teach STEM, teachers need to understand all three components of a learning trajectory—goals (the STEM content), developmental progressions, and instructional activities. This requirement appears to place too heavy a burden on curricula alone, even on curricula designed to help teachers learn.

Teachers also need off-site, intensive training that focuses on these three components and the connections among them—though such training must be connected to classroom practice. Then they need time to try out the new strategies in their classrooms, supported by coaches who give them feedback. The success of Building Blocks, TRIAD, and other projects can largely be attributed to such professional development organized around learning trajectories. These projects included far more extensive and intensive professional development than the usual one-shot workshop, ranging from five to 14 full days.

### **Technology and Engineering**

Young children are motivated by such simple engineering tasks as building with blocks, and by interacting with technology.<sup>38</sup> Unfortunately, few researchers have examined engineering among young children. Block-building has been widely studied, so we know that preschoolers' competence

at this activity predicts the number of math courses they take and their grades in high school. Furthermore, developmental progressions for block-building are well established.

Various computer technologies can improve how and what children learn about STEM, and about other subjects. However, the T in STEM refers to *learning about* technology rather than *using* technology, and learning how to apply it to solve problems. Therefore, we will only briefly describe computer-assisted instruction, and then we'll move on to more active technologies.

### Computer-Assisted Instruction (CAI)

CAI means structured software that instructs students or lets them practice. Experiments show that practice software can help young students develop competence in such skills as counting and sorting, and in addition facts.<sup>39</sup> CAI can also teach at-risk first graders the add-1 rule (adding 1 is the same as “counting one more”) by way of pattern detection.<sup>40</sup> The software asks, “What number comes after 3 when we count?” and then immediately follows by posing a related addition question, “ $3 + 1 = ?$ ”. The software also discourages children from overgeneralizing by giving counterexamples to the add-1 rule. Research reviews of rigorous studies show that when such applications are well designed and implemented, they have a positive impact on children’s math performance—raising a child from the 50th to the 61st to 68th percentile across different studies.<sup>41</sup>

Games may also be effective. Second-graders who averaged one hour of interaction with a technology game over a two-week period responded correctly to twice as many items on an addition facts speed test as students in a control group.<sup>42</sup>

### Computer Manipulatives

Other approaches that have also received support address STEM more directly, as they teach children to use tools for discovery and for problem-solving. A recent review of 66 studies found that the use of computer manipulatives raised a child from the 50th to the 64th percentile.<sup>43</sup> This positive effect may come from the following seven advantages of technology-based manipulatives and activities: (1) They bring mathematical ideas and processes to conscious awareness; (2) they encourage and facilitate complete, precise explanations; (3) they support mental actions on objects; (4) they can change the nature of the manipulative (for example, computer shapes can be precisely cut apart or scaled, unlike wooden or plastic shapes); (5) they symbolize mathematical concepts; (6) they link the concrete and the symbolic with feedback; and (7) they record and replay students’ actions.

### Syntheses of Approaches

Technologies that use a combination of these teaching strategies and tools can help children follow learning trajectories. Manipulative-based, dynamic models can help children develop foundational understandings. Connecting multiple representations (such as manipulatives, spoken words, symbols, and actions) helps to build understanding and to connect children’s own concrete and symbolic mental representations, all while they’re learning to use the tools to solve problems. For example, the Building Blocks software employs a series of technological activities that incorporate manipulatives and board games to progressively develop children’s competence in counting. This leads to counting-based addition and subtraction strategies. If

children make several consecutive mistakes, they receive brief hints and then tutorials. A management system moves the children along a research-based learning trajectory, using formative assessment to ensure that each child is learning new concepts and skills through tasks that are challenging but achievable. Building Blocks software was one of the strongest mediators of children's learning, but it's still unclear exactly how the software contributed to learning. Significantly, a separate study showed that the Building Blocks software was effective even when used alone, raising a child from the 50th to the 67th percentile.<sup>44</sup>

### **Logo and Coding: Computer Science and Engineering**

Many types of software let children build STEM objects virtually. The oldest and most-studied software that teaches all four STEM subjects for early childhood is called Logo. In Logo's computer coding, children begin by directing an onscreen robot or turtle to draw geometric shapes. Many children can draw shapes with pencil and paper, but drawing shapes using Logo commands requires them to analyze the visual aspects of the shape and the movements needed to draw it. Writing a sequence of Logo commands to draw a shape encourages children to think precisely about that process.

After working with the robot or turtle, students show greater explicit awareness of the properties of shapes and the meaning of measurements. An evaluation of a Logo-based geometry curriculum across grades K–6 revealed that Logo students scored statistically higher than control-group students on a general geometry achievement test, making about twice

the gains of children in comparison groups (raising a child from the 50th to the 82nd percentile).<sup>45</sup>

Finally, computer coding shouldn't be considered work on virtual worlds only. In robotics environments, for example, children are engineers. They create LEGO structures that have lights, sensors, motors, gears, and pulleys, and they control their structures through computer code. The few studies that have examined LEGO–Logo suggest that such experiences can positively affect children's math and science achievement as well as their higher-order thinking skills. If they start as young as kindergarten, both boys and girls benefit from work with robots, and few differences appear between them. Recently, researchers have described how very young children at different developmental levels approach programming a robot, which suggests that this may be a promising approach for future engineering experiences.

### **Conclusions**

Children from preschool through the primary grades are interested in learning about STEM and can think about these subjects in ways that are surprisingly broad and deep. Not only does math competency predict later school success, but all areas of STEM contribute to other developmental goals, such as language and executive function. Children whose teachers use research-based approaches demonstrate higher levels of STEM achievement and thinking. Learning trajectories can support children's learning, and can also aid in assessment and curriculum development. Children whose teachers use research-based learning trajectories demonstrate higher levels of mathematical reasoning.

Current research in learning trajectories points the way toward math learning that is more effective and efficient—but also creative and enjoyable—through culturally relevant and developmentally appropriate curricula and assessment. However, we

still have much to learn about teaching certain topics in STEM and about the characteristics of curriculum development and professional development that will let children realize their full potential in these critical subjects.

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# Neuroscientific Insights: Attention, Working Memory, and Inhibitory Control

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*C. Cybele Raver and Clancy Blair*

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## Summary

In this article, Cybele Raver and Clancy Blair explore a group of cognitive processes called executive function (EF)—including the flexible control of attention, the ability to hold information through working memory, and the ability to maintain inhibitory control

EF processes are crucial for young children’s learning. On the one hand, they can help students control their anxiety when they face challenging academic tasks. On the other, these same processes can be undermined when children experience chronically stressful situations—for example, poverty, homelessness, and neighborhood crime. Such adverse early experiences interfere with children’s development of EF, hampering their ability to manage challenging situations

Through both behavioral examples and empirical evidence, Raver and Blair illustrate how children’s cognitive development is intertwined with EF. They show how children’s regulation of higher-order thinking is related to the regulation of emotion—in both top-down and bottom-up fashion—and they review research on early brain development, EF and emotion regulation, and children’s academic performance. They also examine the efficacy of educational interventions that target EF and of integrated interventions that target both emotional and cognitive regulation.

What does our understanding of EF imply for policy in pre-K–3 education? First, write Raver and Blair, to help young children learn, school districts need data not only on their academic readiness but also on key dimensions of EF. Second, we already have interventions that can at least partially close the gap in neurocognitive function and academic achievement between children who face multiple types of adversity and those who don’t. In the long run, though, they argue, the best way to help these children is to invest in programs that reduce their exposure to chronic severe stress.

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In the past 10 years, formal educational opportunities for children from early childhood to third grade have changed dramatically. Prekindergarten and kindergarten programs have become increasingly available, and standards for learning in the early elementary grades have become more academically rigorous. As a result, young children in the United States are spending more time in formal education and working harder on academically anchored content.<sup>1</sup> For example, the Common Core math standards say that by first grade, children should be able to solve word problems that involve “adding to, taking from, putting together, taking apart, and comparing,” with the challenge of solving for unknown values and using “objects, drawings, and equations with a symbol for the unknown number to represent the problem.”<sup>2</sup> To be sure, academic challenges such as these require complex, higher-order cognitive skills. Importantly, they also require children to modulate their attention, emotions, and motivation so that they remain focused and persistent when the academic going gets tough. In this article, we discuss recent advances in neuroscience that help reveal the pathways that connect young children’s higher-order cognitive skills, their emotional skills, and whether they succeed or struggle in this academically challenging terrain.

We first outline several breakthroughs in how neuroscientists understand children’s brain development. These breakthroughs highlight the role that a group of cognitive processes called executive function (EF) play in children’s opportunities for learning. What exactly is EF? It encompasses the flexible control of attention, the ability to hold information through working memory, and the ability to maintain inhibitory control.

Early in the article we offer a behavioral example and empirical evidence to illustrate what attention control, working memory, and inhibitory control look like and how they work together to support children’s early learning. We also consider new findings in neuroscience demonstrating that just as higher-order cognitive processes (including mindsets) can help students modulate anxiety when they face challenging academic tasks, these same processes can be undermined when anxiety and challenge become too great.

Science has recently given us elegant evidence of how these cognitive and emotional domains of children’s brain function are wired together in both top-down and bottom-up fashion. We carefully describe how children’s regulation of higher-order thinking is related to the regulation of emotion using these top-down and bottom-up models; briefly review research on early brain development, how changes in brain function and related competencies are measured, and how both EF and emotion regulation contribute to children’s academic performance; and examine factors that support or constrain children’s development of those regulatory competencies, allowing some children to navigate cognitively demanding and emotionally challenging tasks more easily than others. In the remainder of the article, we discuss educational interventions that target EF and integrated interventions that target both emotional and cognitive regulation. We review the efficacy of these approaches, which range from individually administered treatments for clinical levels of EF difficulty to school interventions that can take place in classrooms. We wrap up with implications for policy and prevention in the context of starting early.

## Top-Down Executive Function and Academic Success

Imagine a preschooler who wants to join older siblings or peers as they play a blazingly intense card game like Uno. The group's energy is high, and there's laughter all around. But this child doesn't know how to play. To get into the game, she needs to focus her attention, with her brain working at remarkably rapid pace to pick out important details (for example, the numbers and shapes on the cards, or how many cards each player gets). She can sort these key details from irrelevant ones, such as whether players hold the cards in their left or right hands. In short, children must be able to focus their attention flexibly so that they can manage competing and sometimes conflicting chunks of incoming information, in addition to being alert and oriented to cues in their environment. Whether they're learning a card game or managing larger, more academically challenging contexts, children must also handle competing decision rules for how to categorize information and solve problems. This ability to *shift cognitive set* flexibly—that is, to see relationships among things in one way and then shift the mental frame and see them in a different way—is central to executive function. To assess attention shifting, we ask children to sort test items (pictures of objects, shapes, etc.) to reflect similarity in one way, such as color; then we ask them to shift their attention to a second dimension along which the items can be categorized, such as size, and to sort them accordingly. Young children's abilities to focus and flexibly shift their attention play an important role in their capacity to solve problems in the context of play and learning.<sup>3</sup>

To learn the card game, the child in our example also needs to hold a lot of

information in mind, such as what patterns or groups of cards may be played and when. In other words, she needs strong working memory skills. We can easily assess working memory orally, for example, by asking children to quickly learn a sequence of numbers or words and then to repeat back or recall them in the reverse order. Developmental research shows that children's working memory changes rapidly during early childhood and plays a key role in goal-directed behavior and higher-order problem solving of many kinds.<sup>4</sup>

Finally, the child who wants not only to play but also to win that card game needs to have some basic capacity to avoid behavioral ruts—that is, she has to inhibit her tendency to respond automatically. For example, she may have to stifle the urge to grab a card she really needs to make a good hand so as not to tip that hand to other players. In psychological terms, this ability to inhibit a more automatic or reactive response in favor of a reflective and flexible one is called *inhibitory control*. Young children increasingly develop this capacity to inhibit knee-jerk responses in favor of more reflective responses that help them meet goals and avoid errors.<sup>5</sup> To assess inhibitory control, we give a child tasks that encourage a pattern of response that the child repeatedly engages in but that must be overcome—that is, inhibited—in response to a specific cue. A game like Simon Says, in which the rules quickly switch, is a good example. Of course, inhibitory control is in many ways linked to attention and memory. Children younger than three, for example, may not only have trouble inhibiting impulsive responses but also following and remembering the rules of the game. Older children master these skills so that in both academically and socially challenging contexts, they can inhibit a

previously learned or dominant but incorrect response in favor of a less dominant, correct response.

These three EF skills (flexible shifting and focusing of attention, working memory, and inhibitory control) are the foundations of both children's and adults' abilities to meet goals of all kinds. They serve as air traffic control for a great deal of brain activity.<sup>6</sup> Specifically, EF is associated with neural activity in areas of the prefrontal cortex, located in the anatomically topmost and forward regions of the brain. The signals from the prefrontal cortex extend to cortical and subcortical areas anatomically behind and below the prefrontal cortex (including areas responsible for motor and emotional responses to stimuli, such as the basal ganglia, amygdala, and hippocampus), and to some degree help control activity in those areas. For this reason, EF is described as working in top-down fashion.<sup>7</sup> In combination, EF skills let children organize information in new ways.

Researchers have developed several models of EF (as well as more broad constructs of self-regulation and "approaches to learning") that focus to greater or lesser degrees on how the dimensions of EF work within and across individuals, and within and across

educational settings from preschool through K–12 education.<sup>8</sup> In all these models, the consensus is clear: EF gives children increasing cognitive and behavioral control, not only letting them solve more complex academic problems but also allowing them to take other children's perspectives and understand that those perspectives may differ from their own.<sup>9</sup>

The neurobiology of executive function offers insight into its role in children's early learning and how early educational experience and high-quality caregiving support and foster its development. EF, like the prefrontal cortex, matures throughout childhood and isn't fully developed until early adulthood.<sup>10</sup> This leaves ample opportunity for children's experiences to have an extended influence on EF's development and on the development of the prefrontal cortex and its many connections throughout the brain. Although EF and the prefrontal cortex develop over an extended period of time, research suggests that the prefrontal cortex is active in infancy and that early indications of EF-like abilities can be observed in the processing of language and early inhibition of reaching behavior.<sup>11</sup> Not until children are two or three years old, however, can complex EF abilities be directly measured.<sup>12</sup>

### A Year of Growth

What skills can preschoolers demonstrate on simple tasks that require attention, memory, and inhibitory control? A recent study in Boston suggests that although most children can understand basic rules of a game in the fall of their prekindergarten year, only about half of them can flexibly remember the different rules of EF tasks and switch the way they use them. By the spring of their preschool year, most students in high-quality prekindergarten gained substantial proficiency in mastering the more complex versions of the tasks. For example, more than three-fourths of students who were assessed could remember and use more complex rules, and the majority of students could use impulse control and memory to perform well on trials that required higher EF skills.

Source: Christina Weiland et al., "Associations between Classroom Quality and Children's Vocabulary and Executive Function Skills in an Urban Public Prekindergarten Program," *Early Childhood Research Quarterly* 28 (2013) 199–209, doi: 10.1016/j.ecresq.2012.12.002.



Given EF's close relation with the prefrontal cortex, its development in children is fostered by types of caregiving and early experiences that facilitate activity in and functioning of this area of the brain in its top-down role. These include parenting behaviors that are grouped together as *sensitive care*, specifically, parenting that's characterized by joint attention, high levels of scaffolding of behavior (where the adult provides appropriate levels of support and challenge), and low levels of intrusiveness and detachment. Failures of executive control are frequent in early childhood (for example, during the terrible twos), and parents and caregivers need to exercise patience and understanding. Three- to four-year-olds don't have the same capacity for executive function that six- to seven-year-olds do, and these differences are reflected in the educational approaches taken in prekindergarten and the early elementary grades. Prekindergarten involves activities through which children acquire information about academic content through purposeful play and exploration. Prekindergarten also often involves shorter periods of teacher-led instruction that take into account preschoolers' more limited attention skills and inhibitory control. Early elementary education requires children to begin putting information to use in more formal math, reading, and writing activities that capitalize on their capacity for longer periods of focused and sustained attention, inhibitory control, and working memory. Early parenting and prekindergarten education that fosters EF prepares children to meet the expectations of the early elementary grades.

We now have strong evidence, including experimental evidence, to show that the development of EF before children enter school consistently predicts early math and

early reading skills, even when we control for prior achievement and measures of general mental ability.<sup>13</sup> From the standpoint of cognitive ability, EF is manifestly important for holding information in mind when solving mathematics problems and for learning early literacy skills such as phonemic awareness, where a compound word is understood to be composed of two shorter words (for example, toothbrush.) Accordingly, our research has consistently shown—across multiple samples of children from low-income homes—that individual EF differences in children as young as four or five predict their math and literacy ability from preschool through later elementary school.<sup>14</sup> For example, in two different studies, Clancy Blair (one of the authors of this article) and colleagues found that children's EF predicted their performance in math across the early school years, even after taking into account their general cognitive abilities (or IQ) and other aspects of social-emotional competence.<sup>15</sup>

Other research teams have found that children's EF skills predict academic achievement over the early elementary years and through adolescence.<sup>16</sup> Several studies have taken into account (or statistically controlled for) early measures of children's achievement and found that these self-regulatory skills are related to later achievement net of those early skills.<sup>17</sup> Longitudinal studies—that is, studies that follow children over time—have also shown that just as EF promotes math and reading, learning math and learning to read foster the development of EF.<sup>18</sup>

The more purely cognitive aspects of EF explain part but not all of the self-regulation story when predicting young children's academic achievement in school settings. Specifically, models that emphasize only

the top-down cognitive aspects of EF don't fully account for the way that emotions—such as frustration, anxiety, enthusiasm, and motivation—can undercut or energize EF. Children's capacity to manage or modulate emotions (whether they're playing a game with peers or handling the feelings that arise when tackling difficult academic material) is called *emotion regulation*. Prevailing definitions of emotion regulation highlight not only how children's emotions are regulated themselves, but also how emotions regulate cognitive functioning and social interactions.<sup>19</sup> We now turn to those emotional regulatory processes and how they work hand in hand in a bottom-up fashion with top-down EF.

### **Bottom-Up Emotional Regulation and Learning**

Let's return to the preschooler trying to work her way into (and possibly even win) that fast-paced card game. If she gets too excited by the thought of beating her opponents or too frustrated from having lost the most recent hand, she may lose focus and miss her turn; she may momentarily forget the rules; or she may lose behavioral control and jump the gun, playing her hand too soon. In short, her excitement or frustration play a significant role in how well she learns and plays the game. As the neurobiology of EF indicates, and parents and teachers attest, young children's EF skills can be alternately supported or derailed by their emotional state and by the physiological response to the stress that accompanies emotional responses to environmental challenges.<sup>20</sup> In broad-brush terms, this happens because the brain areas associated with reactivity and regulation of emotion and stress—structures in the limbic brain below the cortex, sometimes referred to as the reptilian brain—are

reciprocally connected with the prefrontal cortex; consequently, both influence and are influenced by EF. The connectivity between the limbic and cortical areas of the brain makes perfect evolutionary sense—the brain areas associated with emotion and stress need to communicate effectively with the thinking brain (the prefrontal cortex) to direct attention, thinking skills, and planning and problem-solving resources to things that are important for our wellbeing.<sup>21</sup> Emotional arousal sharpens and strengthens attention to the environmental details that are relevant to our goals and interests. At very high levels, however, emotion can disrupt cognitive control, hijacking attention and depleting cognitive resources.<sup>22</sup>

Neurobiologically, the way that the emotional (limbic) brain communicates with the thinking brain is by increasing neurotransmitter levels that at a moderate level cause neurons in the prefrontal cortex to be more active. Those key neurotransmitters (dopamine and norepinephrine) work in concert with the hormone cortisol, the end product of stress-related activity in what's known as the body's hypothalamic-pituitary-adrenal (HPA) axis. Because cortisol is present in children's saliva, it offers scientists a rough proxy for measuring how children's brains and bodies are responding to their environments. When levels of cortisol and other neurotransmitters are too high (indicating that a person is emotionally overwrought and stressed out) or when they are too low (indicating that the person is bored and lethargic), activity in the prefrontal cortex drops; consequently, the valuable thinking skills that this brain area supports aren't as readily available. This bottom-up, top-down relationship between emotions and higher-order cognitive skills is paralleled by children's increasing capacity

## Rapid Improvement

How much does children's EF skill grow over time? In one study of young children in rural and semirural communities, growth in EF was about 1.5 standard deviations per year—meaning that a four-year-old child in the lowest end of the distribution for her age group would be at the upper end of the distribution for three-year-olds. This rapid growth means that parents and prekindergarten teachers can expect pronounced improvement in children's abilities to hold information in mind; to flexibly regulate attention, emotion, and behavior in response to changing contexts and contingencies; to show higher levels of sustained attention and engagement; and to disengage from activities when they need to. By kindergarten, evidence from nationally representative data sets suggests, teachers recognize and value these increased competencies; children perform better not only on direct assessments of EF but also on teacher-reported measures of attention, persistence, and behavioral control.

Source: Michael T. Willoughby et al., "The Measurement of Executive Function at Age 3 Years: Psychometric Properties and Criterion Validity of a New Battery of Tasks," *Psychological Assessment* 22 (2010): 306–17, doi: 10.1037/a0018708.

to exert top-down cognitive control over negative emotional states, such as frustration and anxiety, and also to maintain the optimal levels of attention and focus associated with the motivation and engagement that are essential for doing well in school.

As we saw in the card game, a child's acquisition of challenging material can be accompanied by a surge of excitement and pride in her role as a learner. Alternately, children can become increasingly aware of failures, with corresponding negative self-appraisal and rising withdrawal from the process of learning—effectively turning EF off. To explore this process, we must take a step back to map the ways that children's emotional processes are regulating (and dysregulating) and regulated.<sup>23</sup> A good example of the role that the bottom-up, top-down nature of EF plays in education can be seen in a recent study of first- and second-graders. Anxiety about mathematics co-opts the working memory resources that students need for complex problem solving, leaving them vulnerable to choking under pressure.<sup>24</sup> Only a few studies have examined the neurobiological and behavioral mechanisms that link younger children's anxiety levels to their acquisition and recall of academic information in the early elementary grades.<sup>25</sup> This promising area of research is

likely to yield new directions for educational intervention.

From early childhood through early elementary school, fortunately, children grow increasingly competent at using voluntary cognitive control to rein in their emotions. Attention, working memory, and inhibitory control each play a key role in that process. This relationship between emotion and EF highlights the complex and interrelated nature of influences on learning, and shows that focusing on the social and emotional aspects of self-regulation is a key part of elementary education.<sup>26</sup>

First, research in both neuroscience and developmental science shows that voluntarily focusing attention (both visually and psychologically) away from sources of distress is a powerful way to manage emotion and maintain behavioral self-control.<sup>27</sup> Landmark research on young children's ability to delay gratification using prohibited but tempting food rewards (such as a marshmallow) is often used to illustrate the power of executive attention. Children who can distract themselves from the source of temptation are able to wait longer and are correspondingly more successful in meeting the task's goal than are children who look at or think about the tempting item.<sup>28</sup> In

an innovative experimental twist on the marshmallow delay task, young children have also been found to accrue information about the reliability or predictability of their environments. Children who were randomly assigned to interact with an adult experimenter who was unreliable in coming through with promises (of stickers) waited significantly less time before eating the marshmallow than did children randomized to interact with a more reliable adult.<sup>29</sup> These findings show that young children can mentally focus on the prospect of either a more positive or more negative outcome, demonstrating experimentally induced differences in the power of young children's mindsets for self-control.

In more recent work with older children at risk for anxiety and depression, psychological distraction away from potential negative outcomes, such as performing badly on academic or social tasks, has consistently been associated with a reduction in negative mood, while rumination (or difficulty psychologically disengaging attention from negative mental perceptions) has been associated with increased activity in limbic brain areas and greater feelings of worry and sadness.<sup>30</sup> As we'll discuss below, the recursive top-down, bottom-up nature of executive function and emotion regulation holds substantial promise for educational intervention. Helping children modify their attention biases away from negative stimuli and toward more positive stimuli may reduce negative moods and give them greater emotional and cognitive self-control.<sup>31</sup>

Second, neuroscience research provides strong evidence that children can adapt through *set-shifting*, that is, reorienting how they appraise stimuli that were originally

understood to be upsetting.<sup>32</sup> People deploy this form of EF when they take a psychological step back from experiencing a situation or event as painful, frustrating, or upsetting, and instead reappraise it in ways that limit its disruptive power. As a top-down form of emotion regulation, cognitive reappraisal is associated with increased prefrontal cortex activity and decreased activity in emotional areas of brain, such as the amygdala and medial orbitofrontal cortex.<sup>33</sup> The cognitive reappraisal model tells us why some children—and adults—may be more vulnerable than others to interpreting their own errors and difficulties when learning new material as a lack of ability or intelligence, leading them to be less motivated to learn. In an exceptionally powerful set of mindset interventions, researchers have illustrated that cognitive reappraisal can substantially shift older students' emotional responses to learning new, difficult material and their neurocognitive responses to making errors.<sup>34</sup> Those EF-based skills let students exert willpower in ways that have been depicted as cool and logical; students become empowered by reflecting on a given situation or problem, setting and monitoring progress toward goals, and implementing specific strategies to manage behavior and meet those goals.<sup>35</sup>

In sum, neuroscience, developmental science, and education research together give researchers and policymakers new ways to understand the recursive neurocognitive and emotional processes that underlie young children's success and failure when learning. Rapid advances in research also show that adverse early experiences impede the development of EF and their related capacity to manage negative emotions and motivation in challenging situations. Accompanying

advances in prevention science point to the ways that children's EF and emotional and behavioral self-regulation can be substantially improved through environmental enrichment from both parents and teachers.

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*Children's early experiences with their caregivers profoundly influence the processes that undergird their executive functions and emotion regulation later in early childhood.*

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### **What Helps and What Hurts**

As we've said, children's early experiences with their caregivers profoundly influence the neurobiological and behavioral processes that undergird their executive functions and emotion regulation later in early childhood.<sup>36</sup> Sensitive, contingent parental care not only scaffolds children's attention, EF, and regulation of emotion, but also supports optimal connectivity at the neurobiological level.<sup>37</sup> Conversely, children who experience severely neglectful caregiving are at greater risk of neurobiological and behavioral harm; multiple regions of their brains that are responsible for EF and emotion regulation are at greater risk of both structural and functional compromise.<sup>38</sup> Several studies show that when children are adopted from highly neglectful institutional care settings into homes with more sensitive caregivers, their emotional and higher-order cognitive skills can partially recover, with corresponding partial improvement in brain health and connectivity—especially if they're adopted before they're two years old.

