Center on Children and Families at BROOKINGS

THE SOCIAL GENOME PROJECT

Income and Education as Predictors of Children's School Readiness

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Findings

This study uses data from the Early Childhood Longitudinal Study- Birth (ECLS-B) Cohort to estimate associations between two important indicators of family socioeconomic status—family income and maternal education—and children's school readiness measured by academic skills, behavior, and physical health at school entry.

- **We find large gaps in our measures of school readiness across groups of children defined by family income and maternal education.** Such differences are much smaller, however, when potential confounds are included as controls in regressions.
- In multivariate models, we find significant, but modest, links between household income and measures of children's achievement and behavior, but not health. Specifically, our estimates imply that **an additional $1,000 of average income throughout early childhood would result in about a 0.015 standard deviation in reading and math scores for children in low-income families**, with smaller effects in children's behaviors.
- With respect to maternal education, we find higher levels of education predict higher achievement and physical health, but not behavior. Our estimates imply that **an additional year of school would increase math and reading scores by 0.06 to 0.09 standard deviations**.

The paper concludes with a discussion of the challenge of developing effective policies to increase family income and maternal education.

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Introduction

Many children and youth from families of low socioeconomic status do poorly in school. On average, they perform less well on standardized tests compared with more advantaged youth and are less likely to graduate high school and complete college. These lower levels of academic achievement and educational attainment contribute to lower levels of economic success in adulthood and lower social mobility in our society. Children born into families at the bottom fifth of the income distribution are twice as likely as middle-class children to remain in that bottom bracket as adults (Isaacs, Sawhill & Haskins, 2008). Efforts to improve the economic prospects of children from low-income families have often focused on the educational system, but often with disappointing results (Jacob & Ludwig, 2009). Disparities in academic skills and other areas of development are apparent well before children enter school, suggesting that efforts targeted early in the life course may be effective in preventing the disparities that schools seek to remediate. If we could identify strategies for improving the school readiness of disadvantaged children before they enter kindergarten, we might be able to improve their opportunities for achieving the American Dream.

Children's readiness for school is influenced by many different factors; in this paper we focus on two aspects of families' socioeconomic standing: family income and parental education. We focus on the independent effects of these family characteristics because, though highly correlated, theoretically and empirically they exert independent effects. While many parents with low levels of education often have low incomes as well, these parental resources may affect families and children in different ways. The thought experiment is as follows: if you could choose your parents, do you think you would be better off being born to educated, yet poor, parents, or to parents who were well-off, despite lacking a high school diploma? Or, to frame it as a policy question, as our nation seeks ways to improve children's school readiness, will we get more bang for the buck from policies to support parents' income or policies to increase parents' educational attainment?

Our interest in identifying key outcomes and determinants of school readiness stems from a larger project, in which a team of researchers is developing a life cycle model of the U.S. population from birth to age 40 in order to better understand how various policy interventions might improve the life prospects of disadvantaged children and increase economic mobility. This analysis is one of several being undertaken to better understand how child outcomes at key turning points (e.g., entry to school, graduation from high school) are influenced by children's circumstances at birth, their home environment, and experiences in schools and other out-of-home settings.

Background

It is widely recognized that children begin learning long before they enter school and that development proceeds at an astonishingly rapid rate during the first few years of life (Shonkoff & Phillips, 2000; Knudsen, Heckman, Cameron, & Shonkoff, 2006). Neuroscience research has documented how complex cognitive capacities are built on earlier foundational skills, and strongly shaped by interactions with caregivers and environments (Knudsen et al., 2006). Psychologists often refer to the early years as a "sensitive" period for a child's cognitive and socioemotional development, in recognition of the fact that some skills are most easily acquired during this time (Nelson, 2000).

Efforts to improve children's early school success require defining what it means to be ready for school, and what constitutes school readiness is often itself a topic for discussion. Most researchers, teachers, and parents alike point to both pre-academic skills, such as recognizing letters and numbers, as well as attention and learning-related skills, such as

sitting still and following directions. Also of importance are children's physical health and behaviors, particularly the presence or absence of problem behaviors.

Each of these domains reflects an important facet of child development and has empirical linkages to later success in school and life. Duncan et al. (2007) find that early academic skills are an important predictor of school achievement, even after adjusting for many background differences between early achievers and their peers. Early academic skills also predict high school completion, although the associations are quite small (Duncan and Magnuson, 2011). Duncan et al. (2007) also find that learning related behaviors, particularly attention skills, are predictive of later achievement. Several other studies, which use broader measures of learning-related behaviors, find that such behaviors predict academic learning in preschool and early school years (McClelland et al., 2000; Yen et al., 2004; Howse et al., 2003; Bierman et al., 2009). Behavior problems in early childhood, particularly persistent externalizing behavior problems, have been linked to educational attainment, future earnings, and crime (Duncan & Magnuson, 2010; Cunha and Heckman 2009), although some studies find it does not predict later achievement (Duncan et al. 2007; Bierman et al. 2009). Finally, physical health in early childhood has been linked to adolescent and adult health, and there is also some evidence of linkages to educational attainment and earnings (Almond & Currie, 2010; Case et al., 2005 Currie et al., 2010; Currie, 2009).

Given the sensitivity of young children's development to caregiving during their early years, school readiness studies often focus on the influence of family contexts in shaping young children's development. One of the most robust findings from these studies is the connection between parents' economic resources and their children's early development (Brooks-Gunn & Duncan, 1997). Economists, sociologists, developmental psychologists, and neuroscientists emphasize different pathways by which poverty may influence children's development. Economic models of child development focus on what money can buy.[1] They view families with greater economic resources as being better able to purchase or produce important "inputs" into their young children's development (e.g., nutritious meals; enriched home learning environments and child care settings outside the home; safe and stimulating neighborhood environments), and, for older children, higher-quality schools and post-secondary education. Thus, children from higher income families may benefit from a range of positive developmental contexts that lower income children do not experience. At the other end of the spectrum, children's exposure to multiple negative contexts (e.g., noise, pollution in low-income neighborhoods) may lead to elevated stress among children, which overwhelms their adaptive resources and thus lowers their level of well-being (Evans, 2004).

Psychologists and sociologists, perhaps not surprisingly, point to the quality of family relationships to explain poverty's detrimental effects on children. These theories suggest that higher incomes may improve parents' psychological well-being and family processes, in particular the quality of parents' interactions with their children.[2] Poverty and economic insecurity take a toll on a parent's mental health, which may be an important cause of low-income parents' less responsive and supportive parenting.[3] Depression and other forms of psychological distress can profoundly affect parents' interactions with their children.[4] A long line of research has found that low-income parents, as compared with middle-class parents, are more likely to use an authoritarian and punitive parenting style, and are less likely to provide their children with stimulating learning experiences in the home.

Seminal work by Brooks-Gunn and Duncan (1997) coordinating regression-based analyses across multiple longitudinal datasets resulted in several important conclusions. First, the association between income and children's well-being is stronger for achievement and cognitive outcomes than for behavioral ones. Second, the effect of family income is non-linear, with increases in income at the low end of the income distribution mattering more than those at the high end of the distribution. Finally, early poverty appears to be more

strongly linked to children's achievement and cognitive outcomes than poverty during later childhood.

Because poverty and economic disadvantage are confounded with many other types of disadvantages, the regression-based studies, such as those done by contributors to the Brooks-Gunn and Duncan (1997) volume, risk attributing to income what might be due to other related family characteristics (see Blau, 1999 and Mayer, 1997 for a discussion of these issues). In the years since, numerous studies have sought to better identify the causal role of income by capitalizing on quasi-experiments, in which policy changes have increased parents' economic resources. Unfortunately, many studies of this type look at achievement and older children and only two studies focus specifically on early academic skills among young children.

In an analysis of data from seven random-assignment welfare and anti-poverty studies, Duncan and colleagues (2011) found that preschool and elementary school children's academic achievement was improved by programs that boosted both income and parental employment, but not by programs that only increased employment. Their results suggested that a $1,000 annual income boost is associated with between .05 and .06 standard deviation gains in achievement test scores. Milligan and Stabile (2008) found similar results in a study that took advantage of variation across Canadian provinces in the generosity of the National Child Benefit program to estimate income impacts on child achievement. Contemporaneous increases in family incomes were associated with increased receptive vocabulary skills for children ages 4-6 in families with low levels of maternal education. The effect was sizeable, with a $1,000 annual income increase being associated with nearly a .07 standard deviation difference. Follow-up analyses found that these effects persisted over time and were largely concentrated among boys.

Milligan and Stabile's study also examined behavioral and health outcomes, albeit across a larger age range of children. They found that income increases were associated with reductions in aggression, primarily for girls, but not with changes in children's health status or attention. Dearing et al. (2006) also found significant negative effects of lower family income on externalizing behavior, especially for children who live in chronically poor households, but not on internalizing behavior. The lack of contemporaneous links between family income and young children's health in the United States and Canada is complicated by the general good health experienced by most children in developed nations. There is research, however, finding robust links between early childhood poverty and negative adult health outcomes (Duncan et al., 2010), as well as between family income and low birth weight, often used as a measure for health at birth (Currie, 2009).

In sum, prior studies suggest that family income in early childhood is associated with children's school readiness, however, the associations are non-linear and strongest for children's academic skills. The magnitude of the associations with children's learning related behaviors, problem behaviors, mental health, and physical health are less robust and more selective.

Studies of children's development routinely find that children with more highly educated parents have higher levels of cognitive development and academic achievement than children of parents with lower levels of education (Haveman & Wolfe, 1995). Although most studies consider parents' education to be fixed during a child's life, it has become increasingly common for adults to accrue education in a discontinuous fashion, and to extend their schooling well into adulthood (Astone et al., 2000; Jacobs & Stoner-Eby, 1998). Attending school during adulthood is particularly common for economically disadvantaged mothers (Rich & Kim, 1999).

One obvious way in which higher levels of parental education may benefit children is through higher family income. Parents' skills also may directly improve child well-being, for

example, by improving parenting behaviors and parents' abilities to accomplish their parenting goals (Attewell & Lavin, 2007; Michael, 1972). More educated parents spend more time with their children, and their time is spent in ways that are more likely to enhance their children's development (Guryan et al., 2008; Kalil & Ryan, 2010). In addition, parents with higher levels of education promote their children's achievement by holding higher expectations for their children, providing more stimulating learning materials and activities, engaging in higher quality parent-child instruction, using more varied and complex language and speech patterns, as well as becoming involved in and supportive of their children's learning (Attewell & Lavin, 2007, Davis-Kean, 2005; Hoff, 2003; Neitzel & Stright, 2004; Raviv, Kessenich, & Morrison, 2004; Richman, Miller, & Levine, 1992). Because the various possible mechanisms linking parents' schooling to their children's development are usually studied in isolation, it is unclear which of these pathways is most important. It is also not known how these processes might interact to promote and reinforce children's achievement.

As is the case for family income, most studies do not clearly isolate the causal effect of parental education on school readiness (Sobel 1998). Few studies are able to disentangle parents' educational attainment from other sources of advantage, such as cognitive endowments, that may lead to higher levels of achievement among both parents and children. The few U.S. studies that have tried to isolate the effects of parental education *per se* typically find positive but modest effects of maternal and paternal education on children's outcomes, with an additional year of schooling associated with an increase in children's test scores of about 0.10 of a standard deviation (Neiss & Rowe, 2000; Rosenzweig & Wolpin, 1994).[5] A study by Carneiro and colleagues (2007) using instrumental variables found an additional year of maternal education would increase children's reading and math scores by .05-.10 standard deviations at ages 7 or 8, but have a much more limited effect at ages 12-13. There is some evidence that the effects of parental education may be non-linear, such that increasing the education of mothers with a high school degree or less boosts children's achievement more than increasing the schooling of college-educated mothers (Haveman & Wolfe, 1995; Gennetian, Magnuson, & Morris, 2008). For example, a recent study suggests welfare recipients randomly assigned to participate in mandated education or training improved their young children's academic school readiness by as much as a quarter of a standard deviation (Gennetian, Magnuson, & Morris, 2008). However, a study with the ECLS-K data finds a somewhat smaller effect of about .10 standard deviations from an additional year of maternal schooling among low-educated mothers.

Research on maternal education's causal effect on children's behavior problems and mental health is very limited. In an analysis of the welfare-to-work experiments, Magnuson (2003) found no significant associations between maternal education and children's externalizing behavior and pro-social behavior, as reported by mothers. Carneiro and colleagues (2007) found that an additional year of maternal education was associated with a .05 to .09 standard deviation reduction in behavior problems index at ages 7-8, but again a smaller amount among older children.

Research examining maternal education's effect on a child's physical health in developed countries is similarly sparse. Currie (2009) notes that although there is a robust correlation between parental education and child health, the causal literature "is small and still has many holes." Currie and Moretti (2003) use availability of colleges in the woman's county of residence while she is college age as an instrument for maternal education, and estimate that an additional year of maternal education reduces both low birth weight and pre-term birth probabilities by 1 percentage point. McCrary and Royer (2006), on the other hand, use school entry date policies in California and Texas as an instrument and conclude that maternal education does not affect low birth weight, gestational length, or infant mortality. These findings suggest that the extent to which maternal education is causally linked to children's later behaviors and health is not fully understood.

In sum, the prior literature suggests that both family income and maternal education will have strong associations with at least some aspects of school readiness. Yet, no study to date has provided a comprehensive examination of the strength of these associations with multiple domains of school readiness, using nationally representative data. The present study aims to fill this gap in the literature by using rich nationally representative panel data to examine the effects of family income and maternal education on several key domains of school readiness.

Data

Data for this study are taken from the Department of Education's Early Childhood Longitudinal Study-Birth Cohort (ECLS-B).The ECLS-B follows a nationally representative birth cohort of over 10,000 children born in 2001. 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). Through direct child assessments, parent surveys, and teacher surveys, the ECLS-B gathered data about children's school readiness, as well as information on their birth circumstances, parents and home environments, and out-of-home care settings.

We combined child outcome data from the fall 2006 and fall 2007 surveys in order to examine school readiness for children who were generally age five and had entered kindergarten by the time of assessment.[6] Our analysis file consists of 6,800 children who are in the sample through the fall of entering kindergarten and we used the weights developed by NCES for kindergarten entry to correct for attrition and sampling design.[7]

School Readiness Measures

The five child outcome measures used in this analysis data were collected through a combination of direct assessment of the children and surveys of their parents and kindergarten teachers. Early academic skills are measured in two domains, math and reading skills, using Item Response Theory (IRT) instruments designed for the ECLS-B and completed when the child was five years old and had recently entered kindergarten (in the fall 2006 or 2007). The reading assessment includes questions regarding basic/phonological skills, initial understanding, developing interpretation, demonstrating a critical stance, and vocabulary. The mathematics assessment includes questions regarding number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions.

