Early School Adjustment and High School Dropout

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Abstract

Although school attainment is a cumulative process combining mastery of both academic and behavioral skills, most studies have offered only a piecemeal view of the associations between early childhood capacities and subsequent schooling outcomes. Using two large longitudinal datasets, this study describes the relative contribution of children's problem behaviors and academic skills to their long-term educational outcomes. After adjusting for family and individual background measures, we find that age 7 or 8 skills and behaviors are modestly and often inconsistently predictive of high school completion, attending college, and completed years of schooling. Neither reading nor math is consistently more predictive of high school completion than the other. Antisocial behavior predicts high school completion, but the associations are consistently significant only after about age 10. In contrast, attention problems do not predict adolescent and early-adult school attainment. We also investigate whether persistently high behavior problems or low achievement during the early elementary years matter for later attainment. We find that persistent reading, math, and antisocial behavior problems, but not attention problems, prior to age 10 predict at least some of our attainment outcomes.

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Introduction

Educational attainment is an important input for later life chances. Dropping out of high school is particularly costly to both individuals and to society, and is associated with lower lifetime earnings, higher rates of unemployment and social benefit receipt, as well as worse health. Given these costs, preventing high school dropout and more generally raising educational attainment have become important goals of intervention programs and education reform policies.

How best to prevent high school dropout and improve educational attainment is not well understood. School attainment is a cumulative process combining mastery of both academic skills, such as reading and mathematics, with behavioral skills, such as sustaining attention throughout the school day, engaging in the curriculum, and getting along with teachers and fellow classmates (Entwisle & Alexander, 1990; Pungello, Kuperschmidt, Burchinal, & Patterson, 1996). Although a range of proximal predictors of high school dropout have been identified during the high school years, the early foundations of educational attainment have remained largely unexamined, in part because of a dearth of the requisite longitudinal data. Few studies have been able to offer more than a piecemeal view of the associations between eventual school attainment and early-grade academic and behavioral skills.

Using two large longitudinal datasets, this study describes the relative contribution of children's academic and behavioral skills for children's long-term educational outcomes. We also investigate the importance of persistence along these achievement and behavior dimensions in elementary school, with the expectation that persistent problems in any of these domains will be more predictive of lower attainment than any one point-in-time measure of them.

Background

Reading and Math Skills

Research on how children acquire reading and math skills indicates that specific early academic skills serve as the foundation for later learning, but also suggests that more general cognitive skills, particularly oral language and conceptual ability, may be increasingly important for later mastery of more complex reading and mathematical tasks. Basic oral language skills become critical for understanding texts as the level of difficulty of reading passages increases (NICHD Early Child Care Research Network, 2005; Scarborough, 2001; Snow, Burns, & Griffin, 1998; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998). Likewise, mastery of foundational concepts of numbers allows for a deeper understanding of more complex mathematical problems and flexible problem-solving techniques (Baroody, 2003; Ferrari & Sternberg, 1998; Hiebert & Wearne, 1996). The relative stability of children's academic achievement throughout childhood and adolescence (Catterall, 1998; Kowaleski-Jones & Duncan, 1999; Pungello et al., 1996) suggests that early academic skills may be strong predictors of later educational attainment, but few studies have followed children's achievement long enough to establish the magnitude of these associations.

Indirect evidence of an association between early achievement skills and educational attainment is found in preschool follow-up studies. Several studies of high-quality preschools have indicated that the programs boosted early school achievement and subsequently had important effects on high school completion (for a summary, see Duncan, Ludwig, & Magnuson, in press). However, given that the programs might have affected multiple aspects of children's skills and behavior, as well as their family environments, it is difficult to attribute the increase in high school completion to their increased early skills (Reynolds, Ou, & Topitizes, 2004).

Direct evidence on the association between early skills and later educational attainment is rare. One exception is Entwisle, Alexander, and Olson's (2005) examination of the Baltimore School Study data. Their analysis of a 1982 cohort of first grade children found that a composite of reading and math test scores did not significantly predict educational attainment at age 20 or 21, when controlling for family characteristics and student's first grade marks, which likely also measure academic skills.