Fortunately, few children experience such severe deprivation in infancy. Although studies of children in acutely deprived environments, as well as research on brain and behavioral development among maltreated children and children in foster care, tell us a great deal about the brain's malleability in the face of both environmental insult and intensive support, they don't tell us about how those processes unfold for most children in most families and communities in the United States.<sup>39</sup> Recent evidence from research on both human infants and animals makes abundantly clear that the normative neurobiological and endocrine processes underlying children's attention, EF, and emotion regulation are in large part shaped by whether and how parents provide sensitive, contingent care and organized, stable routines from the early months of life through early childhood.<sup>40</sup> Both caregivers and infants experience positive changes in brain function, brain connectivity, and stress hormones when they are behaviorally in sync; this dynamic, self-reinforcing synchrony supports early attention, emotional control, and EF.<sup>41</sup>

Conversely, studies show that parents who struggle with high levels of anxiety, negative mood, and psychosocial strain also struggle at a neurobiological level to accurately read and tune in to their babies' cues.<sup>42</sup> They chronically miss opportunities to connect with their babies through coordinated attention and positive emotional exchanges involving smiles, laughter, and delight.<sup>43</sup> Moreover, studies of young children's neuroendocrine function have demonstrated that higher-quality care from nonparental caregivers in childcare settings can also contribute to early regulation of both cognition and emotion.<sup>44</sup> The good news is that recent interventions using



neuroscientific tools to measure infants' and toddlers' neurocognitive and emotional development clearly show that we can support both parents and children into more positive trajectories of interaction, with positive implications for early EF and emotion regulation.<sup>45</sup>

Forces outside the parent-child dyad can also alternately support or undercut healthy development. Specifically, extensive research over the past two decades has shown that poverty—and the associated exposure to a range of adverse experiences collectively referred to as toxic stress—makes parents more likely to misinterpret their children's cues and to be more irritable, more intrusive, and less patient during routine interactions, leaving parents and children at greater risk of falling out of interactional sync.<sup>46</sup> By disrupting interactions with caregivers, poverty-related stress puts children at greater risk for neuropsychological difficulties with EF, for difficulty modulating fear and anger, and for less optimal patterns of attention.<sup>47</sup> Family socioeconomic disadvantage can have negative, stress inducing, and neurocognitively costly consequences for adults as well as for children.<sup>48</sup>

However, positive caregiving can buffer young children in the face of adverse experiences, and many, many parents provide sensitive, nurturing care while struggling to make ends meet.<sup>49</sup> In our own research with a longitudinal sample known as the Family Life Project, we found that children growing up in rural and semi-urban areas hard-hit by poverty had higher resting levels of the stress hormone cortisol between 7 and 24 months of age compared to somewhat more economically advantaged peers. In our longitudinal analyses, it

was clear that positive parenting behavior substantially protected children from these negative consequences of poverty.<sup>50</sup>

In addition to the stress of struggling to make economic ends meet, many US families also experience sufficient disruption and instability both inside and outside the household to place children's EF skills and emotion regulation at risk. In the past five years, we've learned a great deal about several sources of stress, including lack of safety and lack of stability or predictability, which appear to be particularly toxic. For example, evidence from both animal and human studies suggests that chaotic, unpredictable, or unstable conditions may compromise organisms' ability to appropriately regulate their physiological, cognitive, and behavioral responses to stress.<sup>51</sup> Clinical research suggests that high levels of instability, such as when foster children experience multiple changes in households and caregivers, have grave consequences not only for the way they react to stress, but also for their emotion regulation and EF.<sup>52</sup> New research shows that less extreme forms of family turbulence, including adults moving in and out of the household or families changing households frequently, also takes a toll on children's stress physiology, EF, and inhibitory control.<sup>53</sup> High levels of mobility or instability outside the home can also affect children—national Head Start data suggest that switching preschools in early childhood predicts greater academic difficulty in kindergarten and early elementary school.<sup>54</sup>

Another source of toxic stress that can place children's development of EF and their academic achievement at greater risk is exposure to threatening people, places, and situations. Children's risk of



exposure to those types of threats increases in conditions of economic hardship, but many children across a range of economic strata must cope with sources of stress like bullying, family violence, or neighborhood crime. For example, regardless of family income, exposure to violent, traumatic events restructures children's attentional, emotional, and cognitive control networks to be on high alert. Adults and children who've been exposed to traumatic threats have consistently been found to pay more attention to negative cues, to have more difficulty switching cognitive gears in the face of negative information, and to experience more negative moods.<sup>55</sup> The behavioral effects of exposure to violence are paralleled by clear evidence of changes in activation and connectivity of brain regions associated with emotion processing, attention, and executive function.<sup>56</sup> Witnessing or overhearing aggression between adults in the household is also associated with significant compromises in children's physiological stress response, their capacity to regulate their attention and emotion, and their effortful control.<sup>57</sup> The negative effects of threatening events and experiences also extend to children's experiences of violence in their neighborhoods and schools. For example, analyses among older children suggest that chronic exposure to the threat of violence from their peers detracts from children's ability to regulate their stress response physiology, attention, emotion, and cognition.<sup>58</sup> Though rates of bullying are lower in elementary school than in middle school, evidence suggests that kindergarten through third grade can be deeply stressful for a small number of students who experience chronic verbal and physical aggression from peers.<sup>59</sup> Similarly, our findings suggest that exposure to violent crimes in the neighborhood has deleterious

consequences for children's attention biases in both the preschool and early elementary years.<sup>60</sup> Biased attention to negative social cues and hypervigilant and reactive cognitive response profiles may help children detect early warning signs of conflict in the short run, but they are maladaptive in the long run.

We want to be clear: Many, many children who live settings that can be characterized as turbulent, unsafe, or economically disadvantaged are doing well in school. Exposure to adverse events doesn't destine a child to have trouble regulating cognition, emotion, and attention. Instead, such exposure raises the probability that a given child will face regulatory difficulty, making it harder to navigate demands and expectations at school. A key implication is that many children don't come to school on a level playing field with their counterparts who are exposed to less stress, given the way adverse experiences affect children's ability to remain cognitively reflective, calm, and focused. Just as we must recognize the toll that toxic stress takes on children's potential, we must examine how interventions can support self-regulation and help all children meet their academic potential.

## **Interventions**

In nationally representative surveys, kindergarten teachers consistently name the skills that make up EF and emotion regulation as key components of young students' ability to successfully handle the first few months of formal schooling. Recent efforts to measure kindergarten readiness at the state level reflect this (see box). But how can teachers and schools do their part to support children's EF and emotion regulation, particularly given the substantial

## Using EF to Assess School Readiness

EF's association with school readiness and early school achievement is so well established empirically and theoretically that 12 states include it as one aspect of readiness in their initiatives to assess and ensure school readiness for all children. (The initiatives include the Ready for Kindergarten: Early Childhood Comprehensive Assessment System in Maryland and Ohio; the BUILD K-3 Formative Assessment System encompassing nine states; and the Arkansas Early Learning Standards). These readiness assessments and standards describe behavioral and academic competencies that are appropriate for children between the ages of four and six. For executive function, these competencies involve behaviors such as understanding and following multistep instructions; seeking and gathering information; managing the expression of thoughts, feelings, and impulses; and similar behaviors in which EF is understood to be central. Age-appropriate expectations for behavior in these readiness assessments map well to what we know about the development of EF in the preschool period.

Source: Patricia J. Bauer and Philip David Zelazo, "The National Institutes of Health Toolbox for the Assessment of Neurological and Behavioral Function: A Tool for Developmental Science," *Child Development Perspectives* 8 (2014): 119–24, doi: 10.1111/cdep.12080.

disparities in EF and emotion regulation skill across groups of young children? We now turn to several examples of interventions and classroom approaches that hold promise for prekindergarten through early elementary school.

### Individualized Interventions Targeting EFs and Related Top-Down Processes

First, a large number of clinical and educational tools have been designed to directly target children's attention, working memory, and inhibitory control.<sup>61</sup> For example, students who are having trouble in key EF domains receive skills-based support over several sessions to learn how to stay more attentive and organized in completing schoolwork.<sup>62</sup> A recent meta-analysis examined whether such programs are effective among elementary-aged students and reported surprisingly large estimates of their benefits: approximately six extra months' worth of learning (or, for readers familiar with statistical analysis, about three-fourths of a standard deviation) across measures of motivation, self-regulated learning, and achievement. These findings suggest that explicit instruction in self-regulated learning strategies may benefit some students who

struggle with EF. However, this approach hasn't been well evaluated among children who face high levels of adversity, particularly when they also face higher levels of performance-related anxiety, and it may not be sufficient as the primary or sole technique.

Alternatively, a set of individually targeted *brain training* approaches has recently been developed with clinically referred groups of children who have high levels of difficulty with attention and inhibitory control. These computer-based methods focus on changing children's underlying neurocognitive functioning. For example, to enhance their working memory, young children repeatedly practice increasingly challenging versions of a specific type of working memory task (in about 20 sessions of 30 or more minutes), using an adaptive video game-like format. The repeated practice leads not only to immediate improvement on the task, but also to improvement on similar types of working memory tasks (with effect sizes equal to approximately half of a standard deviation).<sup>63</sup> However, evaluations of this approach have yielded mixed evidence of whether children also improve when it comes to more general skills, such as academic achievement or classroom behavior.<sup>64</sup> Yet

this direct training approach continues to hold neuroscientists' and clinicians' interest because trials with adults have yielded intriguing evidence of increased neural activity in the working memory–related circuitry associated with the prefrontal cortex and associated neurotransmitters.<sup>65</sup> Working memory training has also been found to yield significant benefits for children with attention deficit hyperactivity disorder. One problem with those randomized controlled efficacy trials is that they were not balanced for the potentially positive influence of social engagement with the clinician or trainer.<sup>66</sup> This problem suggests that we need a second set of randomized controlled trials using alternate control conditions that vary in the ways children receive social support from adults while completing computer-based training.

Like the self-regulated learning strategies we described above, these training approaches haven't been extensively tested to see how well they work with children who face great adversity. Another problem is that these approaches have been individually delivered in the laboratory. We don't know whether they can be delivered in the classroom, or whether their benefits can be sustained at home and in school—settings that can be disorganized, unpredictable, or chaotic. A third approach, then, has been to target the classroom to support young children's EF more broadly.

### **Classroom Approaches Targeting Top-Down Processes**

In the past decade, a range of classroom activities and approaches to teacher training has been introduced and evaluated using randomized controlled trials. Many of the trials have produced substantial evidence that

these methods benefit children's attention, working memory, and impulse control. For example, several trials have targeted children's EF through structured small-group and whole-class activities involving inhibitory control, cognitive flexibility, and working memory that can be delivered at various times of the school day. An initial evaluation of such activities—delivered over 16 brief playgroup sessions of 20 to 30 minutes with a small sample of children—found minimal effects.<sup>67</sup> However, a second evaluation with a larger group of low-income children and classrooms found that those explicitly EF-building activities were associated with small to moderate gains on two measures of EF of approximately one-fifth to one-third of a standard deviation (equivalent to about two to three months' worth of expected growth and development).<sup>68</sup>

In contrast to using EF-targeted classroom activities limited to specific times of the day, a program called Tools of the Mind takes a comprehensive approach, meaning that all classroom learning is structured to foster EF (and other aspects of children's development, particularly oral language).<sup>69</sup> Tools of the Mind aims to reorient teachers' instructional style to emphasize scaffolding of children's planning, self-regulation, and learning, and to reorient classroom activities to make them more child-centered and child-directed. One of the program's major learning activities is structured sociodramatic play, in which children plan and then act out pretend scenarios such as “grocery store” in a designated area of the classroom with props like a cash register and grocery items. In carrying out this type of purposeful play, children practice switching between their pretend and stage-directing roles while using language to regulate their own and their peers' attention and actions. Children

also collaborate in pairs to complete activity center-based learning activities, such as breaking down words into sounds, placing objects into categories, and jointly solving early math problems. Throughout the day and school year, the program also offers opportunities for children to reflect on and discuss their progress on learning and on planning and problem solving with their teachers.<sup>70</sup> The theory behind Tools of the Mind is that children who experience a classroom environment conducive to EF will improve not only on measures of EF and emotion regulation, but also on measures of academic ability.

Evaluations of Tools of the Mind have produced mixed results. An early evaluation of the program's preschool version was promising, but a later, larger trial found that Tools of the Mind had no effect on any aspect of preschool children's school readiness.<sup>71</sup> A third evaluation with children who were English language learners from low-income homes found that the program produced effects at one site but not another.<sup>72</sup> But an evaluation of the kindergarten version of Tools of the Mind, using a randomized controlled trial spanning several school districts in Massachusetts, demonstrated that the approach clearly benefited both middle-income and low-income children, with gains in both self-regulation and early academics.<sup>73</sup> Moreover, compared with the control group, kindergartners in schools with a high proportion of low-income students showed the largest benefits in the areas of working memory, executive attention, inhibitory control, reasoning ability, and vocabulary.<sup>74</sup> In contrast to many interventions whose benefits appear to fade out after one or more years, children who were initially enrolled in Tools of the Mind kindergarten classrooms continued to demonstrate greater gains in

reading and vocabulary into the first grade than their control group counterparts. In short, Tools of the Mind has demonstrated academic benefit for young children in some but not all studies. Though mixed, this evidence has been persuasive enough to educational leaders that many school districts have adopted classroom EF approaches in both prekindergarten and kindergarten.

### **Classroom Approaches Targeting Both Bottom-Up and Top-Down Processes**

As we said above, the neurobiological model of bottom-up, top-down relationships between EF and emotion regulation suggests that we should widen our intervention approaches to help children not only increase their attention and inhibitory control, but also manage anger, sadness, and fear.<sup>75</sup> In efficacy trials among low-income preschoolers, several classroom approaches to simultaneously support stronger EFs and emotional and behavioral self-regulation have yielded impressive short-term benefits, and smaller but significant impacts when taken to scale. This type of intervention approach has also come up against the problem of fade-out: That is, it has yielded mixed (rather than overwhelmingly strong) evidence of sustained improvement in children's academic performance through the transition to kindergarten.<sup>76</sup>

What does this type of intervention look like in real-world classrooms? One model for kindergarten through fifth grade, called SECURe, explicitly targets multiple domains of self-regulation, including EF, emotional regulation, and interpersonal skills. To do so, it uses a number of mechanisms: helping teachers manage their classrooms, restructuring daily routines, and directly supporting the curriculum through brain

games and lessons.<sup>77</sup> Preliminary results indicate that this multipronged approach has impressive benefits, particularly given that the early efficacy trials have been conducted among a large number of schools that vary in their capacity to successfully implement new curricular and instructional approaches.<sup>78</sup>

Given that children's emotional difficulties can also be tied to parents' lack of responsiveness and unpredictability (and to lack of safety in the home and neighborhood), some prevention scientists have also found innovative ways to include parents as well as teachers in early intervention. Trials that incorporate parents and teachers have yielded substantial benefits for young children, improving both their emotion regulation and their academic readiness.<sup>79</sup> Some interventions work through parent groups that meet in schools, successfully bolstering self-regulatory and early literacy skills for students who are at higher risk for emotional and EF difficulty. One example of a program targeting children at greater risk is the KITS intervention, where the group intervention to parents is delivered over a relatively short period during the two months before children transition to kindergarten.<sup>80</sup> Additionally, a few prevention models have tackled the behavioral and neurocognitive consequences of children's exposure to trauma in both the community and the home. Although these models haven't yet been extensively tested through experimental design to see whether they lead to EF benefits and academic gains, they hold substantial promise from both theoretical and practitioner perspectives.<sup>81</sup> Similar approaches that target the school climate more generally in elementary and middle schools, such as School-Wide Positive Behavioral Interventions and Supports, have yielded clear benefits.<sup>82</sup> These programs

not only reduce aggression and bullying among children, but they may also help adults to reinterpret children's poor emotion regulation, effectively changing teachers' mindsets regarding whether economically vulnerable students in their classrooms have the capacity to change, grow, and learn.<sup>83</sup> School leaders who have implemented programs that focus on trauma report that students express greater trust of adults and a stronger sense of emotional attachment and belonging, and that they're better at focusing their attention and maintaining a more reflective cognitive orientation to learning.<sup>84</sup>

These approaches are guided by models of bottom-up regulation, which propose that if we help children develop greater emotional self-control through intervention, environmental stress will be less likely to hijack their higher-order cognitive processes. But what about targeting top-down EF processes to help young learners manage negative emotions like frustration and anxiety? A burgeoning model that falls loosely into the category of mindset interventions has demonstrated impressive positive impacts on helping children to shift their ideas about their own capacity to learn and to hold up under academic pressure.<sup>85</sup> Interventions that follow this model are based on evidence that older students' encounters with situational cues that highlight expectations of failure not only capture their attention but also trigger greater demands on EF and emotional regulation.<sup>86</sup> In field experiments among students in middle school, high school, and college, mindset interventions have been found to reduce feelings of anxiety, improve motivation, and improve academic achievement.<sup>87</sup> But we know less about whether younger children will experience the same benefits. Nor do we know whether the academic gains from such interventions



result from changes in children's EF and corresponding regulation of emotion. Children's ability (and encouragement through intervention) to shift set may be a key mechanism for helping them adopt new, more flexible perspectives on their own and others' minds, intentions, and feelings.<sup>88</sup> Children's stronger versus weaker self-regulation skills may also be a key factor that influences their vulnerability to situational triggers and either amplifies or attenuates the effect of mindset interventions on their academic performance. For example, during a tough math test students with stronger EFs may be more likely to shift their attention from errors in their performance and focus instead on larger goals.<sup>89</sup> Other students with less skill in flexibly deploying their attention may get more easily snagged by early but transient indicators of test-taking difficulty, and they may have a harder time tamping down rising feelings of anxiety. Whether or not mindset approaches are found to directly involve EFs, studies of these interventions demonstrate that students' higher-order cognition can forcefully shape beliefs, mood, effort, and outcomes in ways that are empowering and liberating. This represents an exceptionally innovative and exciting area for research.

## Policy Implications

Recent analyses of longitudinal data suggest that children's self-regulation plays a powerful role in predicting the long-term likelihood that they'll experience "health, wealth, and public safety."<sup>90</sup> For example, one analysis found that four-year-olds' attention and persistence predicts not only their academic achievement in high school, but also their odds of finishing college by age 21, even after accounting for their achievement levels and other characteristics,

such as their mothers' educational level.<sup>91</sup> Given their powerful role in predicting later academic and behavioral success, we're gravely concerned by mounting evidence that adversity places young children's EF and emotional regulation in jeopardy.

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*School districts need data not only on the academic readiness of young children entering preschool and early elementary school, but also on key dimensions of EF.*

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One key policy implication is that school districts need data not only on the academic readiness of young children entering preschool and early elementary school, but also on key dimensions of EF such as attention, working memory and inhibitory control. Given both direct and indirect linkages among EF, emotion regulation, children's ability to handle increasingly challenging academic demands, districts would be also be wise to have information on so-called soft skills, for example, children's capacity to modulate negative emotions. Fortunately, low-cost tools for directly assessing children's cognitive control and emotion regulation are increasingly available and show promise that they can be taken to scale. We have expanded the assessment toolkit used to assess young children's EF in the lab to include large numbers of children in kindergarten and universal prekindergarten in large, urban school districts like New York City. Wider use of such tools would help us estimate how many children have trouble with EFs—information that would have strong public



health significance. For example, if data on children's EFs were collected citywide, they could be geocoded and mapped to help policy leaders clearly see where scarce educational resources could be deployed to make the most difference for children's early learning.

A second policy implication is that interventions targeting EF and related self-regulatory skills in preschool through the early elementary grades can and do alter young children's early academic trajectories. In this article, we've highlighted the value of targeting not one but many possible mechanisms at both the neuropsychological and behavioral level, using interventions designed to work both with individual children and with classrooms as a whole. When those different mechanisms are activated, we have strong evidence that

we can at least partially, if not fully, close the gap in neurocognitive function and academic achievement between children who face multiple types of adversity and their better-off counterparts in early childhood and the early elementary years.

Third, though we may make progress in supporting young children with interventions that represent more oars in the water, we are rowing against the tide of children's continued exposure to high levels of adversity as they grow older. We must now find the political will to invest in programs that reduce children's exposure to stresses like family financial hardship, household instability, and neighborhood crime, turning the tide for young children's neurocognitive development, academic achievement, and behavioral health in the years ahead.

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# Quality in Early Education Classrooms: Definitions, Gaps, and Systems

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*Robert Pianta, Jason Downer, and Bridget Hamre*

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## Summary

Parents, professionals, and policymakers agree that quality is crucial for early education. But precise, consistent, and valid definitions of quality have been elusive. In this article, Robert Pianta, Jason Downer, and Bridget Hamre tackle the questions of how to define quality, how to measure it, and how to ensure that more children experience it.

Definitions of quality in early education, the authors write, generally include four aspects. The first is a program's structural elements, such as length of the school day or teachers' qualifications. The second encompasses general features of the classroom environment, ranging from playground equipment to activities involving staff, children, or parents. Third are the dimensions of teacher-student interactions that children experience directly. Finally, aggregate indices—such as *quality rating and improvement systems*—combine measurements across types of program elements.

Pianta, Downer, and Hamre find very little evidence that programs' structural features influence children's development. Instead, they zero in on teacher-student interactions—characterized by teachers' sensitivity to individual needs, support for positive behavior, and stimulation of language and cognitive development—as a key indicator of classroom quality that appears to benefit all children from prekindergarten through third grade.

Teachers' interactions with children can be significantly and systematically improved through targeted and sustained professional development. Yet efforts to improve the quality of such interactions at scale and to ensure that quality remains consistent from prekindergarten through third grade have so far been ineffectual. If we accept the evidence that direct experiences within classrooms are the best indicators of program quality, the authors argue, then the next wave of science and policy must refine and advance the definition, measurement, production, and consistency of these experiences in early education.

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In this article we describe efforts to define, measure, and promote quality in classrooms that serve young children from preschool to third grade (pre-K–3). Parents, professionals, and policymakers agree that quality is important in early education. But definitions of quality vary. In preschool, many features are bundled together as quality, including adult-child ratios, teachers' qualifications, length of the school day, curriculum and materials, and aspects of teacher-student interaction. In kindergarten to third grade (K–3), *quality* most often refers to teachers or schools, or is defined in terms of student achievement. The preschool and K–3 systems don't have common definitions, measures, or reference points for discussing quality, and that confuses efforts to increase early education's impact on children's learning. Scholars and educators agree that quality in early education matters, but precise, consistent, and valid definitions have been elusive. We must solve the issues of definition and measurement so that our focus on quality can improve children's development and learning across the critical early years.

## Defining Quality in Early Education

Definitions of quality in early education generally include four aspects: a program's structural elements; features of the classroom environment; the dimensions of teacher-student interactions that children experience directly; and aggregate indices, such as quality rating and improvement systems, that combine measurements across types of program elements. Structural elements include the length of the school day, teacher training, and teacher-student ratios; these can be viewed as preconditions that set

the stage for more direct experiences that foster children's learning. Features of the classroom environment might include cleanliness, learning and play materials, the daily schedule, and how the setting is arranged. Teacher-child interactions encompass teachers' behavior, language, and emotional warmth and tone as they conduct activities and manage the classroom. Interaction processes are inherently dynamic, of course, and may vary according to such factors as a given child's preferences; the teachers' knowledge, skills, or mood; and organizational features such as school leadership.

## Structural Elements of Quality

Policymakers face pressing decisions about where to invest resources in educational programs. Often, they apply the minimal standards recommended by professional organizations. When it comes to structural elements in preschool programs, the American Public Health Association and the American Academy of Pediatrics, the National Association for the Education of Young Children, and the National Institute for Early Education Research have all recommended standards that have shaped investments.<sup>1</sup> The National Governors' Association, federal and state education departments, and teachers' unions have also created educational standards for kindergarten through third grade. Among the dozen or so structural elements included in most standards, those most often considered are teachers' qualifications and teacher-student ratio. The research on elements of structural quality in early learning indicates the following:

1. Prekindergarten and kindergarten class sizes above 20 are generally associated

with poorer outcomes for children, even after controlling for factors such as family income that may correlate with large class size.<sup>2</sup>

2. The duration of children's exposure to a program matters.<sup>3</sup> Children enrolled in full-day preschool (typically 6 to 6.5 hours a day, 5 days a week, and 180 days a year) achieve greater learning gains both in preschool and in kindergarten than children enrolled in shorter programs.
3. The evidence on whether a teacher's degree and certification make a difference is murkier. For lead teachers, credible research supports the hypothesis that a bachelor's degree leads to higher-quality teaching, though it also supports the hypothesis that a BA doesn't *ensure* effective teaching.<sup>4</sup> Retrospective analyses indicate that state prekindergarten programs that show promising impacts on student learning in elementary school (for example, those in North Carolina, Maryland, and Pennsylvania) all require teachers to have a BA, but this evidence doesn't prove a causal link.<sup>5</sup>

The structural elements of programs from prekindergarten through third grade vary considerably. Most state prekindergarten programs limit class size to 20 or fewer children; in 2011–12, the average elementary school class size in the United States was 26, with some states averaging more than 30.<sup>6</sup> As for the duration of the school day, children are much more likely to attend full-day programs in kindergarten through third grade than in preschool. Reforms in the past decades have dramatically increased the number of full-day kindergarten classrooms. In 1977, only 28 percent of kindergarteners attended a full-day program; by 2013, the number was 77

percent.<sup>7</sup> In contrast, many state prekindergarten and Head Start programs still last only half a day, although recent Head Start policy changes may push programs to add hours.

To be certified to teach K–3 children, nearly all states require a bachelor's degree (many call for a master's degree) and some level of specialized training. More than 95 percent of teachers in K–3 classrooms meet these criteria (shortages exist in urban districts and states with rapidly growing populations). In state-funded prekindergarten programs, minimum requirements range from a Child Development Associate certificate to a master's degree; only 30 of 53 state prekindergarten programs reviewed by the National Institute for Early Education Research required a BA.<sup>8</sup> In Head Start, almost 70 percent of lead teachers have a BA. Family- or center-based child-care programs are much less likely to have credentialed or degreed teachers.<sup>9</sup>

Building full-day programs with small class sizes and well-qualified staff can set the stage, but it doesn't ensure effective process quality and positive outcomes for children. Observational studies of programs from preschool to third grade show that even when classrooms meet the structural standards for quality (a full-day program, small classes, and fully credentialed teachers), teacher-student interaction is highly variable and low-quality instruction is common.<sup>10</sup>

## General Features of the Classroom Environment

In the past few decades, researchers have used a suite of observational measures to assess various features of early education classrooms.<sup>11</sup> The most common is the Early Childhood Environmental Rating Scale–Revised Edition (ECERS–R), which

captures a range of features, from playground equipment to hygiene (for example, the staff's hand-washing) to interactions among staff, children, and parents.<sup>12</sup> The ECERS is the standard measure of quality to which others are compared, at least in early education.<sup>13</sup> A version of ECERS for elementary schools exists but isn't used often, so parallel K–3 data are uncommon.

ECERS's role as a measure of quality was supported by results of the Cost, Quality and Outcomes (CQO) Study conducted in 151 for-profit and nonprofit child-care centers across four states during the early to mid-1990s. Among a sample of 757 preschoolers, higher ECERS ratings predicted stronger academic skills—but most of the children attended programs that were rated mediocre or worse.<sup>14</sup> The ECERS–R has been included in a number of large-scale early education studies, including the National Institute of Child Health and Human Development's Study of Early Child Care and Youth Development, the Head Start Impact Study, the Multi-State Study of Pre-Kindergarten by the National Center for Early Development and Learning (NCEDL), and the Head Start Family and Child Experiences Survey. The evidence from these large-scale longitudinal studies (that is, studies that follow children over time), and from smaller intervention studies, has generally confirmed the findings of the CQO Study: that is, that the ECERS–R provides modest positive prediction of child outcomes.