Our measure of learning-related behaviors 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. The scale has a high level of internal consistency (alpha Cronbach is .90).

Teacher reports also are used to construct a measure of externalizing problem behaviors, based on 6 questions about whether or not a child acts impulsively, disrupts others, is overly active, is physically aggressive, annoys other children, and has temper tantrums. The scale has a high level of internal consistency (alpha Cronbach is .90).

Finally, physical health is based on the parent's overall rating of child health on a 5-point scale (1 poor and 5 excellent). We collapsed the five categories into just two categories to create a dichotomous variable (poor/fair health vs. good/very good/excellent health). This dichotomization avoids placing undue importance on the difference between very good and excellent health, a distinction which is unlikely to be relevant for a child's school readiness.

With the exception of the health measure, we used continuous measures of outcomes. Each continuous outcome was standardized to have a mean of 0 and a standard deviation of 1. A higher score indicates a better outcome for all school readiness outcomes (e.g., more learning-related behaviors, fewer behavior problems, in good/very good/excellent health).

We also created a summary school readiness measure—the percentage of children who score no more than one standard deviation below average on the four continuous measures and have a health status of good or higher.[8] We do not believe that children who are 1.05 standard deviations below average are dramatically less likely to succeed in school than children who are 0.95 standard deviations below average, nor is there much break in the data at these cut points. As a result, the thresholds are somewhat arbitrary, selected in the absence of good evidence for empirically based thresholds within each domain that distinguish children who will succeed in kindergarten from those who will not. Still, it provides a useful summary of school readiness across the five domains.

Our summary measure is a complement, not a replacement, for the individual measures, each of which captures a different dimension of child development. While there are strong correlations between our two measures of early academic skills (0.78) and between our measure of learning-related behaviors and problem behaviors (0.70), there are smaller correlations between academic skills and behaviors (ranging from 0.22 to 0.44). Finally, the correlation between health and other measures is quite low (0.12 or lower).

Family Income and Maternal Education

The ECLS-B collects information on total household income in each year of the parent interview. We average this measure of pre-tax, cash household income over the four interviews in early childhood to get a better measure of economic resources than is provided by a single year of income, and express it in 2001 dollars. The underlying ECLS-B data is a mixture of exact income for low-income households near the poverty line and categorical data for the majority of the sample (in $5,000-$10,000 increments). For observations with categorical data, we impute continuous income by regressing household income on family characteristics for a nationally-representative sample of similarly-aged children from the Current Population Survey (CPS) born during the same year as the ECLS-B children, and using this regression to impute incomes – within categories – in the ECLS-B. As an alternative measure of income, we use a measure of household income divided by the federal poverty threshold based on household size, to produce a more refined measure of a family's per capita command over resources. This measure is calculated by the National Center for Education Statistics (NCES) and does not rely on our income imputations, though it does include some imputation by NCES.[9]

Our main education variable is mother's highest level of education, measured at the first interview (child's age 9 months). We focus on maternal education because it measures the human capital of the parent who is most often the child's primary caregiver. We also control for the father's education. Additionally, to capture the grandparents' socioeconomic status we control for the maternal grandparents' education (with the latter defined as the higher of the maternal grandmother or maternal grandfather's education). These education variables are coded into five-categories: less than a high school degree, high school diploma/equivalent, some college or vocational/technical program, bachelor's degree or some graduate school, and a master's degree or above.[10]

In some analyses, we examined not only these five categories, but also the extent to which mothers gained in educational attainment between the first interview and the child's entry to kindergarten. In the process of developing this longitudinal measure of educational attainment, we found we had to clean the data on maternal education when the child is 2, 4 and 5 years, in order to minimize observations where a mother would report non-logical changes in education (i.e., a mother would report having a college degree at the 9-month interview and the same mother would report having a high school diploma at age 2 years and then a college degree at age 4 years).[11]

Descriptive Statistics

We are interested in the extent to which school readiness differs by family economic resources and parental education. We begin considering this question by estimating simple differences across groups defined by different family income and parental education characteristics. Simple differences across groups indicate the strong association between income (and related measures) and school readiness outcomes (see Table 1). Fewer than half (46 percent) of children with household incomes of less than $25,000 at age five score well on all five readiness measures in our analysis, compared to 84 percent of children from households with incomes of more than $100,000. Similar patterns are found when economic disadvantage is measured by asset ownership or poverty status. Moreover, the relationship between family resources and school readiness outcomes is consistently monotonic, with each increase in family resources at birth associated with an increase in school readiness outcomes for each of the measures in the analysis.

On average, differences in academic skills (math and reading) across income subgroups are larger than differences in learning-related behaviors and problem behaviors across these groups. For example, average early academic skills for children born into poor families are about one-half standard deviations below average (-0.51 on math and -0.46 on reading), while average behavioral measures for poor children are about one-quarter of a standard deviation lower than average (-0.27 on learning-related behaviors and -0.18 lower on problem behaviors). In addition, poor children are 1.9 percentage points less likely to be in good to excellent health than children overall.

In any one year, about 24 percent of our sample of young children lived in poverty, but a much larger percentage—40 percent—were poor in at least one year of the four years in which their parents were interviewed (at roughly 9 months, 2 years, 4 years and 5 years). This includes 9 percent who were persistently poor each year observed, 18 percent who were poor in 2 or 3 years, and 12 percent who were poor in one of the four years observed. Not surprisingly, the children who were in persistently poor families have lower levels of performance than those who experienced transient poverty. Again, we see that differences are more pronounced for achievement than for the behavioral measures. However, the pattern fails to be strictly monotonic. For instance, there is little difference between children who are persistently poor and children poor for three out of four years; the difference in math readiness is the only difference that was statistically significant (at 95 percent level of confidence).

Turning to education, the descriptive results in Table 2 show that maternal education also is strongly associated with school readiness. Average math and reading readiness scores range from about -0.5 for children whose mothers lack a high school diploma to +0.7 for children whose mothers have a master's degree or higher. Behaviors are less sensitive to maternal education, with attention and other learning-related behaviors ranging from -0.2 to +0.3 and problem behaviors ranging from -0.1 to +0.2 between the top and bottom educational subgroups. Health outcomes, though showing little variation in our measure, are associated with maternal education: 95.4 percent of mothers in the lowest maternal education subgroup report their children are in good/very good or excellent health compared to 99.9 percent of mothers in the highest maternal education subgroup (these percentages are 2.6 percentage points below and 1.9 percentage points above the overall average, respectively). Less than half (47 percent) of children whose mothers did not complete high school are school ready under our summary measure, compared to 83 percent of children whose mothers have a bachelors degree.

Table 1. School Readiness Outcomes by Family Economic Circumstances

	In Subgroup (Percent)	Math (z-score)	Reading (z-score)	Learning-Related Behavior (z-score)	Problem Behavior (z-score)	Good Health (Delta Percent for All *)	School Ready (Percent)
All	100.0	0.00	0.00	0.00	0.00	0.0	65
By Household Income (at 9 months)							
Less than $25,000	35	-0.43	-0.37	-0.19	-0.11	-1.5	51
$25,001 - $50,000	30	-0.05	-0.05	-0.02	-0.01	0.2	62
$50,001 - $100,000	26	0.36	0.33	0.15	0.06	1.1	78
Greater than $100,000	10	0.68	0.54	0.32	0.25	1.7	86
By Household Income (at 5 years)							
Less than $25,000	27	-0.48	-0.43	-0.27	-0.19	-1.5	46
$25,001 - $50,000	28	-0.17	-0.15	-0.07	-0.03	-0.3	61
$50,001 - $100,000	28	0.24	0.22	0.16	0.13	0.7	74
Greater than $100,000	17	0.61	0.54	0.26	0.13	1.6	84
By Assets (Checking/savings account, investments or own home, at 9 months)							
None	20	-0.50	-0.47	-0.29	-0.17	-3.1	44
Only 1 of above assets	26	-0.20	-0.16	-0.13	-0.10	0.1	58
2 of the above 3 assets	22	0.06	0.07	0.01	0.00	0.8	68
All 3 assets	30	0.44	0.38	0.29	0.21	1.3	81
By Poverty Status(at 9 months)							
Less than 100% FPL	23	-0.51	-0.46	-0.27	-0.18	-1.9	48
100% to 184% FPL	25	-0.22	-0.21	-0.07	-0.02	0.2	59
185% FPL or more	52	0.33	0.30	0.15	0.09	0.8	75
By Time Spent in Poverty							
Each year interviewed**	9	-0.67	-0.60	-0.35	-0.24	-1.8	42
3 out of 4 interviews	9	-0.47	-0.48	-0.35	-0.20	-1.7	45
2 out of 4 interviews	9	-0.36	-0.31	-0.22	-0.12	-2.0	51
1 out of 4 interviews	12	-0.25	-0.15	-0.04	0.00	-0.7	60
Never observed poor	60	0.28	0.24	0.14	0.08	1.0	75

Notes: The percentages in each subgroup may not add to 100 because of rounding and omission of small numbers of children whose subgroup is unknown. * The health measure shows the difference in percentage points from the overall percentage of children in good, very good or excellent health (98.0 percent). **Children are observed at ages 0, 2, 4 and 5. The longitudinal analysis of years spent in poverty is restricted to children who participated in all relevant waves of the survey.

Differences in school readiness outcomes by father's education follow similar patterns, with school readiness increasing with father's educational attainment. However, children with low-educated fathers do not score as poorly as children with low-educated mothers. Half (50 percent) of children whose fathers lack a high school diploma are school ready compared to 84 percent of children of college-educated fathers. We also find a positive association between child outcomes and the educational level of the children's grandparents (measured on their mother's side), with the association strongest for achievement and health.

The longitudinal data in the ECLS-B allows us to divide each of our five maternal education subgroups into two groups: those that maintain the same educational status during early childhood and those that gain education by the time the child is five. Gains in maternal education are associated with higher math and readiness scores at each level of maternal education, although not all differences are statistically significant. For example, the subgroup that has an education gain above a base level of "less than high school" has a mean reading readiness score of -0.37, significantly higher than the subgroup that has "less than high school" in both time periods (-.60).[12] However, the same is not true for children's behavior.

For four out of five education levels, gains in maternal education are associated with unchanged or even negative behavioral outcomes. Continuing the example above, the learning-related behaviors for the "less than high school" group with education gains are worse than for the group that remains unchanged (-0.30 vs. -0.06, a statistically significant difference) and the gap is even larger for problem behaviors (-.22 vs. +.13). The generally negative correlation raises the possibility that children's behavior may be adversely affected by the experience of having a mother actively pursuing educational degrees during early childhood, although there may be a third underlying factor (such as unemployment or maternal job loss) that explains both the pursuit of education and the child's behavior.[13]

Table 2. School Readiness by Education Levels

	In Sub-group (Percent)	**Math** (z-score)	**Reading** (z-score)	**Learning-Related Behavior** (z-score)	**Problem Behavior** (z-score)	**Good Health** (Delta Percent for All)*	**School Ready** (Percent)
All	100.0	0.00	0.00	0.00	0.00	0.0	65
By Maternal Education (9-month)							
Less than high school diploma	20	-0.56	-0.52	-0.19	-0.09	-2.6	47
High school/GED	29	-0.20	-0.17	-0.13	-0.08	-0.2	57
Some college/voc or technical	27	0.12	0.11	0.03	-0.02	0.6	70
B. A./ some grad school	17	0.51	0.45	0.28	0.19	1.5	83
MA/MS or above	7	0.74	0.69	0.31	0.21	1.9	85
By Father's Education (9-month)							
Less than high school diploma	12	-0.44	-0.43	-0.09	0.01	-2.2	50
High school/GED	19	-0.11	-0.11	-0.06	-0.02	-0.1	60
Some college/voc or technical	22	0.15	0.15	0.07	0.07	0.6	72
B. A./ some grad school	16	0.49	0.42	0.30	0.20	1.2	84
MA/MS or above	11	0.74	0.70	0.35	0.25	1.9	86
Unknown	20	-0.41	-0.34	-0.31	-0.31	-0.6	50
By Grandparents' Education (9-month							
Less than high school diploma	26	-0.35	-0.31	-0.11	0.01	-1.4	54
High school/GED	26	-0.01	0.00	0.02	0.00	0.0	66
Some college/voc or technical	20	0.13	0.06	-0.03	-0.05	1.0	68
B. A./ some grad school	15	0.26	0.28	0.09	-0.03	1.3	74
MA/MS or above	10	0.54	0.50	0.23	0.15	1.3	81
By Maternal Education Over Time (Ages 9 months and 5 years)**							
< HS diploma at both ages	12	-0.61	-0.60	-0.06	0.13	-2.8	48
< HS diploma + education gain	5	-0.47	-0.37	-0.30	-0.22	-1.8	49
HS diploma/GED	20	-0.21	-0.20	-0.10	0.00	-0.5	59
HS diploma + education gain	6	-0.17	-0.12	-0.11	-0.20	0.9	57
Some college or voc/tech	22	0.10	0.09	0.03	-0.03	1.0	71
Some college + education gain	2	0.36	0.39	0.24	0.11	***	77
B.A.	14	0.48	0.43	0.27	0.22	1.5	84
B.A. + education gain	1	0.54	0.46	0.31	0.13	***	82
MA/MS or higher	8	0.71	0.66	0.32	0.23	1.9	85
MA/MS + education gain	0.6	0.92	0.77	0.15	-0.23	***	**

Notes: The percentages in each subgroup may not add to 100 because of rounding and omission of small numbers of children whose subgroup is unknown.* The health measure shows the difference in percentage points from the overall percentage of children in good, very good or excellent health (98.0 percent). ** In the case of maternal education over time, 8 percent of the sample are missing, including 5 percent with unknown education of the biological mother in at least at one time period (due to item nonresponse or biological mother not living in household) and 3 percent where maternal education was reported to drop over time, even after significant cleaning of maternal education data. *** Cell size too small to produce reliable estimate.

Gaps in academic skills tend to be larger across SES groups than across subgroups defined by other characteristics, as shown in Figures 1 and 2. The range in average math readiness outcomes between the lowest and highest education and income groups, for example, is 1.3 standard deviations for education and 1.1 for household income. This is considerably larger than the range of 0.6 between children of single and married mothers and the similar-sized gaps between children of teen mothers and mothers in their 30s, and between black or Hispanic children as compared with non-Hispanic white children. It also is much larger than the 0.5 gap by preschool experience, where both Head Start children and children who did not attend any preschool program have lower math readiness than children who attended a preschool program other than Head Start. Reading readiness scores generally follow the same pattern as math readiness scores (see Figure 2). For tabulations underlying the figures, see Appendix Table A1.

