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Starting School at a Disadvantage:

The School Readiness of Poor Children

Julia B. Isaacs, Brookings Institution

Executive Summary

Poor children in the United States start school at a disadvantage in terms of their early skills, behaviors, and health. Fewer than half (48 percent) of poor children are ready for school at age five, compared to 75 percent of children from families with moderate and high income, a 27 percentage point gap. **This paper examines the reasons why poor children are less ready for school and evaluates three interventions for improving their school readiness.**

Poverty is one of several risk factors facing poor children. Mothers living in poverty are often unmarried and poorly educated, they have higher rates of depression and poor health than more affluent mothers, and they demonstrate lower parenting skills in certain dimensions. In fact, the gap in school readiness shrinks from 27 percentage points to 7 percentage points after adjusting for demographic, health, and behavioral differences between poor and moderate- and higher-income families. Even so, **poverty remains an important influence on school readiness**, partly through its influence on many of the observed differences between poor and more affluent families. Higher levels of depression and a more punitive parenting style, for example, may result from economic stress and so models controlling for these factors may understate the full effects of poverty on school readiness.

In addition to poverty, key influences on school readiness include preschool attendance, parenting behaviors, parents' education, maternal depression, prenatal exposure to tobacco, and low birth weight. For example, **the likelihood of being school ready is 9 percentage points higher for children attending preschool**, controlling for other family characteristics, and is **10 percentage points lower for children whose mothers smoke during pregnancy** and also **10 percentage points lower for children whose mothers score low in supportiveness during parent-child interactions**. These findings suggest a diverse set of policy interventions that might improve children's school readiness, ranging from smoking cessation programs for pregnant women to parenting programs, treatments for maternal depression, income support programs and expansion of preschool programs.

Preschool programs offer the most promise for increasing children's school readiness, according to a simple simulation that models the effects of three different interventions. Expanding preschool programs for four-year olds has more direct effects on school readiness at age five than either smoking cessation programs during pregnancy or nurse home visiting programs to pregnant women and infants, the two other alternatives considered.

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Introduction

Americans aspire to live in a society where children of humble origins who work hard can rise to middle-class status. Yet many children who are born into poverty struggle to make ends meet as adults, failing to earn enough to achieve middle-class status. Nearly two out of three children born into the bottom fifth of the income distribution remain in the bottom two-fifths of the income distribution as adults (Isaacs, Sawhill and Haskins, 2009). Often, lack of economic success can be traced back to failure to complete college or even high school, which in turn stems from academic and behavioral struggles during grade school. In fact, there is a large health and skills gap between poor children and their more affluent peers even before they enter school.

Poor children start school at a disadvantage. Their health, behaviors, and skills make them less prepared for kindergarten than children growing up under better economic conditions. Fewer than half (48 percent) of poor children are school ready at age five, under a summary measure that encompasses early math and reading skills, learning-related and problem behaviors, and overall physical health. Children born to parents with moderate or higher incomes are much more likely to enter school ready to learn; three-fourths (75 percent) of these children are ready for school at age five. In other words, there is a 27 percentage point gap in school readiness between poor children and those from moderate or higher income families.

Kindergarten teachers find it easier to teach children if they have pre-academic skills, such as recognizing letters and numbers, and if they can sit still, follow directions, and pay attention. Children who are aggressive, have temper tantrums or exhibit other problem behaviors, as well as children in poor health, pose challenges to kindergarten teachers struggling to impart basic skills in a classroom setting.

School readiness has effects beyond the first few months of kindergarten; children with higher levels of school readiness at age five are generally more successful in grade school, are less likely to drop out of high school, and earn more as adults, even after adjusting for differences in family background (Duncan et al., 2007, Duncan et al., 2010). Entering school ready to learn can improve one's chances of reaching middle class status by age 40 by about 8 percentage points, according to a recent analysis that uses linked data sets to track success from birth to age 40 (Winship, Sawhill and Gold, 2011).

With growing awareness of the importance of early years, federal and state governments have expanded their investments in young children. State spending on public pre-kindergartens, for example, increased each year from 2000 to 2009. The federal Head Start program has expanded to serve younger children, Congress enacted the new Maternal, Infant and Early Childhood Home Visiting Program two years ago, and the most recent "Race to the Top" competition included some funding for states' systems of early childhood education.

Even so, early childhood programs receive much less funding than public education. Moreover, early interventions are at risk for funding cuts, as federal and state budgets are squeezed by rising spending on health and retirement costs and falling tax revenues. State funding on public pre-kindergartens actually fell in 2010, the first cut after a decade of expansion (Barnett et al., 2010). At the federal level, early education programs must compete with many other programs annually for increasingly scarce federal dollars. In this fiscal environment, it is important to understand the effects of expanding (or cutting) programs addressing children's school readiness.

This paper examines children's readiness for school at age five, comparing poor children to children from more affluent families. After an initial section documenting a sizable gap in school readiness, the next two sections address two important questions. First, why are poor children less ready to learn than children from more affluent families? Second, does a better understanding of key explanatory factors suggest targets of opportunity, that is, points of

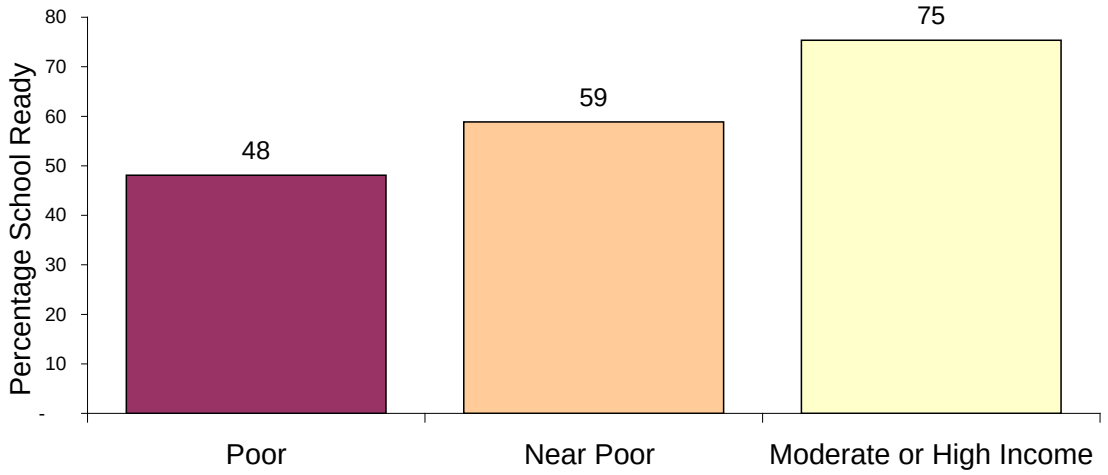
possible intervention to improve the early academic skills and behaviors of low-income children? Finally, the concluding section describes a simulation that compares the effects and costs of three different interventions: preschool programs, smoking cessation programs, and nurse home visiting programs.

I. Poor Children Are Less Ready for School at Age Five than Other Children

Fewer than half (48 percent) of poor children compared to 75 percent of children from moderate or high-income households are ready for school at age five, resulting in a 27 percentage point gap in school readiness, as shown in Figure 1. This comparison focuses on the difference between children from households with income below 100 percent of poverty ($18,000 for a family of three or $23,000 for a family of four, in 2011 terms) and children from households with income above 185 percent of poverty. This latter group spans a broad spectrum of family income, from incomes just above 185 percent of poverty ($33,000 for a family of three in 2011) to much higher levels of family income.

Children who are "near poor" (from households with income between 100 and 185 percent of poverty) also enter kindergarten at a disadvantage, although faring better than poor children: 59 percent of children with incomes just above the poverty line are ready for school at age five. School readiness rises to 86 percent for children born into households with income above $100,000, and falls to 42 percent for children who are persistently poor: not just at birth, but also at ages two, four and five years (Isaacs and Magnuson, 2011).