More recent studies have evaluated specific components of quality assessed by the ECERS–R. These studies detect stronger associations for the ECERS–R indicators that reflect teachers' language and social behaviors.<sup>15</sup> A secondary analysis across four large-scale longitudinal studies (including

NCEDL and CQO) examined partial correlations between the ECERS–R and child outcomes.<sup>16</sup> Controlling for background characteristics, partial correlations indicated positive (though modest) relations between the ECERS–R and preschool children's gains in academic, language, and social skills. Another recent study drew from the nationally representative Early Childhood Longitudinal Study–Birth Cohort (ECLS–B) to examine relations between the ECERS–R and children's academic, language, and socio-emotional functioning at age five.<sup>17</sup> After employing a rich set of controls, researchers found no evidence of a linear association between the ECERS–R and child outcomes in the whole sample. Nor was there any evidence that higher levels of quality improved growth in outcomes for low-income children.

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The ECERS has played a major role in early education program accountability and quality improvement, thanks to regulations and investments in aspects of quality measured by the ECERS–R. These have helped raise ECERS scores in child care and in Head Start, where scores have gradually increased nationwide, undoubtedly improving



children's experiences and enhancing their safety. Higher ECERS scores may also have contributed to benefits measured in aspects of children's development during earlier studies (such as CQO). But recent studies suggest that as programs have gotten up to speed on ECERS-defined quality, and as the variation among programs has decreased, links between early childhood education programs' ECERS scores and child outcomes may have weakened.<sup>18</sup> The latest studies suggest that the ECERS elements that best predict child outcomes are those related to teacher-student interactions. Not surprisingly, the new version of the rating scale, ECERS-3, puts more emphasis on these interactions. But research has yet to show that the ECERS-3 is more closely linked to child outcomes.<sup>19</sup>

### **Teacher-Student Interactions**

There's a growing consensus that teachers' daily interactions with students are among the most important ways to foster child development in prekindergarten through third grade. When large-scale, longitudinal randomized controlled studies have examined the various indicators of quality (that is, structural elements, features of the physical environment, and interactions with teachers and peers), children's interactions with teachers have shown unique and positive associations with learning gains.<sup>20</sup> The same general pattern also appears in studies of K-3 classrooms.<sup>21</sup> Although the size of the effects in these studies tends to be small, teacher-student interactions hold up as significant predictors, even after controlling for numerous other family and school factors.

Unfortunately, few children consistently experience effective interactions with teachers. To begin with, children's

interactions with teachers are sparse. According to data collected on state-funded prekindergarten programs in 10 states, children interacted with an adult only 27 percent of the time on a typical day.<sup>22</sup> It's a similar story for children in informal child-care settings and in kindergarten.<sup>23</sup> And in one of the few large-scale observational studies of US elementary classrooms (covering more than 800 classrooms in first, third, and fifth grades), the typical child interacted with a teacher for only four minutes each hour.<sup>24</sup> Although most teachers are busy all day interacting with children, the individual child has a different perspective: interaction with the teacher, whether one-on-one or in a small group, is the exception rather than the rule.

As for the quality of these interactions, research suggests that early childhood classrooms are moderately positive social settings for children. However, they're quite passive when it comes to whether teachers stimulate children's thinking and help them develop knowledge and concepts.<sup>25</sup> Instructional support is generally low for teachers in pre-K-3 classrooms, and it's even lower for teachers who work with disadvantaged students.<sup>26</sup> There are exceptions: some programs have worked to improve interactions, typically with aligned and focused professional development for teachers.<sup>27</sup> But most teachers continue to emphasize basic skills, assigning their students tasks requiring a discrete answer that's either right or wrong, rather than posing more ambiguous challenges that elicit analysis, reasoning, or problem-solving.

Most studies of teacher-child interaction were conducted in highly regulated state and federal early childhood programs, so these results may actually overestimate the

quality of teacher-student interactions in the broader world of public and private child-care centers and family child-care homes. For example, when a mix of state prekindergarten, Head Start, and child-care classrooms were observed in rural North Carolina and Pennsylvania, the programs scored lower on social and organizational aspects of teacher-student interactions than did Head Start or state prekindergarten.<sup>28</sup>

Moving up from prekindergarten to K–3 reveals a similar pattern. A study that drew on data from more than 4,000 prekindergarten through fifth-grade classrooms found that the quality of teacher-student interaction in elementary-school classrooms was consistent with that of prekindergarten. There was one exception, however: instructionally supportive interactions (such as asking open-ended questions to promote conceptual understanding, or providing specific feedback) tended to be somewhat higher on average in elementary school than in prekindergarten.<sup>29</sup> In the Study of Early Child Care and Youth Development, interactions that facilitate higher-order thinking and conceptual understanding were rated on a seven-point scale, in which 1–2 meant low quality, 3–5 meant mediocre quality, and 6–7 meant high quality. Ratings ranged from 1.85 to 2.90 in several prekindergarten and kindergarten samples, and from 2.11 to 3.61 in first- through fifth-grade classrooms. (Ratings of 5, 6, or 7 for instructional quality are fairly rare, and ratings of 3 and 4 are consistently associated with higher levels of student achievement.) The pattern of observing higher cognitive stimulation in elementary schools than in prekindergarten has also been found in more recent studies of first- through third-grade classrooms.<sup>30</sup>

Many studies that consider multiple domains of interaction simultaneously have also found that the quality of interactions varies markedly, ranging from sensitive and stimulating to harsh and dismissive. In the NCEDL study of state prekindergarten programs, only 15 percent of classrooms demonstrated high-quality interactions in both emotional and instructional support, whereas 19 percent scored well below the mean on almost all dimensions of emotional, organizational, and instructional supports.<sup>31</sup> Poor and African-American children are more likely to experience less-effective interactions in early childhood programs.<sup>32</sup>

### Quality Rating and Improvement Systems

Quality rating and improvement systems (QRISs), which aggregate separate indicators of quality, play a prominent role in documenting and improving the quality of early childhood programs. Their guiding framework presumes that the ratings will create a local market for quality as parents seek higher-rated programs and that in this way, more children will experience high-quality programs that improve their readiness for school.<sup>33</sup>

Most QRISs rate programs according to an assortment of quality indicators, and then create a composite to produce an overall rating. These composite ratings are communicated to parents, and they can also trigger financial incentives and investments in improvement. The use of QRISs has expanded greatly, thanks in part to federal funding through the Race to the Top Early Learning Challenge Grants. In 2010, 26 states and communities employed a QRIS.<sup>34</sup> Today, all but a few states are either implementing or planning to implement such a system.<sup>35</sup>

The underlying assumption is that programs with high QRIS ratings will produce better outcomes for children, but that isn't well documented by research. Studies of several quality rating systems and the indicators they comprise demonstrate that although a few of the assessments aggregated to produce QRIS ratings are associated with children's learning outcomes, the ratings themselves are not.<sup>36</sup> These rating systems are complex, due to the large number of quality features, arbitrary cut points, and the method used to aggregate the quality indicators. Such factors may undermine the extent to which these measures predict children's learning. This limited evidence suggests that caution should be used in developing and deploying QRISs, since large investments in such systems may not lead to notable improvements in child outcomes. Experimentally controlled studies suggest that targeting specific aspects of quality—such as interactions and curriculum—is a more promising way to increase children's knowledge and skills.<sup>37</sup>

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### **Interactions Matter**

Researchers have conducted hundreds of studies of children's development that focus on different aspects of quality. Not surprisingly, these studies have produced mixed evidence about the extent to which quality is directly associated with, or causes, children's developmental progress. In the studies with the largest samples and the

strongest designs for causal inference, the size of any quality effects on learning has been modest. When researchers have examined several types of quality together (for example, structure, classroom features, and teacher-child interactions), they've found the most evidence for positive effects from aspects of quality that children experience directly, such as teacher-child interactions and the availability of stimulating learning materials.<sup>38</sup> And very little evidence has been found to support the hypothesis that structural features influence children's development.<sup>39</sup> In the remainder of this article, we more fully examine the research on teacher-child interactions and discuss how newer research may influence the way we conceptualize and measure quality in prekindergarten through third grade.

Teacher-student interactions—characterized by teachers' sensitivity to individual needs, support for positive behavior, and stimulation of language and cognitive development—are a key element of classroom experience that appears to benefit all children across the pre-K–3 span.<sup>40</sup> Children learn more when teachers emphasize conceptual understanding, give feedback that extends students' skills, and engage children in conversation.<sup>41</sup>

Longitudinal studies offer important insights into how teacher-student interactions can affect children. A recent longitudinal study of more than 1,000 children in rural schools found that in both prekindergarten and kindergarten, children whose classrooms were more emotionally supportive and better managed demonstrated stronger social skills and fewer behavior problems the next year than did children in lower-quality classrooms.<sup>42</sup> And those early experiences with teachers appear to have a lasting

influence. In the Study of Early Child Care and Youth Development, children who experienced more responsive teaching in early childhood demonstrated better cognitive and academic achievement and fewer outward-directed problems through elementary school and into adolescence.<sup>43</sup>

Recent work in a variety of international settings—including Central and South America, Europe, and Asia—has also shown that teacher-child interactions support development and learning. In a large-scale study of classroom quality and child outcomes in rural Ecuador, children in the first two years of schooling (ages six and seven) were assigned randomly to teachers. The children's academic skills improved more when they were assigned to classrooms in which teachers demonstrated particularly high levels of instructional support.<sup>44</sup> Studies in Chile, Finland, and Portugal produced similar findings.<sup>45</sup> Although the nature and magnitude of the associations between teacher-child interactions and student outcomes varied across these studies, there's growing evidence that elements of these interactions are important for children's learning across a wide spectrum of settings and cultures, and perhaps represent a universal resource for children's development.

Vulnerable children (such as those who come from low-income families, are dual language learners, or have problems with self-regulation) benefit more from effective teacher-student interactions than children who have more resources at their disposal.<sup>46</sup> And children reap the most academic benefit from effective teacher-student interactions when they're exposed to such interactions for a number of years.<sup>47</sup> Emerging evidence also suggests that the

quality of teacher-student interactions can either reduce or increase children's susceptibility to developmental risks. For example, children who demonstrated high physiological and behavioral reactivity in first grade performed better than expected when they were examined for mental health symptoms as teenagers if they had experienced more positive teacher-student relationships. Meanwhile, their counterparts who experienced negative teacher-student relationships fared much more poorly.<sup>48</sup> And children with a history of being anxious and withdrawn have poorer outcomes (for mood, social skills, and peer rejection) when their classrooms lack emotional support.<sup>49</sup>

In the studies we've discussed, the size of the effects associated with teacher-student interactions has typically been modest; at least one recently published study found no consistent associations.<sup>50</sup> Most published studies have used only statistical controls to reduce or adjust for what are called *selection effects*—primarily, the concern that higher-achieving children may be pushed toward classrooms whose teachers display high-quality interactions. However, evidence from recent intervention studies and random assignment studies demonstrates a more compelling causal link. For example, when teachers improve their practices after being trained and coached in teacher-student interactions, the children in their classrooms benefit academically, socially, and behaviorally.<sup>51</sup>

Other evidence for a causal link between interactions and development comes from large-scale studies that randomly assigned children to classrooms to evaluate how the classrooms affected achievement and development. Two such studies have found significant associations between children's

learning and their exposure to interactions.<sup>52</sup> One of them, conducted in first- and second-grade classrooms in Ecuador, estimated that teachers in the top 25 percent in terms of the quality of their interactions with students produced the equivalent of almost nine months more growth in their children's achievement over teachers in the bottom 25 percent.<sup>53</sup>

### Processes Embedded in Interactions

Recent work suggests several areas that require more research before we can refine the theory and measurement of teacher-student interactions. These areas include the different ways individual children experience the same classroom; combining features of interactions with aspects of instructional activities and curricula; and the characteristics and capacities that help teachers enhance their skills in interacting with children.

*Children's individual interactions with teachers.* Most research on pre-K–3 classroom quality combines the experiences of all children, even though children in the same classroom approach learning differently.<sup>54</sup> Children's own attitudes also predict how well they'll adjust to school.<sup>55</sup> Young children who display positive emotions toward teachers tend to have better academic and social outcomes, even when controlling for the large number of other factors that could affect the results.<sup>56</sup> Children's engagement in classroom tasks and activities forecasts greater achievement in preschool and the early elementary grades.<sup>57</sup> The emerging focus on individualized experiences appears likely to refine our understanding of which aspects of a program affect all children and which ones depend more on the children's individual characteristics and behaviors.

*Content of instructional interactions.* It's increasingly clear that well-organized instructional content can itself support more effective teacher-student interactions.<sup>58</sup> For example, teachers following a particular mathematics curriculum aren't just exposing children to math; they're also interacting with children, and the curriculum's instructional activities can shape the way they do so. A curriculum or activity that focuses on rote learning (such as counting or recognizing shapes) leads a teacher away from open-ended questions that promote reasoning. Problem- or project-based activities, on the other hand, help teachers develop children's thinking and analysis skills. This type of instruction can occur not only in areas of traditional academic content but also when it comes to teaching social, emotional, and self-regulatory skills. Researchers have identified teacher behaviors that focus on *emotion content*—for example, emotion coaching, modeling of emotions, use and labeling of emotion words, and social problem-solving dialogues—and these instructional experiences are embedded in many social-emotional learning curricula.<sup>59</sup> Finally, we need to know more about which types of instructional interactions are critical for certain groups, such as children with disabilities or dual language learners, even though they might be unimportant for other children.<sup>60</sup>

*Teacher capacities.* There's growing interest in the personal capacities that can help teachers interact with children. A better understanding of these capacities could guide regulation, policy, and teacher preparation. Here we briefly describe two such capacities that have shown particular promise of increasing quality of interaction: teachers' ability to observe children's cues and teachers' regulation of their own stress and emotion.

## *Giving teachers opportunities to learn from seeing others teach effectively may be one way to improve quality.*

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Teachers' behavior involves real-time processing of the information they pick up in everyday classroom interactions. Presumably, teachers who process information more accurately will have better-calibrated interactions with regard to their students' individual and collective needs. One area of research focuses on teachers' skills in observing and analyzing their own practices and those of others, typically using video. An experimental study demonstrated not only that teachers' observation and video-analysis skills can be quantified, but also that these skills are associated with gains in the quality of observed teacher-student interaction and student engagement.<sup>61</sup> And in treatment-on-the-treated designs (which examine how variation of intervention experiences might contribute to the effects of the intervention within the treatment group), exposing preschool teachers to more video examples of effective teaching correlates strongly with improvements in the quality of their interactions with children.<sup>62</sup> Studies of teachers in older grades have documented that watching effective teaching can bring about effective teaching.<sup>63</sup> Giving teachers opportunities to learn from seeing others teach effectively may be one novel way to support improvements in quality from prekindergarten through third grade.

Teachers' skills in self-awareness, regulating their own emotions, and stress management may also shape teacher-student interactions.<sup>64</sup> Growing evidence supports a link between

teachers' classroom behavior and their mood, stress, and emotional resourcefulness. When teachers experience negative emotions, stress, and burnout, their classroom interactions are less likely to be effective and their students are more likely to exhibit problem behavior.<sup>65</sup> Unfortunately, nearly half of all teachers leave the profession in their first five years, citing stress or burnout as the primary factor. And half the teachers who retire early name chronic occupational stress and mental or physical health problems as the reasons for their decision.<sup>66</sup>

Evaluations of interventions that use mindfulness-based stress reduction have demonstrated that teachers' emotional wellbeing can affect their interactions with students.<sup>67</sup> In a number of randomized controlled trials, training teachers in mindfulness techniques or yoga dramatically lowered their stress levels. The decrease in stress was accompanied by an increased ability to detect cues, greater cognitive flexibility, and more-positive interactions with students.<sup>68</sup> Further research on the links across physiological, psychological, and behavioral features of teacher-student interactions could target interventions more precisely to improve students' behavior and learning.

## **Conclusions**

The past two decades have seen unprecedented public investment in early education: the expansion of kindergarten to nearly universal enrollment, a movement from half- to full-day kindergarten for many low-income children, the expanded enrollment of low-income children in state-funded public prekindergarten, and expansions of Head Start and Early Head Start. These investments have increased early



education opportunities for young children tremendously. At the same time, the evidence very strongly indicates that the early learning opportunities provided by these investments don't lead to the improved outcomes that could help bridge the achievement gap between low- and middle-income children simply by virtue of children's enrollment or exposure.

Equally compelling evidence shows that in both prekindergarten and K-3, programs vary in impact from locality to locality and from classroom to classroom, and programs with a greater educational focus have more impact.<sup>69</sup> Furthermore, although the strongest public prekindergarten or Head Start programs can significantly reduce achievement gaps, we have few examples of such superior programs and far too many examples of programs with marginal effects that wane as children grow older. Thus when trying to understand variation in impacts and how to develop, design, and scale up early education opportunities that truly put children on a path to success in school, the question of quality is very relevant.

We believe that quality is the right focus for research and program development. But we have yet to identify clearly which ingredients of early education opportunities will yield the most positive and pronounced impacts on children from prekindergarten through third grade. To the extent that research has identified such ingredients, the data point to children's direct experiences with teachers who engage them in learning activities that have educational and developmental value. If we take it as a given that the term *quality*, when applied to an educational opportunity, should involve a direct link between that opportunity and its intended outcomes, then the evidence supports

defining quality in terms of these proximal classroom experiences and not through an amalgamation of structural features.

What do we know about quality as defined in terms of children's direct experiences in the classroom? We know that children's experiences are linked only loosely to regulations and the policy infrastructure intended to support programs (for example, finances and credentialing). We know that effective interactions with a teacher are unevenly distributed and difficult to produce at scale. We know that effective teacher-child interactions and strong, developmentally aligned curricula are not as readily available to low-income children as they are to higher-income children. We know that teachers' capacities to interact effectively with young children, in social and instructional forms, are tied to their own mental health and social supports. And we know that teachers' interactions with children and their ability to carry out educational activities can be significantly and systematically improved through targeted and sustained professional development.

But despite all that we know, efforts to improve quality at scale and to ensure consistency in prekindergarten through third grade have been ineffectual at best. And because education has a cumulative impact on children, we must take a multi-year perspective on quality as a first step toward ensuring gains that last for low-income children. An effective, high-quality program can close achievement gaps and noticeably contribute to a child's development in just nine months. But most children are lucky to get nine months of exposure to a high-quality program, and even those who do are unlikely to receive it for a second, third, or fourth year in succession. This lack of coherence and

consistency is a fundamental and egregious shortcoming in our current approach to early education.

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To build coherence in early education, we need both a clear definition of quality and scalable approaches to measuring and improving quality. If we want actionable results from the next phase of research to promote early learning for low-income children, it may not be helpful to ask the high-stakes question, “Does prekindergarten impact third-grade test scores?” Rather, we may need to analyze the conditions under which large, diverse communities build and implement early education *systems* that promote learning and reduce gaps. We suspect that if we anchored such an analysis in assessments of children’s actual experiences with teachers over the entire pre-K–3 period, we would get a richer, more actionable set of results than we’d receive from yet another high-stakes evaluation of the impact of preschool (such as the Head Start Impact Study). We would also better understand how the intersection between

curriculum implementation and supportive, cognitively enriching teacher-student interactions can affect children’s exposure to content and instructional activities.

US states and the country as a whole lack a coherent approach to providing educational opportunities for low-income children across the span from preschool to elementary school. Thus our investments in these programs aren’t optimized. Although the evidence so far doesn’t strongly support the view that programs’ structural features (such as teacher credentials) have significant or lasting impacts on children’s learning, we recognize that programs do need thresholds for minimally acceptable elements of their infrastructure. It’s striking that we have yet to agree on a set of minimal qualifications for adults who teach young children, whether they’re teaching in private child care, Head Start, public prekindergarten, or public school K–3 classrooms.

There’s also little agreement among policymakers on the performance standards that should be applied to teachers, or on how to measure those standards. In short, to the extent that teachers of young children play an essential role in fostering high-quality learning opportunities, pre-K–3 children can expect a stunning level of variation—both from year to year and setting to setting—in classroom experience and even in the basic qualifications of school personnel (such as their educational level).

How can we reduce such variation? There’s growing evidence that well-designed curricula, coursework, and coaching can improve pre-K–3 teachers’ instructional interactions with students in ways that promote children’s development. Yet we need to know more about how these classroom

supports work together. Can a strong, evidence-based curriculum suffice to help young children learn, or must it be paired with professional development that promotes high-quality interactions in instructional activities and lessons? What's the ideal combination of these classroom resources to help young learners prepare for and excel in early schooling? These are pressing questions for research and for experimentation and innovation in policymaking and regulation. If we accept the evidence suggesting that direct experiences within classrooms are the best indicators of program quality, then the next wave of science and policy must refine and advance the definition, measurement, production, and consistency of these experiences in early education.

In terms of basic research, we would benefit from further differentiating among associations between quality inputs and child

outcomes. Are there specific properties of teacher-student interaction or curriculum and instruction that have different effects on specific child outcomes? Are there optimal doses of these resources, and is there an optimal timing for children's exposure to them? From the policymaker's perspective, what are the best ways to structure and deliver support for teachers, to embed it in incentive structures, and to program it into career development paths? This knowledge will let us help the early education workforce acquire and deepen the skills that foster children's learning.

The evidence suggests that it's time to shift our attention to children's and teachers' everyday experiences in classrooms, and to put those experiences at the core of what we mean by quality in early education. That should be the starting point for the next generation of science, policy, and practice.

## ENDNOTES

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# The Early Care and Education Workforce

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*Deborah Phillips, Lea J. E. Austin, and Marcy Whitebook*

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## Summary

In this article, Deborah Phillips, Lea Austin, and Marcy Whitebook examine educational preparation, compensation, and professional development among the early childhood workforce. Their central theme is that these features look very different for preschool teachers than they do for the elementary school teaching workforce.

Most teachers of kindergarten through third grade can count on clear job requirements, professional development opportunities, workplace supports such as paid planning time, and a transparent and rational salary structure based on qualifications and experience. These teachers often earn a wage that approaches the median income in their communities.

For most preschool teachers, Phillips, Austin, and Whitebook write, the situation is very different. Job requirements and qualifications vary wildly from program to program and from state to state. Professional development is both scarce and inconsistent. Compensation often fails to reward educational attainment or training; in fact, many preschool teachers are among the lowest-paid workers in the country. Poor compensation fuels turnover, which means that society loses investments in professional learning, and produces economic insecurity and stress among preschool teachers.

The crux of quality in early childhood education lies squarely in the interactions that transpire between teachers and children, the authors write. Thus it's long past time, they argue, to recognize prekindergarten through third grade as a continuum that requires a seamless system of professional learning and compensation tied to qualifications, including education. To move beyond incremental improvements in the quality of early care and education, they conclude, empirical research, intervention, and policy alike should focus on the preparation, professional development, compensation, and wellbeing of early childhood teachers.

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**E**arly childhood teachers constitute the linchpin of quality in prekindergarten through third grade. Yet they are some of the most erratically trained and poorly paid professionals in the United States. The contradiction inherent in this characterization of the early care and education workforce, and its implications for the wellbeing of the millions of young children in early childhood care, has been addressed by three National Academies reports that span 25 years.<sup>1</sup> In 1990, the report *Who Cares for America's Children?*<sup>2</sup> stated that “quality child care also requires settings and conditions that value adults as well as children.”<sup>2</sup> In 2000, the Committee on Integrating the Science of Early Childhood Development, in *Neurons to Neighborhoods*, agreed that “good quality care requires an environment that values adults as well as children.”<sup>3</sup> In 2015, the Committee on the Science of Children Birth to Age 8 argued, “It is through the quality work of these adults that the nation can make it right from the very beginning for all of its children.”<sup>4</sup> These statements capture the scientific community’s longstanding concern that when it comes to policies and practices affecting the nation’s early education workforce, the stakes are high.

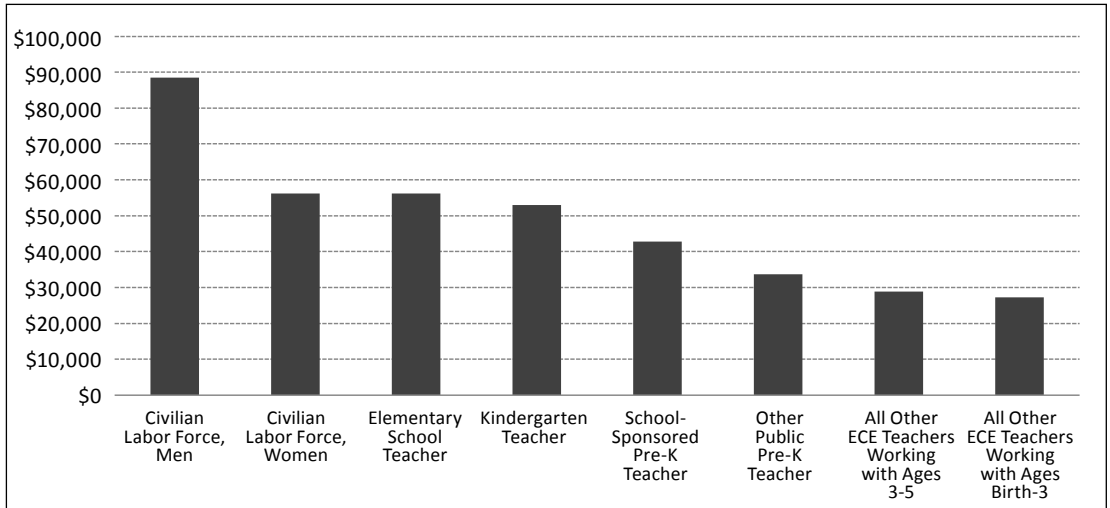
This article paints a portrait of this workforce with respect to educational preparation, compensation, and professional development. A central theme is that these features look very different for preschool teachers than they do for the elementary school teaching workforce. We also examine the relatively sparse evidence on what this portrait implies for teachers’ wellbeing, classroom practices, and stability.

## The US Early Childhood Landscape

The characteristics of the workforce responsible for the care and education of young children from birth through the first years of elementary education have fluctuated wildly over the years. During World War II, for example, more than three thousand federally funded child care centers linked to the war effort routinely employed certified teachers, recognizing their dual role in supporting working mothers and educating young children.<sup>5</sup> Fifty years later, legislation authorizing the Child Care and Development Block Grant subsidy program for low-income families tied teacher qualifications in federally subsidized child care centers to state child-care regulations that typically required, at best, a high school degree.<sup>6</sup> Today, the early care and education teaching workforce ranges from people without a high school degree to people with graduate training. Some teachers get evidence-based in-service training and coaching; others have no access to professional learning opportunities. Some teachers earn a living wage that approaches the median income in their communities, while others are among the lowest-paid workers in the country.<sup>7</sup> Child care programs themselves rely on different funding streams, exist in different types of settings, and serve different populations of children. Not surprisingly, the pathways into the early childhood workforce, the opportunities for professional development, and the compensation and other work supports together have been characterized as “perpetuating a cycle of disparity.”<sup>8</sup> To make sense of this vast workforce, we need to understand the fragmented goals, structure, and funding of the field in which its members work. This fragmentation



**Figure 1.** Mean Annual Salary of Civilian Labor Force and of Teachers with a BA or Higher, 2012



Source: Marcy Whitebook, Deborah Phillips, and Carollee Howes, *Worthy Work, STILL Unlivable Wages: The Early Childhood Workforce 25 Years after the National Child Care Staffing Study* (Berkeley: Center for the Study of Child Care Employment, University of California, Berkeley, 2014).

derives from diverging historical trajectories of K–12 and prekindergarten care and education. These diverging trajectories reflect very different assumptions about educational programs before and after children formally enter school regarding their purpose, how they’re funded, their clientele, and their personnel systems for teachers.