The pattern is somewhat different for the behavioral measures, where differences by gender and family structure are as large, if not larger, than differences by SES (see Figures 3 and 4). Boys exhibit more behavior problems and fewer learning-related behaviors than girls, with the differences amounting to half a standard deviation. Children of single parents also score nearly a half standard deviation lower than children of married parents on both behavioral measures (.49 and .46 on the two measures). Differences across income and education groups are of a similar magnitude – half a standard deviation—for learning-related behaviors, but are smaller for problem-related behaviors (0.3 to 0.4). Children of teen mothers score about 0.4 standard deviations below older mothers across both behaviors. One interesting contrast to the normal pattern of lower school readiness scores for more disadvantaged groups is that Hispanics, though below average on math and reading, are rated by teachers near the national average with regard to externalizing or problem behaviors, and children of immigrants do better than average on this behavior measure (see Figure 4).

In the domain of physical health, mothers who lack a high school diploma and immigrants are the least likely to report their child is in good to excellent health, followed by poor children, Head Start children, and low birth weight children, (between 3.5 and 4 percent in poor/faith health), as shown in Figure 5.[14]

Looking at overall school readiness outcomes across SES and non-SES subgroups, there are three subgroups in which fewer than half (47 to 49 percent) of the children are doing well on all five school readiness measures: those born below poverty, to mothers without a high school degree, or to single mothers (see Figure 6). Children of teen-age parents and children with household income less than $25,000 at birth also have very low rates of school readiness (51 percent). At the other extreme, more than 80 percent of children in the highest income group (>$100,000) and the two highest education groups (bachelors, and masters or higher) are school ready. In brief, while patterns differ somewhat across school readiness outcomes, socioeconomic status is highly correlated with school readiness.