Figure 1: Likelihood of Being Ready for School at Age Five, by Poverty Status at Birth



Source and Notes: Brookings tabulations of data from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B). Near poor is defined as household income between 100 and 185 of poverty percent and moderate or high income is defined as household income above 185 percent of poverty.

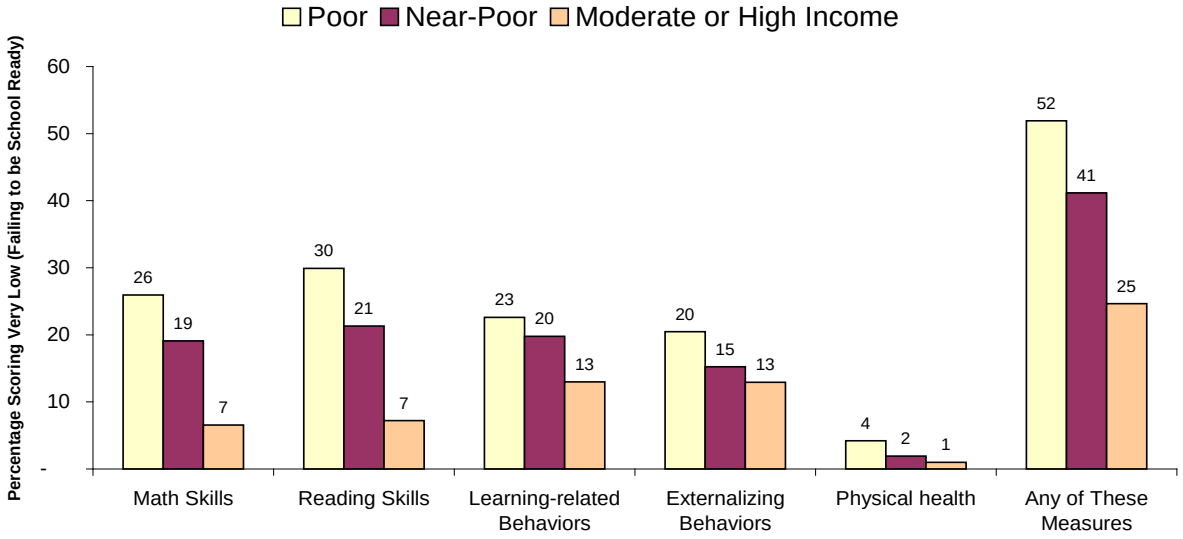
The school readiness patterns analyzed here come from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), which follows a nationally representative sample of children from birth (in 2001) through entry into kindergarten (in the fall of 2006 or 2007). Nearly one quarter (23 percent) of children in the sample were born into poor families, another quarter (25 percent) of children fall into the near-poor group, and the remaining half (52 percent) are classified as having moderate or higher income.

The ECLS-B has rich data on children's school readiness, including measures of children's early academic skills, socio-emotional behavior, and physical health. Each of these domains is

important for later success and contributes to the school readiness measure used in this analysis. Specifically, school readiness is measured by combining direct assessments of early math skills and early reading skills with overall health status taken from parent surveys and two behavioral measures drawn from kindergarten teacher reports (learning-related behaviors, such as paying attention, and externalizing or problem behaviors, such as disrupting others). Children are rated as "school ready" provided they do not score "very low" on any of these underlying measures; "very low" is defined here as poor/fair on health, and more than one standard deviation below average on the academic and behavioral measures.

As shown in Figure 2, poor children are much more likely than other children to score very low on math and reading skills: three out of ten poor children (30 percent) score very low on early reading skills, compared to only 7 percent of children from moderate- or high-income families. Differences are smaller but still substantial on the behavioral and health measures. More than half (52 percent) of poor children score very low on at least one of the five measures, and so fail to be school ready, compared to one-quarter of children from moderate- or high-income families.

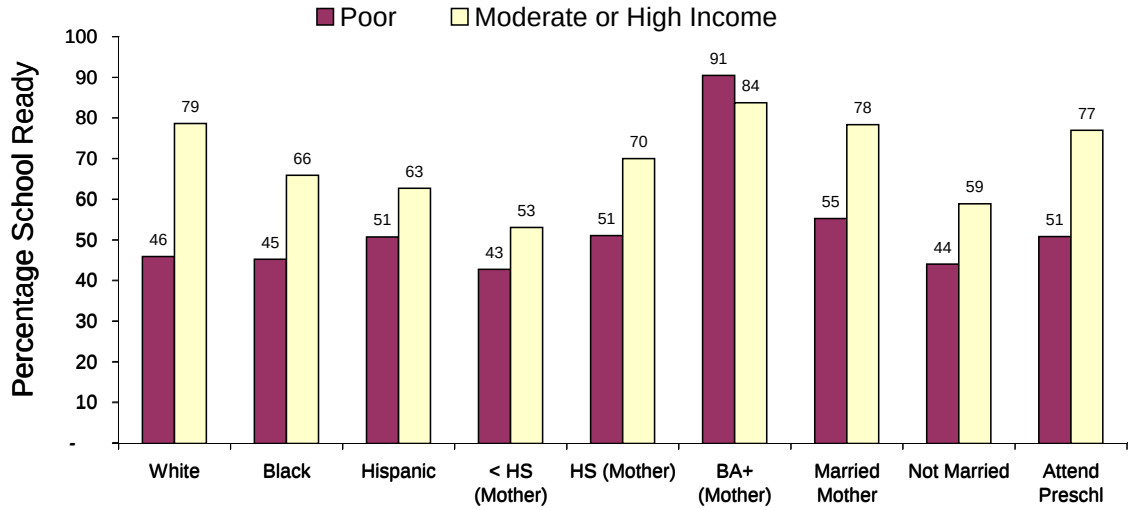
Figure 2: Likelihood of Scoring Very Low (Failing to Be School Ready) on Measures of School Readiness, by Poverty Status



Source and Notes: Brookings tabulations of data from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B). Very low is defined as more than one standard deviation below average on the academic and behavioral measures and in poor/fair health on the physical health measure.

Poverty affects school-readiness across a wide range of populations. For example, poor whites are less school ready than moderate/higher income whites, and the same is true of blacks, Hispanics, children of married parents, children of unmarried parents, and children whose mothers have a high school degree or less (see Figure 3). In addition, poor children who attend preschool programs are less likely to be school ready than preschool attendees from more economically advantaged backgrounds. Children with college-educated mothers provide an exception to the general pattern: poor children whose mothers have a college degree or higher are as well-prepared for school as other children of college-educated mothers (but this small group represents only 2 percent of all poor children).

Figure 3: Likelihood of Being Ready for School at Age Five, by Poverty Status at Birth and Selected Child and Family Characteristics



Source and Notes: Brookings tabulations of data from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B). Poor at birth is defined as household income less than 100 percent of poverty and moderate or high income is defined as household income at or above 185 percent of poverty. School readiness of near-poor children (incomes 100-185 percent) is not shown but generally lies between the two other groups.