Public education for all children from kindergarten or first grade through high school was established more than a century ago as a public good, guaranteeing universal access to free services. Key features of personnel systems, such as qualifications, compensation, and working conditions, are relatively uniform for K–12 teachers throughout the United States, and they rely on well-established funding streams.<sup>9</sup> States and types of schools (public, charter, and private) share a wide consensus that elementary through high school teachers should obtain at least a bachelor’s degree, be specifically qualified to teach the subject matter for which they’re responsible, and earn a living wage (albeit a wage that

remains below the national average for all BA-educated workers; see figure 1).<sup>10</sup> In public schools, teachers must also get provisional certification before they begin teaching, and they typically participate in an induction or mentoring program for new teachers, followed by continuing professional development.<sup>11</sup>

Preschool care and education, in contrast, has yet to be fully embraced as a public good. As a result, most early care and education programs operate in a private market, supported largely through parent fees.<sup>12</sup> Programs funded with federal, state, and local government dollars are designed primarily to serve children considered to be at risk for poor school performance because of poverty, involvement in the child welfare system, or disabilities.

Among publicly funded programs, some aim primarily to meet the needs of low-income working adults; thus they emphasize access, flexibility, and cost. This has been the case with programs such as

the Child Care and Development Fund, the subsidy program authorized by the Child Care and Development Block Grant as part of the effort to move welfare-dependent families into the paid labor force. Other publicly funded programs (for example, Head Start and state prekindergarten programs) aim primarily to help low-income children develop and to get ready for school; they emphasize learning opportunities and support services.

Until recently, welfare-linked child care hasn't been seen as requiring a professional, knowledgeable, or decently paid teaching workforce; rather, providing safe care and warm interactions has been considered sufficient.<sup>13</sup> Qualifications for teachers in subsidized child-care centers in most states still reflect this perception that the work is unskilled. Of 50 states, 34 require that child care teachers have only a high school education, or less.<sup>14</sup> Preschool programs that focus on school readiness, in contrast, depend on teachers' capacity to support early learning and healthy development—their knowledge and skills are integral to setting young children on a path toward success in school and, ultimately, economic independence. Accordingly, many states set higher qualifications for teachers in state prekindergarten programs than for those working in subsidized child-care centers. In 2015, 33 of 57 state prekindergarten programs required teachers to have a bachelor's degree.<sup>15</sup> The 2007 Head Start reauthorization required that at least 50 percent of Head Start teachers have a bachelor's or advanced degree in early childhood education by 2013, fueling a notable increase in the educational qualifications of Head Start teachers (see below).

## Characteristics and Conditions of the Early Childhood Workforce

The demographic profiles of the early childhood and K–12 teaching workforce differ substantially, aside from the fact that both consist primarily of women. Among the approximately one million members of the center-based early childhood teaching workforce, slightly more than one-third (63 percent) are people of color. In contrast, 84 percent of the more than three million K–12 teachers are white.<sup>16</sup> The two workforces also differ in their educational attainment and compensation.

### Educational Attainment

Reflecting the relatively uniform educational requirements for K–12 teachers across school districts and states, in 2015 the vast majority (92 percent) of elementary and middle school teachers held at least a bachelor's degree. About 47 percent held at least a master's degree.<sup>17</sup> In contrast, in 2012 the 568,000 center-based teachers serving three- to five-year-old children reflected a much wider range of educational backgrounds: 45 percent held a bachelor's degree or higher, 17 percent had completed a two-year associate degree, 24 percent had completed some college, and 13 percent had completed high school or less.<sup>18</sup> Despite the variation, these levels of higher education far exceed the relatively low bar set by state child care regulations for teachers working with children before they enter school. Educational attainment is lower among center-based teachers who work with children from birth to three years old, but it's still somewhat higher than state the requirements would suggest. In 2012, 28 percent of infant-toddler teachers had completed only high school or less, but 17 percent had earned an associate degree and

19 percent had earned bachelor's degrees or more.

The proportion of teachers with a four-year degree varies by the type of early childhood program and the funding source. As of 2012, we see the highest proportion of lead teachers with a bachelor's degree or higher (76 percent) in state-sponsored prekindergarten programs and the lowest in for-profit center-based early care and education (25 percent in independent facilities and 50 percent in chains). Roughly half of lead teachers in Head Start and in nonprofit community-based and religious-based programs had earned bachelor's or higher degrees.<sup>19</sup>

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### *Child-care workers have experienced no increase in real earnings since 1997.*

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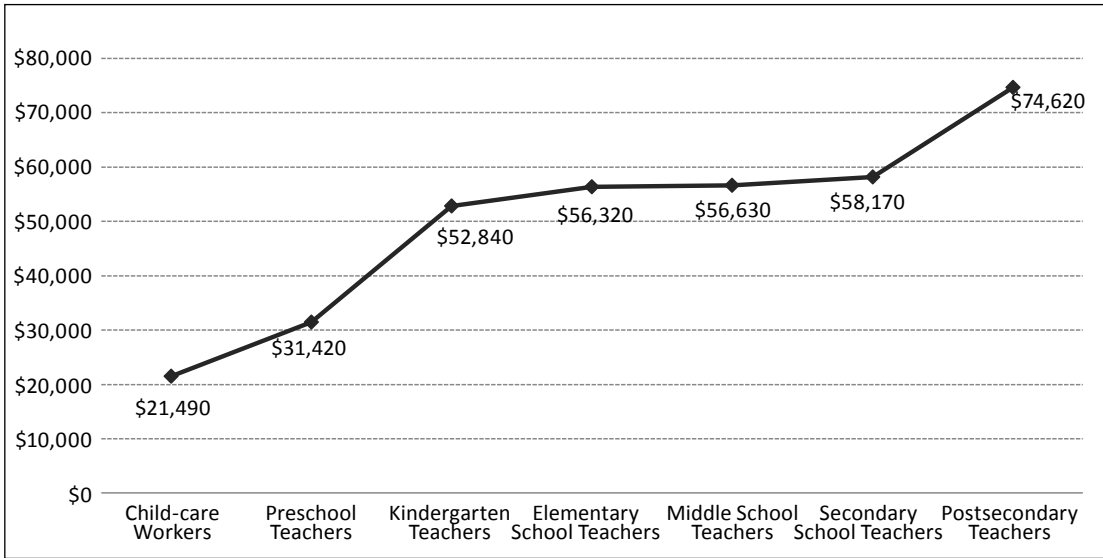
#### **Compensation**

Most K–3 teachers, a few prekindergarten teachers, and all teachers who work in the Department of Defense child care system can count on clear job requirements, professional development opportunities, workplace supports such as paid planning time, and a transparent and rational salary structure based on qualifications and experience.<sup>20</sup> Most teachers who work with children before they enter kindergarten, however, don't fare as well. For many early childhood teachers, compensation fails to reward educational attainment or training. Poor compensation fuels turnover, which means that society loses investments in professional learning, and produces economic insecurity and stress among preschool teachers.

A recent examination of US Census data revealed the following:<sup>21</sup>

- Child-care workers—defined by the Bureau of Labor Statistics as people who “attend to children ... and perform a variety of tasks, such as dressing, feeding, bathing, and overseeing play”—have experienced no increase in real earnings since 1997. Their average hourly wage was \$10.20 in 1997 and \$10.33 in 2013 (in constant 2013 dollars). Child care workers earn less than adults who take care of animals, and barely more than fast food cooks—a situation that may change to the detriment of child care workers as minimum wage requirements increase for fast food and service employees. Among workers whose wages are tracked by the US Department of Labor, child-care workers fall in the third percentile.
- Preschool teachers—defined by the Bureau of Labor Statistics as people who “instruct preschool children in activities designed to promote social, physical, and intellectual growth needed for primary school”—have fared somewhat better. Their wages, though they remain low, have increased by 15 percent in constant dollars since 1997 and now average \$15.11 per hour. They fall in the 19th percentile of workers.
- Kindergarten teachers have seen a 7 percent increase in wages over the same 16-year period. They now earn an average of \$25.40 per hour and fall in the 60th percentile of workers.
- From 1997 to today, child-care workers have earned about two-thirds of what preschool teachers earn, an income that falls barely above the poverty level for

**Figure 2.** Mean Annual Salary of Teachers, by Student Age/Grade Level, 2013



Source: Marcy Whitebook, Deborah Phillips, and Carollee Howes, *Worthy Work, STILL Unlivable Wages: The Early Childhood Workforce 25 Years after the National Child Care Staffing Study* (Berkeley: Center for the Study of Child Care Employment, University of California, Berkeley 2014).

a family of three. Today, among teachers with bachelor’s degrees, community-based public prekindergarten and Head Start teachers earn only two-thirds of what kindergarten teachers earn, and even teachers in school-sponsored prekindergartens earn 80 percent of kindergarten teachers’ income (see figure 2), illustrating the very low reward for educational attainment that characterizes the preschool workforce.<sup>22</sup>

These broad statistics don’t capture the vast variation in teacher wages by type of program and funding source.<sup>23</sup> In the context of an overall 19 percent increase in real wages between 1990 and 2012 for all center-based teachers, wage growth ranged from 3.6 percent in public school-sponsored programs to more than 29 percent in independent, nonprofit, or government-run programs. Still, hourly wages are highest for teachers in public school-sponsored centers, followed closely by those in Head Start centers. These

two sectors, however, constitute less than one-quarter of all center-based preschool programs.<sup>24</sup> For-profit programs, which constitute about one-third of programs serving three- to five-year-olds, pay the lowest wages.

Data from Head Start Program Information Reports for 1997 to 2013 are especially revealing regarding the absence of an educational premium for early childhood teachers. Since 1997, the share of Head Start teachers with a two- or four-year college degree has increased by 61 percent (to 95 percent of teachers), and the share of assistant teachers with a degree has increased by 24 percent (to 30 percent of assistant teachers).<sup>25</sup> Yet the wages of Head Start teachers and assistant teachers grew by only 17 and 11 percent, respectively, between 2007 and 2013. Moreover, most of this wage growth occurred prior to 2007, after which wages for both groups of teachers increased by only 1 percent.

## Implications of the Gap between Education and Compensation

No researchers have studied how the persistent mismatch between education and compensation in early care and education affects teachers' motivation to get more education or training (absent an explicit requirement), or their motivation to remain in the field once they get a degree. Associations between low wages and teacher turnover, on the other hand, have been well documented, as have associations between job stress and turnover.<sup>26</sup> Lead classroom teacher turnover in Head Start is now at 25 percent per year.<sup>27</sup> In 2012, the National Survey of Early Care and Education examined departure rates "among staff who work directly with children."<sup>28</sup> Departure rates in different types of programs ranged from 8 to 27 percent. About half of all centers saw at least one staff member depart during the study year; among those centers, rates of departure ranged from 21 to 31 percent. These preschool-teacher turnover rates are notably higher than those for K–3 teachers, which in recent years have been in the range of 7 to 8 percent.<sup>29</sup>

The costs of turnover and retraining new employees haven't been examined or built into estimates of the cost-effectiveness of pre-K education, and thus they remain hidden. Studies of other industries estimate the cost associated with replacing and training a new employee due to turnover at about 20 percent of the earnings associated with that position.<sup>30</sup> The costs to sustained improvement in instruction for young children can be easily imagined, although they're impossible to calculate—data on the career trajectories of people in the early care and education workforce who get more education or professional development are

either incomplete or not collected.<sup>31</sup> The costs to children are implied by correlational evidence that links higher teacher turnover rates to poorer-quality teacher-child relationships.<sup>32</sup> The costs to the wellbeing of the early care and education workforce and to the various forms of public assistance they must rely on are only beginning to be documented.

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## Economic Insecurity among the Early Childhood Workforce

Preliminary evidence from the Supporting Environmental Quality Underlying Adult Learning (SEQUAL) teacher questionnaire suggests that economic insecurity is endemic among preschool teachers in many types of childhood centers.<sup>33</sup> A recent study in a large southeastern state asked early childhood teachers to identify how worried they were about finances along a 6-point scale, where 1 equaled no worries and 6 equaled strong worries; the average score was 3.7.<sup>34</sup> About 60 percent had scores of 4.0 ("somewhat worried") or higher. The teachers were particularly worried about retirement savings, paying monthly bills, paying for routine health care for themselves and family members, housing and transportation costs, and (among nearly half of respondents) having enough food for the family.<sup>35</sup> Teachers with more education were less worried than

others; nonetheless, 42 percent of those with an associate degree or higher reported worrying about having adequate food for their families.<sup>36</sup> Of those with at least one child under the age of 18, 57 percent reported worrying about having enough food.

What are the potential consequences for young children of high economic insecurity and other sources of stress among their teachers? Recent research on teachers' mood, stress, teacher-child interactions, and children's experiences (in both preschool and elementary classrooms), has begun to give us some answers.<sup>37</sup> Children form developmentally essential relationships not only with their parents and other family members, but also with other regular caregivers, including early childhood teachers. Like relationships with parents, these relationships can either expose children to or buffer them from harmful stress and its consequences. Teachers who are more depressed and more stressed have been observed to be less sensitive, more intrusive, and harsher in classroom interactions with children.<sup>38</sup> They're also more likely to portray their relationships with the children in their care as conflictual, and they're more prone to consider and act on expelling preschool-age children.<sup>39</sup> Research has extensively documented the consequences for young children of having teachers who are less sensitive and less responsive.<sup>40</sup> Some of these consequences are substantial. For example, children cared for by unsupportive, intrusive, and insensitive teachers display elevated levels of the stress hormone cortisol, greater anxiety and vigilance in their child-care program, and compromised immune functioning; their parents report that they suffer more frequent infections.<sup>41</sup>

Economic insecurity also means that some child-care workers turn to public income supports. Data from the US Bureau of Labor Statistics show that child-care workers are almost twice as likely as the average American worker to rely on public support (46 percent versus 25 percent).<sup>42</sup> The annual cost to the nation between 2007 and 2011 amounted to \$2.4 billion in expenditures on the Earned Income Tax Credit, Medicaid, the Children's Health Insurance Program, food stamps, and Temporary Assistance for Needy Families. About half of people who work primarily with preschool-age children in this national sample had their own children under 18; among this subgroup, participation rates were particularly high. Four out of five of these workers whose youngest child was under five participated in public support programs, as did two out of three workers in single-parent families with children from five through 18 years of age. Child care workers who earned less than the proposed federal minimum wage of \$10.10 per hour were one and a half times more likely to rely on public assistance than were their counterparts who earned more.

In sum, society's expectations of the early childhood workforce have never been higher. Meeting these expectations requires that all teachers have access to and are consistently rewarded for efforts to improve their professional practice, whether through higher education or professional learning opportunities.<sup>43</sup> Yet the evidence suggests that these basic requirements are far from being met. We lack sufficient empirical evidence on how this situation affects the quality of classroom practice, the effectiveness of investments in professional development, and children's early learning and development.



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*At best we have two systems—a chaotic system for the prekindergarten workforce and a more rational and coherent system for K–3 teachers, with only a thin band of overlap.*

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### Professional Preparation and Development

Our nation lacks a professional learning and development system for prekindergarten through third grade. At best we have two systems—a chaotic system for the prekindergarten workforce and a more rational and coherent system for K–3 teachers, with only a thin band of overlap that affects the approximately 6 percent of prekindergarten teachers who are based in elementary school systems and thus integrated into their elementary schools' professional development and wage structures. Teachers who work in Head Start, Early Head Start and Department of Defense early childhood programs receive required and continuous in-service professional development, but no research tells us whether these training systems are effective.<sup>44</sup>

If we want to improve the professional preparation and development of early childhood teachers, we would ideally begin with a deep understanding of how these teachers foster healthy early development and learning, and of the competencies they need to do so. As the science of early childhood development has advanced, so too has our understanding of the complex

demands that early childhood teachers face. In essence, early childhood teachers are responsible for three interrelated goals: to provide young children with high-quality interactions and environments for early learning; to protect them from the consequences of stress, disruption, and chaos that can arise both outside and within the classroom; and to prepare them to grow up and make meaningful contributions to a highly diverse society.<sup>45</sup>

In a 2015 report, *Transforming the Workforce for Children Birth Through Age 8: A Unifying Foundation*, the National Academies drew on research and professional expertise to underscore the complexity of working with children during the first eight years of life, and to recommend ways to strengthen professional preparation standards for early childhood practitioners and for colleges and universities.<sup>46</sup> The report called on higher education programs to give students foundational knowledge about development and learning throughout a child's first eight years, in addition to differentiated instruction for specific age ranges and subjects. It also issued a call to develop and enhance interdisciplinary higher education programs for early care and education professionals, including practice-based and supervised learning opportunities.

However, efforts to carry out these and earlier recommendations for early childhood teacher preparation have been stymied by inconsistent evidence regarding links between teachers' education levels and children's developmental outcomes; by persistent attitudes that educating children before kindergarten requires less expertise than educating early elementary students; and by resistance to paying the added costs to support and sustain a better educated

preschool workforce.<sup>47</sup> The net effect is that although all states agree that teachers in K–3 classrooms (and beyond) should obtain at least a bachelor’s degree, there is no consistent educational floor for teachers who work with younger children. With the exception of those who work in state prekindergarten programs, it’s rare for teachers of preschool-age children to be individually licensed or certified.<sup>48</sup> Colleges and universities have designed their programs that prepare teachers of children in grades K–3 in response to codified expectations from state boards of education and school districts, as well as from well-defined teacher roles. Programs that focus primarily on training teachers of children from birth to age five, on the other hand, have evolved without coordination, shared views of what skills are essential, or oversight. When we contrast this bifurcated system of teacher preparation and compensation with the extensive developmental evidence that the pace and substance of learning before children formally enter school is no slower or less consequential than it is during the early elementary grades, the mismatch is staggering.

The challenges of evidence, attitudes, and funding notwithstanding, people who study early education generally agree that developmental science—reflected in rising expectations of what preschool education can and should accomplish—can help us figure out what knowledge and skills preschool teachers need. We also know that if we want to ensure high-quality preschool education that promotes early learning and development, simply requiring teachers to have a bachelor’s degree isn’t sufficient. Teacher preparation must be effective and evidence based.

It’s daunting to assess the quality, purpose, and content of formal early childhood preparation. Historically, any course of study within one of several disciplines focused on children of any age has been considered an acceptable form of teacher preparation.<sup>49</sup> Too often, very different higher education programs are assumed to produce equivalent results. National accreditation standards for early childhood teacher-preparation programs could encourage reform and strengthen higher education programs.<sup>50</sup> But because accreditation is voluntary, less than one-quarter of US early childhood degree programs at the associate, baccalaureate, or graduate level have been awarded accreditation.<sup>51</sup> Moreover, we have minimal evidence that accreditation is closely linked with better teacher preparation or better outcomes for children.<sup>52</sup>

Recently, researchers have assessed the quality of early childhood higher education programs—and how these programs affect teachers’ practice in early childhood classrooms—using a tool developed at the University of California, Berkeley, called the Early Childhood Higher Education Inventory. Their work has revealed both a lack of uniformity in what constitutes early childhood teacher preparation and a gap between the National Academies’ recommendations and the great variety of preparation programs.<sup>53</sup> Across the seven states assessed with the inventory, early childhood higher education programs reported different and often vague goals (for example, “to prepare students for multiple roles involving young children”); in no state was preparing teachers and administrators the primary goal of all early childhood degree programs.<sup>54</sup> Associate degree programs were most likely to require courses about infants and toddlers as well as preschoolers, but they

seldom focused on children in kindergarten or higher grades.<sup>55</sup> In contrast, bachelor's and graduate degree programs, although less likely to require courses about infants and toddlers, consistently required a focus on preschoolers, and were most likely to cover children in kindergarten or higher grades.<sup>56</sup>

Colleges and universities that train early childhood teachers have long been criticized for the variability of their course content.<sup>57</sup> Critics point to a paucity of coursework on the latest science of child development, family engagement, and adult learning; uneven coverage of academic instruction, notably math education; minimal training for teaching dual language learners and children with special needs; field-based learning that isn't connected to coursework and has dubious educational value; low faculty quality and diversity; and the difficulty of moving from two-year to four-year institutions.<sup>58</sup>

Moreover, despite widespread agreement that field-based learning is critically important for teachers who work with children of all ages, the different education and certification requirements for teachers across the birth-to-age-eight spectrum affect the availability and structure of such experiences.<sup>59</sup> Early childhood preparation programs share no standard of field experience for student teaching—defined as full-time immersion in a classroom, with increasing responsibility for curriculum planning and teaching, and supervision by a cooperating teacher. For example, while all bachelor's degree programs in New Jersey include a student teaching requirement, only 32 percent of such programs in California do so. Nor do standards guide practicums—short-term experiences associated with a course, often focused on a particular skill or population of children and supervised by a

faculty member or mentor.<sup>60</sup> In Nebraska, for example, all bachelor's degree programs require a practicum, while only 87 percent of such programs in California do so. Associate, baccalaureate, and graduate programs alike have inconsistent rules about the timing of the first practicum in a student's course of study; moreover, the number of on-site hours typically required for completing a practicum course ranges from only a few to more than 100. Although practicums are the most common type of field-based learning that early childhood degree programs require, particularly at the associate degree level, their inconsistent application makes it hard to assess whether such experiences offer students the depth and diversity of experiences or feedback they need to develop their teaching skills.

Our portrait of teacher preparation in the early childhood field, even within institutions of higher education, reveals a system that encompasses highly variable educational opportunities of uneven quality that are accessed by a vast variety of individuals through very different entry points. Such great variability makes it even harder to examine the impact of simply having or not having a particular degree or certification. As this reality has become increasingly apparent, those who study professional preparation in early care and education have begun trying to identify the essential ingredients of effective professional learning, offered through various in-service approaches, and to design and evaluate effective models and approaches.

In 2013, a joint statement by the Foundation for Child Development and the Society for Research in Child Development summarized the most promising evidence on this topic, stating that “intensive, developmentally focused curricula with integrated professional

development and monitoring of children's progress offer the strongest hope for improving classroom quality as well as child outcomes during the preschool years."<sup>61</sup> This so-called strongest hope model is further characterized by coaching at least twice a month, in which an expert teacher—in person or by video—gives feedback and support for in-classroom practice. Indeed, recent randomized evaluations of professional development approaches that do and don't include consultation suggest that the consultation component has added benefits.<sup>62</sup> The inextricable link among curricula, professional development, and regular monitoring of individual children's progress to guide teachers' practice is increasingly well documented by research focused on preschool-age children.<sup>63</sup> The central conclusions of this research are that curricula are only as effective as the professional development that accompanies them and that teachers' capacity to adapt curricula to children's individual learning trajectories represents a critical element linking what's on paper and what teachers are trained to do.

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*Curricula are only as effective as the professional development that accompanies them.*

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Other recent summaries of this evidence have further refined our understanding of effective professional learning approaches. These approaches include coaching and mentoring; workshops, training, and courses; reflective practice; learning networks; and communities of practice. They can be delivered through a similar variety of

mechanisms, including training embedded in classroom practice, offsite training in a college or other setting, or technology-based instruction.<sup>64</sup>

In sum, whether early childhood teachers can meet high expectations will hinge largely on whether we align the content of their professional training and development—and the infrastructure that surrounds it—with the knowledge and skills that the science of early development now tells us are essential to teachers' effectiveness. We must also acknowledge that a more coherent, evidence-based, accessible, and equitable system of professional development for early childhood teachers won't be sufficient to ensure high-quality early care and education for all. That will require us to tackle the intertwined factors related to recruiting talent into the field, the compensation and working lives of the early care and education workforce, and the high turnover rates that characterize the profession.

### **New Directions for Research, Practice, and Policy**

We offer three areas for the next stage of empirical work directed at pressing questions of policy and practice regarding the early childhood workforce.

First, evidence at the intersection of neurobiology, developmental science, and early education carries vast implications for how we think about children's early childhood teachers—their influence on early development, their responsibility in managing many children's first encounters with peers and situating most children's first experiences in an instructional environment, and the importance of their own knowledge, skills, and wellbeing. We need a much deeper understanding of the personal, workplace,

and economic supports that teachers require if they are to carry out these responsibilities competently and consistently. And we sorely need to experiment with interventions that focus on teachers' economic wellbeing and mental health.

Second, we need to focus on the bifurcated professional development and compensation systems across the preschool and early elementary grades, as well as on the virtual lack of a system across the wide array of preschool programs. As more preschool teachers acquire higher degrees, for example, are talented teachers seeking higher pay by leaving preschool for elementary school classrooms, and perhaps leaving community-based preschool programs for programs based in schools? Such a trend could, in turn, contribute to the weak associations we see between degree attainment and child outcomes.

Third, scientific inquiry into professional development for early childhood teachers is developing rapidly. A growing number of experimental studies are attempting to find the most critical elements of professional development in this field, and whether approaches from one early education system can be generalized to another. We agree with several recent reports about the need to:<sup>65</sup>

- better understand the connections between the factors in higher education that are considered to be most effective and the teaching practices and outcomes of graduates;
- develop new tools to assess teacher performance that can be modified through professional learning processes and that capture a greater share of the variance in student outcomes;

- study leadership in the field and how it fosters improved practice via professional learning; and
- identify the features of coaching and coaches that are associated with significantly improved professional practice.

Another area that warrants much greater attention from researchers involves the divergent needs of early childhood teachers with different cultural, educational, and experiential backgrounds, and what these differences imply for professional development.

With regard to policy and practice, we note two crucial issues. First, we've seen major advancements in the education and training of Head Start staff, the integration of coaching and other professional development opportunities into state quality rating and improvement systems, the availability of scholarships for college education and engagement in professional development, and the engagement of colleges and universities in various state initiatives that aim to improve the competence of the early childhood workforce. But these important efforts haven't been accompanied by policies to improve compensation. For example, among the National Institute for Early Education Research's 10 measures of high-quality state preschool programs, five focus on teaching staff; all five deal with teacher qualifications, and compensation isn't included.<sup>66</sup> Similarly, the 2007 Head Start reauthorization addressed education and training but was silent on compensation. Typically, when money is set aside to promote quality, expenditures are allowed on a range of initiatives,

including both professional development and compensation. When we track these expenditures, we see serious investments at the state level with regard to professional learning opportunities. But investments in compensation and working conditions lag far behind.<sup>67</sup> A 2015 analysis of how states implemented the federal Early Learning Challenge grants concluded that “inadequate compensation and lack of workplace supports persist as the greatest challenges and the ‘elephant in the room’ that is not being directly addressed.”<sup>68</sup> When a grant program explicitly mentions compensation, as the Preschool Development and Expansion Grant Program did, almost all recipients offer a plan to improve compensation.<sup>69</sup> Our strongest policy recommendation is that legislation or regulations should firmly link requirements or incentives for improving professional learning to salary equity and improved working conditions.