Figure 1. Math Readiness by Child and Family Characteristics

Figure 2. Reading Readiness by Child and Family Characteristics

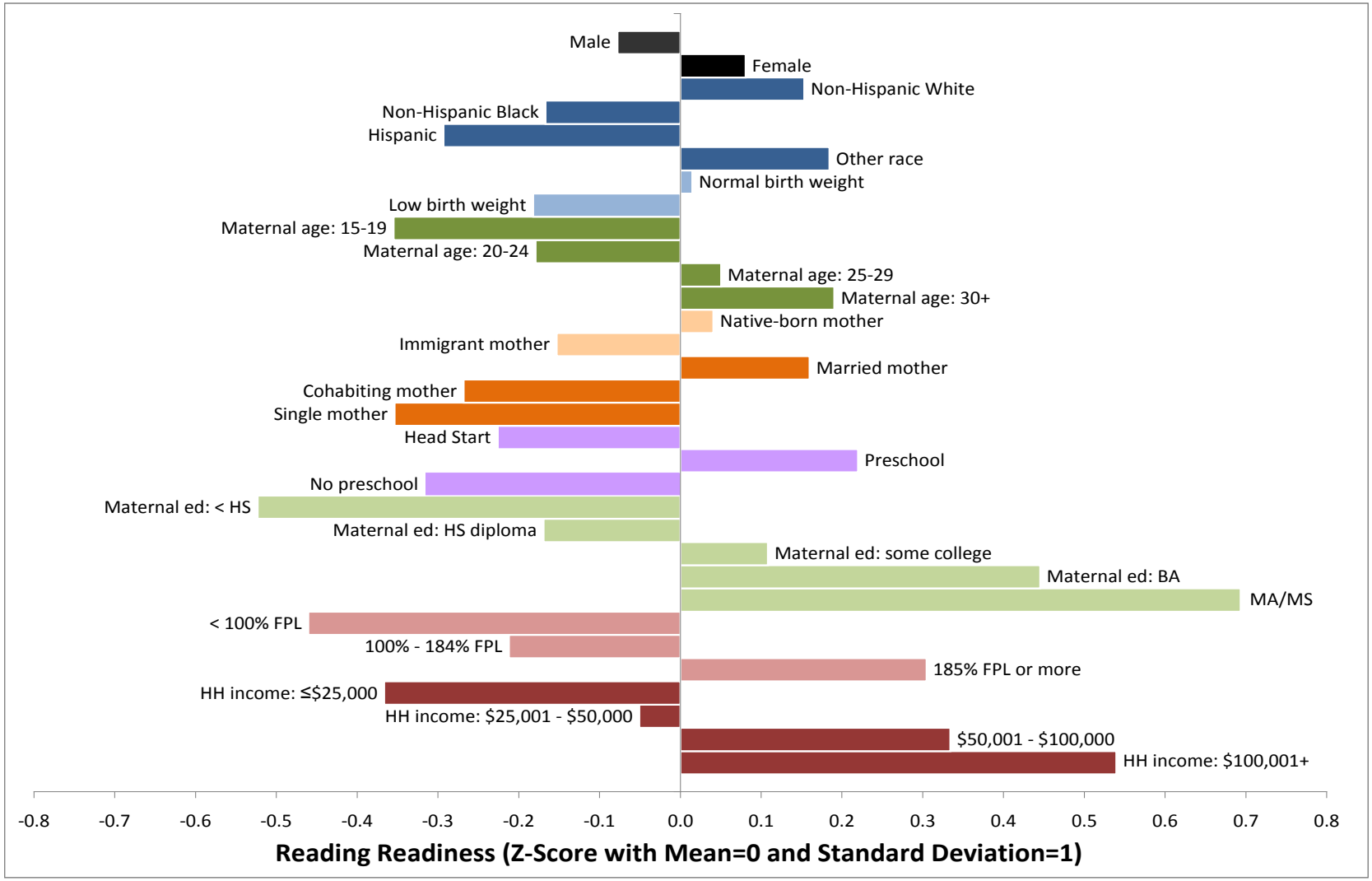


Figure 3. Learning-Related Behaviors by Child and Family Characteristics

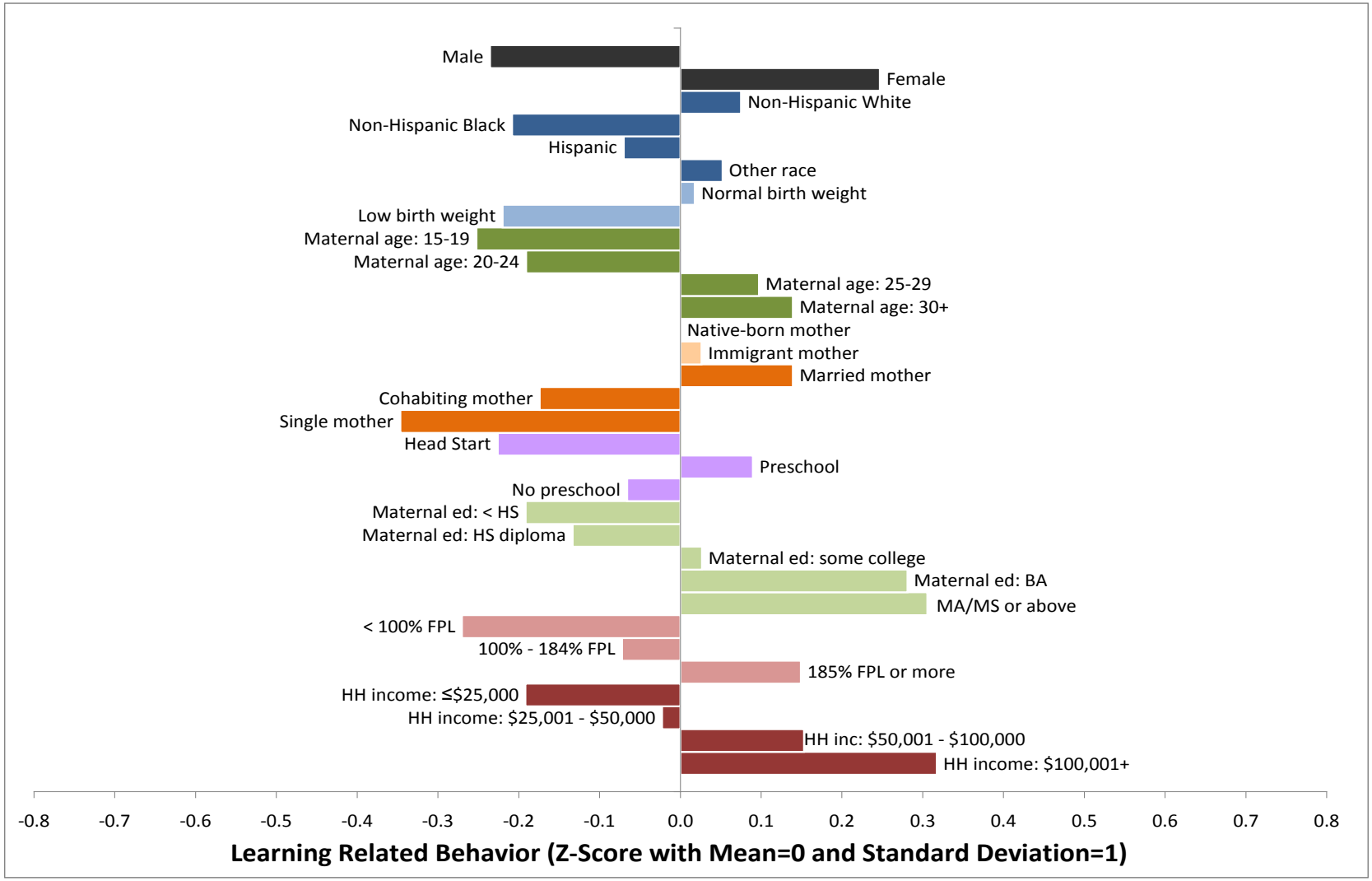


Figure 4. Problem Behaviors by Child and Family Characteristics

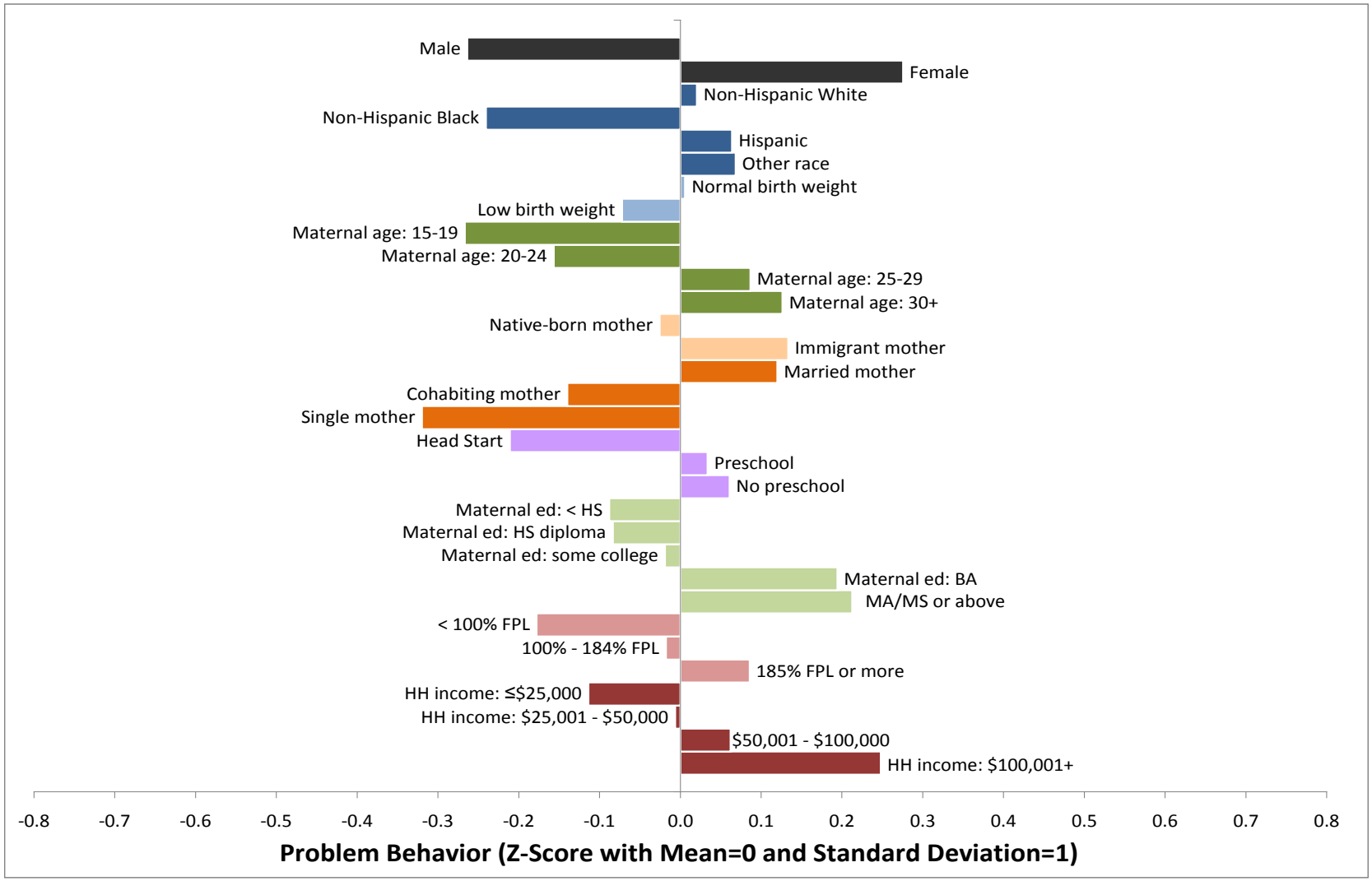


Figure 5. Physical Health Outcomes by Selected Child and Family Characteristics

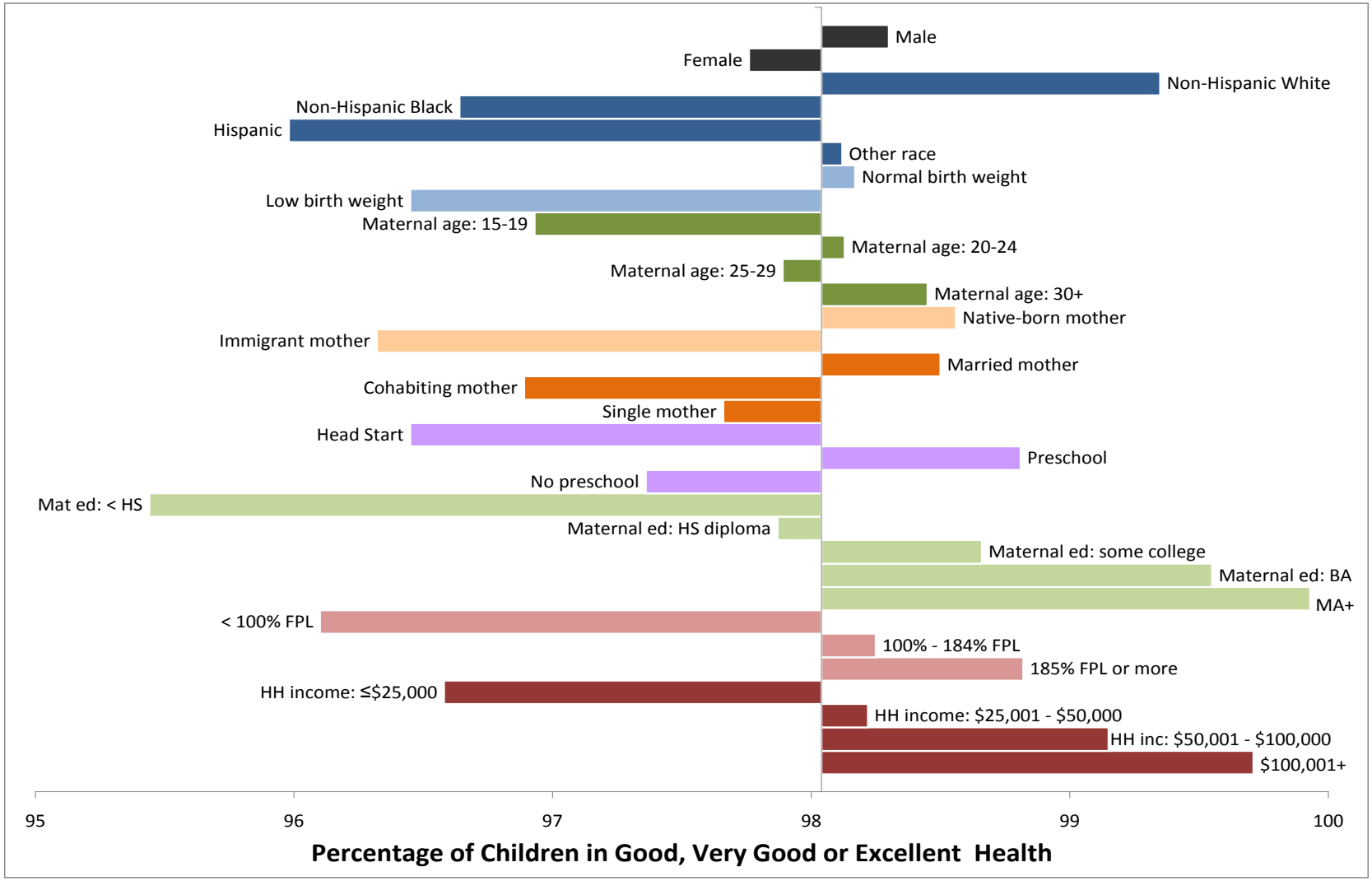
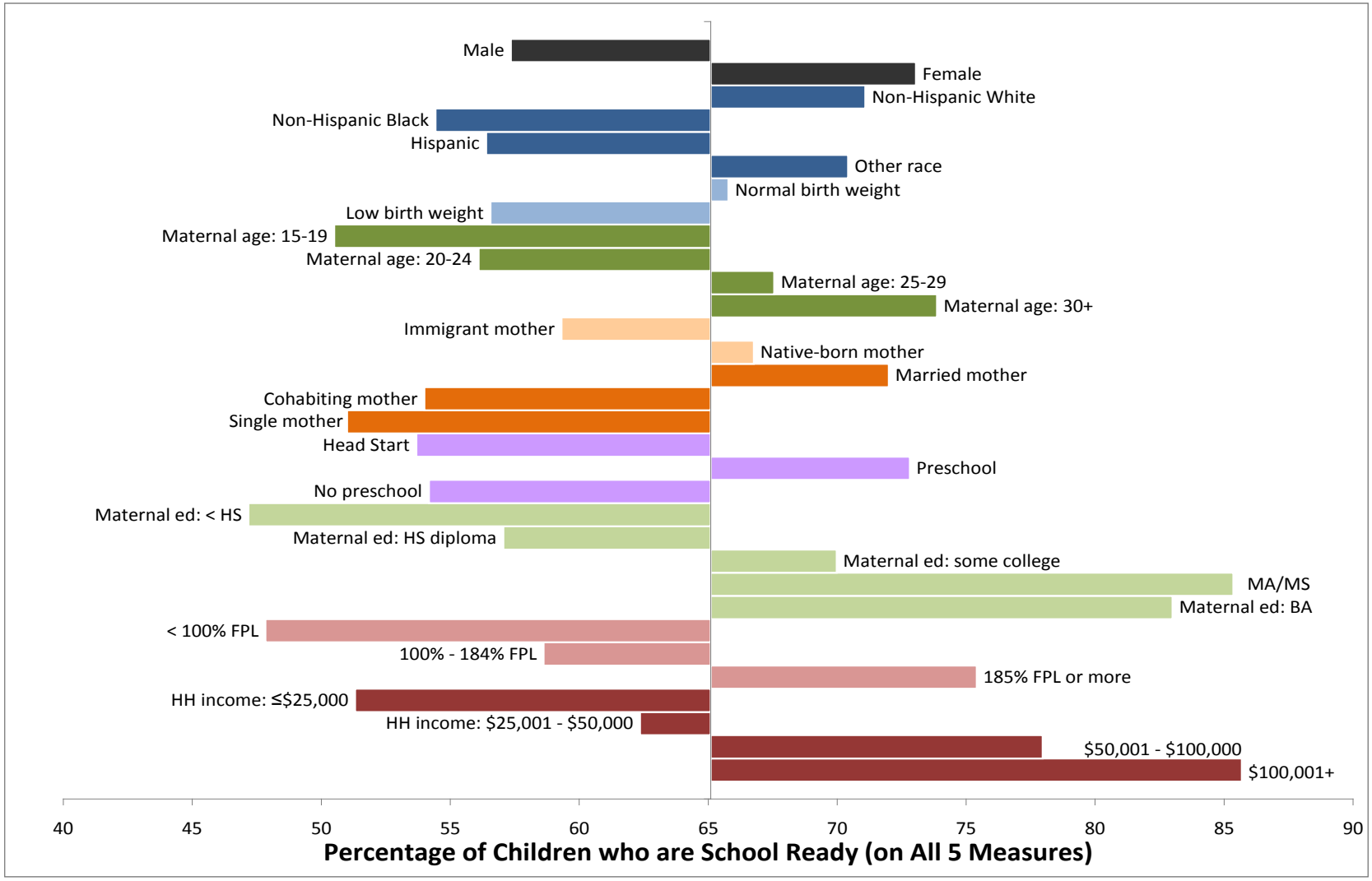


Figure 6. Overall School Readiness by Selected Child and Family Characteristics



Although the descriptive statistics provide a portrait of how children are performing, they do not adequately indicate the extent to which differences in children's school readiness can be uniquely attributed to income or parental education. Indeed, disadvantages are confounded in families, and mean differences between groups undoubtedly overstate the importance of household economic and parental education. For this reason, we also estimate regression models that include covariates.

In selecting covariates for our multivariate analyses, we are careful to select factors that are likely to be correlated with our independent variables of interest, but unlikely to be directly resulting from them. In this way, we avoid overcontrolling for factors that may themselves be part of the mechanisms that explain how household income or parental education may affect children. Most notably, we do not control for preschool participation, which is itself influenced by both family income and maternal education. In all our regressions we control for the following family and child characteristics measured at 9 months: gender; race (non-Hispanic White, non-Hispanic Black, Hispanic, or Other); birth date of the child (in months); grandparents', mother's and father's education (less than high school, high school, some college or vocational/technical program, Bachelor's degree or some graduate school, Master's degree or higher); family structure at birth (biological mother is cohabitating with a partner, biological mother is single, biological mother is married); mother's age at birth (continuous measure in years); whether mother worked prior to birth; birth order (dummy indicator for first born); immigrant status; region of the country (Midwest, South, West, or East); household size (continuous); and whether the family resides in an urban community. In the income regressions, we also include measures of whether the mother smoked while pregnant, whether the baby was breastfed, and whether the mother was in good health. We excluded these measures from the parental education regressions because there is evidence that maternal education may determine such health related behaviors.

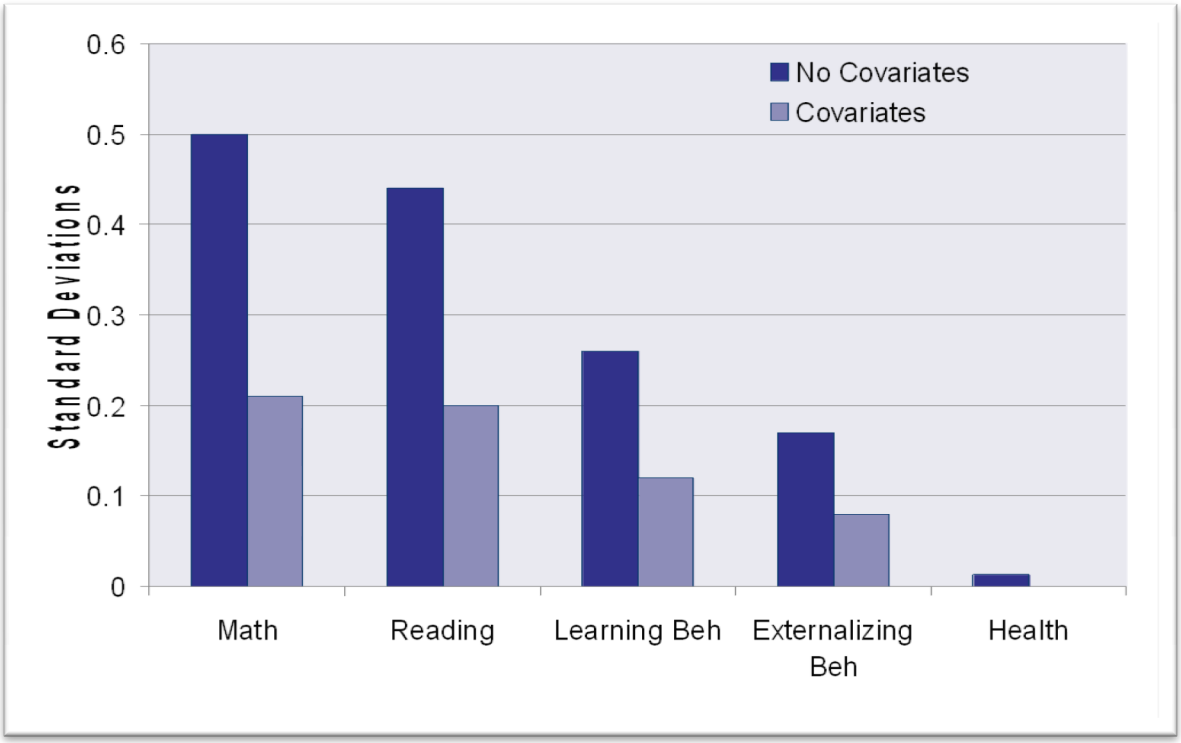
Household Income

Prior theory and research suggest that increased income for low-income families is likely to matter more than increases for more affluent families. For this reason, we use non-linear specifications of household income in all of our estimation models. First we examine the simple relationship between the natural log of household income and the school readiness outcomes, without any other covariates (see Panel A of Table 3). As would be expected from the descriptive results already presented, associations between household income and children's academic skills are stronger than those with either behavior or health.[15]

Of more interest may be the results where covariates are entered into the estimation models. The resulting coefficients on household income drop in half for most measures, as shown in Figure 7 and Panel B of Table 3. For example, we find that a one unit increase in log income predicts a 0.21 standard deviation increase in math test scores. To aid in interpreting results, a one unit increase in log income is equivalent to an increase of almost $14,000 for a very low-income family (average household income of about $8,000) and an increase of $63,000 for a moderate-income family (average household income of about $36,000).[16] These coefficients suggest that for a very low-income family, an increase of $1,000 in average household income during early childhood is associated with an increase of about .015 standard deviations in reading and math, with much smaller increases in behavior (.008 and .005 standard deviations respectively). Income effects are smaller for moderate-income families (0.003 in math test scores for families at $36,000). Though small, the

effects of income remain statistically significant, except for our measure of physical health, which is not associated with household income once covariates are added.

Figure 7. Estimated Effects of Log Household Income, With and Without covariates



Our results for school readiness, estimated as marginal effects for a child at the mean of all variables, show that a one-unit increase in log income is associated with an 8.3 percentage point higher probability of being school ready (see last column of Table 3). At the mean log household income of 10.5 ($36,000), a one-unit increase would correspond to about a $63,000 income increase. Equivalently, at this point in the income distribution, a $1,000 increase in average household income would be associated with a 0.1 percentage point probability of being school ready at age five. If we estimate marginal effects at a much lower point in the income distribution (at $8,100), we get a slightly larger marginal effect (.092, $p<.05$, result not shown). At this lower income level, a $1,000 increase in average household income would be associated with a 0.7 percentage point increase in the probability of being school ready. Although the effects of income may appear small, it is one of very few variables that has a significant effect on overall school readiness as shown in Appendix Table A2.

Table 3. Summary of Regressions of School Readiness on Household Income

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Panel A. Bivariate Association with No Covariates						
Natural log of average income	.50***	.44***	.26***	.17***	.013***	.184***
	(.02)	(.02)	(.02)	(.02)	(.002)	(.014)
Panel B. Multivariate with Covariates						
Natural log of average income	.21***	.20***	.12**	.08*	-.000	.082***
	(.03)	(.03)	(.04)	(.04)	(.002)	(.024)
Panel C. Multivariate using spline regressions with knot at $25,000 (scaled in $10,000)						
Average income <$25,000	.16***	.18***	.14**	.14**	-	.069**
	(.04)	(.04)	(.06)	(.06)		(.029)
Average Income >$25,000	-.14***	-.16***	-.13**	-.14**	-	-.061**
	(.04)	(.04)	(.06)	(.06)		(.029)
Panel D. Time Spent in Poverty (Omitted: Never Observed Poor)						
Poor in 1 out of 4 Years	-.18***	-.08	-.01	.04	-.004	-.019
	(.05)	(.06)	(.07)	(.07)	(.004)	(.034)
Poor in 2 out of 4 Years	-.17**	-.13**	-.17*	-.09	-.006	-.085*
	(.05)	(.06)	(.09)	(.09)	(.005)	(.044)
Poor in 3 out of 4 Years	-.20**	-.24**	-.29**	-.16*	-.005	-.132**
	(.07)	(.07)	(.10)	(.09)	(.004)	(.045)
Poor in 4 out of 4 Years	-.36***	-.32***	-.21*	-.17	.000	-.121**
	(.08)	(.07)	(.11)	(.11)	(.004)	(.054)

Notes: Significance levels: ***p<.01 **p<.05 *p<.10. The "Health" and "School Readiness" columns present results from probit regressions expressed as marginal effects. Covariates for Panels B, C and D include race, gender, month of birth, education of mother's parents, family structure, mother's age at birth of child, firstborn status, whether mother worked prior to birth, maternal education, paternal education, region, mother's immigrant status, household size, smoking during pregnancy, breastfeeding, health status of mother, lives in urban area. For full results for Panel B, see Appendix Table A2. In accordance with National Center for Education Statistics (NCES) guidelines, sample sizes are rounded to the nearest 50For all math and reading multiple regressions, N = 6400 (for the bivariate regression, N = 6650). For all learning-related behavior and externalizing behavior multiple regressions, N = 4500 (for the bivariate regression, N = 4700). For all health multiple regressions, N = 6500 (for the bivariate regression, N = 6800). For all school readiness multiple regressions, N = 4300 (for the bivariate regression, N = 4500). Variable definitions: Average income" is the mean of household income between birth and age five. In panel C, a unit of income is $10,000. Math, reading, learning-related behavior, and externalizing behavior scores are standardized to have a mean of 0 and a standard deviation of 1. Health is dichotomized as poor/fair health and good/very good/excellent health. School readiness is dichotomized as school ready (scoring well in each of the five outcomes as explained in the text) or not.