Attention Problems

By increasing the time children are engaged and participating in academic endeavors, attention-related skills such as task persistence and self-regulation should, at least in theory, predict children's achievement and school outcomes. Consistent evidence suggests that the ability to control and sustain attention as well as participate in classroom activities predicts achievement test scores and grades during preschool and elementary school even after holding constant children's academic ability (Currie and Stabile, forthcoming; Duncan et al., 2007; Howse, Lange, Farran, & Boyles, 2003; McClelland, Morrison, & Holmes, 2000; Rabiner & Coie, 2000; Raver, Smith-Donald, Hayes, & Jones, 2005; Yen, Konold, & McDermott, 2004).

Whether problems with attention skills are also linked with lower levels of educational attainment is less studied, but if achievement predicts later educational attainment, then we might expect that early attention skills would also predict attainment. Some sparse evidence suggests such a link (Mannuzza & Klein, 2000; Vitaro, Brendgen, Larose, & Tremblay, 2005). Vitaro and colleagues (2005) found that attention problems at age 6 predicted later high school non-completion among a Quebec community-based sample. These analyses held constant children's aggression, but could not control for differences in early academic skills. Currie and Stabile (forthcoming) take a more comprehensive look at links between hyperactivity and later schooling success using nationally representative data from both the U.S. and Canada and both OLS and sibling fixed effects models.[1] Although they find consistent linkages to achievement scores, grade retention, and special-education placement, they fail to find associations between early hyperactivity and a measure of completed schooling (being in school between ages 16 and 19).

Antisocial Behavior Problems

Children's problem behaviors, particularly externalizing or antisocial behavior,

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[1] Currie and Stabile's (forthcoming) Canadian and U.S. samples were aged 4 to 11 when attention problems were first measured.

are expected to affect both individual learning and later attainment. Problem behavior may lead to child-teacher conflict, disciplinary actions, and social exclusion (Newcomb, Bukowski, & Pattee, 1993; Parker & Asher, 1987), and as a result may adversely affect achievement (Ladd, Birch, & Buhs, 1999; Pianta & Stuhlman, 2004).

Despite theoretical reasons to expect associations between problem behavior and academic outcomes, empirical evidence linking problem behaviors to school outcomes is mixed. Among young children, examining externalizing problems separately from attention has clarified the role of each in achievement, suggesting that attention is more predictive of later achievement than more general problem behaviors (Barriga et al., 2002; Hinshaw, 1992; Konold & Pianta, 2005; Ladd, et al., 1999; Normandeau, 1998; Trzesniewski, Moffitt, Caspi, Taylor, & Maughan, 2006; Rapport, Scanlan, & Denney, 1999). For example, Duncan and colleagues (2007) looked across six datasets and failed to find evidence that school-entry externalizing behaviors were associated with achievement during middle childhood once attention skills and prior achievement are taken into account (Duncan, et al., 2007).

A lack of association between early problem behavior, particularly externalizing behavior, and later achievement, however, does not imply that it will be unpredictive of later educational attainment. Studies have found that adolescent behavior problems do indeed predict later attainment. If links between early and later behavior problems are strong enough, then early behavior problems might well be associated with educational attainment. Indeed, several studies have found that early behavior problems are linked to subsequent educational attainment, although these studies tend to involve selective samples and few covariates to control for possible confounding factors (Ensminger & Slusarick, 1992; Farmer, 1995; McLeod & Kaiser, 2004). For example, based on their analysis of a New Zealand sample, Ferguson and Horwood (1998) find that third grade conduct problems were predictive of high school dropout. Other studies yield less conclusive support for links between early behavior problems and later attainment. Currie and Stabile (forthcoming) find mixed evidence for links between antisocial behaviors between ages 4 and 11 and school enrollment between ages 16 and 19.