II. Why Are Poor Children Less Ready for School?

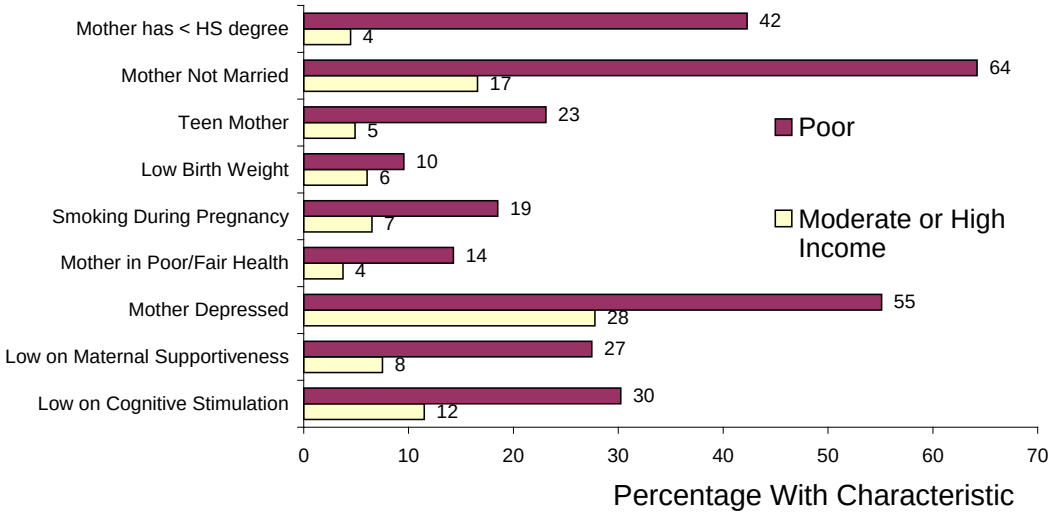
At the simplest level, there are two basic theories as to why poor children have worse outcomes than other children. Proponents of one view focus on the economic differences between poor families and other families, and argue that many of the negative outcomes observed in poor children and their families are a by-product of lack of financial resources. Another explanation is that it is not money itself, but the many parental characteristics that are associated with poverty that are harmful to children (Mayer, 1997). Analysis of these and other data suggests that both explanations play a role: poor children do worse in school partly because their families have fewer financial resources but also because their parents tend to have less education, higher rates of single and teen parenthood, poorer health, and other characteristics that place their children at risk for less successful outcomes.

There are several ways that family income can directly influence child development. From an economic perspective, families with lower incomes have less access to the resources needed for healthy development, such as nutritious meals, enriched home environments, high-quality child care settings, and first-class health care resources (Becker, 1981). Poor children also may suffer from the negative effects of living in neighborhoods with more crime and air and noise pollution (Evans, 2004). From a psychological perspective, the stress of living in poverty has a profound effect on parents, contributing to depression, anxiety, and other forms of psychological stress that can negatively impact their interactions with children. Even when parental stress does not manifest itself in observed changes in mental health, it can contribute to a harsh and less supportive parenting style, according to a body of research dating back to the Great Depression (Mcloyd, 1990; Chase-Lansdale and Pittman, 2002).

While poverty may have myriad influences on family life, it also is true that poor families differ from other families across a range of characteristics, some of which may be independent of, or forerunners to, poverty status. As shown in Figure 4, many poor children live with unmarried parents who have not graduated from college and may not have completed high school. More than half of their mothers show moderate or severe signs of

depression, a depression rate nearly twice that of more affluent mothers. Poor children also are at higher risk of prenatal tobacco exposure and low birth weight, although these are relatively infrequent events (see Figure 4). In addition, in comparison to their wealthier counterparts, more poor children live with mothers who score low on providing cognitive stimulation (e.g., infrequently reading books, telling stories, singing songs) or score low on sensitivity, warmth, and general supportiveness during parent-child interactions (based on videotaped observations of the parent and child at age two).

Figure 4: Poor Families Differ from Moderate/High Income Families on Many Characteristics that May Affect School Readiness



Source and Notes: Brookings tabulations of data from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B). Poor at birth is defined as household income less than 100 percent of poverty and moderate or high income is defined as household income at or above 185 percent of poverty. Prevalence of characteristics among near-poor children (incomes 100-185 percent) is not shown but always lies between the two other groups for all characteristics shown in the figure.

With the range of differences shown in Figure 4, one might well expect that much of the "poverty gap" in school readiness is influenced by family characteristics rather than family income. In fact, the poverty-related gap in school readiness drops considerably, from 27 percentage points to 10 percentage points, if we add statistical controls for family demographics. It shrinks further, to 7 percentage points, after adjusting for other factors that are more prevalent in poor than in moderate and higher-income families, as shown in Figure 5.

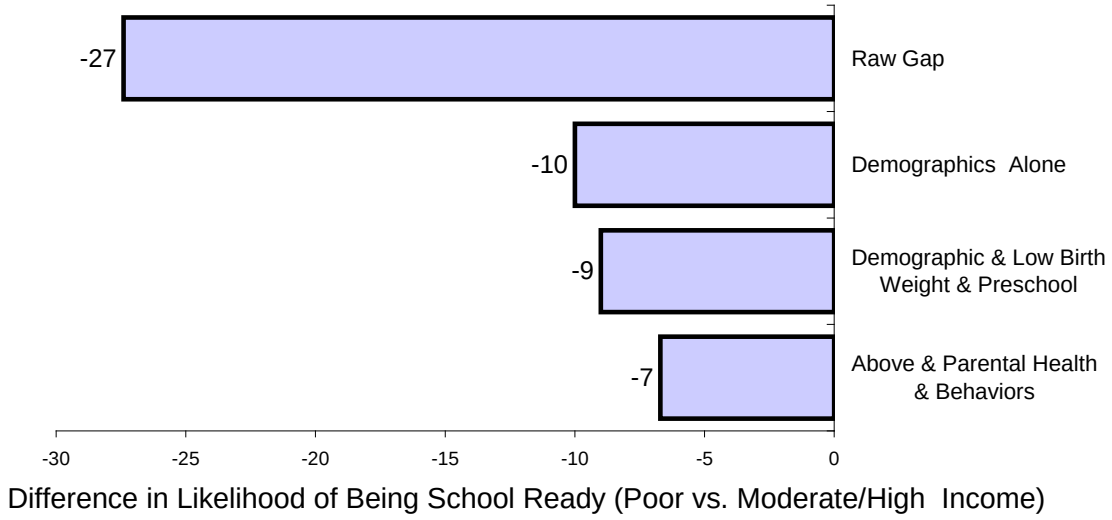
The demographic controls in this analysis include the parents' level of education, marital status, and mother's age at birth, as well race/ethnicity, immigrant status, gender, and age in months. Parents' education is a large factor explaining why children from moderate and high income families enter school with higher reading and math skills—their parents are better educated. Children's early academic skills are higher, on average, when parents have more years of schooling, and this association persists even after controlling for parents' inherent abilities, according to evidence from welfare reform evaluations and sophisticated statistical analyses (Gennetian, Magnuson & Morris, 2008; Carneiro et al., 2007). In addition, the "education" effect also reflects underlying differences in parents' skills and preferences, which are often passed on to their children, by both inherited traits and upbringing.

The large number of poor children living with an unmarried mother also contributes to the poverty gap in school readiness. Children living with single and even cohabiting parents tend to have worse outcomes, particularly behavioral outcomes, than similar children living with

married parents, according to several studies (Waldfogel, Craigie and Brooks-Gunn, 2010). Living with teen parents also may put children at additional risk, although researchers find little evidence regarding effects on early academic skills and mixed evidence regarding effects on behavioral outcomes (Levine et al., 2007).

The poverty gap is much smaller after controlling for demographic factors, but still substantial, in both statistical significance and policy relevance (10 percentage points). The gap shrinks further after adding controls for low birth weight and preschool attendance, two potential pathways for how poverty may affect children's development. Families with fewer economic resources may have less access to good health care or nutrition (which may show up in lower birth weight babies) and also may have decreased ability to send their children to preschool programs. In fact, although low birth weight and preschool participation exert independent effects on school readiness, they do not explain much of the remaining poverty-related gap in school readiness, and the gap remains at 9 percentage points, even after adding controls for low birth weight and preschool attendance.

Figure 5: School Readiness Gap (Poor vs. Moderate/High Income), Various Levels of Controls



Source and Notes: Brookings analyses of data from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B). Poor is defined as household income less than 100 percent of poverty and moderate or high income is defined as household income at or above 185 percent of poverty. Demographics include parents' level of education, marital status, mother's age at birth and immigrant status, and child's gender, age in months and race/ethnicity. Parental health and behaviors include physical health, smoking during pregnancy, breastfeeding, depression, parenting behaviors (parental supportiveness and provision of cognitive stimulation) and maternal employment; the analysis also controls for use of non-parental care, and number of children and adults in the household.