With regard to practice, it’s long past time to recognize prekindergarten through third grade as a continuum that requires a seamless system of professional learning and compensation tied to qualifications, including education.<sup>70</sup> Teacher preparation and credentialing systems at the state level should be updated to ensure that all teachers of young children have credentials that align with research-based knowledge about young children’s learning needs and capacities. This process will be successful only to the extent that it recognizes the growing diversity of the children in early childhood classrooms with regard to culture, language, and special needs. An effective teacher-preparation system also depends heavily on a coordinated higher education system that’s aligned with the same research-based knowledge and that recognizes the same realities about today’s early childhood population.

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*Our strongest policy recommendation is that legislation or regulations should firmly link requirements or incentives for improving professional learning to salary equity and improved working conditions.*

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## Conclusions

The crux of quality in early childhood education lies squarely in the interactions that transpire between teachers and children.<sup>71</sup> Teachers, in turn, guide these interactions.<sup>72</sup> Effective early childhood teachers are purposeful, intentional, and reflective in their instructional strategies. They deploy proactive management strategies, attend and respond to individual differences among the children in their classrooms, offer all children consistent emotional availability, and sustain a positive classroom climate. You might say that early childhood teachers blend the skills of air traffic controller, conflict negotiator, party planner, detective, and, of course, educator. To fulfill the promise of early education, we need professional development systems and practices that help teachers carry out these responsibilities. Children’s competence, resilience, and tolerance are at stake.

To move beyond incremental improvements in the quality of early care and education, empirical research, intervention, and policy alike should focus on early childhood teachers—their preparation, development,

compensation, and wellbeing. One central challenge for progress is the persistent gap between the prekindergarten and K–3 educational systems, which affects the vast majority of the early childhood workforce and raises profound equity issues. Another is the fragmentation and historic disparities in sponsorship, funding, and policy structures that plague the prekindergarten workforce

and the preschoolers and families who rely on this workforce. The central opportunities for progress lie in the growing national recognition that early childhood education plays a vital role in the lives of children and the wellbeing of society, and that early childhood teachers are essential to ensure that early childhood education's vast potential is realized.



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# Supporting Young English Learners in the United States

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*Lisa Barrow and Lisa Markman-Pithers*

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## Summary

Simply put, children with poor English skills are less likely to succeed in school and beyond. What's the best way to teach English to young children who aren't native English speakers? In this article, Lisa Barrow and Lisa Markman-Pithers examine the state of English learner education in the United States and review the evidence behind different teaching methods.

Models for teaching English learner children are often characterized as either English immersion (instruction only in English) or bilingual education (instruction occurs both in English and in the students' native language), although each type includes several broad categories. Which form of instruction is most effective is a challenging question to answer, even with the most rigorous research strategies. This uncertainty stems in part from the fact that, in a debate with political overtones, researchers and policymakers don't share a consensus on the ultimate goal of education for English learners. Is it to help English learner students become truly bilingual or to help them become proficient in the English language as quickly as possible?

On the whole, Barrow and Markman-Pithers write, it's still hard to reach firm conclusions regarding the overall effectiveness of different forms of instruction for English learners. Although some evidence tilts toward bilingual education, recent experiments suggest that English learners achieve about the same English proficiency whether they're placed in bilingual or English immersion programs. But beyond learning English, bilingual programs may confer other advantages—for example, students in bilingual classes do better in their native languages. And because low-quality classroom instruction is associated with poorer outcomes no matter which method of instruction is used, the authors say that in many contexts, improving classroom quality may be the best way to help young English learners succeed.

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Being bilingual brings many advantages. At the most basic level, speaking two or more languages creates more economic and social opportunities as it expands the number of people you can communicate with in an increasingly global economy. And some research indicates that bilingual people have higher levels of executive functioning, particularly when it comes to inhibitory control and cognitive flexibility.<sup>1</sup> These skills have been found to correlate with academic success. (See the article in this issue by Cybele Raver and Clancy Blair for a full description of executive function and its relation to school success.) Some evidence even suggests that bilingualism may protect against the cognitive decline associated with aging.<sup>2</sup> Although there is near consensus that bilingualism is beneficial, bilingual education itself is a complex and controversial topic. One aspect of US bilingual education is teaching languages other than English to students whose first language is English. In this article, we focus on another aspect—teaching English to children who aren't native English speakers.

For decades, researchers, educators, and policymakers have debated how best to prepare young children whose native language isn't English to succeed in classrooms where English is the language of instruction, with very little conclusive evidence. The crux of the debate surrounds the amount, frequency, and duration with which students should use their native language in school, which is in large part associated with the underlying educational goal: Is the intent to make students bilingual (fluent in both their native language and English), or is it to make sure that English learners master the language as rapidly as

possible? The debate is politically charged, and tolerance of or support for bilingual education has varied over time.<sup>3</sup>

## The State of US English Learner Education

Title VI of the Civil Rights Act of 1964 and the Equal Educational Opportunities Act of 1974 require public schools to help English learner students “participate meaningfully and equally in educational programs.”<sup>4</sup> School districts must identify potential English learner students, assess English language proficiency on an annual basis, and continue to monitor former English learner students for at least two years after English proficiency is established. With the passage of the No Child Left Behind Act of 2001, Title III established federal formula grants for states to support the needs of English learner students aged 3–21, with the goal of helping them attain English language proficiency. Much of the policy, including these grants, was retained in the reauthorization under the Every Student Succeeds Act (ESSA) of 2015. No Child Left Behind specifically refers to children who are *limited English proficient* (LEP), while the ESSA replaced the term with *English learners*. We use English learners throughout this article.

In defining English learners, ESSA and the Improving Head Start for School Readiness Act of 2007 (HSA) refer to “difficulties in speaking, reading, writing, or understanding the English language, that may be sufficient to deny the individual a) the ability to meet the challenging State academic standards; b) the ability to successfully achieve in classrooms where the language of instruction is English; or c) the opportunity to participate fully in society.”<sup>5</sup> ESSA also holds states accountable by requiring them to adopt



English language proficiency standards that “(i) are derived from the four recognized domains of speaking, listening, reading, and writing; (ii) address the different proficiency levels of English learners; and (iii) are aligned with the challenging State academic standards.” The act also requires local education agencies that receive Title III funds to “demonstrate success in increasing—(A) English language proficiency; and (B) student academic achievement.” Similarly, HSA performance standards include language about ensuring that English learner children are making progress toward English language acquisition.<sup>6</sup> Based on these policies, education of English learners in the United States by and large means programs designed to help these students achieve proficiency in English. National policy isn’t focused on teaching students to be proficient in more than one language. That said, ESSA requires only that programs for developing English proficiency be “evidence-based,” not that the program be designed to make students fluent only in English or bilingual in English and their native language. The HSA is similarly noncommittal about which programs Head Start Centers are to implement. But the *Head Start Early Learning Outcomes Framework* (intended to guide Head Start program design) describes English learners in terms of how they may differ on various indicators and asserts that “continued development of a child’s home language in the family and early childhood program is an asset and will support the child’s progress in all areas of learning.”<sup>7</sup> The Head Start framework also stresses that English learners must be allowed to demonstrate knowledge, skills, and abilities in any language (English, their home language, or both). Finally, state-funded preschool regulations vary from state to state: 14 of 41 states with state-funded preschool

programs have no policies regulating services for English learners; 24 states permit programs to offer bilingual preschool classes; and 14 states permit monolingual, non-English preschool classes.<sup>8</sup> As a result, we see a wide variety of programs across the United States at both the preschool and primary grade levels.

In table 1, we present data on the proportion of children who speak a language other than English in the home, as well as the proportion identified as English learners or LEP. In 2014, more than one-fifth of US children aged 5–9 were potential English learners, meaning that they spoke a language other than English in their home. For children under 5 years of age, we have less comprehensive data; we report figures from Head Start programs, which primarily serve three- and four-year-olds, and from select states for which data on preschool-aged children are available. The proportion of Head Start students who report a home language other than English fell slightly between 2004 and 2014, from 29 to 28 percent, while the proportion of five- to nine-year-olds reporting a home language other than English rose from 19 percent in 2004 to 22 percent in 2014.<sup>9</sup> The American Community Survey identifies people age five and up as LEP if they are reported to speak English less than very well. Only 6.2 percent of five- to nine-year-olds fell into that category. Of course, speaking English very well is only one component of proficiency. School districts typically identify English learner students through a home language survey, followed by a more formal assessment of English language proficiency. Not all children whose primary language isn’t English are identified as English learners. Still, in the 2013–14 school year, 16.5 percent of public school students enrolled in

**Table 1.** Percent of Children Speaking a Language Other than English in the Home and Percent of Children Identified as English Learners, Select Populations in 2004 and 2014

Population	Age range	Percent speaking a language other than English in the home		Percent English learner/LEP		
		2004	2014	Grade/age range	2004	2014
Head Start	3–4	28.80	28.30			
American Community Survey	5–9	19.34	22.43	5–9	6.83	6.20
US public schools				K–3		16.5
California	5–9	43.77	43.45	K–3	35.82	36.24
Texas	5–9	31.56	36.61	Pre-K–3		28.50
Florida	5–9	23.79	28.32	Pre-K–3		15.97
Illinois	5–9	20.96	24.69	Pre-K–3	10.96	13.31
New York	5–9	25.56	30.38	Pre-K–3		11.11

Sources: Office of Head Start, “Head Start Services Snapshot: National (2014–2015),” <http://eclkc.ohs.acf.hhs.gov/hslc/data/psr/2015/services-snapshot-hs-2014-2015.pdf>; American Community Survey; US Department of Education, “Table 204.27: English Language Learner (ELL) Students Enrolled in Public Elementary and Secondary Schools, by Grade and Home Language: 2013–14,” *Digest of Education Statistics*, [http://nces.ed.gov/programs/digest/d15/tables/dt15\\_204.27.asp](http://nces.ed.gov/programs/digest/d15/tables/dt15_204.27.asp); CalEdFacts, <http://www.cde.ca.gov/re/pn/fb/>; Texas Education Agency, “ELL Student Reports by Category and Grade,” <https://rptsrv1.tea.texas.gov/adhocrpt/adlepcg.html>; Florida Department of Education, “Florida EDStats,” <https://edstats.fldoe.org/SASPortal/main.do>; Illinois State Board of Education, Data Analysis and Progress Reporting Division, *Illinois Bilingual Education Programs: 2004 Evaluation Report* (Springfield, IL: Illinois State Board of Education, 2005); Illinois State Board of Education, Data Analysis and Accountability Division, *Bilingual Education Programs and English Learners in Illinois: SY 2013 (2012–2013 School Year) Statistical Report* (Springfield, IL: Illinois State Board of Education, 2015); New York State Education Department, “New York State Data,” <http://data.nysed.gov/>.

kindergarten through third grade fell into that category.<sup>10</sup>

English learner students and young children aren’t uniformly distributed across the United States. In fact, more than 50 percent of the US total reside in just five states. By far, California public schools serve the most English learner students of any state and have the largest share of students who are English learners. About one-third of all public-school English learner students in the nation are enrolled in California schools, and 24 percent of all California public school students are English learners (see table 2).<sup>11</sup> Texas, Florida, New York, and Illinois round out the rest of the top five for the number of English learners

served; New Mexico, Texas, Nevada, and Colorado round out the top five for the largest shares of public school students (grades K–12) who are English learners. In table 1, we also report American Community Survey data on the proportion of five- to nine-year-olds whose home language isn’t English for the five states with the largest number of English learners, as well as data from these states on the proportion of young public school students who are English learners, including preschool students for states other than California.<sup>12</sup> Notably, 36 percent of California public-school students in kindergarten through third grade are English learners, as are about 30 percent of Texas prekindergarten through third-grade students.

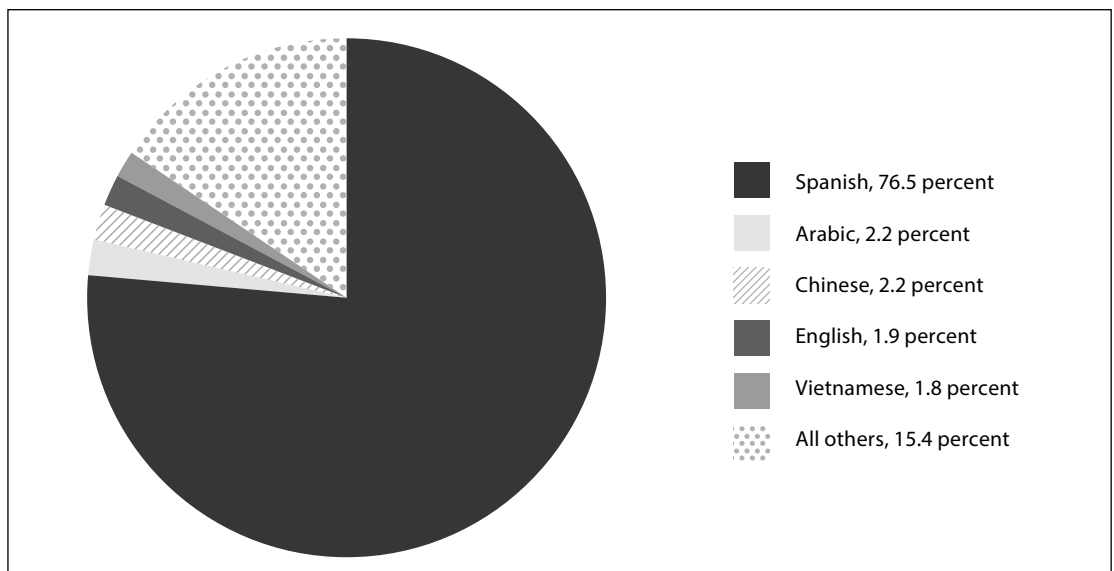
**Table 2.** Top Five States in Two Measures of English Learner Enrollment, 2013–14

State	Percentage of total US public school English learner students	State	English learner public school students as a percentage of total state student population
California	30.59	California	23.89
Texas	16.42	New Mexico	16.90
Florida	5.78	Texas	15.71
New York	4.89	Nevada	15.49
Illinois	3.79	Colorado	13.49

Sources: National Clearinghouse for English Language Acquisition, "Title III State Profiles," <http://www.ncele.us/t3sis/index.php>, and National Center for Education Statistics "Table 203.40: Enrollment in Public Elementary and Secondary Schools, by Level, Grade, and State or Jurisdiction: Fall 2013," *Digest of Education Statistics*, [http://nces.ed.gov/programs/digest/d15/tables/dt15\\_203.40.asp](http://nces.ed.gov/programs/digest/d15/tables/dt15_203.40.asp).

Among all English learners, Spanish is by far the language most commonly spoken at home.<sup>13</sup> Figure 1 shows the proportion of all public elementary and secondary English learners who speak each of the top 30 languages reported. Among public elementary and secondary English learner students at all grade levels, 76.5 percent report that Spanish is their home language, followed by Arabic, Chinese (including both

Mandarin and Cantonese), English, and Vietnamese.<sup>14</sup> (You may find it surprising that some English learners speak English in the home; this category includes children who live in multilingual households as well as adopted children who were raised in a non-English-speaking household before adoption.) The proportion whose home language is Spanish is somewhat higher among Head Start participants.<sup>15</sup>

**Figure 1.** Most Commonly Reported Home Languages of English Learner Students Enrolled in Public Elementary and Secondary Schools

English learners are also likely to come from poorer families, meaning that they have fewer resources at home. In a study using a nationally representative sample of children born in the United States in 2001, researchers reported that 41 percent of children growing up in bilingual households (those with a primary home language other than English and frequent exposure to two languages) come from families in the lowest fifth on an index of socioeconomic status, while only 10 percent are in the highest fifth.<sup>16</sup> In contrast, only 14 percent of children growing up in households where English is the primary home language live in families in the lowest fifth, and 22 percent are in the highest fifth. Similarly, a report using 2013 data from the American Community Survey indicates that 28 percent of five- to 17-year-old children growing up in households where a language other than English is spoken are poor, compared to 19 percent of children growing up in an English-only household.<sup>17</sup> The average English learner student faces both the disadvantage of coming from a poor family and the disadvantage of being an English learner in a primarily English-language education system. As a result, it's hard to distinguish which disadvantage drives worse educational outcomes for English learner students.

In the 2013–14 school year, states identified roughly 4,930,000 students (9.8 percent of total enrollment) as English learners and reported serving 92 percent of them in programs funded with Title III grants, based on data compiled from the Consolidated State Performance Report (CSPR).<sup>18</sup> The same data show that English learner students are served by many types of Language Instruction Educational Programs (LIEPs), as defined by No Child Left Behind. Such programs may serve English learner students

only, but they may also include English-proficient students if they are designed to make all students proficient in English and another language. The CSPR asks states to report on the types of LIEP programs they use in two categories—English Only or English and Another Language. Most states (43, including the District of Columbia, based on our calculations from the 2013–14 CSPR data) report that at least one local education agency makes use of a program in the English and Another Language category. Eight states (Alabama, Arkansas, Hawaii, Missouri, New Hampshire, North Dakota, Vermont, and West Virginia) report having nothing but programs in the English Only category.

The CSPR also asks states to report the number of certified or licensed teachers in Title III-funded activities and to project how many more such teachers will be needed in five years. Overall, in the 2013–14 school year, there were just over 345,000 licensed or certified teachers in Title III-funded activities.<sup>19</sup> This number was largely unchanged from 2011–12; however, some states, such as Illinois and Nebraska, more than doubled the number of such teachers over that two-year span, while the number declined elsewhere. In the following five years, states expected to need around 24 percent more such teachers, on average.

### **Why This Matters**

The high school graduation rate for English learner students was 61 percent in 2012–13, compared with an overall US graduation rate of 81 percent.<sup>20</sup> The gap in high school completion rates doesn't apply directly to young English language learners because they may become English proficient before reaching high school;

however, early achievement gaps between English learners and their native-English-speaking peers can still translate into lower educational attainment. English proficiency and educational attainment are associated with higher wages. Using decennial Census data and age at arrival in the United States, researchers have estimated that a person who speaks English poorly earns roughly 33 percent less than one who speaks English well.<sup>21</sup> However, not all of the relationship between English proficiency and wages is a direct effect of English skills on worker productivity. The researchers found that the majority of the earnings gap can be explained by lower levels of educational attainment. That is, people with greater English proficiency get more education, explaining a large share of the gap in earnings.

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*A person who speaks English poorly earns roughly 33 percent less than one who speaks English well.*

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Students who are English learners when they enter kindergarten score consistently lower on tests of mathematics (given in Spanish or English) and reading (given only in English) than do students who enter kindergarten proficient in English, although the sizes of the test score gaps are smaller than those between students with college-graduate versus high school-graduate parents, or the gap between white and black students (excluding Hispanic students). Data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K) let us compare outcomes for a representative sample of children who enrolled in kindergarten in 1998–99. These

data indicate that among students assessed in Spanish or English, those who were not proficient in English when they entered kindergarten scored lower in mathematics in the fall of their kindergarten year than did those who were proficient in English.<sup>22</sup> This gap is roughly the size of the gap in mathematics between white and black students in the fall of their kindergarten year. By spring 2002 (when most children in the study were enrolled in third grade, where all students are assessed in English), the gap had narrowed to about 45 percent of the white-black gap. By spring 2007 (eighth grade), the gap in average scores was 28 percent of the gap between white and black students. Thus, while a test score gap remained between students who were English learners in kindergarten and others, students who weren't proficient in English when they started kindergarten didn't fall further behind their peers and, in fact, partially closed the gap by eighth grade.<sup>23</sup>

Using the ECLS-K to look at reading assessment scores by English proficiency is somewhat more complicated, because students are assessed only in English, and thus the pool of students being compared changes over time.<sup>24</sup> Specifically, kindergarten students are assessed only if they score well enough on an exam of English proficiency, whereas all students are assessed from third grade on. Not surprisingly, kindergarten students who are not proficient in English (but proficient enough to take the exam) score lower on the reading assessment than do kindergarten students who are proficient in English. The size of the gap is roughly 70 percent of the gap between white and black students. The gap widens somewhat to roughly three-quarters of the white-black gap in third grade, when all students are assessed in reading, and narrows

to 47 percent of the gap between white and black students by eighth grade. Again, we see that English learner students continue to perform more poorly on reading assessments than do students who aren't English learners, although we see the gap narrowing between third and eighth grade.<sup>25</sup> However, test score gaps remain for both math and reading even in eighth grade, suggesting that these English learner students will be more likely to drop out of high school and ultimately complete less education. One caveat, of course, is that these data represent simple averages and thus don't tell us how much other student and family characteristics beyond English proficiency may contribute to students' below-average math and reading scores. In fact, a recent study using the Early Childhood Longitudinal Study Birth Cohort (ECLS-B) finds that 75 percent or more of the early (preschool and kindergarten) reading score gaps between English learner children and others can be explained by differences between the two groups in such characteristics as mother's education level, household income, and parents' literacy activities in the home.<sup>26</sup>

## **How Do We Help Young English Learner Students?**

How can we best help children acquire the level of English proficiency they need to achieve their potential in classrooms where English is the language of instruction and to participate fully in our predominantly English-language society? It's an open question. Models for teaching English learner children are often characterized as either English immersion (instruction only in English) or bilingual education (instruction occurs both in English and in the students' native language), but each type includes several broad categories. For

purposes of Title III, the reporting form for the CSPR lists five categories within each type. Under English Only, the five categories are sheltered English instruction, structured English immersion, specially designed academic instruction delivered in English, content-based English as a second language (ESL), and pull-out ESL; under English and Another Language, the form lists dual language, two-way immersion, transitional bilingual, developmental bilingual, and heritage language programs (see box 1 for descriptions adapted from those provided by the National Clearinghouse for English Language Acquisition). We note, however, that no programs are so clear-cut in practice. Different programs have been referred to as additive or subtractive models, depending on the role that the native language plays in instruction. Additive models add English instruction to native language instruction, whereas subtractive models focus on transitioning English learners to English immersion programs as rapidly as possible and thus subtracting native language instruction.<sup>27</sup> Another distinction among the English and Another Language programs is how long a student may participate. Such programs can be defined as either *early exit* or *late exit*. In early exit bilingual programs, students transition into an English-only classroom within two or three years. In late-exit bilingual education programs, students stay in the program much longer; transition into a mainstream English program usually doesn't occur until the end of fifth or sixth grade. Late-exit programs can be found in both transitional and developmental models. Within all of these programs, the percentage of time dedicated to the primary language and to English can vary.<sup>28</sup> Transition from bilingual to mainstream, English-only classrooms and reclassification as former English learner depend on a student's level

**Box 1. Types of English Learner Programs Funded by Title III Grants**

<b>English Only Programs</b>
<p><b>Sheltered English instruction:</b> An instructional approach used to make academic instruction in English understandable to English learners to help them acquire proficiency in English while achieving in content areas. Sheltered English instruction differs from ESL in that English is not taught as a language with a focus on learning the language. Rather, content knowledge and skills are the goals. In the sheltered classroom, teachers use simplified language, physical activities, visual aids, and the environment to teach vocabulary for concept development in mathematics, science, social studies, and other subjects.</p> <p><b>Structured English immersion:</b> In this program, language-minority students receive all their subject matter instruction in English. The teacher uses a simplified form of English. Students may use their native language in class; however, the teacher uses only English. The goal is to help language-minority students acquire proficiency in English while achieving in content areas.</p> <p><b>Specially designed academic instruction delivered in English:</b> See structured English immersion.</p> <p><b>Content-based English as a second language:</b> This approach to teaching English as a second language makes use of instructional materials, learning tasks, and classroom techniques from academic content areas as the vehicle for developing language, content, cognitive, and study skills. English is used as the medium of instruction.</p> <p><b>Pull-out ESL:</b> A program in which English learner students are pulled out of regular, mainstream classrooms for special instruction in English as a second language.</p>
<b>English and Another Language Programs</b>
<p><b>Dual language:</b> Also known as two-way immersion or two-way bilingual education, these programs are designed to serve both language-minority and language-majority students concurrently. Two language groups are put together and instruction is delivered through both languages. For example, native English-speakers may learn Spanish as a foreign language while continuing to develop their English literacy skills, and Spanish-speaking English learners may learn English while developing literacy in Spanish. The program seeks to help both groups to become biliterate, succeed academically, and develop cross-cultural understanding.</p> <p><b>Two-way immersion:</b> See dual language.</p> <p><b>Transitional bilingual:</b> An instructional program in which subjects are taught through two languages—English and the native language of the English language learners—and English is taught as a second language. English language skills, grade promotion, and graduation requirements are emphasized, and the native language is used as a tool to learn content. The primary purpose of these programs is to facilitate English learner students' transition to an all-English instructional environment while receiving academic subject instruction in the native language to the extent necessary. As proficiency in English increases, instruction in the native language decreases. Transitional bilingual education programs vary in the amount of native language instruction provided and the duration of the program. The programs may be early- or late-exit, depending on the amount of time a child may spend in the program.</p> <p><b>Developmental bilingual:</b> A program that teaches content through two languages and develops both languages with the goal of bilingualism and biliteracy. May also be referred to as a late-exit program.</p> <p><b>Heritage language:</b> The language a person regards as their native, home, and/or ancestral language. Includes indigenous languages (for example, Navajo) and immigrant languages (for example, Spanish in the United States).</p>

Source: Adapted from [http://www.ncele.us/files/rcd/BE021775/Glossary\\_of\\_Terms.pdf](http://www.ncele.us/files/rcd/BE021775/Glossary_of_Terms.pdf).

of English proficiency and the goal of the program. How proficiency is assessed in these programs also varies in terms of what skills are necessary to be considered ready to transition and what tools are best used to assess these skills.<sup>29</sup>

### Arguments for Bilingual Education

Young children (prekindergarten–third grade) enter school still developing proficiency and literacy skills in their home language, whether it's English or another



language. School is where students go to strengthen these skills. Young students whose native language isn't English face an especially great challenge, as they must continue to develop a strong foundation in their native language while trying to learn English. Frequently, these students are called *dual language learners*, because they are working on learning two languages at the same time. One argument for bilingual education is that these young students still need help reaching proficiency in their first language as well as in English. Supporters of this approach also argue that not teaching children in both languages is unjust because it may deny them the benefit of being bilingual later in life.<sup>30</sup>

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In addition, advocates of bilingual education propose that a relationship exists between learning a first and second language, and that a strong foundation in a child's first language will help in second-language acquisition.<sup>31</sup> Researchers don't completely understand what mechanisms transfer from one language to another, but some suspect that skills such as phonological awareness, decoding, and knowledge of letters and sounds can probably be transferred and that they can help students acquire English.<sup>32</sup> These researchers caution that although certain skills may transfer, such a transfer

isn't automatic; for transfer to occur, they argue, students need instruction in areas such as identifying common cognates.<sup>33</sup> In addition, the transfer theory relies heavily on children having a strong foundation in their native language. Therefore, those who support the theory argue that students (especially young children) should remain in intensive bilingual programs for a long time so that they can reach a high level of linguistic competence in their native language. Researchers who support this theory of bilingual education contend that although such students may gain English proficiency a bit more slowly in the short run, strengthening their native language skills will bring better English proficiency in the long run.<sup>34</sup>

Another argument for bilingual education is that students need time to gain proficiency in English. Factors involved in English proficiency include oral- and academic-language development (that is, the ability to communicate effectively in academic settings, which typically rely on more formal language structure and vocabulary). Oral language proficiency in English is associated with greater academic gains in English reading achievement, including reading comprehension and writing, and academic English proficiency is related to long-term success in school.<sup>35</sup> According to researchers, English learners typically take three to five years to achieve advanced proficiency in oral English and four to seven years to develop academic English proficiency.<sup>36</sup> The speed of language acquisition depends on both the child and environmental factors.<sup>37</sup> These researchers caution that although students' language development initially progresses somewhat rapidly, progression to higher levels of proficiency is much slower and therefore

students should have the support and time they need to fully develop these skills.<sup>38</sup>

Finally, while working on becoming English proficient, English learner students are also trying to meet the same academic expectations in math, reading, etc., as their native English-speaking peers. Although such demands vary by age, another argument for adopting a bilingual education approach is that students will continue progressing in academic development while becoming proficient in oral and academic English.<sup>39</sup>

### **Arguments against Bilingual Education**

Arguments against bilingual education are based on the premise that English immersion is the most efficient way to acquire English proficiency and that children whose native language is not English should learn English as quickly as possible to be able to receive all the benefits available to them in an English-speaking society.<sup>40</sup> These researchers generally don't support the language transfer theory, citing research that finds no short- or long-run differences in the rate of English language acquisition between students in English immersion and bilingual education programs.<sup>41</sup> Some advocates of English immersion claim that there's a critical period for language acquisition, and thus the earlier students are exposed to and learn English, the better. Although scholars argue about whether a critical period exists for acquiring a second language, few challenge the idea that early exposure to language (in infancy and early childhood) is associated with peak proficiency—particularly in certain aspects of language acquisition such as sound production and grammar.<sup>42</sup> Some researchers suggest that we can see a decline in average proficiency in children introduced to a second language as early as four to six years

old; however, the exact age at which such a decline occurs has been debated, and some suggest that we should be thinking in terms of a “range of age factors” that include an interaction between biology (brain plasticity and other neurological changes) and factors such as exposure and motivation.<sup>43</sup> Others further argue that English learners are hurt by being segregated from their English-speaking peers, making it harder for them to assimilate into American society.<sup>44</sup> And yet others argue that bilingual education is more expensive and that we lack enough qualified bilingual teachers in all native languages to offer high-quality bilingual education.<sup>45</sup>

### **Is Bilingual Education the Same for All Students?**

Some research suggests that degree of language transfer may vary from language to language, depending on the structures of the native and secondary languages in question. As a result, bilingual education's impact on students may depend on students' native languages.<sup>46</sup> In a recent correlational study, researchers looked at multiple cohorts of students from a large urban district (totaling 13,750) who entered the district in kindergarten. These students were followed over time to examine their outcomes in literacy and math. The data were separated by ethnicity to examine differences for Latino and Chinese English learner students. The trajectories of the two groups differed. Based on standardized test scores in English Language Arts (ELA), test scores grew faster among Latino English learner students enrolled in dual language and bilingual classes than among Latino English learner students enrolled in English immersion classes. As a result, average ELA test scores in the seventh grade were higher for Latino English learner students who were enrolled

in dual language or bilingual classes when they entered kindergarten than for their peers enrolled in English immersion classes. In contrast, ELA test scores didn't grow any faster among Chinese English learner students enrolled in dual language classes than among Chinese English learner students enrolled in English immersion classes. But Chinese English learner students enrolled in a developmental bilingual program performed worse than their peers enrolled in English immersion classes. Researchers suspect that the differences arose because Spanish and English are more structurally similar than Chinese and English.<sup>47</sup> Although the authors attempted to control for parental preferences and observable differences between students, the students weren't randomly assigned to the programs, so we can't rule out the possibility that part of the difference between Chinese and Latino English learners is explained by which students chose which language programs.