One explanation for these somewhat contradictory findings is that the determinants of achievement and attainment differ, and that attainment, as opposed to achievement, may be most strongly predicted by early behavior. Another possibility is that the developmental trajectories of problem behavior are more important than the level of early behavior problems. Studies have consistently shown that meaningful trajectories of behavior can be identified and that about 5% to 10% of children can be characterized as displaying "chronic" aggression throughout middle childhood (Kokko, Tremblay, Lacourse, Nagin, & Vitaro, 2006). These children not only start with higher levels of aggression than other children, but their aggression remains high during the early school years. Using trajectories of aggression to predict high school non-completion, Kokko and colleagues (2006) found that children who displayed high (albeit somewhat declining) levels of aggression during middle childhood were significantly more likely to drop out than children with moderate or low levels of aggression. But Kokko and colleagues' research included few controls in the model. Most notably, since early achievement was not controlled, it is possible that the apparent effects of persistently high aggression were in fact due to early achievement problems.

In sum, prior research has provided some evidence about how young children's skills influence their later labor market and school successes, but the piecemeal nature of the data, coupled with concerns about sample selection and analytic methods, suggest that there is much more to be learned. This study presents a new and rigorous set of analyses with data from two large-scale longitudinal datasets to provide a more complete understanding of the determinants of children's educational success. The analyses describe the relative contribution of children's academic and behavioral skills for children's long-term educational outcomes, using both point-in-time as well as persistence measures of early skills and behaviors. In doing so, we shed light on the formative role of children's early school experiences in shaping their life chances.

Data

Our data are drawn from two well-known U.S. longitudinal studies: the National Longitudinal Survey of Youth (NLSY) and the Baltimore Beginning School Study (BSS).

National Longitudinal Survey of Youth

The National Longitudinal Survey of Youth is a multi-stage stratified random sample of 12,686 individuals aged 14 to 21 in 1979 (Center for Human Resource Research, 2004). Black, Hispanic, and low-income youth were overrepresented in the sample. Annual (through 1994) and biennial (between 1994 and 2000) interviews with sample members, and very low cumulative attrition in the study, contribute to the quality of the study's data.

Beginning in 1986, the children born to NLSY female participants were tracked through biennial mother interview supplements and direct child assessments. Given the nature of the sample, it is important to note that early cohorts of the child sample were born disproportionately to young mothers. Our target sample consists of 3,893 children who were age 5 or 6 in 1986 (n=921), 1988 (n=1,160), 1990 (n=951), or 1992 (n=861). These children were ages 19 or 20 in 2000, 2002, 2004, and 2006, respectively. With its biennial measurement interval, the NLSY yields two independent samples of children (i.e., those observed at age 5, 7, 9, etc., and those observed at age 6, 8, 10, etc.). Table 1 provides descriptive information (described below) at age 5 for the first of these two samples and at age 8 information for the second. The NLSY sample has substantial fractions of both African-Americans and Hispanics.

Beginning School Study

The Beginning School Study (BSS) has followed a group of 838 children from their first grade year in 1982. Sampling began with a stratified random sample of 20 Baltimore, Maryland (U.S.) public schools (Entwisle et al., 2007). From there, roughly 12 first-graders were randomly sampled from each classroom, with a participation rate of 97% among those selected. Interviews were conducted between first grade and ages 28/29.

Many children attending Baltimore public schools in the early 1980s came from disadvantaged families, although not as uniformly disadvantaged as the children in many urban school districts today. Table 1 provides BSS sample characteristics from information gathered in grades 1 and 4. Nearly 60% of the sample participants are African-American, with virtually all of the remainder white. About a third of the sample

lived with a single parent at the baseline year and over two-thirds were eligible for a free or reduced price lunch at some point during their elementary school years.