An alternative method to specify non-linear associations is to estimate a spline regression, which allows the slope of the regression line to differ based on a designated "knot" or turning point. We place the knot in our spline regression at $25,000 based both on prior research (Duncan et al., 2010) and our own examination of the data. In this specification, an additional $10,000 of income below $25,000 would yield an increase of .16 standard deviations in math, and thus a $1,000 increment would correspond to about a .016 standard deviation increase (see Table 3, Panel C).

The slope above $25,000, however, is not as steep, with a $10,000 increment in income yielding only a .02 standard deviation increase in math (the slope for income over $25,000 is the sum of both slope parameters, i.e., for math an additional 10,000 income is .16 -.14=.02). Results for reading were nearly identical to those for math, and the pattern of coefficients indicate similar patterns of associations, although slightly smaller, for both learning related behavior and externalizing behavior.[17]

In terms of our school readiness summary variable we found that a $10,000 increase in income below $25,000 resulted in an approximately 7 percentage point increase in the probability of being school ready. To rescale, a $1,000 increase would result in a 0.7 percentage point increase in school readiness, similar in magnitude to the results from the log income specification with covariates. The same income increment above $25,000 would be associated with only a roughly 1 percentage point increase in the probability of school readiness (.069-.061=.008).

Finally, we make use of the longitudinal nature of the data to consider how persistent poverty may be more strongly associated with outcomes than transitory poverty. Using information on family income and household size, we characterized children according how many years they lived in poverty out of the four years of observations. Results show that experiencing only one year of poverty is associated with lower math skills, but not with lower reading or behavior (see Table 3, Panel D). On the other hand, four years of poverty (all of the available observations) is associated with significantly worse math and reading scores, as well as learning related behaviors (effect sizes ranging from -.36 to -.21). These findings suggest that persistent poverty is more harmful than transitory poverty, although it is not the case that each additional year brings significantly worse outcomes. For example, in our summary measure of school readiness, students who have experienced three or four years of poverty have similarly lower rates of school readiness (about 12-13 percentage points lower than children who have never experienced poverty).

Maternal Education

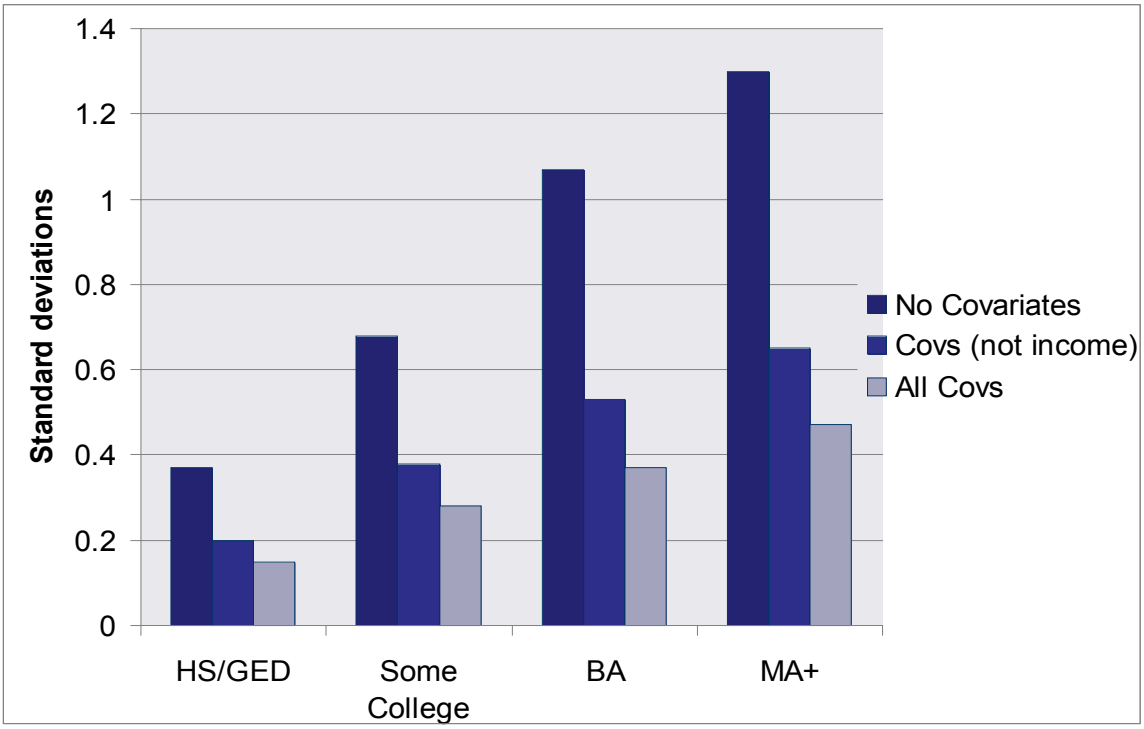
Based on prior studies and the descriptive statistics presented earlier, we expect children's school readiness to be associated with their mother's educational attainment. Bivariate analyses confirm maternal education gradients for nearly all outcomes. The children of more highly educated mothers perform significantly better than children whose mothers have not completed high school. For example, children of mothers who have completed a Master's degree or higher are 29 percentage points more likely to be school ready than those who do not have a high school degree (or GED), as shown in Table 4, Panel A.

Our next specifications add in covariates (Table 4, Panels B and C). We use a more parsimonious set of covariates in these regressions than in the income regressions because three of our covariates used in the income estimation models—maternal health status, smoking during pregnancy, and whether the child is breastfed—are possibly determined by maternal education, and therefore are not appropriate to include as controls.[18] In one specification (Panel B), we also drop household income and mother's age at the birth of her child, because these also may be affected by maternal education. Yet, in an alternate specification (Panel C), we include them because it is likely that correlations between these variables do not only reflect the causal effects of maternal education. In this way, we hope to provide an upper and lower bound for the magnitude of the association.

With our full set of covariates , which would represent the lower bound of the associations, we find that resulting coefficients are substantially lower than in the bivariate associations, and somewhat lower than with the more parsimonious set of covariates. Nevertheless, we find that higher levels of maternal education are associated with a significantly higher levels of academic skills and better health. Compared with children of mothers who have not completed high school, the academic skills are in the range of .15 standard deviations higher for children whose mothers have a high school diploma and more than twice that (.37 math and .32 reading) for children whose mothers have a bachelor's degree (see Figure 8 for effects on math). There is no association, however, between maternal education and learning related-behavior or externalizing behaviors, with the full set of covariates added to the model.[19] Nevertheless, the associations with academic skills and physical health are strong enough that higher levels of maternal education are linked with our measure of school readiness. For example, having a mother who has completed a four-year college degree is associated with about a 10 percentage point increase in school readiness compared with a mother who has not completed high school (see Figure 9).

Finally, we again take advantage of our longitudinal data to consider how increases in a mother's education following the birth of her children might be associated with her children's school readiness. We found that approximately 15 percent of mothers had increased their education after the birth of their children; mothers with lower levels of education were more likely to undertake additional schooling (as shown at the bottom of Table 2). With the exception of the less than high school degree at birth, each category that improved their education resulted in larger coefficients, yet with small sample sizes in each category and modest differences, the differences were not significant.

Figure 8. Estimated Effects of Maternal Education on Children's Math Achievement, with Varying Levels of Covariates



Note: The omitted category is less than a high school diploma.

Figure 9. Estimated Effects of Maternal Education on Children's School Readiness Composite, with Varying Levels of Covariates

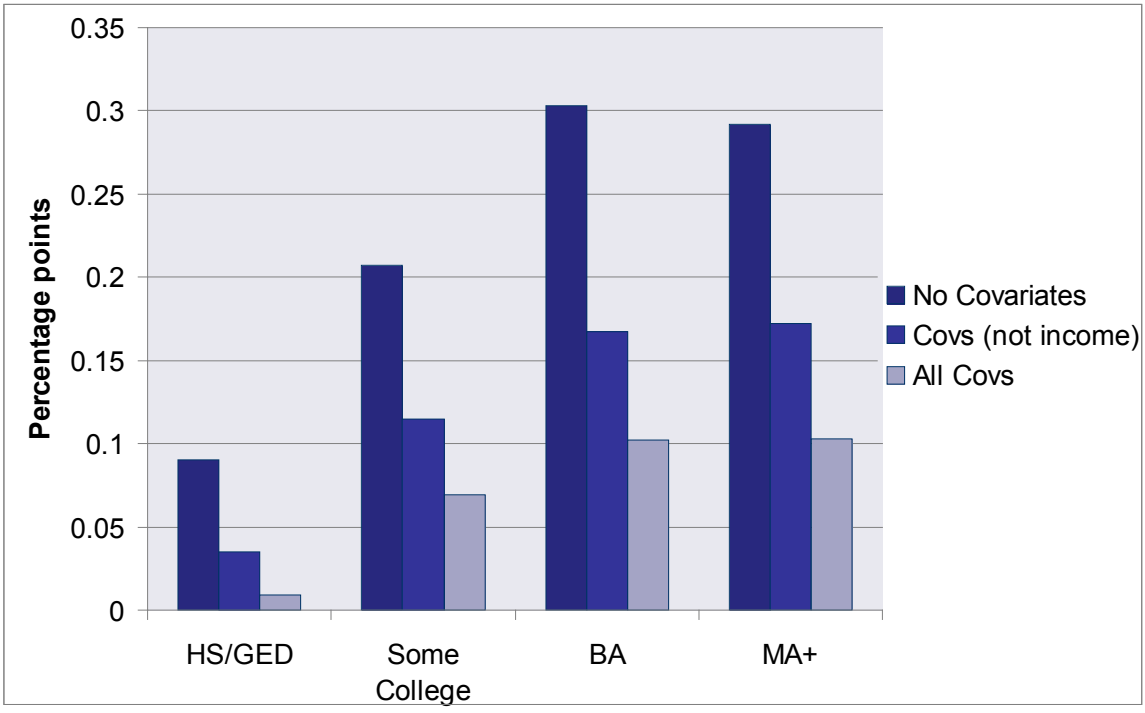


Table 4. Summary of Regressions of School Readiness on Maternal Education

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Panel A. Bivariate Association with No Covariates						
High school diploma/equivalent	.37***	.35***	.06	.00	.011**	.090**
	(.04)	(.04)	(.06)	(.07)	(.003)	(.028)
Some college or voc/tech program	.68***	.63***	.22***	.07	.015***	.207***
	(.04)	(.05)	(.06)	(.06)	(.003)	(.024)
BA/some grad school	1.07***	.97***	.47***	.28***	.019***	.303***
	(.05)	(.05)	(.07)	(.07)	(.003)	(.022)
MA/MS or above	1.30***	1.22***	.50***	.30***	.018***	.292***
	(.06)	(.07)	(.09)	(.08)	(.002)	(.024)
Sample Size =	6700	6700	4700	4700	6900	4500
Panel B. Multivariate With Covariates Excluding Income & Maternal Age						
High school diploma/equivalent	.20***	.21***	-.04	.00	.005**	.035
	(.04)	(.04)	(.07)	(.07)	(.002)	(.036)
Some college or voc/tech program	.38***	.37***	.07	.07	.005**	.115***
	(.04)	(.05)	(.08)	(.07)	(.002)	(.032)
BA/some grad school	.53***	.47***	.17*	.17**	.008**	.167***
	(.06)	(.06)	(.09)	(.08)	(.002)	(.036)
MA/MS or above	.65***	.61***	.19*	.18*	.009***	.172***
	(.08)	(.08)	(.11)	(.10)	(.001)	(.044)
Sample Size=	6450	6450	4500	4550	6600	4350
Panel C. Multivariate with Covariates, Including Income and Maternal Age						
High school diploma/equivalent	.15***	.16***	-.08	-.03	.005**	.009
	(.04)	(.04)	(.07)	(.08)	(.002)	(.039)
Some college or voc/tech program	.28***	.28***	-.00	.01	.005**	.069*
	(.05)	(.06)	(.08)	(.08)	(.002)	(.038)
BA/some grad school	.37***	.32***	.07	.07	.008***	.102**
	(.06)	(.07)	(.10)	(.09)	(.002)	(.047)
MA/MS or above	.47***	.44***	.07	.07	.009***	.103*
	(.08)	(.09)	(.12)	(.11)	(.002)	(.058)
Sample SIze=	6450	6450	4500	4550	6600	4350

(Table continued on next page)

Table 4. (continued): Summary of regressions of school readiness on maternal education

Panel D. Multivariate with Changes in Maternal Education (ages 9 months and 5 years)	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Less than high school diploma + education gain	.12	.17	-.21**	-.30***	.003*	.012
	(.10)	(.11)	(.11)	(.08)	(.002)	(.059)
HS diploma/GED at both ages	.18***	.23***	-.16*	-.10	.004**	.027
	(.05)	(.06)	(.10)	(.08)	(.002)	(.041)
HS diploma/GED +education gain	.23**	.31***	-.06	-.13	.005***	.020
	(.08)	(.09)	(.12)	(.11)	(.001)	(.055)
Some college or voc/tech at both ages	.33***	.37***	-.10	-.15*	.006***	.083**
	(.06)	(.06)	(.10)	(.09)	(.002)	(.037)
Some college or voc/tech + education gain	.41***	.48***	.11	.00	.003*	.144**
	(.10)	(.11)	(.14)	(.13)	(.002)	(.054)
BA or some grad school at both ages	.47***	.50***	.01	-.01	.007***	.148**
	(.07)	(.07)	(.12)	(.09)	(.002)	(.047)
BA or some grad school + education gain	.56***	.48***	-.05	-.22	.005***	.112
	(.08)	(.10)	(.18)	(.18)	(.001)	(.072)
MA/MS or above at both ages	.66***	.67***	.06	-.02	.007***	.154**
	(.09)	(.10)	(.14)	(.11)	(.001)	(.051)
MA/MS or above + education gain	.72**	1.04**	-.24	-.09	n.a.	-.035
	(.34)	(.39)	(.37)	(.49)	n.a.	(.253)
Sample Size =	5650	5650	4000	4000	5750	3800

Notes: Significance levels: ***p<.01 **p<.05 *p<.10. The "Health" and "School Readiness" columns present results from probit regressions with marginal effects. For all results except Panel D, all educational categories represent mother's education at birth and the omitted category is "less than high school diploma." For Panel D, changes in maternal education are between child's birth and child's fifth birthday; omitted category is "less than high school diploma and no change in ed." In Panel D, "MA/MS or above & increase in ed" dropped because it predicts success perfectly. In accordance with National Center for Education Statistics (NCES) guidelines, sample sizes are rounded to the nearest 50. Covariates for Panel B include race, gender, month of birth, education of mother's parents, family structure, firstborn status, whether mother worked prior to birth, , paternal education, region, mother's immigrant status, household size, health status of mother, lives in urban area. Covariates for Panel C and D include the same plus mother's age at birth of child and household income. For full results for Panel C, see Appendix Table A3. Variable definitions: Average income" is the mean of household income between birth and age five. In panel C, a unit of income is $10,000. Math, reading, learning-related behavior, and externalizing behavior scores are standardized to have a mean of 0, sd of 1. Health is dichotomized as poor/fair health and good/very good/excellent health. School readiness is dichotomized as school ready (scoring well in each of the five outcomes as explained in the text) or not.