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*When it comes to the question of whether to teach English learner students in a bilingual classroom, it's likely that there isn't a single answer for all schools.*

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In addition, when it comes to the question of whether to teach English learner students in a bilingual classroom, it's likely that there isn't a single answer for all schools. Although the majority of English learner students speak Spanish as their home language, more than 50 languages were reported among the top five languages across all states.<sup>48</sup> As a result, some local education agencies need to

serve students and families with a number of different home languages, and they may or may not have teachers and staff who are also fluent in those languages. Therefore, some types of programs, such as dual language immersion, aren't feasible in all schools or for all students. However, as English learners constitute a growing share of US public school students, it's imperative that we develop and adopt programs that serve them effectively.

In the sections that follow we examine what research has to say about how best to educate young English learners. Because of the scope of this issue of *Future of Children*, we focus on younger children (grades prekindergarten–third grade). We also focus mainly on Spanish-speaking students, because they represent the largest population of English learners in the United States and have been the subjects of almost all the current research. Where appropriate, we incorporate other research; however, our main focus is on children's language and literacy development.

### **Evaluations and Reviews: Bilingual versus English Immersion Classes**

Numerous studies have compared how bilingual education and English immersion affect academic performance and English language acquisition. The results have been conflicting, leaving most researchers still uncertain about which is the best way to educate English learners. These studies vary in their methodology and quality. Very few can be categorized as experimental or quasi-experimental studies that allow us to make causal conclusions. Further, many correlational studies fail to include appropriate control variables. Studies that aren't experimental or don't include appropriate controls fail to

consider that the students enrolled in bilingual or English immersion programs may differ in either observable or unobservable characteristics (for example, their degree of exposure to the English language or their literacy in their native language) that may also affect outcomes and limit our ability to make causal statements. Experimental and quasi-experimental studies confront this problem either by random assignment or by relying on sources of random variation that assign some children to bilingual programs and others to English immersion programs.

For the purposes of our review, another weakness of many studies is that they typically include children from kindergarten through 12th grade. This factor makes it hard to answer questions specifically about children in preschool and the primary grades, whose needs differ from those of older children. Younger children are still trying to gain a strong foundation in their native language while simultaneously mastering English, whereas older children are likely to have higher levels of literacy in their native language but face greater academic demands and tasks that require more abstract thinking and higher-order language manipulation.

In addition, many existing studies are short-term, and short-term studies, whether experimental or correlational, may obscure benefits that appear only in the long term. A recent non-experimental study highlights this problem. This study focused on English learner students in a single district who entered school in kindergarten, and although the students weren't randomly assigned to different groups, the researchers controlled for parental preferences and other observed differences between students in the different programs.<sup>49</sup> In second grade, the authors found that dual language students scored

significantly worse on the state administered ELA exam than did English learner students enrolled in other bilingual and English immersion programs. However, the authors were able to follow some cohorts of students as far as seventh grade, and they found evidence that students enrolled in the dual language program caught up to students in the other programs by fifth grade. Thus, if we had only the short-run results, we might conclude that dual language programs harm students' ELA achievement. Yet the longer-run evidence suggests that dual language programs may be just as effective but take longer to develop students' English language skills, as advocates of bilingual education have hypothesized.

### **Language of Instruction for English Learners in Preschool**

The amount of high-quality research on language of instruction for preschool-aged English learners is limited. In a systematic review of studies conducted between 2000 and 2011, researchers identified 25 that looked at education interventions for English learner children from birth to five years old.<sup>50</sup> These studies primarily focused on Spanish-speaking children between three and five years old, and they included studies on professional development, curricular programs, and supplemental instruction, not just those that specifically investigated the impact of language of instruction. The reviewers concluded that current research studies make it difficult to disentangle the effects of a certain curriculum or learning strategy from the effects of language of instruction.

Two recent experimental studies, included in the review, look at how bilingual education affects young students' language development. These two studies randomly assigned

preschool students to bilingual or English immersion classes and found that over the course of one year, preschool students in bilingual classes had better outcomes overall in Spanish and similar outcomes in English compared to their peers in English immersion classes. These studies specifically investigated receptive and expressive vocabulary, phonological awareness, and rhyming, and they found statistically significant gains in Spanish for the bilingual group. Combined with the finding that there were no overall significant differences in English achievement between the two groups, these results suggest that providing less instruction time in English didn't compromise students' English language development but did help the students retain their native language skills.<sup>51</sup> Notably, however, these experiments were based on small samples (150 students in one study and 31 in the other) and considered only short-run outcomes after one year of bilingual or English immersion education, so the results may not apply to other populations and longer-term impacts. In a longitudinal follow-up of the smaller experiment, researchers found that in second grade, overall performance in English among students in the bilingual program was still equal to that of students in the English immersion program.<sup>52</sup>

Going beyond assigning students to English-only or bilingual classrooms, another experiment looked at how bilingual supplemental-language instruction affected students' language development. In one randomized evaluation, 94 Spanish-speaking preschool students were assigned to one of three groups—a traditional curriculum control group; a group that received the traditional curriculum plus supplemental, small-group literacy instruction in English; or a group that received the traditional

curriculum plus supplemental, small-group literacy instruction using a transitional Spanish/English model. Students who received the supplemental instruction in either English alone or Spanish and English performed significantly better in emergent literacy skills in both languages than did those who received only the traditional curriculum. Moreover, those who received the transitional Spanish/English literacy supplement performed significantly better than the other two groups in emergent literacy skills in Spanish. Students in the transitional Spanish/English group also performed better in English in two areas (vocabulary and print knowledge); the researchers suggest that this finding may indicate some level of language transfer.<sup>53</sup>

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*The preschool evidence finds in favor of using bilingual education programs—with the caveat that the studies are relatively small and generally apply only to outcomes after one year.*

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In summary, studies of bilingual programs for preschool students find that students randomly assigned to a bilingual program perform equally well on tests of English achievement as their counterparts assigned to an English-only program, and in the case of one study, outperform their counterparts in some English literacy areas. Further, the preschool evaluations consistently find that students randomly assigned to bilingual programs outperform English-only program students on tests of Spanish achievement. Thus, the preschool evidence finds in favor

of using bilingual education programs. The caveats are that the studies are relatively small and generally apply only to outcomes after one year.

### **Language of Instruction for English Learners in Grades K–12**

More studies look at the effectiveness of bilingual education for grades K–12 than for younger children; however, they are much more likely to rely on observational data than on experimental or quasi-experimental strategies. Starting in the 1980s, a series of reviews and meta-analyses attempted to look at studies systematically and determine the effectiveness of bilingual education for grades K–12.<sup>54</sup> Again, the conclusions of these reviews range from the finding that bilingual education makes no difference in outcomes for English learners to the finding that bilingual education is an effective way to educate English learners. The differences depend on factors such as the types of studies that were deemed appropriate for review based on methodology, goals, and how bilingual education was defined; what outcomes the reviewers were seeking to examine (English proficiency, native language proficiency, or acquisition of content material); and how the reviewers defined effectiveness.<sup>55</sup> Some researchers deem a program to be effective if students in a bilingual program learned as much English as the students in an English immersion group and retained their native language. Others find a program to be effective only if the students in a bilingual program learned significantly more English than those in an English immersion program.

More recent meta-analyses have reached a similar range of conclusions. Two major reviews conducted in 2006 (one by the National Literacy Panel and the other by the

Center for Research on Education, Diversity and Excellence) concluded that teaching students to read in their first language promotes higher levels of reading achievement in English.<sup>56</sup> Similarly, a 2012 meta-analysis found that bilingual reading programs for elementary school students are more effective than English-only reading programs.<sup>57</sup> At the same time, the authors cautioned that many of the reviewed studies were short-term and that the researchers didn't assign students randomly to one group or another. For these reasons, the authors called for additional research using randomized designs to assess long-term outcomes. In contrast, another recent review that focused only on experimental and quasi-experimental studies was less optimistic about bilingual education; it concluded that bilingual education doesn't seem to be systematically better or worse for improving English proficiency.<sup>58</sup> Overall, then, studies that focus on children in grades K–12 suggest that bilingual education is at least as effective as English-only programs.

Randomized evaluations can allow us to make causal statements because they help ensure that differences in outcomes aren't driven by differences in which students receive which type of program. As we noted when we discussed preschool studies, few long-term randomized evaluations of bilingual instruction have been conducted. One exception is a recent evaluation of programs in six schools in different states that randomly assigned Spanish-dominant kindergarteners to either bilingual or English immersion programs. These students were then followed for up to four years. In all cases, reading instruction used the same curriculum either in English or Spanish. The study found that first-grade students in the bilingual classes had significantly higher

scores in Spanish and significantly worse scores in English than did students in English immersion classes. By fourth grade, all the students had transitioned to an English immersion classroom and no significant differences were found in English or Spanish, with the exception that students assigned to the bilingual class scored significantly higher on a Spanish comprehension measure. The authors concluded that all the fourth-grade students were fully bilingual, as measured by their scores on receptive vocabulary, and that language of instruction wasn't a factor in how their English proficiency grew—all the students made similar gains in English language skills (and perhaps decreased in Spanish skills) over time.<sup>59</sup>

Similar findings have been found in more recent quasi-experimental studies. These studies use a regression discontinuity design to evaluate the impact of bilingual education. Regression discontinuity exploits variation in treatment of English learner students generated by policy rules to compare students or programs just above or below a threshold that determines the type of program students receive. As a result, it generates more opportunities to study bilingual programs by using plausibly random variation that is already occurring “naturally,” thus adding to the information provided by the few studies that have randomly assigned students to different program types. For example, in one large urban district a researcher compared students in third through eighth grade who were just above and below the cutoff score in English language proficiency to be eligible for bilingual education. Students just below the cutoff score were eligible for bilingual education, while those just above the cutoff were not. The researcher found no significant differences in reading or

math achievement (in assessments given in English) between students based on their eligibility for the bilingual program.<sup>60</sup> One critique of this study is that it could assess the impact of bilingual education only on students at the margin of qualifying for bilingual education. Therefore, although bilingual education in this district might not affect reading and math achievement scores for marginal English learner students, it might help English learner students with very low levels of English proficiency. Further, the study couldn't assess impacts on native language achievement because it relied on administrative data consisting of reading and math achievement tests given in English.

Regression discontinuity has also been used to assess the rules used to determine whether students should be classified as English learners (and are therefore entitled to associated services) or assigned to mainstream English-language classes. A recent study used data from the Los Angeles Unified School District in this way to assess rules for assigning kindergarten students to English learner status and for reclassifying older students as English proficient.<sup>61</sup> In this case, a difference in outcomes for students at the margin of the test score cutoff was interpreted as evidence that the test score cutoff was set at the optimal level. The study's author concluded that we would see achievement gains if more kindergarten students were classified as English learners and if students were transferred to mainstream English-language classes at an earlier age. As with small experimental studies, however, the caveat is that these results apply specifically to the Los Angeles Unified School District and the English learner programs it offers. The findings don't necessarily apply outside California or even to other districts in the state.



Finally, regression discontinuity has been used to study what happens to both English learner and non-English learner students when English learner students are offered bilingual education. One study investigated bilingual education in the 261 school districts in Texas most likely to be affected by the state's bilingual education law. By law, Texas districts must offer bilingual education when they have 20 or more English learner students in a particular grade and language; if there are fewer than 20, the district may choose either bilingual education or ESL. Using regression discontinuity, researchers compared student outcomes in districts that were just above the 20-student cutoff (and therefore more likely to provide a bilingual program) to student outcomes in districts just below the cutoff. They found no significant differences on standardized test scores for English learner students in districts that were required to offer bilingual programs compared to districts that offered ESL programs. However, in districts required to provide bilingual education, native English speakers' standardized test scores were significantly higher.<sup>62</sup> Again, the study relied on district standardized tests given in English, and therefore the authors couldn't estimate impacts on achievement in the English learner students' native language—in this case, Spanish.

Overall, meta-analyses, randomized evaluations, and regression discontinuity studies find that bilingual education has neutral to positive effects on K–12 students' English language development. They also offer some evidence that rules for when to transfer English learners into mainstream classes may not be optimal and that bilingual education may have spillover effects on non-English learner students that often aren't taken into consideration.

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*English learner children may benefit at least as much from high-quality preschool programs as other children do, if not more so.*

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## **Classroom Quality**

Some researchers argue that classroom quality may be more important for young English learners' educational outcomes than language of instruction. Research has shown that participating in high-quality preschool programs has large benefits for all children, and the limited research that focuses on preschool quality and English learner children indicates that they may benefit at least as much from high-quality preschool programs as other children do, if not more so.<sup>63</sup> Of course, preschool-aged English learners likely need teachers who are trained to work with such students, so a high-quality preschool designed for non-English learner students probably isn't enough.<sup>64</sup> High-quality preschool teachers for English learners may need to understand language theory and pedagogy related to first and second language acquisition, be sensitive to the role that culture plays in language and overall development, and be able to foster positive peer relationships and parental engagement. Some researchers who investigate the effectiveness of bilingual education programs suggest that the varying quality of these programs may explain why bilingual education is not always more successful than English immersion.<sup>65</sup> One recent correlational study examined how classroom quality moderates the relationship between instructional language and child

outcomes. It found that the amount of Spanish instruction was positively correlated with children's outcomes in high-quality classrooms with more responsive and sensitive teachers, but negatively correlated with children's outcomes in low-quality classrooms.<sup>66</sup> (See the article in this issue by Robert Pianta, Jason Downer, and Bridget Hamre for more about teacher responsiveness and classroom quality).

What can teachers who work with young bilingual children do to improve instruction? Instruction in phonemic awareness has been found to help all children with early literacy development. As children's language skills grow stronger, recommendations for tailoring this instruction to English learners include providing more concentrated work on English phonemes or combinations of phonemes that don't exist in the students' native language.<sup>67</sup> Vocabulary, which is associated with reading comprehension, is also an important aspect of language instruction. Students whose native language isn't English typically enter school with a limited vocabulary of English words, in terms of both breadth (number) and depth of word knowledge (knowing many things about a word, such as its meaning and semantic associations).<sup>68</sup> Thus researchers recommend that teachers target depth of word knowledge when working with English learners and take advantage of students' first language in building vocabulary, especially if the language shares cognates with English.<sup>69</sup>

A recent review of research-based practices for young English learner students highlights five practices to help support English learner students in the classroom:<sup>70</sup>

1. Use frequent assessments in both a child's first and second language to adapt

instruction to the child's developing levels of language proficiency;

2. Use focused, small-group activities to give English learner children opportunities to respond to questions and receive more individualized instruction;
3. Provide explicit vocabulary instruction;
4. Use academic English in instruction to further develop academic English, and provide explicit opportunities to learn academic English such as the words for mathematical concepts; and
5. Promote socioemotional development by creating positive teacher-student relationships and facilitating peer interactions.

## Conclusions

As a whole, the research evidence is still inconclusive regarding the overall effectiveness of different forms of instruction for English learners. Which form of instruction is most effective is a challenging question to answer, even with the most rigorous research strategies. This uncertainty stems in part from the fact that researchers and policymakers don't share a consensus on the ultimate goal of education for English learners. Is the goal to help English learner students become truly bilingual or to help them become proficient in the English language? Evidence from meta-analyses, with the finding that teaching children to read in their native language improves reading achievement in English, leans in favor of bilingual education in the early years. However, the studies underlying these meta-analyses are generally non-experimental, and therefore the effects we see may be caused by factors other than the language of

instruction. Recent evidence from small, randomized evaluations at the preschool level suggests that English learners achieve about the same English proficiency whether they're placed in bilingual or English immersion programs. Furthermore, even if students enrolled in bilingual classes don't outperform their peers enrolled in non-bilingual classes in terms of English achievement, they do outperform their peers in Spanish-language achievement.

Beyond the question of whether bilingual programs do better than immersion programs at improving language proficiency for English learners, the optimal design of bilingual programs isn't clear. Which approach or combination of approaches is most effective in moving English learners to English proficiency? We don't know, for example, whether curricular or supplemental bilingual programs are most effective for student achievement. Nor are we certain how quickly students should be transitioned from bilingual to English immersion classrooms. Should students enter an English immersion program as soon as possible, or should they stay in a dual language classroom until they have a strong foundation in their native language (early- versus late-exit bilingual programs)? Other important issues to consider include the teacher workforce in various languages and the benefits and costs of bilingual education for non-English learner students.<sup>71</sup> Districts also need to keep in mind that bilingual education may be more costly than English immersion programs, may increase segregation, and may be infeasible for some schools and some languages.

Another source of uncertainty is that existing US research has largely focused

on Spanish-speaking students, because roughly three-quarters of public-school English learner students report Spanish as their home language. However, US immigration patterns have shifted in recent years, with more immigrants coming from Asia and fewer coming from Mexico.<sup>72</sup> Existing research on bilingual education may not apply to a growing population of English learner students from Asian countries. Thus, additional research that looks simply at the impact of "bilingual" education versus "immersion" isn't likely to offer school districts the kind of guidance they need to craft truly effective programs for English learners.

Meanwhile, several researchers have argued for greater attention to the quality rather than the language of instruction.<sup>73</sup> If a setting can offer a high-quality program with a bilingual teacher, then the research evidence suggests that at the least, students won't be harmed in terms of learning English, and they may be able to retain their native language skills. However, if districts can't provide a high-quality bilingual program, schools may be better off working to increase classroom quality generally or exploring supplemental bilingual programs rather than trying to ensure that students have access to a fully bilingual education. Overall, if the goal is to help English learners become proficient in English, then educators and policymakers must keep in mind that bilingual education is but one tool and that other factors also deserve attention, including the quality of instruction, supplemental programs, and the family and community environment that are critical for a young student's success.

## ENDNOTES

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# Supporting Young Children with Disabilities

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*Kathleen Hebbeler and Donna Spiker*

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## Summary

What do we know about young children with delays and disabilities, and how can we help them succeed in prekindergarten through third grade?

To begin with, Kathleen Hebbeler and Donna Spiker write, identifying children with delays and disabilities to receive specialized services under the Individuals with Disabilities Education Act poses several challenges. First, even though eligibility is based on 14 disability categories listed in the law, each state determines its own criteria for those conditions. Second, young children—especially those with disabilities—are hard to assess. Third, deciding where to draw the line for eligibility along a continuum of functioning is a matter of policy rather than science. In recent decades, the authors note, the concept of disability has been moving away from a medical model that sees disability as an impairment that resides in the child and toward a framework that emphasizes children’s functioning and interaction with their environments.

The authors review effective ways to support development and learning among young children with disabilities, including language and social skills interventions, preschool curricula, instructional and other practices, and multi-tiered systems of support. Then they examine a critical policy issue: the inclusion of young children with disabilities in regular education classrooms. One critical finding is that high-quality instruction in general education classrooms is a major factor in good educational outcomes for children with disabilities, and for their successful inclusion from preschool to third grade. Moreover, improving the quality of general education benefits all children, not just those with disabilities.

Hebbeler and Spiker also examine what we know about the transitions young children with disabilities make from one setting to another—for example, from prekindergarten to kindergarten. Here they conclude that we need far more research if we’re to understand what makes such transitions successful.

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**F**or nearly all children, the time between turning three and completing third grade involves adjusting to new environments. Some children go from preschool to kindergarten, and then on to first, second, and third grade. Others go to more than one preschool or child-care setting, or even change schools. Unfortunately, some young children in the United States still don't attend preschool at all, so their first major transition is from home to kindergarten. What happens in each of a child's environments, including the home, plays a critical role in what that child will know and be able to do by the end of third grade. This is especially true for children with developmental challenges—delayed development, atypical development, or physical impairments that limit their ability to experience the world around them. These children require specialized support to achieve their full potential. It's well established that children who receive such support early in life are more likely to do well later.<sup>1</sup>

This article focuses on children with delays and disabilities and the kinds of services and support these children need from preschool through third grade to experience good outcomes. We begin by discussing how young children with disabilities are identified, the challenges of identification, and a new framework for describing disability. We follow this with a summary of what is known about effective interventions to support development and learning in this population. The third section addresses a critical policy issue: the inclusion of young children with disabilities in regular education classrooms. The fourth section discusses what is known about supporting children as they transition from one setting

to another across the preschool to third grade span.

## **Identifying Children with Disabilities**

### **Children Served Under the Individuals with Disabilities Education Act**

Many US children with delays and disabilities receive specialized services under the Individuals with Disabilities Education Act (IDEA). This federal law was passed in 1975 and has been amended several times since. The 1986 amendments granted children aged three, four, and five the same rights the original law had given to school-age children with disabilities. These include the right to a free public education in the least restrictive environment appropriate to the child's needs. Each eligible child must have an Individualized Education Program (IEP). The IEP's required components include annual goals and a statement of the special education and related services the child will receive. To be eligible for special education, a child must have one of 14 disabilities identified in the law (see table 1), as well as an educational need that would benefit from special education.

In fall 2013, about 745,000 three- to five-year-old children, or 6.0 percent of US children in that age range, were receiving services under IDEA. By comparison, about 5.8 million children aged 6 through 21 were receiving IDEA services, representing 8.5 percent of that population. Among three- to five-year-olds, most were found eligible for special education services because of a primary disability of speech or language impairment, or a developmental delay. The next most common disability was autism. Among six- to nine-year-olds

**Table 1.** Primary Disability of Children Aged 3–5 and 6–9 Served under IDEA Part B by Disability Category, Fall 2013.

Disability Category	Percent of Total	
	Children 3–5	Children 6–9
Speech or language impairment	44.2	40.7
Developmental delay	37.1	7.8
Autism	8.4	9.2
Other health impairment	3.0	10.2
Intellectual disability	1.9	4.4
Hearing impairment	1.2	1.2
Specific learning disability	1.2	20.2
Multiple disabilities	1.1	1.6
Orthopedic impairment	0.9	0.9
Emotional disturbance	0.4	3.1
Visual impairment	0.4	0.4
Traumatic brain injury	0.2	0.3
Deaf-blindness	Not available	Not available

Source: Data from U.S. Department of Education, ED Facts Data Warehouse, IDEA Part B Child Count and Educational Environments Collection (2013–14). Data extracted as of July 3, 2014, from file specifications 002 and 089.

receiving IDEA services, the most frequent primary disability categories were speech or language impairment, specific learning disability, other health impairments, and autism.

These data conceal several challenges in identifying children for IDEA services. First, even though eligibility is based on the disability categories listed in the law, each state determines its own criteria for those conditions. For example, a state may use the developmental delay category with children older than five, but only 15 states do so through age nine.<sup>2</sup> As a result of such differences, we see striking variation across states in the percentage of children who receive services. In 2013, the share of preschoolers receiving special education ranged from a low of 3.6 percent in Texas to a high of 10.7 percent in Arkansas. Among

older children, the range runs from 6.2 percent in Hawaii to 11.5 percent in New Jersey.<sup>3</sup> No evidence suggests that these differences result from differences in the nature of these states' populations. Rather, they are the result of policy choices.