The poverty gap reduces somewhat further, to 7 percentage points, in the full model, which adds additional controls for maternal health and behavior, specifically, measures of physical health, smoking during pregnancy, breastfeeding, depression, and parenting behaviors (parental supportiveness and provision of cognitive stimulation).

Parental health and behaviors play a complex role in the analysis. These may be caused, at least partially, by the parents' lack of financial resources: impoverished circumstances, overcrowded housing, and lack of access to good health care can result in health problems, higher levels of depression, and a harsher parenting style. On the other hand, a chronic physical or mental health condition can exist independent of poverty status, and may even be a cause, rather than a result of poverty (with poor health dragging down employment and earnings, and thus increasing chances of entering poverty).

If one focuses on the ways that economic stress affects parents' health and their interactions with their children, one is likely to view these parental health and behavior measures as pathways or mediators through which the true underlying cause—poverty—operates. Under this view, the 7 percentage-point estimate from full model, which includes controls for these factors, understates the extent to which poverty is a root cause of poor children's diminished school readiness. Alternatively, some might argue that parental education, marital status, health, and behaviors—rather than the amount of money families have to spend on their children—are the real causes of the diminished school readiness of poor children. Statistical analyses such as these cannot tell us which interpretation carries more weight.[1]

The best evidence as to whether income has a causal effect on school readiness comes not from regression analyses, but from experimental programs, such as welfare-to-work experiments, where two otherwise identical groups of families with children receive different levels of income as a result of a policy intervention. An analysis of several such random-assignment experiments has found that children's math and reading skills were indeed improved by programs that increased parental income and employment, but not by programs that only increased employment (Duncan et al., 2011). In addition, a quasi-experimental study of varying child benefits in Canada found higher levels of child achievement (e.g., higher vocabulary scores) in children whose families received higher income supplements (Milligan and Stabile, 2008). These quasi-experimental studies provide convincing evidence that money matters, although it is not the only influence on young children's developmental outcomes.

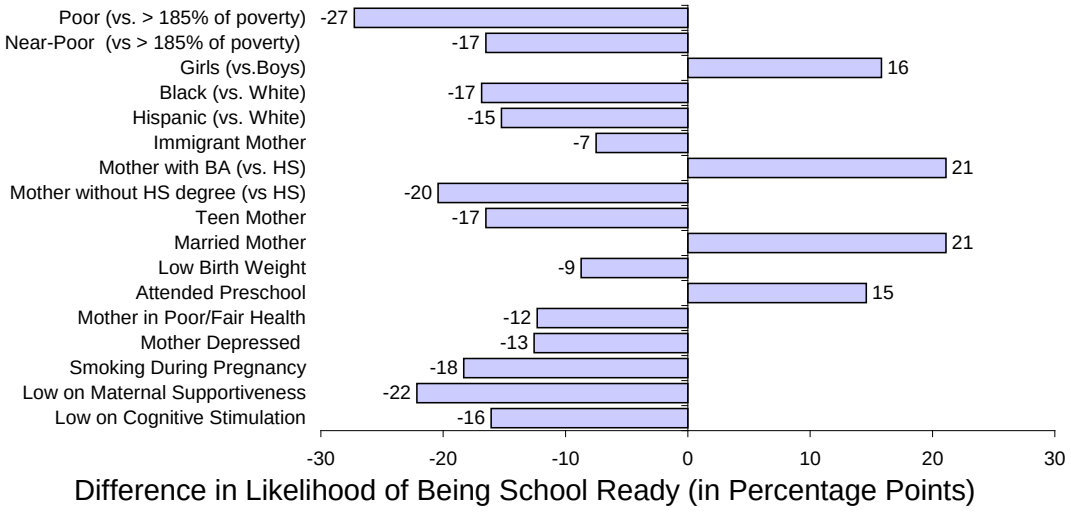
III. Multiple Targets of Opportunity for Addressing School Readiness of Poor Children

Poverty is one of multiple, inter-related influences on children's school readiness. This section considers influences other than money by first looking at simple differences across groups of children (see Figure 6), and then by examining which differences persist when adding statistical controls (see Figure 7). While the full model with statistical controls provides some guidance as to which factors contribute to children's school readiness, the model may overstate or understate the causal impacts of specific variables, and so it is important to compare estimates from the statistical model to the broader social science literature.

Girls are markedly more school ready than boys; the average 5-year old girl is 16 percentage points more likely to be school ready than the average boy (see Figure 6). The gender gap is largely independent of family background and remains at 14 percentage points even with statistical controls (see Figure 7). The gender difference in school readiness is driven by behavioral differences: girls score a half-standard deviation higher than boys on behavioral measures, on average. (See the appendix, Table A-1, for regression estimates for math, reading, learning-related behaviors, externalizing behaviors, and health, as well as overall school readiness.)

[1] As a final note to Figure 5, the "unexplained portion of the poverty gap" could have been dropped even further, approaching zero, if the analysis had included an even richer set of mediators for the effects of poverty, such as the family's ownership of assets (e.g., home, savings account), material possessions (e.g., computer, car), food insecurity, housing conditions, and neighborhood crime and safety. When economists Waldfogel and Washbrook included such controls in their careful analysis of income-related gaps in children's school readiness, they found no significant residual gap in academic skills and behavioral outcomes between children from the bottom and the middle fifth of the income (Waldfogel and Washbrook, 2011).

Figure 6: Various School Readiness Gaps (Before Controlling for Confounding Factors)

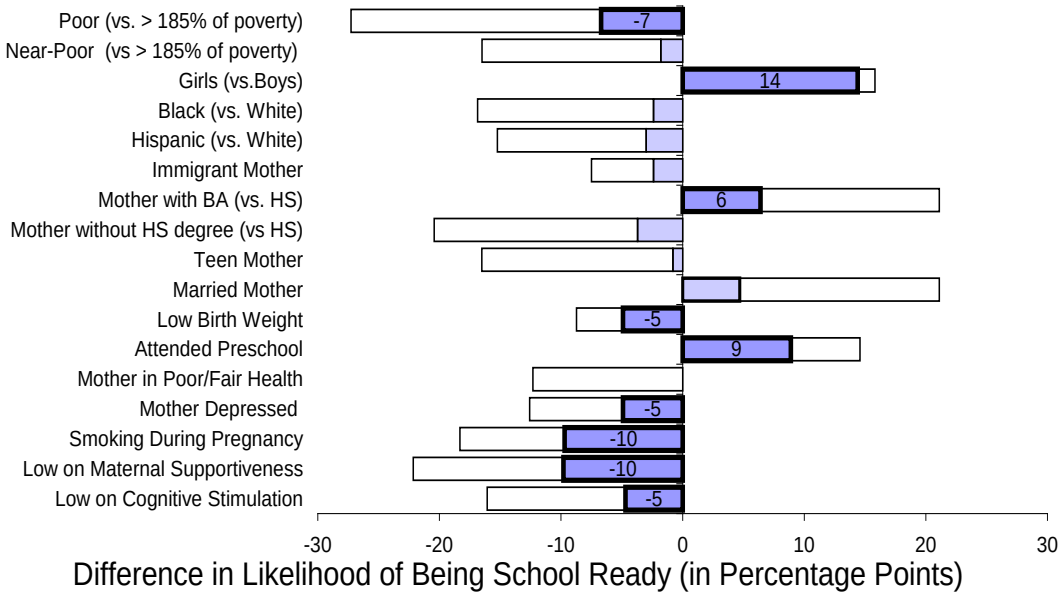


Source: Brookings analyses of data from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B)

Children of college-educated mothers and children attending preschool enter school with more skills than their counterparts without these advantages. The positive effects of these factors persist after adding controls, though the magnitude is smaller. The impact of attending preschool, for example, drops from 15 percentage points to 9 percentage points after accounting for family characteristics associated with selection into preschool. Random-assignment and regression-discontinuity studies have also found positive effects of preschool programs on various dimensions of school readiness, with the most extensive evidence and largest effects regarding pre-academic skills (Camilli et al., 2010; Isaacs, 2008).