Discussion

Our findings, like those of prior studies, suggest that income is a significant predictor of children's outcomes. The bivariate associations are substantial, but once a set of basic demographic covariates are added, the remaining associations are much smaller. An additional $1,000 of average income throughout early childhood would result in about a .015 standard deviation increase in reading and math scores, although smaller effects for children's behaviors. Prior quasi-experimental studies have found much larger increases in academic skills as a result of increased income among poor

populations, with about a $1000 of income resulting in .06 to .07 standard deviation increase (Duncan et al., 2011; Milligan and Stabile, 2008).

What might explain the discrepancy in effect sizes across studies? First, as with all non-experimental studies, it is difficult to rule out alternative hypotheses for the observed correlation and at the same time, not over-control. Though we selected our covariates carefully, it is possible that we that some of our covariates should not have been included. Second, our estimates may be downwardly biased by measurement error. Recall, that a large percentage of the income data was reported as categorical income, and was imputed. Yet, this was most likely to occur at the higher end of the distribution, and thus it would be less likely to affect estimates at the low end of the income distribution. Even when parents reported exact income, however, there may be recall error. Studies that have found larger effects both included a broader definition of income which included some in-kind benefits, such as food stamps, and tax transfers and also either relied on administrative data (Duncan et al., 2011) or asked more detailed questions about the components of household income (Dahl & Lochner, in press) than the ECLS-B, which asks only one question. It is, of course, also possible that the particular form of income changes studied by the quasi-experiments were unique, and not generalizable beyond the context of the specific study.

We also find that maternal education is strongly associated with children's school readiness, at least in the domains of their academic skills and health. The mean differences are quite large, and the associations remain statistically significant, even when we include controls. We also find that although point estimates are higher for mothers' who return to school compared with those who do not, the differences are not statistically significant. We caution that our models are not as well specified to account for prior differences between children of mothers' who get further education and those who do not.

It is difficult to compare our estimates of the benefits of maternal education to prior experimental studies, as the samples, contexts, and types of education studied differ. That said, prior non-experimental estimates suggest that an additional year of mother's schooling is associated with about a .05-.10 standard deviation higher level of achievement (Carneiro et al., 2007). Studies of changes in maternal education after the birth of a child find much larger estimates (.2-.3) among less educated parents, but no such effects among more advantaged families (Magnuson, 2003, 2007). A rescaling of our results would suggest that an additional year of school (completed before the birth of a child, across the education distribution) would increase academic skills by .06 to .09 standard deviations.[20] Thus, our results from models with covariates are roughly in line with prior studies. While the results of a one year increase in maternal education are significant, a larger increase, for example, increasing from a high school degree to a four-year college degree, would have an even more substantial effect on children's school readiness (0.26 to 0.32).

By way of comparing the effects of education and income on early academic skills, it is worth noting that the effects of an additional year of completed schooling on math and reading skills (0.06 to 0.09) would be comparable to increasing average early childhood family income by about $5,000 according to our estimates. Of course, presumably increasing parental education would likely increase their earnings as well (Card, 2001).[21] The two different measures of family background do not have comparable effects on the other domains, however. Increases in household income appear to have significant effects on our two behavioral measures, but not on physical health, while the reverse is true of increases in maternal education. Increased schooling by children's mothers appears to have positive effects on children's physical health, but holding household income constant, no associations with children's

learning-related behaviors or their likelihood of exhibiting problem behaviors in school settings. It is important to keep in mind, however, that to fully compare the effects of income and education on children's school readiness, it is necessary to also consider the relative costs and effectiveness of policy initiatives designed to increase family income or raise levels of education.

The magnitude of income effects shown in our estimation models suggest that large changes in income, considerably more than $1,000 annually, would be needed to generate meaningful changes in children's school readiness. One approach is to try to improve parents' income through improving their success in the labor market. While welfare-to work programs have been successful in raising the earnings of low-income mothers, earning gains have been modest, amounting to a five-year earning gain of about $5,000 ($1,000 annually) among more successful programs, according to a national random-assignment evaluation of 11 programs (Hamilton, 2002).

Direct cash supplements to family income are another possible approach. However, if cash allowances were provided universally to families with young children, as in a number of European countries, a large proportion of benefits would be going to middle and upper income families where the additional cash would have minimal effects on children's school readiness. Means-tested cash transfer programs are more effective at targeting resources to needy families, but some parents will reduce their work effort as a result of the cash transfer, particularly in light of the high marginal tax rates built into such programs, and thus raising family incomes requires an even larger transfer.

Programs that condition cash supplements on certain levels of work provide the dual benefit of encouraging parents to increase their earnings while delivering an additional cash supplement to families. An analysis of welfare and work programs found fairly substantial income gains—$1,700 annually over two to five years—among the group of programs that combined work programs with earnings supplements (Morris et al., 2005). The Earned Income Tax Credit, another notable example of the "make work pay" approach, provides up to $3,000 for a family with one child and $5,000 for a family with two children, and has been shown to lead to an increase, not a decrease, in earnings for most families. These examples suggest the possibility of raising the income of low-income families with young children through a "young child" expansion in the EITC or welfare reform programs that include earnings supplements.

Although we find meaningful payoff for increased maternal education, there are few policies or programs that have been proven to consistently boost the educational attainment of low income or at risk students. Policy efforts to increase maternal education can take one of two forms. First, efforts can target the next generation of parents, by seeking to more generally improve youths' educational attainment. Unfortunately, few of the various academic programs developed to increase high school graduation among at-risk adolescents have proved effective. A review of 16 random-assignment evaluations of dropout-prevention programs found only one of them to show clear benefits (Dynarski, 2001). On the other hand, rigorous evaluations of a small number of intensive teen mentoring programs have produced more promising results (Dubois et al., 2002; Roth et al., 1998). But the successes of even these intensive programs are not guaranteed, particularly when they are implemented on a large scale. A more effective policy intervention may be to expand public spending on higher education, including more generous financial aid and the expansion of community colleges, as these efforts have been consistently linked to increases in college attainment and enrollment (Dynarski, 2002; Sefter & Turner, 2002; Turner & Bound, 2003; but see also Heckman and Krueger, 2004). Yet it is worth noting that while enrollment in higher education has increased, degree completion has lagged (Brock, 2010).

A second approach is to promote educational activities among parents. Low-income parents face many barriers to increasing their education, particularly the high costs (Goldrick-Rab & Sorenson, 2010). Several programs have tried to provide additional supports to parents; for example, programs targeting teen mothers may provide supports and incentives to stay in school after the birth of a child, or welfare programs may make cash benefits contingent on mothers' participation in education and training. Have such programs worked? Evaluations suggest that to date, these types of interventions have not been successful in boosting mothers' educational activity above the relatively high level of participation of control group mothers, a large percentage of whom also undertake some type of schooling (McGroder et al., 2000; Quint et al., 1997).

Our analysis suggests that boosting family income and maternal education will affect the school readiness of young children. These findings point to the importance of policies and programs that meaningfully increase the financial resources and educational attainment parents. Yet, the magnitude of the associations in our analysis are modest, and if they prove to be correct, they suggest that relatively large changes in family resources are needed to bring about meaningful improvements in the school readiness of the next generation. Whether such efforts would be worthy is a complicated question that requires consideration of the costs of such endeavors relative to their benefits, as well as the likely costs and benefits of alternative investments. For example, preschool participation and home visiting are two other forms of investments in young children that have been proven to improve some aspects of children's school readiness. In future work we plan to consider how expansions in preschool participation may increase school readiness.

References

Almond, D., & Currie, J. (2010). Human capital development before age five. In O. Ashenfleter & D. Card (Eds.), *The Handbook of Labor Economics, 4b*. Amsterdam: Elsevier Science B.V.

Astone, N.M., Schoen, R, Ensminger ,M., & Rothert, K. (2000). School reentry in early adulthood: The case of inner-city African Americans. *Sociology of Education 73*(3), 133-154.

Atwell,P., & Lavin, D.E. (2007). *Passing the torch: Does higher education for the disadvantaged pay off across the generations?* New York: Russell Sage Foundation.

Becker, G. S. (1981). *A treatise on the family.* Cambridge, MA: Harvard University Press.

Bierman, K. L., Torres, M.M., Domitrovich, C. E., Welsh, J. A., & Gest, S. D. (2009). Behavioral and cognitive readiness for school: Cross-domain associations for children attending Head Start. *Social Development, 18*(2), 305-323.

Black, S. E., Devereux, P. J., & Salvanes, K. G. (2004). Fast times at Ridgemont High? The effect of compulsory schooling laws on teenage births. IZA Discussion Papers 1416, Institute for the Study of Labor (IZA).

Blau, David.M. (1999). The effects of income on child development. *The Review of Economics and Statistics*, *81*(2), 261-276.

Brock, T. (2010). Young adults and higher education: Barriers and breakthroughs to success. *Future of Children, 20*(1): 109-132.

Brooks-Gunn, J., & Duncan, G.J. (Eds.). (1997). *Consequences of growing up poor.* New York: Russell Sage Foundation. Carneiro, P., Meghir, C., & Parey, M. (2007). Maternal education, home environments and the development of children and adolescents. IZA Discussion Papers 3072, Institute for the Study of Labor (IZA).

Card, D. (2001). Estimating the return to schooling: Progress on some persistent econometric problems. *Econometrica,69*(5), 1127-1160.

Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics*, *24*(2), 365-389.

Chase-Lansdale, P. L., & Pittman, L. D. (2002). Welfare reform and parenting: Reasonable expectations. *Future of Children, 12* (1), 167-185.

Cunha, F., & Heckman, J.J. (2009). The Economics and Psychology of Inequality and Human Development. *Journal of the European Economic Association 7*(2–3), 320–64.

Currie, J. (2009). Healthy, wealthy, and wise: Socioeconomic status, poor health in childhood, and human capital development. *Journal of Economic Literature 47*(1), 87-122.

Currie, J., & Moretti, E. (2003). Mother's education and the intergenerational transmission of human capital: Evidence from college openings. *Quarterly Journal of Economics, 118*(4), 1495-1532.

Currie, J., Stabile, M., Manivong, P., & Roos, L. L. (2010). Child health and young adult outcomes. *Journal of Human Resources*, *45*(3), 517-548.

Currie, Janet, and Mark Stabile (2007). Child mental health and human capital accumulation: The case of ADHD. *Journal of Health Economics 25*(6), 1094–1118.

Dahl, G., & Lochner, L. (forthcoming). The impact of family income on child achievement: Evidence from changes in the Earned Income Tax Credit."*American Economic Review*.

Davis-Kean, P.E. (2005). The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. *Journal of Family Psychology*, *19*(2): 294-304.

Dearing, E., McCartney, K., & Taylor, B. A. (2006). Within-child associations between family income and externalizing and internalizing problems. *Developmental Psychology*, *42*(2), 237-252.
Dubois, D. L., Holloway, B. E., Valentine, J. C., & Harris, C. (2002). Effectiveness of mentoring programs for youth: A meta-analytic review. . *American Journal of Community Psychology, 30*(2), 157-197.
Duncan, G. J., Ziol-Guest, K. M., & Kalil, A. (2010). Early childhood poverty and adult attainment, behavior, and health. *Child Development 81*(1), 306-325.
Duncan, G.J., & Magnuson, K. (2011). The nature and impact of early achievement skills, attention skills, and behavior problems. In G.J. Duncan & R. J. Murnane (Eds.), *Whither opportunity?: Rising inequality, schools, and children's life chances.* New York: Russell Sage Foundation.
Duncan, G.J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P., Pagani, L.S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., & Duckworth, K. (2007). School readiness and later achievement. *Developmental Psychology*, *43*(6), 1428-1446.
Duncan, G.J., Morris, P.A., & Rodrigues, C. (2011). Does money really matter? Estimating impacts of family income on young children's achievement with data from random-assignment experiments. *Developmental Psychology,* 47(5), 1263–1279.
Dynarski, M. (2001). Making do with less: Interpreting the evidence from recent federal evaluations of dropout-prevention programs. Paper presented at "Dropouts: Implications and Findings" conference, Harvard University, Cambridge, MA.
Dynarski, S. (2002). The Consequences of Merit Aid. NBER Working Paper Series: Working Paper 9400. Cambridge, MA: National Bureau of Economic Research.
Evans, G. W. (2004). The environment of childhood poverty. *American Psychologist*, *59*(2), 77-92.
Gennetian, L., Magnuson, K., & Morris, P.A. (2008). From statistical associations to causation: What developmentalists can learn from instrumental variables techniques coupled with experimental data. *Developmental Psychology*, *44*(2), 381-394.
Goldrick-Rab, S., & Sorensen, K. (2010). Unmarried parents in college: How postsecondary education affects family stability. *Future of Children, 20*(2), 179-204.
Guryan, J., Hurst, E., & Kearney, M. (2008). Parental education and parental time with children. *Journal of Economic Perspectives*, *22*(3), 23-46.
Hamilton, G. (2002). Moving people from welfare to work: Lessons from the National Evaluation of Welfare-to-Work Strategies. Washington, D.C.: U.S. Department of Health and Human Services, Administration for Children and Families, Office of the Assistant Secretary for Planning and Evaluation and U.S. Department of Education, Office of the Under Secretary, Office of Vocational and Adult Education.
Haveman, R,, & Wolfe, B. (1995). The determinants of children's attainments: A review of methods and findings. *Journal of Economic Literature*, *33*(4), 1829-1878.
Heckman, J.J., & Krueger, A. B. (2004). *Inequality in America: What role for human capital policies?* Cambridge, MA: MIT Press.
Howse, R.B., Calkins, S.D., Anastopoulos, A.D., Keane, S.P., & Shelton, T.L. (2003). Regulatory contributors to children's kindergarten achievement. *Early Education and Development, 14*(1), 101-120.
Isaacs, J. B., Sawhill, I.V., & Haskins, R. (2008). Getting ahead or losing ground: Economic mobility in America. Washington, DC: The Brookings Institution
Jacob, B. A., & Ludwig, J. (2009). Improving educational outcomes for poor children. In M. Cancian & S. Danziger (Eds.), *Changing poverty, changing policies* (pp. 266-300). New York: Russell Sage Foundation.