Dependent Variables

Our primary dependent variable is a dichotomous indicator of whether a child completed high school. In the NLSY, we used information collected when students were age 19 or 20 to determine whether students completed high school. The BSS measures high school completion at age 20 or 21. In both studies, students were coded as having completed high school if they reported that they had obtained a high school degree (but not a General Education Degree, GED). In the NLSY, we also consider the students to have completed high school if they were currently enrolled in a regular high school. We make this exception because the NLSY interview may have occurred when students were a few months shy of graduation. The rate of high school completion is between 77% to 79% in the NLSY and 63% in the BSS (Table 1).

We use two additional measures of educational attainment as outcomes. In the NLSY, for the three oldest cohorts, we used data collected at age 20 or 21 to measure whether the participant ever attended college. Since it is taken early in adulthood, this is a dichotomous indicator of "on-time" college attendance. About 45% to 48% of the sample had attended college by this age. In the BSS, we use information from the age 27/28 interview about the continuous number of years of education that the individual completed. On average, BSS participants had completed 13.6 years of schooling.

Key Predictors

For each study, we use as key independent variables the assessments of academic skills, specifically reading and math achievement, as well as two dimensions of problem behavior — attention problems and antisocial behavior. These are measured every two years in the NLSY data (ages 5/6, 7/8, 9/10, 11/12) and in grades 1, 2, and 4, as well as 9, in the BSS.

Reading and math achievement. In the NLSY, children's early academic skills are measured by standardized Peabody Individual Achievement Tests (PIAT, reading recognition and math). For the purposes of analysis, scores are standardized to have a mean of 0 and standard deviation of 1 (based on the full NLSY sample distribution).

Interviewers verbally administered the PIATs. Children were first given an age appropriate item, and a basal score was established when a child answered five consecutive questions correctly. Once a basal was established, interviewers continued to ask the child questions until the child answered 5 out of 7 consecutive items incorrectly. Subtracting the number of incorrect scores between the basal and the ceiling score from the ceiling score produced a raw test score.

The reading recognition test consists of 84 items that measure word recognition and pronunciation ability. It tests children's skills at matching letters, naming names, and reading single words out loud. Dunn and Markwardt (1970) reported the one-month temporal reliability of a national sample, and the test-retest correlations ranged from a low of .81 for kindergarteners to a high of .94 for third grade students. Overall, the test had an average temporal reliability of .89. Studies of the test's concurrent validity find that the test was moderately correlated with other tests of intelligence (e.g.,Wechsler

Intelligence Scale for Children-Revised) and reading vocabulary (e.g., Metropolitan Achievement Test) (Davenport, 1976; Wikoff, 1978).

The PIAT math subscale consists of 84 multiple-choice items designed to measure mathematic concepts taught in mainstream classrooms. The problems were designed so that children are required to apply math concepts to questions rather than conduct increasingly complicated computations. The test starts with basic skills such as number recognition and counting. The test increases in difficulty to problems involving division, multiplication, and fractions. The most difficult questions involve advanced concepts from algebra and geometry. Dunn and Markwardt (1970) reported one-month test-retest reliabilities from a national sample. The reliabilities ranged from a low of .52 for kindergarteners to a high of .84 for high school seniors. On average, the test-retest reliability was .74. Studies of the PIAT math test's concurrent validity found that the test correlated moderately with other tests of intelligence and math achievement (Davenport, 1976; Wikoff, 1978). The PIAT reading recognition and math test scores are moderately correlated (*r* ranges from .36 at age 13 to .60 at age 8/9).

In the BSS, math and reading skills are assessed by the California Achievement Test (CAT) reading comprehension and math concepts and application subscales. These tests were administered by the school in May, close to the end of the school year, during each year of the BSS study. The test is scored based on national norms, and for the purposes of analysis, scores are standardized to have a mean of 0 and standard deviation of 1 (based on the BSS sample distribution). The correlation between math and reading test scores increased substantially over time, from .48 (in first grade) to .82 (in fourth grade).