Differences by race/ethnicity, immigrant status, family structure, maternal age at birth, and maternal physical health are initially large. For example, black and Hispanic children are less likely to be school ready than white children (by 15 to 17 percentage points) and children of married mothers are more likely to be school ready than children of unmarried mothers (by 22 percentage points). However, these differences reduce to insignificant levels after controlling for income and other confounding factors. In contrast, the effects of poverty remain significant in the full model, with poor children 7 percentage points less likely to be school ready, as already discussed.

Figure 7: School Readiness Gaps (Before and After Controlling for Confounding Factors)



Source and Notes: Brookings analyses of data from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B). Bars with numerical values represent characteristics that are statistically significant (at the 95 percent level, except for low birth weight and cognitive stimulation (90 percent level) and gender and preschool (99 percent level). Additional controls not shown in figure include paternal education, race (other), maternal employment, use of non-parental care, breastfeeding, child's age in months, number of children and adults in the household, and dummies for missing values on selected variables. Paternal education, children's age in months and use of preschool or center-based care before age 4 have statistically significant effects on school readiness (see appendix for more details).

In addition to poverty, a number of other risk factors have negative effects that persist after adding controls for other family characteristics. Prenatal exposure to tobacco and low birth weight have negative effects on school readiness, consistent with other literature (Wakschlag et al., 2002; Johnson and Schoeni, 2007). In addition, children are less likely to be school ready if their mothers showed signs of depression during early childhood, their mothers showed little supportiveness during video-taped observations of parent-child interactions, or their mothers reported that they read, sang, and told stories to their children infrequently. Again, these results are consistent with other studies, with parenting behaviors likely influenced by maternal depression, but also each variable—maternal depression and parenting behaviors—showing some degree of independent effects on child development (Kiernan and Huerta, 2008).

The dark bars in Figure 7 suggest multiple targets of opportunity for improving the school readiness of poor children. In addition to traditional policies aimed at expanding preschool participation or increasing family income, policy makers interested in improving children's school readiness might consider a more diverse set of interventions, such as smoking cessation programs targeted at pregnant women, health and nutrition policies designed to reduce low birth weight and other adverse pregnancy outcomes, parenting programs for low-income parents of young children, mental health treatment options for mothers of young children, or policies to improve the educational attainment of low-income mothers.

IV. Comparison of Three Interventions to Improve School Readiness

The concluding section of this paper discusses three different possible interventions to improve school readiness: 1) expanding voluntary preschool programs to all poor four-year

olds not currently served, 2) providing smoking-cessation programs to all poor pregnant women who smoke, and 3) offering nurse home visiting programs to all first-time mothers with income below poverty. Preschool programs were selected because of the strength of the evidence demonstrating that such programs improve early math and reading skills. Smoking cessation programs targeted at pregnant women were selected because of the magnitude of the negative effects of prenatal exposure to tobacco on school readiness in this analysis (controlling for low birth weight), as well as additional effects through low birth weight. Nurse home visiting programs were selected because they address parenting behaviors, as well as maternal health during pregnancy. Each of these is discussed below, and then their effects on school readiness are compared through a simulation exercise. Finally, there is a brief discussion of policies to raise family incomes.

Preschool Programs

Children who attend some form of preschool program at age four are 9 percentage points more likely to be school ready than other children, according to the regression model summarized in Figure 6. This overall impact is driven by positive effects on early math and reading skills, and smaller, insignificant effects on behaviors (positive for learning-related behaviors and negative for problem behaviors), and no effect on health, according to the detailed analyses shown in the appendix (Table A-1).

These findings are largely consistent with the extensive literature on early childhood education, which finds strong positive impacts on early academic skills, and smaller, sometimes mixed, findings on behavioral measures. For example, a recent meta-analysis of studies of a diverse set of early childhood, center-based programs found an average effect size of 0.23 standard deviations on cognitive skills, and 0.15 standard deviations for socio-emotional skills (Camilli et al., 2010). These effects are larger than those shown in Table A-1, suggesting that preschool programs may, in fact, have larger effects than the 9 percentage point difference used in the simulation exercise.

The effects of preschool program attendance vary, of course, depending on the particular program attended. Children "attending preschool" in the United States attend a diverse mix of programs, including public pre-kindergarten programs, Head Start programs, private nursery schools, and center-based child care settings. Quality varies considerably, both across and within these various types of settings. Substantial impacts have been found for certain model programs (e.g., Perry Preschool, Abecedarian, Chicago Public Schools), as well as some public pre-kindergarten programs. Impacts of Head Start on school readiness have been smaller, and prone to fade-out. Little is known about the effects of private nursery schools and center-based child care settings, and the quality of these settings is quite uneven. The intervention simulated below will be an expansion of the existing mix of preschool programs, varying in both quality and setting.

Smoking Cessation Programs

Smoking cessation programs appear to be a promising intervention, given the strong negative effect of tobacco use during pregnancy seen in Figure 7 (a 10 percentage point reduction in school readiness of children of smokers, in addition to whatever effects may occur through the effect of smoking on low birth weight). As shown in the appendix, maternal smoking during pregnancy is strongly associated with only one domain, behavior problems, with no effects on math, reading, learning-related behaviors or physical health (after controlling for low birth weight). This finding is consistent with other research that finds children of smokers at risk for severe antisocial behavior (Wakcshlag et al., 2002). As a result, the positive effects of smoking cessation programs might not show up in school readiness measures that put more emphasis on academic skills. In addition, the causal connection between smoking and children's behaviors has not been conclusively established; smoking may simply signal the presence of another risk factor that might be associated with smoking during pregnancy and worse child outcomes at age five. However, because negative results of

smoking are found consistently across diverse settings and because biological evidence suggests that nicotine crosses the placental barrier and is associated with fetal neurotoxicity, reducing tobacco use during pregnancy remains an important target of intervention.

Interventions with pregnant smokers generally involve one-on-one counseling of pregnant women, sometimes supplemented with incentives, feedback about fetal health status, and medications or therapies to reduce nicotine cravings. Such programs have only limited success: reducing the number of women who continue smoking throughout their pregnancy by 6 out of 100 women, according to a Cochrane Collaboration review of 72 controlled trials (Lumley et al., 2010). These percentages are in comparison to women in the control group, who are generally exposed to advice to stop smoking and often quit on their own. A similar modest rate of success was reported by the U.S. Public Health Service, which reported that the abstention rate for pregnant smokers increased from 7.6 percent under "usual care" to 13.3 percent after psycho-social interventions (US HHS, 2008). Lumley and colleagues reported a roughly 15 percent reduction in low birth weight and pre-term births for infants born to treated mothers, leading the authors to recommend that smoking cessation programs be adopted in all maternity care settings.

Nurse Home Visiting

Nurse home visiting programs address a number of different risk factors identified in Figure 7 through one intervention. Under what is called the Nurse Family Partnership program, nurses visit low-income, first-time mothers in their homes during pregnancy and infancy, following a curriculum that attempts to reduce smoking and other unhealthy behaviors during pregnancy; improve birth outcomes (with specific attention to reducing pre-term and low-birth weight births); provide coaching and teaching of parenting skills; and encourage mothers to focus on their own future, including setting education and career goals, planning any subsequent births, and building social supports. Nurse Family Partnership has had more documented success than other home visiting programs; some its success may be due to its attention to the prenatal period (clients are enrolled during the second trimester) and its focus on a particularly disadvantaged group (low-income, *first-time* mothers, many of whom are unmarried and/or teen parents). It is one of the program models eligible for funding under the new Maternal, Infant and Early Childhood Home Visiting Program.