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*Young children—especially those with disabilities—are difficult to assess.*

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The second challenge in identifying children for IDEA services stems from the fact that young children—especially those with disabilities—are difficult to assess. However, assessment results are a major determinant of eligibility for IDEA services for children with the most

common disabilities. State eligibility criteria are based on quantitative measures, such as the extent of a child's developmental delay, that are derived from assessment tools. The level of precision required for an eligibility decision far exceeds the capabilities of current assessment tools, which renders the process scientifically indefensible. Furthermore, many tools used to assess children aren't consistent with practices recommended by professional organizations.<sup>4</sup>

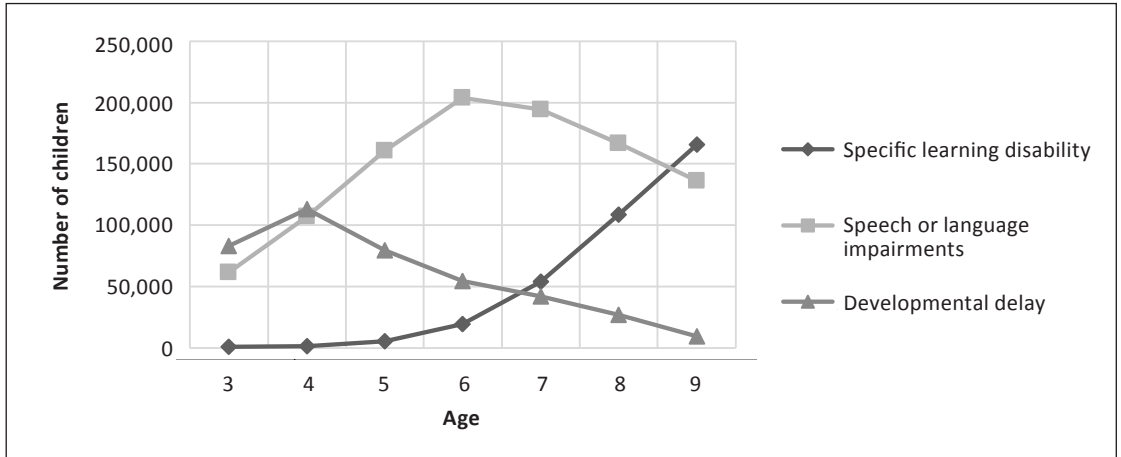
The question of who gets served is further complicated by the fact that disability and delay lie at one end of a continuum of functioning. Most of the continuum is considered typical development. At some point along that continuum, functioning falls so far below what's expected for a given age that a child's development is considered to be delayed or atypical. Deciding where to draw that line for eligibility purposes is a matter of policy, not science. The language skills of a child who scores slightly above the eligibility criteria differ very little from the skills of a child who scores slightly below them. Both children would likely benefit from intervention. But resources are limited, so the states must set criteria to determine who will and will not be served. The question is whether the criteria, as well as the way identification procedures are carried out, should be more equitable from state to state.

Identifying a learning disability by using the gap between a student's ability (as measured by an IQ test) and his or her achievement levels has been widely criticized as atheoretical, inconsistent, unfair, and costly.<sup>5</sup> Dissatisfied with that discrepancy model, many school districts have adopted a model called *multi-tiered systems of*

*support* (MTSS), in which intervention becomes more intense as students move through tiers of instruction. Students who don't make progress with high-quality instruction in a general education setting (tier 1) receive more intensive evidence-based interventions, either in small groups (tier 2) or individualized (tier 3). MTSS models rely on regularly monitoring student progress and using data to decide which students need additional support and special education. Such models, which have been used to identify and support students with learning disabilities and behavior problems, represent a promising approach for determining eligibility for special education among some subgroups of children with disabilities. We'll return to MTSS when we discuss interventions.

Interestingly, the number of children with different disabilities changes as children get older, as some are newly identified and others are considered to no longer have a disability. In fact, the proportion of children with different disabilities served under IDEA varies from one age to the next. The number of children receiving special education increases for each year of age between three and nine. In 2013, almost three times as many nine-year-olds as three-year-olds received special education (487,000 vs. 173,000).<sup>6</sup> Much of the increase occurs as more students are identified with learning disabilities across the early grades. The number begins to climb at age six and rises each year, as figure 1 shows. By contrast, the number of children with speech or language impairment peaks at age six and then decreases each year; at age nine it's surpassed by the number of children with learning disabilities. Finally, the number of children identified as having developmental delays drops continuously



**Figure 1.** Number of Children Served under IDEA by Age and Disability Category: 2013–14

Source: Data from U.S. Department of Education, ED Facts Data Warehouse, *IDEA Part B Child Count and Educational Environments Collection* (2013–14). Data extracted as of July 3, 2014, from file specifications 002 and 089.

between ages four and nine. However, some of this decline occurs because most states don't use developmental delay as an eligibility category for six- to nine-year-olds.

We could speculate that some children who are classified with speech and language delays in preschool are simply reclassified as having a learning disability in elementary school. A longitudinal descriptive study that followed children who received special education from preschool onward found that about 16 percent left special education each year. According to that study, the year-to-year decline in speech and language impairments reflects the fact that these children are no longer receiving special education.<sup>7</sup> A critical question is whether children who are identified as having a learning disability when they experience academic difficulty in early elementary school could have been identified and served earlier.

## ICF-CY: A New Approach

The identification of children for IDEA services follows a medical model that identifies and describes disability based on categories, such as deafness or intellectual disability. The categorical approach sees disability as a condition that resides in the child. It also masks the extreme variation within each category. Although disability lies at one end of a continuum of human functioning, we see large differences among children with the same diagnosis. These differences have significant implications for identification, service delivery, and research. Children with the same diagnosis can differ in many ways, for example in the severity of delays and functioning levels, rates of skill acquisition, health status and conditions, social and behavioral characteristics, and, ultimately, developmental and educational outcomes.

Over the past few decades, the concept of disability has moved away from a medical model and toward a framework that emphasizes an individual's functioning and

interaction with the environment, rather than impairment. The new approach adopts a social model of disability, recognizing that society—through policies and environmental adaptations—either facilitates or impedes the way individuals participate in daily activities. This framework is reflected in the World Health Organization's *International Classification of Functioning, Disability and Health—Children and Youth* (ICF-CY), a taxonomy for classifying functioning that focuses on the way health conditions interact with personal and environmental factors.<sup>8</sup> The ICF-CY overcomes many of the medical model's shortcomings by characterizing functioning along multiple dimensions. It also captures the extent to which a child's environment supports participation in daily activities. In this framework, disability doesn't reside in the child; rather, it's a function of the child and the child's environment.

Consider, for example, the experiences of two children who communicate by signing. One attends a child-care center where the caregivers sign; the other attends a center where they don't. Caregivers who sign provide the first child with the same learning and communication opportunities that spoken language provides to children who hear. The second child experiences a world with far fewer learning opportunities because no one can communicate with her. Or consider the contrasting experiences of two children who use wheelchairs. One lives in a single-story house with easy access to a backyard. The other lives in a second-floor apartment of a building with no elevator. Although these children may have exactly the same degree of hearing loss or motor impairment, their environments offer very different levels of access to learning opportunities.

Viewing disability in this way means examining the extent to which a child can or cannot participate with family members and peers in day-to-day activities at home, at preschool, and in the early primary grades. Environments that aren't adapted to meet children's level of functioning restrict their participation in everyday activities, thus impairing their ability to develop and learn. Missing opportunities to learn is especially harmful for young children because it limits their future ability to fully participate in everyday activities. For children with disabilities, a critical environmental factor that heavily influences their future participation is access to the specialized services they need to promote development and learning in their preschool years so they can succeed in elementary school.

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*Many aspects of the environments children experience are determined by policy choices.*

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The ICF-CY's emphasis on the role played by environment in childhood disability has significant policy implications related to prevention and intervention. Many aspects of the environments children experience are determined by policy choices. A horrific example of the relationship between policy and disability is the severe cognitive and social delays experienced by children placed in Romanian orphanages.<sup>9</sup> These children, who spent their early years in extremely deprived conditions, suffered permanent damage to their functioning as a result. In the United States, risk factors such as lack of prenatal care, environmental toxins, and toxic stress contribute to developmental

problems.<sup>10</sup> On the other hand, wheelchair ramps, assistive technology, and effective educational and therapy services are positive environmental features that can reduce the extent to which a limitation of body structure or function impairs a child's ability to develop and learn. The special education services provided under IDEA are a powerful example of a policy that has positively altered the day-to-day environments of children with disabilities. However, implementation challenges still exist, such as providing consistent access to quality services, securing sufficient funding, and achieving good outcomes for all recipients.<sup>11</sup>

We don't know how many US children would be identified with a disability using the ICF-CY or another more functional approach. One study, the 2005 Survey of Income and Program Participation, combined a medical and functional approach, defining disability for three- to five-year-olds in three ways: as developmental delay; as difficulty walking, running, or playing; or as difficulty moving arms or legs. The study found that, according to parents' reports, these characteristics applied to 3.8 percent of the population. For six- to 12-year olds, the definition was expanded to include more categories (for example, autism and cerebral palsy), producing an estimate of 12.8 percent for this age group. In 2008–09, the National Health Interview Survey asked parents about both limitations (such as whether their children needed help bathing or showering) and diagnostic categories, yielding an estimate that 4.7 percent of children under six and 9.5 percent of children aged six to 11 had disabilities.<sup>12</sup>

In addition to its implications for identifying children with disabilities and delivering services to them, the ICF-CY can also help guide research on the development and learning of children with disabilities. Research based on categorical designations (such as cerebral palsy, spina bifida, or learning disability) is likely to continue, but researchers also need to describe children's functioning across multiple dimensions to more clearly communicate which children are covered by the findings. Intervention researchers in particular need richer descriptions of their subjects—using a perspective derived from ICF-CY—to make their findings easier to generalize to a broader population and translate into practice.

## **Effective Interventions**

The field of research into how effectively interventions support the learning and development of young children with disabilities goes back 60 years. In fact, many of today's interventions have their roots in model demonstration projects funded in the 1960s. Although our knowledge about which practices are effective continues to grow, much remains to be done. Given the diverse needs of children with disabilities, it's not surprising that many studies have found that specific interventions or services can achieve specific outcomes for specific subgroups of children. For example, physical therapy can help children with motor delays, while applied behavior analysis can help children with autism. But we don't know whether some of these practices can be effective for other outcomes or other subgroups.

It's difficult to conduct research on the effectiveness of various interventions for children with disabilities. One challenge

is the fact that all children are entitled by law to individually determined services, which eliminates the possibility of random assignment and the creation of a control group that receives no treatment. Other challenges include the extreme heterogeneity of the population, even among children categorized as having the same disability; assessment tools that haven't been validated for use with children with disabilities; and the recruitment of sufficiently large samples for studies of low-incidence disabilities.

Even studies with random assignment that use a treatment-as-usual control group are logistically difficult to fully implement, because knowledgeable parents often seek potentially beneficial treatments, and researchers can't control this.<sup>13</sup> To tackle some of these challenges, research in special education often uses single-case designs to examine how interventions affect children's learning and behaviors. These single-case designs have been widely used with applied behavior analysis (which we describe later). They provide strong evidence when comparable results are found across children in one single-case study or from multiple single-case studies of an intervention with different types of children or in different settings.<sup>14</sup>

It wouldn't be possible for this article to cover the entire body of knowledge on effective practices and programs for children with disabilities. Instead, we've elected to highlight several research areas to illustrate the types of studies conducted by researchers on promoting positive social and academic outcomes for children with disabilities in preschool and the early elementary grades.

## Foundational Role of Applied Behavior Analysis

From the 1960s to the 1980s, many studies examined whether behavior modification or stimulus-response approaches, also known as *applied behavior analysis* (ABA), could affect specific behaviors displayed by children with disabilities. Studies have shown that ABA techniques, which use reinforcement principles and stimulus-response models of learning, can help establish desired behaviors as well as consolidate and generalize them.<sup>15</sup> Most ABA studies have been highly controlled investigations of specific practices, rather than evaluations of a type of service or a program, often using rigorous single-case designs.

Early studies focused on discrete behaviors because, at the time, most researchers believed that children with disabilities couldn't learn many of the skills that typically developing children master, such as reading. Further research showed this belief to be wrong. Those early ABA studies examined atypical behaviors that interfered with children's ability to learn typical skills—for example, self-stimulation behaviors or lack of interest in others. But other researchers and practitioners criticized the interventions for focusing on isolated skills that didn't generalize to everyday situations or weren't particularly useful for helping children function in everyday settings.

As a result of this criticism—and consistent with the functional views of disability that we described earlier—more recent ABA research has focused on teaching meaningful behaviors. For

example, a method called *pivotal response training* emphasizes a child's motivation to learn by explicitly teaching attention and self-regulation behaviors that help them "learn to learn." These behaviors include initiating and maintaining social interactions, attending to the same thing at the same time with another person (for example, looking at a toy together), and responding to multiple cues. Many ABA studies focus on a single type of disability, most commonly autism or intellectual disability, although some focus on a specific curriculum. The next sections highlight how ABA practices, along with research on child development, underlie much of the research on interventions for young children with disabilities.

### Language and Social Skills Interventions

Many young children with disabilities struggle with language and communication. Poor language development is especially problematic because language skills are the foundation for learning to read and for successful interactions with peers. Researchers examining practices and strategies to promote communication skills have focused on teaching children sounds, words, and so on, often using ABA methods. Interventions have emphasized improving the quantity and quality of language input based on what we know about language development in typical children. Practices that support highly responsive and functional conversations in natural contexts, with both peers and adults, have been shown to promote children's communication and cognitive skills.<sup>16</sup> Many studies have been conducted on these practices; some have

had single-case designs, but randomized controlled trials (RCTs) have been limited.

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Likewise, children with disabilities often have trouble interacting competently with peers and adults—the important social partners from whom they learn skills and with whom they must connect to fully participate in everyday settings. *Social skills training* uses behavioral approaches to teach children age-appropriate social competencies such as communication, problem-solving, decision-making, self-management, and relating to peers. A review of 23 studies involving three- to five-year-olds with disabilities showed that social skills interventions can increase positive social interactions and reduce problem behaviors.<sup>17</sup> This review included studies with multiple- and single-group designs, some of which used quasi-experimental methods, but none were RCTs.

Social skills training can take place in both regular and special education classrooms, and a variety of approaches have been developed. For example, teachers may use a structured approach to explain to students how to perform a desired behavior, giving examples and reinforcing targeted behaviors through questions, answers, and other feedback. In a more nuanced approach, often referred to as *incidental teaching*,



teachers respond to students' own utterances, interactions, and behaviors to encourage the desired social skills (for example, by rewarding positive play).

Limited but promising research backs *peer-directed interventions*, which use peers in natural settings as the primary interventionists to promote social communication in children with disabilities.<sup>18</sup> Typically developing peers who have learned strategies to promote social communication interactions are paired with children with disabilities during play. In some interventions, peers learn strategies to increase interactions, engagement, and communication (such as making requests, paying attention to others, and taking turns).

## Preschool Curricula

Few curricula have been developed specifically for young children with disabilities. One curriculum with evidence of effectiveness from an RCT is Teaching Early Language and Literacy (TELL). This approach involves a set of instructional sequences, scripted teaching activities, and materials for activities to build oral language and early literacy.<sup>19</sup> The Incredible Years curriculum—which focuses on acquiring social skills and reducing behavior problems, positive parenting, and improved classroom management for students in preschool through early elementary school—has a strong research base, including RCTs.<sup>20</sup> The Incredible Years training programs for children, parents, and teachers can be used independently or in combination. Supported by professional development materials to train teachers, therapists, and parents, Incredible Years has been used

successfully in classrooms, clinical settings, and parent groups.

Interestingly, preschool curricula created for typically developing children have not been well studied to see whether they're effective for children with disabilities. Because so many children with disabilities attend regular preschools, this is an important area for future research.

## Instructional Practices

What constitutes high-quality instruction for children with disabilities? Research has identified a number of components.<sup>21</sup> During the preschool years, one important goal is to promote early literacy—oral language, phonological awareness, print awareness, and letter knowledge. These skills are the foundation for later instruction in formal literacy and reading. Practices that support early literacy for typically developing children apply equally well to young children with disabilities—reading books, for example, and teacher-child interactions that focus on asking questions and making predictions to facilitate language development.<sup>22</sup>

However, for children with disabilities to generalize the skills they learn and maintain them over time, they often need instructional practices that are more intense or longer in duration than those that work for typically developing children.<sup>23</sup> Unfortunately, researchers have mainly examined children who receive language and communication interventions delivered by specialists, either in clinics or in small groups within classrooms. We need to know whether teachers can feasibly and effectively implement these same interventions in classroom settings. We also need more research about the appropriate

balance between child-directed and teacher-directed activities—that is, activities in which teachers impart specific literacy skills that children then practice with their peers in play and during other developmentally appropriate classroom activities throughout the day.<sup>24</sup>

We also have good evidence of effectiveness for *naturalistic instruction*, in which teachers use naturally occurring settings and activities as the context for teaching interactions. We've seen that this approach can help children learn new social, language, motor, self-help, and pre-academic skills, but no studies have used RCTs.<sup>25</sup> An example is *embedded instruction*—an activity-based intervention that occurs during everyday activities such as play or routines such as feeding, bathing, or dressing. Adults deliberately arrange the environment and materials to support a child's development and elaborate on child-initiated behaviors to build a child's skills.

### Practices Recommended by the Division for Early Childhood

To support the use of evidence-based practices in the field, the Division for Early Childhood of the Council for Exceptional Children—an international organization for those working with and on behalf of young children with disabilities—has identified 66 recommended practices for people who work with young children with disabilities and their families.<sup>26</sup> These practices reflect the best available empirical evidence as well as the consensus of professionals in the field in eight areas—seven for practitioners and one for program leaders.

For practitioners, the recommendations cover assessment, environment, families, instruction, interaction, collaboration,

and teaming (regular communication and interactions among practitioners from multiple disciplines). The practices encompass the most effective ways to improve learning outcomes and promote the development of young children (aged zero to five) who have or are at risk for delays and disabilities. The recommendations build on developmentally appropriate practices that are recognized within the early childhood special education community as necessary but not sufficient for children who are experiencing developmental challenges.<sup>27</sup> These recommended practices are not specific to a particular disability and can be delivered in all settings, including general early childhood programs.

### Multi-Tiered Systems of Support

As we've said, over the past decade school systems have been moving toward multi-tiered systems of support for children who face learning and behavioral challenges, including children with disabilities. MTSS, also known as *response to intervention*, has no single definition, but most descriptions share the components we described earlier: tiers of instruction, with intervention becoming more intense as students move up the tiers; high-quality instruction in general education settings; continuous measurement of students' learning and progress; a set of data-based decision rules to identify which students need intervention, and at which level; individualized evidence-based interventions; and consideration of special education services for students who don't make sufficient progress.<sup>28</sup>

The Division for Early Childhood, the National Association for the Education of Young Children, and the National Head Start Association have jointly described



the four core features of a response to intervention approach in early childhood as: multi-tiered systems of teaching and caregiving practices; a high-quality curriculum; ongoing assessment and monitoring; and collaborative problem-solving among team members.<sup>29</sup>

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### *The MTSS approach recognizes that poor teaching can contribute to a child's learning problems.*

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At each tier, evidence-based approaches are central to effectiveness. For example, Tier 1 in an MTSS approach—the general education classroom—uses evidence-based curricula that give all children the chance to succeed with good instruction. When monitoring shows that children aren't succeeding, tier 2 methods are brought in, such as more frequent or longer instruction, learning in smaller groups, or instructors with more specialized expertise.<sup>30</sup> The MTSS approach recognizes that poor teaching can contribute to a child's learning problems; its emphasis on high-quality instruction in the general education classroom as part of an identification framework is consistent with the functional approach to disability. Some researchers believe that the MTSS approach may ultimately influence how many children are identified for IDEA services, and may also change the nature, placement, intensity, and timing of the services they receive.<sup>31</sup>

Emerging evidence shows that the MTSS approach improves academic and behavioral outcomes. But we need more research, especially about how districts

are implementing MTSS. Some studies show that in kindergarten through third grade, interventions with a multi-tiered framework can help struggling readers improve.<sup>32</sup> Other studies—of entire school districts that have successfully implemented MTSS models—report improved academic achievement in reading, math, and language arts.<sup>33</sup>

However, a more recent national study that used a regression discontinuity design—a research design that takes advantage of the fact that students who fall just below the cutoff score on a screening test receive services, while those just above the cutoff don't—failed to show positive impacts on reading in the early elementary grades.<sup>34</sup>

One MTSS model with strong evidence of effectiveness, including evidence from RCTs, is called Positive Behavioral Interventions and Supports (PBIS).<sup>35</sup> Designed for kindergarten through 12th grade, PBIS uses school-wide problem-solving models to discourage inappropriate behavior by teaching and reinforcing appropriate behaviors. PBIS has been shown to reduce behavior problems, improve social skills, and improve the school climate—that is, the subjective experience of a school that includes norms, values, and expectations that help children and adults feel socially, emotionally, and physically safe. Taken together, these factors allow for more and better opportunities for high-quality academic instruction.<sup>36</sup> With PBIS, a range of interventions are systematically applied based on the students' demonstrated level of need. The program explicitly addresses the environment's role in the development and improvement of social and behavior problems. PBIS is also being combined with school-wide literacy interventions;

recent research on PBIS is focusing on how to sustain school-wide positive behavioral interventions and supports.<sup>37</sup>

Early childhood programs, too, are increasingly using multi-tiered approaches.<sup>38</sup> The expansion of MTSS among younger children isn't driven by the desire to better identify students with learning disabilities, as it is with the school-age population. Rather, multi-tiered models are promoted as a way to meet preschool children's diverse needs, especially given the current emphasis on including young children with disabilities in regular early childhood programs (a topic we discuss in the next section).

One MTSS approach for early childhood is called the Pyramid Model. A collection of evidence-based practices to increase social-emotional skills and decrease challenging behaviors in preschool classrooms, it uses three tiers of increasingly intensive interventions.<sup>39</sup> The practices were identified by systematically reviewing the research on prevention and intervention practices that led to positive social-emotional outcomes and fewer challenging behaviors in young children, both with and without disabilities. In the community preschool programs where it has been implemented, the model has been found to increase children's pro-social behaviors and to reduce behavior problems in a study that used a single-case design.<sup>40</sup>

Research has also shown that teachers can be coached to implement the Pyramid Model with fidelity. The model's developers have reported positive social and behavioral outcomes in children from one RCT, but they admit that more RCTs are needed. They also acknowledge that we should learn more about the types of professional

development and other factors that can help to effectively implement and sustain the model.<sup>41</sup>

In general, although multi-tiered models have shown positive effects, we need more research to guide their implementation in early childhood.<sup>42</sup> Indeed, all the features of MTSS in early childhood need more study. For example, what are the best approaches for universal screening and for monitoring progress? Which decision-making models best identify the children most likely to benefit from more-intensive interventions? And how should we set the hierarchy of more-intensive and supplemental instructional techniques for children who don't make good progress with the less-intensive approaches?<sup>43</sup>

## **Including Children with Disabilities**

The drive to educate children with disabilities alongside typically developing children has been one of the most remarkable changes in preschool programs and the early elementary grades over the past several decades. This progress has been achieved by parent advocacy and the legislative requirement that children with disabilities must be educated in the least restrictive environment. Opening the doors of general education classrooms gives children with disabilities access to the general early childhood or elementary curriculum, typical peers, and more of the typical activities available to other children. The practice thus holds a promise of better academic and social outcomes. Inclusion, by focusing on full participation and the necessary supports to allow that participation, is also consistent with the ICF view of disability.

In 2013, however, despite IDEA's longstanding mandate for placement in

the least restrictive environment, more than one-third of preschool children with disabilities (34.2 percent) spent no time in a general early childhood program. Instead, they received their special education services in a separate class or other setting.<sup>44</sup> Recently, the US Department of Education and the Department of Health and Human Services released a set of recommendations reaffirming the importance of including young children with disabilities in high-quality early childhood programs alongside their typically developing peers.<sup>45</sup>

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*Inclusion is more than placement. It must give young children with disabilities a sense of belonging and membership, and access to positive social relationships—as well as development and learning.*

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But inclusion is more than that. A joint position statement from the Division for Early Childhood and the National Association for the Education of Young Children defines three components of inclusion: access—that is, a wide range of typical environments and the use of universal design to support full access; participation, including methods that support and promote children's full participation, such as embedded instructional approaches; and supports—infrastructure to support staff, such as appropriate professional-development opportunities and specialized services in the setting.<sup>46</sup> According to that position

statement, inclusion is more than placement. It must give young children with disabilities a sense of belonging and membership, and access to positive social relationships—as well as development and learning.

Beginning in the 1980s, experimental preschool programs demonstrated that children with disabilities could learn alongside typically developing peers while both groups made good progress. That finding has since been replicated in many other studies.<sup>47</sup> A review of 22 studies conducted by the 1990s found that preschool-age children with disabilities who are served in inclusive rather than segregated settings have better outcomes on standard measures of development, social competence, play behavior, and engagement.<sup>48</sup> Of the 22 studies reviewed, 18 used group designs but only six used RCTs.

A more recent research synthesis concluded that children in inclusive classrooms need specialized instruction to achieve good child outcomes. It also found that families of children with disabilities generally view inclusion favorably, although some of them worry about the quality of early childhood programs and services; that early childhood professionals may not be adequately prepared to serve young children with disabilities enrolled in inclusive programs; and that a variety of factors—such as policies, resources, and beliefs—influence whether inclusion is accepted and how well it's implemented.<sup>49</sup>

We know little about what happens to children with disabilities who have experienced inclusive programming in preschool after they enter kindergarten.

One small study that began following such children in kindergarten found that after five years, only 60 percent of them remained in some form of inclusive placement.<sup>50</sup> Another study found that a significant number of children with mild developmental delays who had been fully included in preschool and kindergarten were not in an inclusive placement by first and second grade.<sup>51</sup>

Many factors influence the success of inclusion in the early grades. Are paraprofessionals or aides available to work with the child? Does the child's family advocate for inclusive placement? Do the teachers have the appropriate knowledge and attitude about serving children with disabilities? Moreover, at the elementary level, it's easier and more common to include children with milder disabilities in general education classrooms than children with more significant disabilities.<sup>52</sup> Clearly, we need more research on promoting successful inclusion. Because principals play an important role in supporting inclusive programming in elementary schools, training in special education should be part of their higher education preparation and professional development.<sup>53</sup>

## **Making Transitions**

For young children with disabilities and their families, transitions can be challenging. If a child's disabilities are identified before age three, the family will face moving the child from an infant-toddler program to a preschool program. The shift from mainly home-based services to a group preschool setting will require the child to have certain social, behavioral, and communication skills to meet the demands of the new setting. For many families the transition occurs relatively

quickly, as children are often identified for early intervention (services from birth to age three) only after 15 months of age.<sup>54</sup> For children who receive special education services in preschool, the next transition is to kindergarten, with an accompanying shift to higher academic expectations. Interestingly, IDEA regulations have requirements that cover the transition from early intervention to preschool, but none covering the transition to kindergarten.

That transition is widely recognized as a major life experience for young children. In response, schools have increasingly implemented practices to support successful transition.<sup>55</sup> A national study of preschool special education recipients found that on average kindergarten teachers used 5.4 different transition practices. The same study showed that special education teachers provided more support than regular education teachers. More than 80 percent of kindergarten teachers reported that they received children's records and other information from the children's preschool programs, and that their schools encouraged parents and guardians to meet the child's new teachers. Smaller districts, wealthier districts, and suburban and rural districts offered more support than larger, poorer, and urban districts. Parents and teachers alike reported that when the school took steps to facilitate the transition, the process was easier for children. Overall, 16 percent of parents said that the transition to kindergarten was somewhat or very hard for their child. But that figure was as high as 51 percent for children whose primary disability was emotional disturbance.<sup>56</sup>

We need far more research on the factors that lead to successful transitions for young children with disabilities. We also need to

refine the definition of what constitutes a successful transition.<sup>57</sup> Until now, research has focused on the transition from preschool to kindergarten, and mostly looked at transitions for typically developing children. Young children with disabilities don't just make major life transitions, going from early intervention to preschool and from preschool to kindergarten. Many also make smaller transitions daily or several times a week—for example, when they go from a preschool in the morning to a child-care home in the afternoon. This complexity has led to calls for more research about the best ways to smooth these transitions and improve transition policies and practices.<sup>58</sup> Support for transitions is another example of how environmental factors can mitigate the impact of a child's developmental challenges.