Antisocial behavior and inattention. In the NLSY, behavior problems were assessed by mothers' responses to 28 items that asked how true statements were about a child's behavior during the past 3 months. These questions were created specifically for the NLSY, and consist of items derived from the Achenbach Child Behavior Checklist, as well as other established measures (Baker, Keck, Mott, & Quilan, 1993). The single item questions were recoded so that a response of "not true" corresponded to a score of 0, and "sometimes true" and "often" corresponded to a score of 1.

Six subscales were created by the NLSY staff based on a factor analysis of the items. The process for creating these subscales and the reliability of each is reported in Baker et al. (1993). Two of the 6 behavior problem subscales are used in this study — attention problems (hyperactivity) and antisocial. However, for the purposes of the analyses, the raw scores are translated into standardized scores with a mean of 0, and standard deviation of 1.

The attention problem scale is composed of 5 items that ask about the following child behaviors: being restless and overactive, having difficulty concentrating or paying attention, being easily confused or in a fog, and having trouble with obsessions. The NLSY reports that this subscale has adequate reliability (alpha of .69).

The antisocial subscale is created from 6 items that measure whether the child cheats or tells lies, bullies or is cruel to others, does not feel sorry after misbehaving, breaks things deliberately, is disobedient at school, and has trouble getting along with teachers. The antisocial subscale has adequate reliability (alpha of .67). The attention and

antisocial subscales are highly correlated, with correlations ranging from .50 (age 5/6) to .55 (age 13).[2]

In the BSS, information on children's behavior was taken from teacher reports on a maturity scale administered in the spring of the school year. Teachers rated how indicative particular behaviors were of individual children, with responses ranging from 0 ("not at all like") to 5 ("exactly like").

Based on a confirmatory factor analysis of the data, we summed four items in the maturity scale to create an antisocial subscale. These items include: fights too much, teases, picks on, or bullies other children; rather high strung, tense, and nervous; cheats, lies, is deceitful; has a strong temper, loses it easily. The internal consistency of these items is adequate (alpha=.77, second grade). To capture inattention, we summed two items: is awfully restless, fidgets all the time, can't sit still; can't concentrate, can't pay attention for long. These two items also had adequate internal consistency (alpha=.79, second grade). These measures were standardized to have a mean of 0 and standard deviation of 1 based on the BSS sample distribution. The two subscales are moderately to highly correlated over time, with correlations ranging from .56 (second grade) to .66 (fourth grade).

Covariates

To alleviate concerns that associations between children's behavior and later attainment may be the result of omitted variable biases, covariates are included in our empirical models. The NLSY data provides many more covariates than the BSS. Both datasets provide information on demographic family characteristics. Covariates from the NLSY data also include early childhood measures of children's temperament, receptive language skills, and the quality of family environments as well as maternal risk behaviors.

NLSY covariates. An important strength of the NLSY is the depth and range of longitudinal information collected about families. We take advantage of these data to construct a comprehensive set of covariates that capture potentially important confounds that may be correlated both with early skills and behavior as well as later attainment. A full list of these control measures is provided in Appendix Table 1.

Maternal and interviewer reports of two relevant dimensions of children's temperament — sociability and compliance — are drawn from the children's age 3 or 4 interviews.[3] The Peabody Picture Vocabulary Test-Revised (PPVT) is used to measure

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[2] The antisocial and inattention/hyperactivity scale are both part of the larger externalizing scale created by NLSY staff. When we use the externalizing measure as a dependent measure in analyses results parallel those found for the antisocial measure.

[3] The compliance measure was created by summing maternal ratings of the frequency of children's behavior on a five-point scale from almost never (1) to almost always (5). Taken together, the seven items capture how well the child follows directions. For example, questions include how often "the child obeys when told to go to bed" and "turns off the TV when asked." This measure has adequate reliability, with NLSY reporting the alpha of .59 for children of all ages (Baker et al., 1993). Summing 3 interviewer ratings

children's early receptive vocabulary at age 3/4. The PPVT consists of 175 vocabulary items which increase in difficulty. Nationally standardized scores are used in our analyses.