While it does not have much effect on maternal education or depression, nurse home visiting has some success in reducing smoking during pregnancy, reducing pre-term and low birth weight births, and improving mother's observed responsiveness and sensitivity toward children in parent-child interactions.[2] As a result of these and other changes, children of home-visited mothers show some signs of improved school readiness in the two most recent trials, including gains in early reading and math skills, as well as increases in executive functioning, a measure related to learning-related behaviors. However, these gains were only significant for about half the children in the programs, those children with "low-resource" mothers, defined as mothers scoring low in intelligence, mental health, or self-confidence. [3]

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[2] The smoking effects were found in two of three random-control trials (and there were very few smokers in the third trial); the reduction in low birth was found in one trial, among younger mothers and smoking mothers; and the improvements in maternal sensitivity were found in all three samples (in full sample for two trials and in a subgroup of low resource mothers in the third trial). U.S. DHHS, 2011; Olds et al., 1986.

[3] The positive effects were found in Denver (observations at age four) and Memphis (observations at age six). The original study in Elmira, New York did not find many differences during early childhood, but it relied on IQ tests, rather than the newer measures of school readiness. It did find lower rates of juvenile delinquency at age fifteen, as well as lower rates of child abuse and neglect throughout childhood. U.S. DHHS, 2011; Olds et al., 1998.

Simulated Effects of Interventions

For each of these three interventions, I simulated possible effects on school readiness, using the estimates shown in Figure 7, combined with a number of different assumptions, as described below and summarized in Table 1. In brief, preschool programs offer the most promise for increasing children's school readiness, with more direct effects on school readiness at age five than nurse home visiting or smoking cessation programs.

Table 1: Simulated Effects of Three Different Interventions

	Preschool Programs	Smoking Cessation Programs	Nurse Home Visiting Programs
1. Poor Population (single-year cohort)	23% of 4 million=920,000		
2. Treated Group	221,000[a]	184,00[b]	128,000[c]
3. Affected Group	All newly enrolled (100% of treated)	Smokers who quit due to intervention (6% of treated)	Mothers with low psychological resources (50% of treated)
4. Increased Chances of Being School Ready (for affected group)	8.9% [d]	4.9-9.7% [e]	6.7% [f]
5. Increased Chances of Being School Ready (for treated group) *[row 4 x percentages in row 3]*	8.9%	0.3%-0.6%	3.4%
Additional information:			
Average Cost Per Treatment	$ 7,400	$ 350	$7,200
Total Cost (in billions) *[row 2 x Average Costs]*	1.6	0.1	0.9
Increased Chances of Being School Ready (across all poor children) *[row 5*(row 2/row 1)]*	2.1%	0.1%	0.5%
Other Effects (in addition to effects on school readiness)	Education Earnings	Maternal Health Neonatal Costs	Child Abuse Neonatal Costs Juvenile Arrests

Note: a. The treated preschool population is 24% of all poor year-olds, assuming 66% already enrolled and 10% fail to enroll in a voluntary program. b. The treated population for smoking cessation programs is 20% of poor pregnant women initially smoking (building off the observed 18.5 percent still smoking in the third trimester and assuming a 7.6 percent rate of quitting under usual care). c. The treated population for nurse home visiting is 14% of poor mothers, assuming 30% of poor births are to first-time mothers, 50% of that 30% voluntarily enroll and 1% are already served. d. Estimate from Figure 7 (Table A-1). The 90% confidence interval around that estimate is 4.8 to 13.0%. e. The high estimate from Figure 7 (Table A-1); the low estimate assumes that quitting smoking before third trimester has only half the effect of not smoking at all during pregnancy. The 90% confidence interval around the high estimate is 4.4 to 15.0%. f. Simulated effect assuming math skills of children of low-resource mothers increase by 0.25 standard deviations, reading skills by 0.2 and learning-related behaviors by 0.25, as explained in the text and footnote 7.

Expanding preschool programs to all four-year old children who choose to participate is estimated to affect 221,000 children annually, or 24 percent of poor four-year olds. Other poor preschoolers already participate in preschool programs (66 percent) or are assumed not to participate under a voluntary program (10 percent). As already discussed, preschool attendance is estimated to increase the likelihood of school readiness by about 9 percentage

points for the affected group.[4] Consistent with other research, this analysis suggests that preschool programs would have a substantial impact on the affected children, those newly enrolled in preschool. Note that this simple measure of school readiness probably understates the full benefits of preschool participation, because it ignores benefits for poor children who are just above the cut-off for school readiness, but still could benefit from seeing their math and reading skills increase with a year of preschool participation.

Providing smoking-cessation programs to all poor pregnant women could potentially affect as many as 184,000 pregnant smoking women and their infants per year. The results summarized in Figure 7 suggest large potential impacts; maternal smoking during pregnancy is associated with a 10 percent change in school readiness. However, mothers who quit smoking at some point during the pregnancy may not reap the full benefit of not smoking, and so the simulation includes an alternate low estimate of about 5 percent, assuming only half the full impact for mothers who quit during the pregnancy. Whether the impact is 5 or 10 points for those mothers who quit, the overall impact for all treated smokers is quite small, because children are not affected unless their mothers quit and, as noted above, only 6 out of 100 women enrolled in such programs quit as a result of the intervention. The total impact for children of smoking mothers thus falls to an 0.3 to 0.6 percentage point in school readiness (6 percent x 5-10 percent). While modest, these school readiness gains are in addition to the more obvious health gains for both mothers and infants.[5]

Making nurse home visiting programs available to all first-time poor mothers would expand services to roughly 128,000 pregnant women, or 14 percent of all poor mothers. This estimate of the treated population assumes that first-time mothers represent 30 percent of all poor mothers (based on the ECLS-B data), that 50 percent of these mothers would participate, based on experience with existing programs, and that 1 percent of poor mothers already receive nurse home visiting services.

Unlike the first two simulations, the simulation of nurse home visiting impacts does not rely on estimates from Figure 7, because there is no variable for "participation in nurse home visiting" in the regression analysis. Instead, the simulation draws upon research from studies conducted in Denver and Memphis. Specifically, nurse home visiting programs are assumed to increase early reading skills by 0.2 standard deviations, early math skills by 0.25 standard deviations, and learning-related behaviors by 0.25 standard deviations—but only among children of low-resource mothers, with no observed effects on other children.[6] Such increases would translate into a 6.7 percentage point increase in school readiness according to a

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[4] The point estimate is actually 8.7 percentage points, as shown in Table A-1, with a 90 percent confidence interval ranging from 4.8 to 10.3 percentage points. This simulation uses the estimate for all children and assumes it applies to poor children. An alternate approach would be to re-estimate the model for the sample of poor children; the point estimate of preschool attendance was slightly higher (10.1 vs. 8.9) but the standard errors were also much higher, and so the simulations relied on the estimates for the full population.

[5] This simulation ignores the potential positive effects of reducing cigarette intake, without quitting completely. It also ignores the indirect effects of smoking on school readiness operating *through* effects on low birth weight. The simulation originally included these additional indirect effects, but they were too small to change the final estimate and so were dropped.

[6] The early reading skill effect of 0.2 is based on averaging effect sizes for language development in Denver (0.31), receptive vocabulary (PPVT) in Memphis (0.21) and reading in Memphis (0.09), math skills were only measured in Memphis (where they were 0.25 for arithmetic and also 0.25 for composite of arithmetic and reading, and the 0.25 effect on learning-related behaviors was based on an average effects on executive functioning in Denver (0.49) and academic engagement in Memphis (0.02). These effects are for children of low-resource mothers; effects were much smaller for the full population. No effects were assumed for externalizing behaviors because the effect sizes in both Denver and Memphis were small, even for the children of low-resource mothers. (.03 and .09, respectively, according to the child behavior check list on externalizing behaviors). DHHS, 2011.

simulation that provided such increases to the sample of poor first-born children in the ECLS-B whose mothers were ever depressed (a proxy for mothers with low psychological resources). The effect would be half as large, only 3.4 percentage points, for the full treatment group, assuming that low resource mothers represent half of the poor mothers participating in the program.[7] An alternate approach, which attempted to model the indirect effects of nurse family partnership *through* its effects on smoking, low birth weight and parenting behaviors found considerably smaller effects, 0.6 rather than 3.4 percentage points, but it was not used, because it required a much more extensive set of assumptions.[8]

To sum up the simulations, preschool attendance is estimated to increase school readiness by about 9 percentage points for newly enrolled poor children, compared to an increase of about 3 percentage points in school readiness for children in nurse home visiting programs and 0.3 to 0.6 percentage points for children whose mothers are provided smoking cessation services. While these estimates are quite uncertain, they provide a rough sense of the differential effects of these three interventions.