## Conclusions

Recent developments—such as the renewed emphasis on inclusion and multi-tiered support systems to provide specialized intervention to all children who are struggling—are blurring the distinction between regular and special education.<sup>59</sup> High-quality instruction in general education classrooms, the first tier in an MTSS, is a major factor in good educational outcomes for children with disabilities, and for their successful inclusion from preschool to third grade. Efforts to improve the quality of general education, such as statewide quality rating and improvement systems and various K–3 educational reform initiatives, will benefit all children, including those with disabilities. Creating environments that support social development and help children learn new skills both remediates

and prevents learning and behavior problems.

Providing high-quality learning environments is consistent with the newer concept of disability, which emphasizes functioning and sees disability as the interaction between the individual and the environment. Educational environments from preschool to third grade aren't neutral factors when it comes to existing and emerging disabilities. These environments contribute positively or negatively to the way children will function—and even, for some children, to whether they are considered disabled at all.

The past 50 years have seen substantial research on effective instruction and interventions for young children with disabilities. We still have much to learn, of course, especially with regard to what works best, and for whom. We need to ensure that preschools and classrooms around the country use evidence-based practices. Implementation science provides a framework for improving the quality of tier 1 environments, and also for increasing the frequency and fidelity with which evidence-based practices are implemented.<sup>60</sup>

We also need comprehensive approaches to professional development that are coordinated with the general education community. More effective general education and special education teachers will allow children with disabilities to receive the individualized services that IDEA requires, and will benefit all children. New models of teacher training, both preservice and professional development, will require more collaboration across general and special

education, as well as supportive leadership. If all children are to reap the benefits of effective teaching, professional development needs to be seen as an essential feature of schools' organizational systems. Professional development must support such innovative approaches as co-teaching, coaching, consultation models, professional learning communities, and communities of practice. It must also encourage new ways of teaching, of classroom staffing, and of classroom organization.

Finally, teachers and other staff need support in their efforts to truly individualize instruction for all children, including those with disabilities and learning or behavioral challenges. Appropriate education for children with disabilities is not just an issue of where they are, but also of what is happening to them. Effective educational practices from preschool through third grade are essential to the full participation of children with disabilities—now and in the future.



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# Parent Programs in Pre-K through Third Grade

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*Katherine Magnuson and Holly S. Schindler*

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## **Summary**

Parents strongly influence their children’s development, and prekindergarten and early elementary programs—especially those serving children at risk for low achievement because of their family backgrounds—often feature programming to support parents’ role in their children’s learning. Despite the prevalence of such programs, however, we have little good evidence of their effectiveness. In this article, Katherine Magnuson and Holly Schindler review more promising, fully developed parent “add-on” programs.

In their daily work, preschool and elementary school programs and teachers commonly use a variety of formal and informal activities to support, educate, and involve parents, such as having parents volunteer in the classroom or encouraging children to share classwork or other materials with their parents. Though such practices are widespread, the authors write, we have little rigorous evidence to show that they’re associated with children’s academic success.

“Add-on” parenting programs, in contrast, generally target a particular subset of parents, and they often have a highly specific and clearly developed programmatic approach. Such programs focus on helping parents improve either their children’s early academic skills or their behavior and self-regulation. Among the types of parent support that Magnuson and Schindler review, add-on programs have shown the most promise to improve children’s learning. But parents with many demands on their time may find it hard to sustain a commitment to these programs; technological solutions such as communication by text messaging may be one way to solve this problem.

A final way to involve parents is to give them information about the quality of their prekindergarten or elementary school choices, although such information may not be particularly useful to parents who live near a set of similarly high-performing or low-performing schools, or can’t access programs because of limited enrollments or cost.

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**B**ecause young children spend so much of their time in their parents' care, parents are often described as children's first teachers. Parents' verbal interactions, responsiveness, and stimulation all help to develop their children's early skills and to prepare them to learn in formal settings. However, parents differ in the quantity and quality of their interactions with their children and the degree to which they provide enriching experiences, both of which are important in understanding socioeconomic gaps in children's academic achievement.<sup>1</sup> Thus early learning and educational settings—especially those serving children at risk for low achievement because of their family backgrounds—often feature programming to support parents' role in their children's learning.

Despite the prevalence of parent-related services, practices, and programmatic components in early learning and elementary school, we have little good evidence of their effectiveness. In this review, we discuss why preschools and elementary schools often target parents in their efforts to improve students' learning, and we critically review evaluations of several types of parenting programs for parents of prekindergarten through third-grade children. However, we don't examine more general efforts to involve parents in school activities, school decision-making, and leadership, and to build school-family partnerships.

## **Why Target Parents?**

Parenting behaviors that are consistently warm, responsive, and cognitively stimulating promote children's cognitive and behavioral development, providing a strong foundation for learning in schools.<sup>2</sup> Volumes of research

link children's experiences with their caregivers—and in their home environments more generally—to their early language, literacy, math, social, and behavioral development. However, because many other factors might explain these associations, it's hard to claim that the links between the quality of parent-child interactions and children's early skills and behavior constitute a causal chain.<sup>3</sup> But even if parenting practices and parent-child interactions aren't the only (or even the most) important factor in explaining children's early skills, parenting practices and parent-child interactions likely affect children's school readiness, academic success, and behavior.<sup>4</sup> Convincing evidence comes from studies of twins that try to separate the effects of parenting from the effects of shared genetic factors, as well as from experimental studies showing that if you change the nature or frequency of a specific set of well-defined parenting behaviors, children will gain more of the targeted skills.<sup>5</sup>

Preschool and elementary school parent programs seek to enlist parents to support their children's growth and learning in a way that's congruent with the classroom's instructional content and methods. To achieve these goals, programs take many approaches. They often focus on teaching parents about how they can support their children's learning and on promoting a particular parenting behavior, such as reading books with their children. Nearly all programs strive to communicate effectively with parents, because to support learning, parents must first know which sets of their children's skills are developing, including what areas need more work. Parents also need general information about developmental opportunities and challenges. If parents know more about developmental goals, it's easier to help them embed

learning opportunities in daily routines and use positive parenting strategies. Parents might introduce a new behavior (such as shared book reading or using a quiet space at home), embed learning in daily activities (for example, identifying letters in print, counting, or encouraging independence in self-care), or develop a more general pattern of interactions (for example, holding longer and more complex conversations or praising positive behaviors more often).

Despite these common features, preschool through third-grade programs work with parents in many different ways. Often, they embed parent education, involvement, or support in their educational programs, but not as a neatly packaged component. Another approach is to offer a clearly defined parenting program that focuses on specific skills to support children's early academics or behavior. Yet another is to give parents information about the preschools and elementary schools among which they can choose.

We'll discuss each of these approaches in this article. However, we won't cover several types of related evidence, because the studies available don't directly answer questions about the effectiveness of parent-directed interventions added to prekindergarten through third grade. First, we exclude stand-alone parent programs. Such programs may be designed to improve children's skills or behavior, but they aren't embedded or delivered in early learning programs or schools. Second, we don't discuss programs developed specifically for parents of children who have special needs or receive special education services. Third, we don't review programs designed specifically for one gender of parents, such as fathers; in any case, these are frequently also stand-alone

rather than school-based programs. Fourth, we don't review two-generation programs that try to build both children's and parents' human capital at the same time, in part because Lindsay Chase-Lansdale and Jeanne Brooks-Gunn reviewed them in the Spring 2014 issue of *Future of Children*, and in part because evaluations of such programs have yet to be completed.<sup>6</sup> Finally, we don't review school transition programs, which typically include parenting outreach or involvement as part of a larger effort to improve children's transition to kindergarten.<sup>7</sup>

## **Do Parent Programs Make a Difference?**

Teachers and schools often conduct a variety of formal and informal activities to support, educate, and involve parents. Formal practices include, for example, having parents volunteer in the classroom, one-time parent workshops, occasional teacher home visits, regular discussion sessions, and regular parent-teacher conferences. More informally, teachers may encourage children to share classwork or other materials with their parents, and they may tell parents what children are learning or how positive behavior is being supported in the classroom. Teachers may also send home educational materials to be used in the home, such as a book with suggestions about how parents can extend their children's reading to other learning opportunities.

Though working with parents in these settings is common, we have little rigorous evidence to show that children achieve more academic success when educational programs include practices intended to engage and support parents. It may be that it's not easy to estimate the added value these programs provide for children, given that it's hard to



isolate the impacts of parent activities from those of a broader program. Recently, two sets of reviewers looked systematically across many evaluation studies to compare early childhood programs with and without parenting activities. One review found that any services added to preschool programs (including not only parenting programs but also other forms of social service supports) were associated with significantly smaller effects on children's cognitive development than the effects of the preschool services alone.<sup>8</sup> This finding raises questions about the effectiveness of such added services, although in general, all the programs had a positive impact on children's cognitive and academic outcomes. A second analysis across early childhood education programs looked only at the provision of parenting education programs that sought to directly improve parent-child interactions.<sup>9</sup> This analysis found no differences in effects on short-term measures of children's cognitive or pre-academic skills between preschool programs that did and didn't provide programming and education for parents. But again, all the broader programs effectively boosted children's outcomes. No similar review has looked at elementary school-age children.

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*We have little rigorous evidence to show that children achieve more academic success when educational programs include practices intended to engage and support parents.*

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These analyses provide a clear takeaway: adding any type of parent-related support, service, or practice won't necessarily yield a more effective early learning program as measured by children's academic outcomes. But such broad conclusions have limitations. First, the parenting components of early childhood programs are often ancillary services that may be insufficiently developed or poorly implemented, with little attention paid to identifying key goals or training staff to support those goals. Second, diversity of parenting activities also makes it difficult to interpret their combined effect on a broad set of outcomes, because goals and intent may be quite different from program to program.

Another approach to understanding the role of parenting practices is to study a population of children attending a particular educational program and see whether adding a parent component for some subset of these children improves their outcomes relative to business as usual. In the following sections, we examine the evidence for such add-on parenting programs, distinguishing between programs that focus primarily on children's early academic skills, such as language, literacy, numeracy, and basic concepts, and those that focus on behavior or self-regulation. These programs often have a highly specific and clearly developed programmatic approach compared to the parent-related practices or general support activities found in most pre-K-3 settings. Studies often focus on demonstration programs, which typically have their own funding sources and are implemented in settings with the staffing and commitment to deliver the programs as intended. Although relatively few studies offer empirical evidence for

such programs, these types of approaches have demonstrated the most promise to improve children's learning.

### **Add-On Programs: Language, Literacy, and Reading**

Language and literacy skills have received considerable attention in early learning, and numerous parenting programs have focused on them. Because early language plays a pivotal role in acquiring later reading skills, some programs aim to foster parenting practices that promote children's early language. The key idea is that parents don't fully understand how to engage their children in rich language interactions that will promote early language skills. Specifically, these programs teach parents not only to talk more with their children, but also to use a wide and varied vocabulary, complex grammatical structures, and language for analytic purposes. They also encourage parents to ask their children questions and promote rich language interactions by embedding conversations in daily routines, and in some cases to specifically teach children about language (for example, by playing rhyming word games or identifying letters and sounds in words).

One focus of literacy programs has been to promote interactive or dialogic reading—regular book reading in which parents ask their children to think about and discuss aspects of the story and to interact with the text rather than passively listen. Reading to children promotes comprehension, while engaging them in conversation promotes children's ability to express themselves. This type of interactive book reading for preschool children is most effective when both parents and teachers do it, rather than just teachers alone. Individual attention from parents

during book reading may be an especially good way to engage children in reading.<sup>10</sup>

Several variations on parent-child dialogic reading programs have been evaluated.<sup>11</sup> For example, Raising a Reader, a classroom interactive reading program with a parenting component, included a series of five "family nights" in which parents were instructed in shared reading techniques and given time to practice the approach, as well as to share a meal with other families.<sup>12</sup> Compared to a Raising a Reader program that didn't have family nights, the parenting components were associated with small improvements in spoken language skills and print knowledge (for readers familiar with statistical analysis, the effect sizes ranged from 0.11 to 0.15), but not in more advanced skills like word reading. Because the improved outcomes came in areas that were directly involved in the intervention, the close alignment between the intervention activities and the pattern of results isn't unexpected. However, such programs are often designed with the hope of affecting a wider set of skills. These findings suggest that it may be quite hard to create programs that increase broader school success.

A comprehensive review of programs for early elementary school children who are learning to read found that on average, programs that explicitly promoted parents' role in supporting their children's reading acquisition from kindergarten to third grade had a moderately large effect on children's outcomes compared to children whose parents didn't have the opportunity to participate in such a program.<sup>13</sup> Programs that trained parents to serve as tutors had the largest effect (weighted effect size of 1.15). Programs that focused on having children read to their parents demonstrated

moderate effects (weighted effect size of 0.52), while programs that aimed to increase parents' reading to their children had only small effects (weighted effect size of .18). These findings indicate that add-on literacy programs that encourage parents to support their children's literacy learning can successfully boost certain reading practices and children's skills.

Buoyed by the successes of language and reading interventions, developers have recently broadened the range of skills that parenting programs target. For example, the Research-Based Developmentally Informed Parent (REDI-P) curriculum includes a parent component to support children's classroom learning during the transition from Head Start to kindergarten, focusing on socioemotional and literacy skills.<sup>14</sup> For literacy, REDI-P incorporates aspects of parenting interventions that have proven successful, such as interactive or dialogic parent-child reading and activities like letter identification and letter-sound skill practice. The curriculum embeds socioemotional content in stories and activities, encouraging parents to use targeted praise, help children identify emotions, and support self-control strategies. Parents receive the intervention during 10 home visits in the spring of the Head Start year and six in the fall after their children enter kindergarten.

The results from an experimental evaluation at the end of kindergarten are promising.<sup>15</sup> REDI-P had small to medium impacts on teachers' reports of children's academic performance (effect size of 0.25) and an assessment of literacy skills (effect size of 0.28), but not on vocabulary or reading fluency. Teachers rated the REDI-P children as more self-directed and more socially competent (medium effect sizes

of 0.28–0.29) than the comparison-group children, although they were no less aggressive. Possible explanations for the program's positive impacts include its relative intensity, the use of coaching, the intervention's timing, and its synchrony with the school curriculum. Further research will tell whether the program's effects persist, and whether such a program can feasibly be scaled up.<sup>16</sup>

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*Technology may be able to reach more parents with less effort and cost.*

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### **Technological Approaches to Improve Parenting Programs**

One problem with more intensive programs is that they may achieve greater effectiveness at the cost of a wider reach because parents—especially disadvantaged parents—can't sustain the intensive demands on their time and interest. Technology may be able to reach more parents with less effort and cost. And some technology-based approaches overcome other barriers to improving parenting practices. These approaches assume that changing parenting behavior is complicated, not only (or even primarily) because parents lack information about how to promote their child's learning, but also because of other, behavioral factors. Specifically, factors that may inhibit parents from increasing the number of stimulating parent-child interactions include their perceptions of the task's complexity, lack of attention, and difficulty delaying gratification and disrupting established routines.

One literacy-based program used text messages on mobile phones to break down parenting support for children into small, easy-to-achieve steps and to provide continuous encouragement and reinforcement.<sup>17</sup> The text messages, based on the prekindergarten curriculum, told parents in a widely accessible but nonintrusive way how to embed learning activities in their children's daily lives. A rigorous evaluation found that the program improved children's targeted home-learning activities, parents' involvement in their children's schooling, and some dimensions of children's literacy skills like letter sounds, but it didn't affect other advanced literacy skills like name writing. These promising results suggest we need further research on text message-based approaches to working with parents, and that a simple and achievable set of suggested activities for parents may be important.

Another program gave families tablet devices that were preloaded with electronic books to increase the reach and effectiveness of a parent literacy intervention.<sup>18</sup> Staff members checked in with parents about setting reading goals, and the parents got text messages with reminders, information about progress meeting their goals, and positive encouragement and praise. After six weeks, parents in the intervention group were reading to their children for about 25 minutes a week, compared to less than 10 minutes a week for control-group parents. The next step will be to test whether this increase in reading is sustained over time and whether it improves children's literacy skills.

### **Add-On Programs: Early Math Skills**

In general, developers of parent programs haven't devoted much attention to math. That's unfortunate; numeracy and math skills are foundations for later learning, and

parents can support the growth of these skills. Certain parenting practices, such as direct math instruction, explaining numerical concepts, or practicing math facts—as well as informal activities involving numbers, such as measuring ingredients while cooking or counting tokens in a board game—are strongly linked to children's mathematical learning.<sup>19</sup>

According to a survey of schools in 2001–02, the most common parent “partnership” activities related to math achievement involved communicating with parents—for example, explaining the curriculum and testing. Parent-directed efforts to improve student math achievement or specific math skills were less common. The survey's creators noted that most teachers aren't trained to work with parents to practice math or extend math learning.<sup>20</sup> Given that so few efforts focus on math, it's not surprising that we have almost no empirical evidence on the effectiveness of parent-based math programs in early learning. One small-scale, experimental pilot study involving parents of children in Head Start suggests that parent-based math interventions may have some promise.<sup>21</sup> The parent training sessions were well attended, and an evaluation showed that the program significantly improved children's math skills.

More evidence that parent-based math interventions can be effective comes from a program called Bedtime Learning Together, in which parents used a math application on a tablet.<sup>22</sup> The application presented short text passages related to mathematical topics, followed by mathematical questions for parents and children to answer together. When parents used the tablet an average of once a week over the course of a year, their first-grade children's math skills improved

compared to children whose parents used a reading application. Interestingly, however, these improvements were detected only for children whose parents said they were anxious about math; children of parents who weren't anxious about math saw no benefit. Researchers need to determine whether this type of intervention can be feasibly and effectively embedded in schools in such a way that it reaches and engages the parents of children who might benefit from it substantially.

Finally, another project is examining the effectiveness of a parenting program that targets both reading and math skills. Getting Ready for School, which was developed in Eastern Europe and has been adapted for the United States, promotes parents' engagement in literacy and math learning activities before children enter formal schooling.<sup>23</sup> The program involves a nine-unit activity curriculum with materials and guides, as well as two-hour parent workshops that include online videos showing how to engage children in learning activities. The results of a small pilot study suggested that the intervention might improve some aspects of children's early learning, especially early numeracy and math skills (it had less effect on language and literacy). A larger evaluation, currently under way, should tell us more about the program's potential.

### **Add-On Programs: Socioemotional and Behavior Skills**

The broad concept of school readiness includes children's socioemotional skills. Disparities in these skills by income or socioeconomic status are far smaller than disparities in academic skills.<sup>24</sup> Nevertheless, socioemotional skills and behavior are

important for school success.<sup>25</sup> When asked to identify factors associated with a difficult transition to formal schooling, kindergarten teachers point to weak academic skills, problems with social skills, trouble following directions, and difficulty with independent and group work.<sup>26</sup> These responses highlight the breadth of socioemotional and behavioral skills that children need in the classroom, including prosocial skills, independence, self-regulation, and attention.

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*Children's behavior is most likely to improve when caregivers and teachers have consistent expectations and responses both at home and at school.*

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Because parenting practices are strongly associated with children's early behaviors and socioemotional skills, efforts to improve children's classroom behavior often include parents. Harsh, inconsistent, and coercive caregiver-child relationships early in life are associated with higher levels of externalizing behavior (commonly known as acting out) and low levels of self-regulation.<sup>27</sup> Moreover, evidence suggests that children's behavior is most likely to improve when caregivers and teachers have consistent expectations for and responses to children's behavior both at home and at school.

Many parenting programs that target children's behavior were originally designed for children whose aggressive, defiant, oppositional, or impulsive behaviors were significant enough to warrant clinical



intervention. These include the Incredible Years program, in which parents with children in early childhood education participate in 12 weeks of parent groups that use video vignettes as a platform to discuss parent skills (for example, behavior management) and practice alternative responses. Incredible Years has been shown to be effective in improving the behavior of young children with significant behavior problems.<sup>28</sup>

Increasingly, however, attention has shifted toward heightening the social and emotional skills of all children, not just those with high levels of problem behaviors. Improving early behavior skills in the general population may prevent the emergence of behavior problems, which in turn may reduce the risk of academic problems, such as dropping out or having low levels of engagement, down the road.<sup>29</sup> Some programs for children at risk for social and emotional problems have adopted a prevention framework that targets parents in an effort to reduce risk factors and increase protective factors, such as school engagement and community connections.

In one such program, ParentCorps, classroom teachers and other school staff deliver a series of 13 group-based parenting classes, using video vignettes to support positive parenting skills.<sup>30</sup> ParentCorps aims to create more opportunities for parents and teachers to interact, thereby increasing parents' engagement in their children's education. An evaluation among prekindergarten children enrolled in a large urban school district found that ParentCorps had medium-size effects on effective parenting practices and on teachers' ratings of child behavior problems, although neither parent involvement nor children's more general school readiness were affected. A

second experimental evaluation found that ParentCorps had small positive impacts on kindergarten achievement scores and teacher-rated academic performance.<sup>31</sup> Unfortunately, although it had promising results, the program had trouble reaching parents. Only 42 percent of parents who were eligible for the program enrolled in it, and, on average, enrolled parents attended less than half of the sessions.

Like ParentCorps, Families and Schools Together (FAST) provides group-based parenting programs (eight sessions in all), held at school.<sup>32</sup> Unlike other programs, FAST focuses on building parent-school-community connections and social relationships. Four randomized controlled trials of FAST have been conducted with diverse, low-income populations.<sup>33</sup> The evaluations found high enrollment and retention rates; moreover, each of the studies produced some evidence that FAST improved parent involvement, children's social skills, and children's behavior. However, the results weren't consistent from trial to trial. In some studies, for example, FAST affected social skills; in others, only aggressive behaviors were improved. In some cases, teachers' reports of behavior problems fell significantly; in others, only parents' reports of behavior problems dropped. A large, new, randomized controlled trial is under way that will examine FAST's effectiveness across a large set of outcomes expected to measure the program's theory of change, including parent social support and parent-school engagement.

Like children's early achievement, behavior and socioemotional development have many dimensions. Thus key questions for program developers are which child behaviors to target and which parenting strategies to

emphasize. We also need more research to determine which approaches are likely to work for all children and which are most successful for children who demonstrate high levels of problem behavior. As more evaluations test underlying theories of change and causal mechanisms, we'll learn more about how to design programs to reduce behavior problems and to promote social and emotional competence. One area that could use more attention is how to improve parents' own self-regulation and mental health as a pathway to improving parent-child interactions, and ultimately, their children's behavior. Finally, as is the case for programs that target children's academic skills, enrolling parents and keeping them engaged remains challenging. Although technology has yet to be used as a platform for delivery of programs targeting socioemotional skills, no doubt such programs will be developed and studied in the near future.

### **Parenting Supports: School Information**

A final way to support parents is to give them information about schools and preschool programs. Many school systems now give parents a range of choices about which preschool programs and schools (local public schools, private schools, charter schools, and magnet schools) their children could attend. When researchers have studied efforts to help parents of older children make decisions by giving them clear information about the set of schools their children could attend, they've found that parents who receive well-packaged information choose higher-performing schools.<sup>34</sup> However, they do so only if they live near a school with higher scores. Not surprisingly, information doesn't help

parents when they live near a set of similarly low-performing (or high-performing) schools. For parents of preschool and younger children, states' *quality rating and improvement systems* seek to serve a similar purpose by giving parents clear, easy-to-access information about the quality of early care and learning programs. We don't yet understand how this information affects parents' enrollment decisions, but these systems may be an important way to help parents.<sup>35</sup>

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*Effective programs train their staff in how to work with parents; they also target specific skills or behaviors and focus on parenting practices that are clearly linked to the targeted skills.*

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### **Conclusions**

Given the fundamental role that parenting and home environments play in young children's development, it's clear why prekindergarten and early elementary programs want to work with parents to improve children's academic outcomes. Nevertheless, only a handful of such efforts have been shown to improve children's school learning and adjustment. Looking across the effective parenting programs in prekindergarten through third grade, we see some shared features. First, effective programs train their staff in how to engage and work with parents. Second, they target specific skills or behaviors and focus on



parenting practices that are clearly linked to the targeted skills. Some programs also give parents the materials, such as books, that they need to implement the recommended parenting strategies.

These programs show promise, but their benefits also tend to be limited to the content domains and skills targeted. Although that's not surprising, it suggests that parenting programs are unlikely to have sweeping impacts across many domains of children's academics and behavior. It may be unrealistic to expect a program to improve numerous and diverse aspects of parenting repertoires and behaviors. A significant challenge, then, is to determine which dimensions of parenting practices—and related children's skills and behaviors—in what combinations can be changed most effectively by school-based parenting programs. Moreover, when we think about which skills to focus on, we need to attend to how these short-term changes in parenting and children's skills may affect children's later learning. It may be easy to improve a particular aspect of parenting and children's related skills, but if these don't do much to promote school success in the long run, we may not be making the best use of resources. Unfortunately, few studies of parent programs have long-run follow-ups, so it's uncertain to what extent the programs' impacts persist or are linked to improvement in other skills later in children's lives.

Several more issues loom large for designers of parent programs. One important consideration is the trade-off between sustaining parents' participation and the program's convenience and time demands. Some evidence suggests that shorter, less intensive programs may not be as effective as longer, more intensive programs. But getting parents to show up and keep coming to

longer-lasting programs may be a problem, especially for parents who have many demands on their time. Prevention services may have an especially hard time enrolling and retaining parents, given that their children haven't yet demonstrated low skills or problem behaviors. A related, persistent concern is whether there's a cultural match among program leaders, content, and the families they seek to support. Program design would benefit from greater attention to why parents don't participate. Indeed, problems with parent participation constitute one reason that the use of technology holds promise as a platform for delivery. Technological solutions might reduce the costs, complexity, and inconvenience of either participating in the program or implementing a new parenting strategy. But we need considerably more work to understand how and under what conditions technology can be used to effectively engage parents in supporting their children's learning.

To date, no empirical evidence indicates that incorporating a smattering of parent-related activities into an early learning or elementary school program, even in a systematic way, can improve children's academic and socioemotional skills or classroom behaviors. However, some well-developed and carefully implemented parenting programs can be effective in improving these outcomes, and educators should consider these approaches. We caution, however, that delivering a program so that it reaches parents effectively seems to be important. For parent add-on programs, we think it's best to target families that are likely to benefit from particular types of interventions rather than to implement universal programs. One exception to this argument might be text

message-based parenting programs, though we need more research on the effectiveness of this low-cost mode of parent-based intervention.

In closing, we should also acknowledge that schools and teachers may undertake parent-related activities and seek parent involvement for many reasons that aren't primarily about improving student's academic learning and skills, and that many parent-related practices and partnerships

serve other important goals, such as building community and cultivating leadership. Indeed, just because we lack rigorous evidence that general parent education and involvement can boost children's academic skills or improve behavior doesn't suggest that these efforts shouldn't be an essential part of early learning. It does suggest, however, that such practices aren't likely to be an effective way to improve all children's school success.

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