Data on children's family environments were coded to correspond to two intervals—between birth and age 5 and at age 5/6. Measures available at both times include: family income, family structure, and urban residence. Some information was only measured when children were age 5 or 6, including the quality of children's home environments (HOME) and two measures of family structure (blended family and cohabitation). The highest grade a mother completed when the child was age 5/6 is also used as a control (see Appendix Table 1).

The NLSY measures an array of child and maternal background characteristics, which are used as covariates in analyses. These variables include, for example, measures of the child's race/ethnicity (Black, Hispanic, or non-Hispanic White) and mothers' percentile scores on the Armed Forces Qualifying Test (AFQT, a measure of mothers' academic aptitude assessed in 1980). In addition, several variables that measure mothers' risk-taking behaviors (drug and alcohol use) and her adolescent experiences are also included as covariates.[4]

BSS Covariates. The covariates measured in the BSS are far fewer than in the NLSY. Parent report data are provided for the child's race (African-American or White), mother's age at the child's birth, whether the primary caregiver was a single parent, and the number of siblings in the household. Several indicators of the family's socioeconomic standing are also available, including both mother's and father's educational levels and occupational levels, as well as whether the child qualified for the federal lunch subsidy program.

Missing Data

The longitudinal nature of data collection results in missing data for both studies. To handle the missing data, we used multiple imputation techniques, implemented in

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of the child's cooperation during the assessment created the sociability scale. Children were rated on a scale of poor (1) to excellent (5). Items include, for example, the observer's rating of how cooperative the child was in completing the assessment and of the child's attitude toward being tested. This measure has a high reliability; the NSLY reports an alpha of .93 (Baker et al., 1993). Children who were age 5 or 6 in 1986 do not have early childhood measures of PPVT or temperament because the maternal and child interview was not conducted at an earlier age for these children. In addition, NLSY's restriction of the measurement of sociability to children over age 4 in 1990, resulted in a large number of missing data on this measure for children in cohort 4 that were age 3 in 1990. These data are imputed for children with missing observations.

[4] Currie and Stabile's (forthcoming) analysis takes advantage of the fact that the NLSY provides observations on siblings by estimating fixed-effect sibling models. They find very similar coefficients on early attention and antisocial behavior in their models of school enrollment. Given our lengthy time period between early-grade measurement of skills and behavior and eventual attainment, sibling models are not possible for our analyses.

STATA. For each study, 5 datasets were created and analyzed. This approach assumes that data were missing at random (conditional on observed characteristics).

In the NLSY, between a quarter and a third of a particular age cohort of children is missing information on a key outcome variable (high school completion). Missing data on key predictors (achievement and behavior) is quite low during the early school years, with no more than 10% missing data on achievement or behavior at ages 5 or 6. Yet, as might be expected, rates of missing data increase over time so that by age 13, about 30% of the sample has missing data on one or more of the achievement and behavior variables.

For the BSS, interviewing rules limited the sample size in some years, thus increasing rates of missing data. In the first year of the study, grade 1, about 12% to 16% of data were missing for the key predictors, achievement and teacher ratings of behavior. In grade 2, the study only followed children attending the originally sampled schools. This resulted in 20% to 35% missing data on key predictors. By grade 4, the study was following students as long as they attended Baltimore public schools, but rates of missing data ranged from 35% to 52% for key predictors. Increased efforts to track and include all members of the original data resulted in rates of missing data in grade 9 that were between 27% and 54%. Across grades 2, 4, and 9, the rates of missing data were highest for teacher reports of behavior. Finally, about 21% of the sample was missing outcome information on high school completion at age 20 or 21 or years of completed schooling at age 27 or 28.

Analysis Plan

We estimated probit regression models of high school completion and, for the NLSY, college attendance. We take measures of achievement, attention, and behavior at three time-points chosen to be roughly comparable across the datasets: age 5 (NLSY) and first grade (BSS); age 8 (NLSY) and second grade (BSS); and age 13 (NLSY) and ninth grade (BSS). To ease interpretation of results from the probit models, we present marginal effects, which indicate the percentage point change in the outcome (i.e., high school completion or college attendance) associated with a one standard deviation change in the independent variable of interest. For the continuous measure of years of completed schooling in the BSS, we estimated OLS regressions and produce coefficients that reflect the change in years of complete schooling associated with a one standard deviation change in the independent variable of interest.