Finally, the bottom half of Table 1 compares the costs and effects of the programs across the poverty population. Ball-park costs range from $0.1 billion for smoking-cessation programs for all poor pregnant women (assuming costs of $350 per woman) to $1.6 billion for expanding preschool programs to 4-year olds not currently served (assuming costs of $7,200 per child, or the average of costs for public pre-kindergarten programs and Head Start programs). Costs for nurse home visiting for all poor, first-time mothers choosing to participate are estimated as $0.9 billion, assuming average annual costs of $4,500 and average treatment length of 1.6 years.

The effects summarized above were for the treated groups (e.g., poor preschoolers newly enrolling in preschool programs, poor smoking mothers, etc.), which vary in size across the interventions. For an apples-to-apples comparison of total effects as compared to total costs, it is important to also look at effects across the full poverty population. Effects drop in size when spread across the untreated as well as the treated population, falling to 2.1 percentage points for preschool programs, 0.1 percentage points for smoking programs (the rounded estimate for both the low and high estimates), and 0.5 percentage points for nurse home visiting programs.

It may not be surprising that preschool programs—provided to four year olds and often with the express purpose of preparing children for school—have the highest effects on school readiness, whether measured for the treated group or the full poverty population. Smoking-cessation programs are primarily undertaken to improve maternal and fetal health. This analysis has highlighted the fact that such programs can have additional effects on school readiness—particularly by reducing the number of children with severe antisocial programs—but that is not the main rationale for their adoption. Nurse home visiting programs also have a strong focus on maternal and child health, including child abuse and neglect. However, they

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[7] Low-resource mothers represented half of the mothers in Memphis, and 40 percent of mothers in Denver. Note that the programs served near-poor as well as poor mothers, and so might have served a slightly less disadvantaged population than the population in these simulations. Olds, Kitzman et al., 2004; and Olds, Robinson et al., 2004.

[8] The alternate approach required making assumptions such as the following: NFP reduces smoking by 6 percent, as in smoking cessation programs, NFP reduces low birth weight by 10 percent, based on the author's manipulation of data reported from the trials, and NFP reduces the incidence of low-supportiveness among parents by 10 percent, a fairly arbitrary assumption. These assumptions, combined with estimates from Figure 7, resulted in an overall effect of 0.6 percentage points on those who are home visited, considerably below the 3.4 percent estimate eventually used. The alternate estimate may be low because it ignores effects on non-smokers who had children of normal birth weight and have more normal rates of maternal supportiveness. The difference in estimates also highlights the uncertainty of these simulations, particularly for nurse home visiting programs.

also have been promoted for their ability to improve overall child development, including school readiness, even though home visits stop on the child's second birthday. This simulation suggests that home visiting programs do indeed have some effects on school readiness, though not as large as effects from center-based preschool programs.

A fourth intervention, not directly modeled here, would be to provide families with sufficient income to raise them out of poverty. Moving families out of poverty and into moderate-income status would be fairly costly. For a family of three, there is a gap of more than $15,000 between being in poverty (household income less than $18,000) and having income above 185 percent of poverty (greater than $33,000 in household income). However, if poor families were to experience this substantial increase in income, their children's likelihood of being school ready is estimated to increase by 10 percentage points (using the middle estimate from Figure 5, controlling for demographics, but not for factors that may be influenced by poverty).

Smaller increases in family income also would improve poor children's school readiness. The quasi-experimental evidence discussed earlier suggests that a $1,000 increase in family income, sustained over two to five years, would result in a 0.06 to 0.07 standard deviation increase in early academic skills (Duncan et al., 2011; Milligan and Stabile, 2008). In an earlier analysis of the ECLS-B data used in this paper, Isaacs and Magnuson (2011) estimated that a $1,000 increase in annual household income during early childhood was associated with about a 1 percentage point increase in the probability that very low-income child would be school ready (using the same school readiness measure as in this analysis).[9] Such an increase would cost roughly $5,000 over the first five years of life plus additional costs for administration. Program costs might be lower or higher, depending on whether the program encouraged or discouraged higher earnings among parents. Possible interventions to supplement family income, while at the same time encouraging parents to increase their earnings, include welfare reform programs that contain include earnings supplements and targeted expansions of the Earned Income Tax Credit.

Conclusion

This paper examined children's readiness for school at age five and found a 27 percentage point gap in school readiness between poor children and moderate/high income children. The data presented show that it is not poverty alone that places poor children at risk, but also the fact that their parents have low levels of education, higher rates of smoking, higher rates of depression, and lower parenting skills than children from moderate- and high-income families. These findings suggest a diverse set of policy interventions that might improve children's school readiness, ranging from smoking cessation programs for pregnant women, parenting programs, treatments for maternal depression, and policies to improve the educational attainment of low-income mothers, to income support programs and expansion of preschool programs. A simple comparison of the simulated effects of three interventions—preschool programs, smoking cessation programs, and nurse home visiting programs—suggests that the traditional approach of preschool expansion has the most promise for increasing the school readiness of poor children.

[9] Specifically, Isaacs and Magnuson estimate a 0.7 percentage point increase in the likelihood of school readiness for children from families whose annual household income during early childhood averaged $8,100, before the $1,000 increase. Note that family income had considerably smaller effects on reading and math skills in the Isaacs and Magnuson analysis than suggested by the quasi-experimental findings, suggesting that this estimate may be quite conservative.

Appendix

Data for this analysis are taken from the Department of Education's Early Childhood Longitudinal Study-Birth Cohort (ECLS-B). Assessments were conducted when the children were 9 months old, 2 years old, 4 years old, and when they entered kindergarten (either fall 2006 or fall 2007). The analysis file consists of 4,300 children with complete data on the five school readiness measures and certain key descriptive measures. The analysis was conducted using weights developed by NCES to correct for attrition and sampling design.

Measurement of School Readiness

Children were rated school ready as long as they scored no more than one standard deviation below average on measures of early math skills, early reading skills, learning-related behaviors and externalizing behaviors, provided they also had a health status of good, very good or excellent (rather than poor or fair). The five underlying measures were operationalized as follows:

- The math assessment is based on an Item Response Theory (IRT) instrument that includes questions regarding number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions. The math score was standardized to have a mean of zero and standard deviation of one across children in the sample.
- The reading assessment was derived in a similar manner, based on questions regarding basic/phonological skills, initial understanding, developing interpretation, demonstrating a critical stance, and vocabulary.
- The attention/learning-related behaviors measure reflects kindergarten teacher responses to seven questions assessing behaviors such as a child's ability to concentrate, work independently, and work until finished, as well as a child's eagerness to learn. It was standardized in the same way as the math measure.
- The externalizing problem behaviors measure, also based on teacher reports, was drawn from six questions about whether or not a child acts impulsively, disrupts others, is overly active, is physically aggressive, annoys other children, and has temper tantrums. It was reverse coded (and standardized) so that a higher score indicates a better outcome, consistent with the other measures.
- The physical health measure is based on parents' rating of the child's overall health, from a scale of one to five. The health variable was then dichotomized into either poor/fair health or good/very good/excellent health.