Jacobs, J. A., & Stoner-Eby, S. (1998). Adult enrollment and educational attainment. *Annals of the American Academy of Political and Social Science, 559*(1), 91-108.
Kalil, A., Ryan, R. M., & Corey, M. (forthcoming publication). Diverging destinies: Maternal education and the developmental gradient in time with children. Demography.
Knudsen, E. I., Heckman, J. J., Cameron, Judy L., & Shonkoff, Jack P. (2006). Economic, neurobiological and behavioral perspectives on building America's future workforce. *Proceedings of the National Academy of Sciences*, *103*(27), 10155–10162.
Magnuson, K. (2003). The effect of increases in welfare mothers' education on their young children's academic and behavioral outcomes: Evidence from the National Evaluation of Welfare-to-Work Strategies Child Outcomes Study." Institute for Research on Poverty Discussion Paper (University of Wisconsin, Madison).
Mayer, Susan E. (1997). *What money can't buy: Family income and life chances*. Cambridge, MA: Harvard University Press.
McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioural regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, *43*(4), 947–959.
McClelland, M.M., Morrison, F.J., & Holmes, D.J. (2000). Children at risk for early academic problems: The role of learning-related skills. *Early Childhood Research Quarterly, 15*(3), 307-329.
McCrary, J., & Royer, H. (2006). The effect of female education on fertility and infant health: Evidence from school entry policies using exact date of birth. NBER Working Paper Series: Working Paper 12329. Cambridge, MA: National Bureau of Economic Research.
McGroder, S.M., Zaslow, M.J., Moore, K.A., & LeMenestrel, S.M. (2000). National evaluation of welfare-to-work strategies: Impacts on young children and their families two years after enrollment: Findings from the Child Health Outcomes Study. Washington, D.C.: U.S. Department of Health and Human Services Office of the Assistant Secretary for Planning and Evaluation Administration for Children and Families.
McLoyd, V.C. (1990) The impact of economic hardship on black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*(2), 311-346.
McLoyd, V.C., Jayartne, T.E., Ceballo. R., & Borquez, J. (1994). Unemployment and work interruption among African American single mothers: Effects on parenting and adolescent socioemotional functioning. *Child Development, 65*(2), 562-589.
Michael, R. T. (1972). *The effect of education on efficiency in consumption.* New York: Columbia University Press for the National Bureau of Economic Research.
Milligan, K., & Stabile, M. (2008). Do child tax benefits affect the wellbeing of children? Evidence from Canadian child benefit expansions. NBER Working Paper Series: Working Paper 14624. Cambridge, MA: National Bureau of Economic Research.
Morris, P.A., Gennetian, L.A., & Duncan, G.J. (2005). Effects of welfare and employment policies on young children: New findings on policy experiments conducted in the early 1990s. *Social Policy Report, 19*(2), 3-18.
Neiss M., & Rowe, D.C. (2000). Parental education and child's verbal IQ in adoptive and biological families in the National Longitudinal Study of Adolescent Health. *Behavior Genetics, 30*(6), 487-495.
Neitzel, C., & Stright, A. D. (2004). Parenting behaviors during child problem solving: The role of child temperament, mother education and personality, and the problem-solving context. *International Journal of Behavioral Development, 28*(2), 166-179.

Nelson, C. A. (2000). Neural plasticity and human development: the role of early experience in sculpting memory systems. *Developmental Science, 3*(2), 115-136.

Plug, E. (2004). Estimating the effect of mother's schooling on children's schooling using a sample of adoptees. *American Economic Review 94*(1), 358-368.

Quint, J. C., Bos, H. M., & Polit, D. F. (1997). New Chance: Final report on a comprehensive program for young mothers in poverty and their children. New York, NY: MDRC.

Raviv, T., Kessenich, M., & Morrison, F. J. (2004). A mediational model of the association between socioeconomic status and three-year-old language abilities: The role of parenting factors. *Early Childhood Research Quarterly, 19*(4), 528–547.

Rich, L. M., & Kim, S. (1999). Patterns of later life education among teenage mothers. *Gender and Society*, *13*(6), 798-817.

Richman, A. L., Miller, P. M., & LeVine, R. A. (1992). Cultural and educational variations in maternal responsiveness. *Developmental Psychology, 28*(4), 614-621.

Rosenzweig, Mark, & Wolpin, Kenneth I. (1994). Inequality among young adult siblings, public assistance programs, and intergenerational living arrangements. *Journal of Human Resources 29*(4), 1101-1125.

Roth, J., Brooks-Gunn, J., Murray, L., & Foster, W. (1998). Promoting healthy adolescents: Synthesis of youth development program evaluations. Journal of Research on Adolescence, 8(4), 423-459.

Sefter, N.S., & Turner, S.E. (2002). Back to school: Federal student aid policy and adult college enrollment. *Journal of Human Resources, 37*(2), 336-352.

Shonkoff, J.P., & Phillips, D. A. (Eds.). (2000). *From neurons to neighborhoods: The science of early childhood development.* Washington, D.C.: National Academy Press.

Sobel, M. E. (1998). Causal inference in statistical models of the process of socioeconomic achievement. *Sociological Methods and Research*, *27*(2), 318-348.

Turner, S., & Bound, J. (2003). Closing the gap or widening the divide: The effects of the G.I. Bill and World War II on the educational outcomes of black Americans. *Journal of Economic History, 63*(1), 145-177.

Yen, C., Konold, T.R., & McDermott, P.A. (2004). Does learning behavior augment cognitive ability as an indicator of academic achievement? *Journal of School Psychology, 42*(2), 157-169.

Zahn-Waxler, C., Duggal, S., & Gruber, R. (2002). Parental psychopathology. In M.H. Bornsetin (Ed.), *Handbook of parenting: Vol. 4, Social conditions and applied parenting* (2nd ed., pp. 295-327). Mahwah, NJ: Erlbaum.

Appendix Table A1. School Readiness by Selected Non-SES Characteristics

	In Subgroup (Percent)	**Math** (z-score)	**Reading** (z-score)	**Learning-Related Behavior** (z-score)	**Problem Behaviors** (z-score)	**Good Health** (Delta Percent for All)	**School Ready (All 5)** (Percent)
By Gender							
Male	51	-0.03	-0.08	-0.24	-0.26	0.3	57
Female	49	0.03	0.08	0.25	0.28	-0.3	73
By Race/ethnicity							
Non-Hispanic White	54	0.23	0.15	0.08	0.02	1.3	71
Non-Hispanic Black	14	-0.33	-0.17	-0.21	-0.24	-1.4	54
Hispanic	25	-0.35	-0.29	-0.07	0.06	-2.1	56
Other	7	0.13	0.18	0.05	0.07	0.1	70
By Birth Weight							
Normal	92	0.03	0.01	0.02	0.01	0.1	66
Low Birth Weight (< 2500 grams)	7	-0.32	-0.18	-0.22	-0.07	-1.6	57
By Maternal Age							
15-19	11	-0.38	-0.35	-0.25	-0.27	-1.1	51
20-24	25	-0.24	-0.18	-0.19	-0.16	0.1	56
25-29	26	0.06	0.05	0.10	0.09	-0.2	68
30+	37	0.23	0.19	0.14	0.13	0.4	74
By Family Structure (at birth)							
Married mother	*66*	*0.18*	*0.16*	*0.14*	*0.13*	0.5	
Cohabiting mother	*14*	*-0.26*	*-0.27*	*-0.17*	*-0.12*	-1.2	
Single mother	*19*	*-0.42*	*-0.35*	*-0.35*	*-0.34*	-0.4	
By Mother's Immigrant Status							
Foreign-Born	20	-0.20	-0.15	0.03	0.13	0.5	59
Native-Born	78	0.05	0.04	0.00	-0.03	-1.7	67
*By Preschool Experience (4 years)***							
Head Start	16	-0.32	-0.27	-0.23	-0.21	-1.6	54
Preschool	57	0.22	0.22	0.09	0.03	0.8	73
None	26	-0.29	-0.32	-0.07	0.06	-0.7	54
By Breastfeeding							
Child was Never Breastfed	31	-0.22	-0.21	-0.13	-0.09	-0.7	59
Child was Breastfed	69	0.10	0.10	0.06	0.04	0.4	68
By Maternal Health							
In Fair/Poor Health	7	-0.44	-0.35	-0.35	-0.11	-4.8	54
In Excellent/V. Good/Good Health	93	0.04	0.03	0.03	0.01	0.4	66
By Maternal Smoking (3rd trimester)							
Did Not Smoke	89	0.02	0.03	0.03	0.04	0.0	68
Smoked	11	-0.17	-0.21	-0.25	-0.31	0.8	49
By Birth Month							
September - December	33	0.20	0.20	0.11	0.09	-0.2	71
January – April	33	0.04	0.01	0.02	-0.02	0.3	66
May – August	34	-0.23	-0.20	-0.13	-0.06	-0.1	60

Notes: The percentages in each subgroup may not add to 100 because of rounding and omission of small numbers of children whose subgroup is unknown. * The health measure shows the difference in percentage points from the overall percentage of children in good, very good or excellent health (98.0 percent). ** Preschool excludes children in Head Start centers and includes preschools, pre-K, day care, nursery school, and other center-based care arrangements. Children who are not in Head Start or other preschool may be in parental, relative, and/or non-relative, non-center-based care.

Appendix Table A2. Regressions of School Readiness on Income: Full Results for Panel B of Table 3

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Natural log of average income	.21***	.20***	.12**	.08*	-.000	.082***
Race						
Black	-.16**	.07	.01	-.03	-.032**	-.028
Hispanic	-.19***	-.05	.03	.13**	-.018**	-.005
Other	-.05	.07	-.01	.07	-.018**	.010
Sex						
Female	.05*	.15***	.49***	.54***	-.003	.185***
Maternal Education at birth						
HS Degree	.15***	.16***	-.08	-.03	.005**	.007
Some College	.27***	.27***	-.01	-.01	.005**	.062
BA/Some Graduate School	.36***	.31***	.06	.06	.008***	.094*
MA/MS or higher	.46***	.43***	.06	.06	.009***	.099
Paternal Education						
HS Degree	.08	.11**	-.04	.01	.001	.026
Some College	.15**	.20***	.03	.06	.003	.085**
BA/Some Graduate School	.27**	.27***	.11	.09	.001	.134***
MA/MS or higher	.38***	.42***	.11	.11	.007***	.121**
Maternal Grandparents' Education						
HS Degree	.11**	.11**	.09	.02	.000	.053*
Some College	.07	.01	-.08	-.10	.002	.001
BA/Some Graduate School	.06	.11*	-.02	-.15*	.003	.036
MA/MS or Higher	.18**	.17**	.03	-.04	.000	.044
Marital Status at Birth						
Cohabiting	.02	-.03	-.11	-.08	-.002	-.015
Single	.00	-.12	-.17**	-.15*	.002	-.014
Other	-.12	-.28	-.12	-.34	-.039	-.089
Household size	-.03**	-.05***	-.04**	.01	.002**	-.005
Father is Present in Household	-.00	.08	-.08	-.11	.003	.011
Mother's Age at Birth of Child	.00	-.00	-.00	.01	-.000	.001
Child Is Firstborn	.02	.10**	-.09**	.01	-.001	.008
Mother Employed in Year Before Birth	.02	-.00	-.04	-.16**	.005*	.016
Maternal Nativity						
Non-native	.05	.05	.06	.01	-.001	.007
Health Status of Mother	.17**	.11*	.24**	.05	.017**	.013
Mother Smoked Last 3 Months of Pregnancy	.02	.01	-.11	-.21**	.003	-.092**
Child Breastfed	.09**	.09**	.01	-.05	.002	-.006

(Table continued on next page)

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Region						
Midwest	-.03	-.02	.00	-.03	-.004	-.035
South	.04	.19**	-.01	-.09	-.002	-.006
West	.00	.04	.10	-.02	-.003	-.009
Lives in Urban Area	.06	.10*	-.09	-.07	.002	-.023
N =	6400	6400	4500	4500	6800	4300
R^2 =	0.26	0.24	0.15	0.15	--	--

Notes: Significance levels: ***p<.01 **p<.05 *p<.10. The "Health" and "School Readiness" columns present results from probit regressions with marginal effects; an R-squared statistic is not available for these two regressions. In accordance with National Center for Education Statistics (NCES) guidelines, sample sizes are rounded to the nearest 50. Birth month was also included as a covariate but not shown in the table for conciseness. Variable definitions: Math, reading, learning-related behavior, and externalizing behavior scores are standardized to have a mean of 0, sd of 1. Health is dichotomized as poor/fair health and good/very good/excellent health. School readiness is dichotomized as school ready (scoring well in each of the five outcomes as explained in the text) or not. Average income" is the mean of household income between birth and age five. Maternal educational categories represent mother's education at birth and the omitted category is "less than high school diploma.