Independent Variables

Other key variables are measured as follows:

- Children's poverty status is measured near birth, based on cash income received by household members over the past twelve months, as reported in a parent survey conducted when the infant is about nine months. Children are classified as poor if income is below 100 percent of poverty, near-poor if income is between 100 and 185 percent of poverty and moderate/high income if income is greater than or equal to 185 percent of poverty.
- Maternal education was collapsed into three variables: Less than high school; High school graduate; College degree, based on the 9-month parent survey. Father's

education was measured the same way, with a dummy variable for when the father's data was missing.

- Marital Status is based on marital status at birth, and is dichotomized as married mothers compared to unmarried mothers (single or cohabiting).
- Teen Parent was coded as 1 if the mother was less than 20 at the time of birth.
- Race/Ethnicity was coded as Non-Hispanic White, Non-Hispanic Black, Hispanic, and Other (Asian, Mixed or other). Findings for other race are not included in the summary figures but are shown in the full regressions in Table A-2.
- Immigrant Mother was coded 1 if the mother was foreign-born.
- Low Birth Weight was coded 1 if the child's birth weight was less than 5.5 pounds or 2500 grams.
- Preschool Attendance was coded 1 if the child attended Head Start, a nursery school or pre-kindergarten program, or any form of center-based child care at age four.
- Maternal Health was dichotomized as poor/fair vs. good/very good/excellent health, measured at 9 months.
- Moderate or Severe Depression was based on the CES-D depression scale, with score "1" if scored a 10 or higher at ages 9 months, 4 years or 5 years
- Smoking during Pregnancy was coded 1 if mother said yes to a question about smoking during the third trimester.
- Low in Maternal Supportiveness was coded 1 if the mother scored below 3.5 on a 7-point index measuring parental sensitivity, parental regard, and appropriateness of parental cognitive stimulation during a videotaped parent-child observation at age two (the Two Bag test). Fifteen percent of the sample with data on this measure received this low score.
- Low in Cognitive Stimulation was coded 1 if the mother scored 7 or lower in a 12 point scale measuring frequency of reading out loud, telling stories or singing to children, based on parents' reports at age two; this represented 18 percent of the sample.
- Breastfeeding was coded 1 if mother breastfed at any time in first 9 months

The regression analysis also has variables for mother's employment, operationalized as three dummy variables for whether a child's mother has ever worked (reporting having worked in the past week at any of the four waves of the survey); whether she has ever worked full time (reporting having worked at least 30 hours in the past week at any of the waves; and whether she worked full time when the child was an infant (reporting having worked at least 30 hours in the past week at the nine-month wave). It also controls for non-parental care with three variables, one for whether the child was ever in non-relative care, one for whether the child was ever in relative care, and one for whether the child was ever in center-based care before age four. Since data were collected when children were two and four but not three, the "ever in center care before age four" variable misses some center-based experiences that may have occurred between the age two and age four survey waves. Finally, there are also controls for the number of adults and the number of children in the household as well as the child's birth month, from January-December 2001.

Regression Results

Results from the regression analyses are shown in Table A-1. The School Readiness and Health models are linear probability models estimating the change in percentage points that a child will be school ready (or in good/very good/excellent health. For example, a coefficient of -0.67 in the School Readiness model means that children in poverty a 6.7 percentage points less likely to be school ready than children from moderate/high income households, after controlling for other characteristics. The Math, Reading, Learning-Related Behaviors and Externalizing Behaviors variable are measured continuously, as Z-scores with a mean of 0 and a standard deviation of 1. For example, a coefficient of -.286 in the Math model means that children in poverty score -.286 standard deviations lower than children from moderate/high income households, all other things held constant.

Table A-1: Coefficients on Regression Analyses

	School Ready	Math	Reading	Learning-Related Behavior	External-izing Behavior	**Health**
Poor (vs. > 185%)	-.067**	-.286***	-.276***	-.129*	-.061	-.001
	(.031)	(.049)	(.052)	(.073)	(.071)	(.010)
Near-Poor (vs. >185%)	-.018	-.129**	-.137**	-.031	.003	.011
	(.030)	(.046)	(.051)	(.062)	(.056)	(.007)
Mother BA or More (vs HS)	.064**	.218***	.189***	.137**	.129**	.005
	(.025)	(.042)	(.047)	(.061)	(.043)	(.004)
Mother Less than High School	-.037	-.203***	-.170***	.059	.034	-.013
	(.037)	(.037)	(.039)	(.065)	(.070)	(.009)
Father BA or More (vs. HS)	.082***	.239***	.206***	.141**	.088*	.004
	(.024)	(.051)	(.060)	(.056)	(.046)	(.004)
Father Less than High School	-.077**	-.126**	-.150**	-.022	-.049	-.012
	(.033)	(.058)	(.055)	(.069)	(.077)	(.011)
Father Education Missing	-.048	-.144**	-.126*	-.079	-.120*	.008
	(.041)	(.067)	(.065)	(.077)	(.069)	(.009)
Married	.047	.048	.110**	.129*	.091	-.001
	(.036)	(.049)	(.051)	(.076)	(.078)	(.008)
Teenage Mother	-.008	.049	.017	-.039	-.165**	.004
	(.035)	(.061)	(.069)	(.075)	(.073)	(.007)
Female	.144***	.042	.140***	.471***	.514***	-.007*
	(.018)	(.028)	(.031)	(.037)	(.035)	(.004)
Black (vs. White)	-.024	-.146**	.085*	.015	-.058	-.023**
	(.029)	(.056)	(.047)	(.070)	(.072)	(.009)
Hispanic (vs. White)	-.030	-.188***	-.069	-.022	.050	-.023**
	(.029)	(.051)	(.052)	(.053)	(.058)	(.007)
Other Race (vs. White)	.033	-.001	.102	.015	.052	-.007
	(.031)	(.064)	(.071)	(.053)	(.077)	(.005)
Immigrant Mother	-.024	.015	.025	.004	.004	-.005
	(.028)	(.053)	(.061)	(.069)	(.057)	(.008)

(Continued on next page)

	School Ready	Math	Reading	Learning-Related Behavior	External-izing Behavior	**Health**
Low Birth Weight	-.049*	-.222***	-.102**	-.157**	-.010	-.014*
	(.025)	(.038)	(.040)	(.052)	(.051)	(.007)
Attended Preschool	.089***	.126**	.181***	.052	-.019	-.002
	(.025)	(.041)	(.046)	(.045)	(.046)	(.006)
Mother Smoked while Pregnant	-.097**	.038	.014	-.111	-.249**	.011*
	(.032)	(.054)	(.058)	(.074)	(.090)	(.006)
Child was Breastfed	-.007	.077**	.090**	.023	-.040	.006
	(.020)	(.032)	(.038)	(.045)	(.043)	(.006)
Mother in Poor/Fair Health	.000	-.125*	-.063	-.214**	.002	-.039**
	(.043)	(.065)	(.066)	(.101)	(.074)	(.015)
Low in Cognitive Stimulation	-.047*	-.122**	-.126**	-.124**	-.113*	-.005
	(.026)	(.037)	(.043)	(.046)	(.059)	(.007)
Mother Low in Supportiveness	-.098**	-.256***	-.191***	-.152**	-.063	-.002
	(.030)	(.055)	(.054)	(.070)	(.067)	(.009)

Notes: Significance levels: *** p<.01, ** p<.05, and * p< .10. Though not shown in the table, the full model also controls for maternal employment, use of relative care, use of non-relative care, use of center-based care before age four, child's age in months, number of children and adults in the household, and dummies for missing values on selected variables. The child's age in months and use of preschool or center-based care before age 4 have statistically significant effects on school readiness: babies born in April – August are 10-14 percentage points less likely to be school ready than babies born in January, and children using center-based care before age 4 are 4 percentage points less likely to be school ready than other children (significant at the 90 percent level). Use of center-based care prior to age four is measured roughly in this model but appears to be associated with small positive effects on math and reading skills, which are outweighed by larger negative effects on behavioral measures.

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