Appendix Table A3. Regressions of School Readiness on Maternal Education: Full Results for Table 4, Panel C

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Maternal Education at birth						
HS Degree	.15***	.16***	-.08	-.03	.005**	.009
Some College	.28***	.28***	-.00	.01	.005**	.069*
BA/Some Graduate School	.37***	.32***	.07	.07	.008***	.102**
MA/MS	.47***	.44***	.07	.07	.009***	.103*
Race						
Black	-.17**	.06	.03	.01	-.035**	-.009
Hispanic	-.18***	-.04	.05	.16**	-.019**	.010
Other	-.05	.07	-.00	.08	-.018**	.017
Sex						
Female	.05*	.15***	.49***	.54***	-.003	.185***
Natural log of average income	.21***	.20***	.13**	.09**	-.000	.087***
Paternal Education						
HS Degree	.08	.11**	-.04	.01	.001	.028
Some College	.16**	.20***	.04	.07	.003	.089**
BA/Some Graduate School	.27**	.28***	.12	.10	.001	.141***
MA/MS	.38***	.43***	.12	.12	.007***	.126**
Maternal Grandparents' Education						
HS Degree	.12**	.12**	.09	.02	.000	.053*
Some College	.08	.02	-.07	-.10	.002	.001
BA/Some Graduate School	.07	.12*	-.02	-.15*	.003	.036
MA/MS or Higher	.19**	.18**	.04	-.04	.001	.044
Marital Status at Birth						
Cohabiting	.02	-.03	-.12	-.10	-.002	-.025
Single	-.00	-.12	-.17**	-.16*	.002	-.014
Other	-.17	-.33	-.09	-.24	-.053	-.050
Household size	-.03**	-.05***	-.04**	.01	.002**	-.005
Father Is Present in Household	-.00	.08	-.08	-.11	.003	.015
Mother's Age at Birth of Child	.00	-.00	-.00	.01	-.000	.001
Child Is Firstborn	.02	.10**	-.08**	.01	-.001	.011
Mother Employed in Year Before Birth	.02	-.00	-.04	-.16**	.005*	.016
Maternal Nativity						
Non-native	.06	.06	.07	.02	-.001	.015
Health Status of Mother	.17**	.12*	.25**	.06	.017**	.019

(Table continued on the next page)

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Region						
Midwest	-.02	-.02	.00	-.04	-.004	-.038
South	.04	.19**	-.01	-.10	-.002	-.008
West	.01	.05	.10	-.03	-.003	-.008
Lives in Urban Area	.06	.11*	-.09	-.07	.002	-.023
N =	6450	6450	4500	4550	6600	4350
R^2 =	0.26	0.24	0.15	0.14	--	--

Notes: Significance levels: ***p<.01 **p<.05 *p<.10. The "Health" and "School Readiness" columns present results from probit regressions with marginal effects; an R-squared statistic is not available for these two regressions. In accordance with National Center for Education Statistics (NCES) guidelines, sample sizes are rounded to the nearest 50. Birth month was also included as a covariate but not shown in the table for conciseness. Variable definitions: Math, reading, learning-related behavior, and externalizing behavior scores are standardized to have a mean of 0, sd of 1. Health is dichotomized as poor/fair health and good/very good/excellent health. School readiness is dichotomized as school ready (scoring well in each of the five outcomes as explained in the text) or not. Average income" is the mean of household income between birth and age five. Maternal educational categories represent mother's education at birth and the omitted category is "less than high school diploma.

Appendix Table A4. Regression Results for Comprehensive Model that Includes Covariates that Are Themselves Predicted by Income or Education

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Average Income <25K	.11**	.12**	.02	.07	-.004**	.026
Average income >25K	-.09*	-.11**	-.01	-.07	.004**	-.021
Maternal Education at birth (omitted: less than high school degree)						
HS Degree	.18**	.17**	-.04	-.01	.001	.001
Some College	.24***	.23***	-.03	-.02	.001	.025
BA/Some Graduate School	.35***	.31***	.04	.04	.002	.070
MA/MS or Higher	.50***	.46***	.11	.10	.005**	.088
Paternal Education						
HS Degree	.07	.09	-.13	-.09	.002	-.008
Some College	.17**	.20**	.00	.02	.001	.069*
BA/Some Graduate School	.28**	.28**	.04	.04	.000	.115**
MA/MS or Higher	.38***	.44***	.08	.11	.005**	.124**
Father Present in household	.01	.09	-.11	-.12	.002	-.012
Race (omitted: white)						
Black	-.11*	.11**	.09	.04	-.015**	.002
Hispanic	-.15**	-.01	.09	.14*	-.006	.032
Other	-.03	.11	.09	.17**	-.010*	.053
Sex						
Female	.02	.14***	.45***	.52***	-.001	.172***
Birth month category (omitted: September-December)						
January-April	-.17***	-.20***	-.07	-.08	.001	-.057*
May-August	-.45***	-.43***	-.26***	-.14**	-.001	-.141***
Maternal Grandparents' Education						
HS Degree	.09*	.07	.03	-.01	.001	.033
Some College	.01	-.07	-.12	-.14*	.000	-.024
BA/Some Graduate School	.03	.05	-.11	-.22**	.004**	-.010
MA/MS or Higher	.12*	.08	-.03	-.10	.002	.014
Marital Status at Birth (omitted: married)						
Cohabiting	-.01	-.07	-.04	-.00	-.001	-.000
Single	-.04	-.16*	-.15*	-.13	.000	-.025
Other	-.07	-.34	-.26	-.48	-	-.063
Mother's Age at Birth of Child	-.00	-.00	-.01	.01	-.000	-.001
Child is Firstborn	.01	.06	-.04	.06	.000	.007
Mother Employed in Year Before Birth	.04	.02	-.05	-.19***	.003	-.001
Maternal Nativity (omitted: U.S.-born)						
Non-native	.05	.02	.08	-.01	-.002	-.036
Missing	-.05	.12	-.08	-.28	-.001	.077
Region (omitted: Northeast)						
Midwest	.00	-.00	-.04	-.04	-.011	-.048
South	.05	.18**	-.04	-.08	-.006	-.040
West	.02	.05	.02	-.05	-.006	-.060

(Table continued on next page)

	Math	Reading	Learning-Related Behavior	Externalizing Behavior	Health	School Readiness
Mother Smoked in Last 3 Months of pregnancy	.02	.02	-.08	-.18*	.002	-.103**
Health Status of Mother	.14**	.09	.21*	.07	.010*	.012
Child Breastfed	.05	.08*	.02	-.01	.001	-.013
Lives in Urban Area	.09	.14**	-.12	-.07	.002	-.018
Early Childhood Education (omitted: none)						
Attended Head Start	.13**	.15**	-.09	-.17**	-.002	.040
Attended Other Preschool/Center	.13**	.18***	.00	-.10**	-.000	.070**
Household Assets (home ownership, car ownership, and checking/savings account)						
Holds 2 of 3 Asset Types	-.03	-.02	-.17**	-.09*	-.003	-.056
Holds 1 of 3 Asset Types	-.01	.02	-.19**	-.14*	-.001	-.055
Holds 0 of 3 Asset Types	-.06	-.10	-.31**	-.24**	-.008	-.143**
Low Birth Weight	-.23***	-.12**	-.15**	-.05	-.006	-.068**
Number of Children in Household	-.03*	-.05**	.01	.06**	.001	.009
Number of Adults in Household	-.03	-.03	.03	.06*	.001	.020
Parenting						
Cognitive Stimulation Index: In-home	.07*	.10**	.05	.08	.001	.008
Cognitive Stimulation Index: Out-of-home	.02	.04	.00	-.01	.001	-.003
Number of Children's Books in Household	.00	.00	.00	.00	.000	-.000
Parental Sensitivity and Responsiveness	.08***	.06**	.09**	.02	-.000	.040**
N =	5000	5000	3550	3550	5000	3400
R^2 =	.27	.24	.16	.15		

Notes: Significance levels: ***p<.01 **p<.05 *p<.10. The "Health" and "School Readiness" columns present results from probit regressions with marginal effects; an R-squared statistic is not available for these two regressions. In accordance with National Center for Education Statistics (NCES) guidelines, sample sizes are rounded to the nearest 50. Variable definitions: Math, reading, learning-related behavior, and externalizing behavior scores are standardized to have a mean of 0, sd of 1. Health is dichotomized as poor/fair health and good/very good/excellent health. School readiness is dichotomized as school ready (scoring well in each of the five outcomes as explained in the text) or not. Maternal educational categories represent mother's education at birth and the omitted category is "less than high school diploma. "Cognitive stimulation in-home" is an average of parent responses about the frequency with which she or he engages in selected activities with the child (read books, tell stories, sing, take on errands). "Cognitive stimulation: out-of-home" is an average of parent responses about the frequency with which she or he engages in selected activities with the child (go to a public place like a zoo or museum). The" parental sensitivity and responsiveness" variable is derived from the two-bags test, based on the direct observation of the parent's sensitivity to cues and response to child's distress and growth fostering. All parenting variables were measured when the child was approximately 2 years old.

Notes

[1] See, for example, Becker (1981).

[2] Chase-Lansdale and Pittman (2002); McLoyd (1990); McLoyd, Jayartne, Ceballo and Borquez (1994).

[3] This is reviewed in McLoyd (1990).

[4] This is described in Zahn-Waxler, Duggal, and Gruber (2002).

[5]Studies using European data have been less conclusive; see Black, Devereux, & Salvanes (2004) and Plug (2004). Several use twin or adoptee samples to try to isolate the effect of education per se, but these studies have important methodological limitations.

[6] We use fall 2006 assessments for children who were 5 on September 1, 2006 (all children born Jan-August 2001) and the fall 2007 assessments for remaining children (born Sept-Dec 2001) except that we used the fall 2006 assessment for Sept-Dec babies who entered kindergarten in 2006 and did not repeat it in 2007.

[7] The sample size varies from 4500-6800 across the different regressions, based on availability of data for the different school readiness measures and controls, as shown in the Appendix Tables. The sample size is smallest for measures requiring teacher observations (the two behavioral measures of school readiness).

[8] Under these thresholds, 15.4 percent fail to be ready on math, 17.0 percent fail on reading, 17.4 percent on learning-related behaviors, 15.4 percent on problem behaviors and 2 percent on health.

[9] Households with incomes near 100 and 185 percent of the federal poverty threshold were asked to report exact income, rather than categorical income, allowing NCES to calculate (or in some cases impute) whether a household was above or below these income thresholds.

[10] "Some college" and "vocational/technical program" were separate categories in the original data, as were "bachelor's degree" and "some graduate school." Our primary reason for collapsing these categories was that longitudinal analyses revealed that many mothers would report shifting back and forth across these categories over time, suggesting there was noise in how mothers classified themselves into these categories. We do maintain the distinction between "some college" and "vocational/technical program" in one of our alternate specifications. The underlying ECLS-B data had nine possible categories: (8^{th} grade or below, 9^{th}-12^{th} grade with no high school diploma/equivalent, high school diploma/equivalent, vocational/technical program, some college, bachelor's degree, graduate professional school with no degree, master's degree, and doctorate or professional degree).

[11] In such an example, the cleaned version of the variable would change the educational status at age 2 years to match the reported data for 9 months and 4 years. We limited our cleaning to cases where the mother was the same individual (the biological mother) throughout early childhood. Even after collapsing the 9 original categories into 7 categories (as explained in the footnote above), roughly 1,300 cases reported negative changes in the biological mother's educational status. We cleaned about 900 cases, where one of the four reports of maternal education appeared anomalous relative to the other three reports, leaving about 400 cases where the changes in maternal education were non-logical, but we could not determine which reports were faulty (e.g., high school at age 0, college at age 2, high school at age 4 and college at age 5).

[12] As might be expected, the scores of this subgroup, which gained education but from a very low base, are lower than other, including the subgroup that had a maternal education of high school diploma at both ages (-.20). Tests of statistical significance are at the 95 percent confidence level unless noted otherwise.

[13] The one exception is among children whose mothers have some college or vocational/technical education at nine months; at this education level, the subgroup whose mothers gain education (a bachelors degree or higher) by age five have better behavioral measures than the subgroup without educational gains (0.24 vs. 0.03 for learning-related behaviors and 0.11 vs. -0.3 for problem behaviors).

[14] Some of the health differentials reported by Hispanic and immigrant parents may reflect language/cultural differences in defining fair/poor health, although their children also may objectively be in worse health.

[15] One concern might be that the behavior measures are available for only a proportion of those with test scores, and thus the difference in strength of associations might be due to differences in the sample selection. To test this idea, we ran regressions with the test scores as outcomes only for the sample of children that had teacher-reported behavior outcomes. We found that associations between income and test scores were larger in this sample than in the full sample, suggesting that this is not likely the explanation for weaker associations with behavioral outcomes.

[16] A one unit increase, from a log income of 9 to a log income of 10 corresponds to an income increase from $8,100 to $22,000. Further up the income distribution, an increase of log income from 10.5 to 11.5 corresponds to an income increase from $36,000 to about $99,000.

[17] Placing the knot higher up in the income distribution, at $45,000 reduces the estimated benefit of an additional $10,000 to just .10 standard deviations for math and .11 for reading for income increments below $45,000 (or $1,000 increment associated with a .01 standard deviation increase). An increase of $10,000 above $45,000 will increase math scores by .02 standard deviations and reading scores by .01.

[18] In Appendix Table A-4, we show regression results for a model that adds preschool education, maternal smoking, and other covariates that are themselves predicted by education and income. As expected, these reduce the magnitude of the estimated effects of maternal education – and of income – on children's school readiness. They continue to have significant effects on math and reading, and to some extent, but not on behaviors and not on our summary measure of overall school readiness.

[19] Our regressions of teacher-reported behaviors have a smaller sample because of missing data, it is possible that this difference in sample might affect our estimates for the behavior outcomes. Put another way, we might find smaller effects for the behavior measures because of the composition of the smaller sample. For this reason, we ran our academic outcomes on the smaller teacher-report sample. We did find evidence that the associations between maternal education and academic skills were slightly smaller for this group, but the significance and pattern were largely the same. Finally, we also disaggregated our vocational and technical program and some college category. The estimates for some college were larger for math but not reading (.32 and .28 vs. .24 and .20 respectively) or school readiness (.10 vs. .07).

[20] These are our results from Table 4, Panel B, where we include many covariates, but allow family income and maternal age at birth to increase with increases in maternal education. The increase from high school graduation to BA is an increase of 0.33 (.53-.20), or 0.83 per year, assuming high school represents 12 years and a BA represents 16 years of education. If we assume some college is roughly 14 years, we get similar effects for high school to some college and some college to BA (0.9 and 0.75 per year, respectively). Effects in reading are slightly smaller (0.65 per year based on the growth from 12 years to 16 years. We thus summarize the overall effects as falling in the 0.6 to 0.9 range.

[21] We estimate that math readiness cores would increase by 0.15 for each additional $1,000 increase in average household income and would increase by 0.83 for each additional year in maternal education. It would thus take $5500 to equal one year of maternal education (0.83/0.15=5.5). The comparable numbers for reading readiness scores are 0.14 per $1,000 increase in average household income and 0.65 per additional year in maternal education, or $4600 to equal one year of maternal education (0.65/0.14=4.6). An increase of $5,000 is thus roughly equivalent to an increase in one year of maternal education, looking across math and reading readiness.