Point-in-time Measures

First, we estimated bivariate models, in which each measure of achievement and behavior is entered by itself, without any other predictors. In the absence of measurement error, this specification is likely to provide an upper bound of the possible effect of early academic skills and behavior problems on later educational attainment.

A key challenge in our regression modeling is to ensure that we have accounted for the possibility of omitted variable bias, which is likely to arise if unobserved family or child characteristics are correlated both with children's school entry skills and their later achievement. For this reason, in our second specification we include as many prior measures of relevant child and family characteristics as possible. As described above, in

the BSS this is a basic set of family and child characteristics. In the NLSY the controls include a similar set of basic family and child characteristics, as well as a measure of the child's earlier temperament and receptive language skills and the mother's academic aptitude and health-risk behaviors. In this specification, we do not include other concurrent measures of behavior and achievement. Thus, to the extent that skills and behaviors cluster, but exert independent effects, this specification will likely still overstate the predictiveness of children's skills and behavior.

In our third model, we omit child and family covariates but include all four concurrent measures of children's achievement and behavior. This approach parses out variance across these differing domains, but does not hold constant family background characteristics. If the measures of reading and math skills as well as inattention and antisocial behavior problems reflect prior family experiences, then this model will reduce the potential for omitted variable bias.

Our final specification, which we consider our preferred model, includes all concurrent measures of achievement and behavior, as well as the full set of controls. This specification should greatly reduce the potential for omitted variable biases and enable us to more thoroughly isolate the unique prediction of early skills and behavior to later attainment.

Persistence Measures

Prior research has suggested that a student's trajectory of behavior problems may be more important than their level of behavior problems at any single age in predicting later educational attainment (Kokko et al., 2006). This might also be true for achievement trajectories. To test whether the *persistence* of academic and behavior problems is a stronger predictor of later attainment than early behavior, we categorized children according to their pattern of scores during the early school years (age 6, 8, 10 in the NLSY and grades 1, 2, and 4 in the BSS). Based on prior empirical work, we chose the 75th percentile or above to demark a "high" level of behavior problems, and likewise chose the 25th percentile or below to demark low achievement.

We then formed four groups: i) *early only* — the 6% to 12% of NLSY and BSS children, respectively (see Table 2), who fell into the most problematic quarter in the first but neither second nor third timepoint for the given behavior or achievement problem distribution; ii) *persistent* — the 7% to 11% of NLSY and BSS children who had high behavior problems (or low achievement) on all three measurement occasions; iii) *no problems* — the 54% to 61% of NLSY and BSS children who never fell into the most problematic quarter of the given behavior or achievement distribution; and iv) *mixed* — a residual group composed of the 24% to 31% of sample children who fell into the most problematic quarter at least once but did not fit either the "early only" or "persistent" profiles.

How overlapping are these persistent problem trajectories? In the NLSY, of those children in the persistent antisocial category, nearly 20% are also categorized as having persistent math or reading problems and 30% are considered to have persistent inattention problems. Of those with inattention problems, 21% have persistent reading problems and 25% have persistent math problems. Of those with reading problems, 43% have math problems. While this overlap may seem considerable, it is worth recalling that with the

relatively small number of cases being categorized as persistent problem behavior, no more than 4% of all children fall into any two persistent problem categories and much less than 1% fall into all four persistent categories. Rates of overlap were similar in the BSS sample.

Results

Bivariate Associations

Data presented in the first column of Table 3 show bivariate relationships between high school completion (and the other attainment measures) and the four key achievement tests and behaviors measured around school entry. Table 4 repeats this information for measures taken shortly after school entry. For both tables, the top panel shows results for the NLSY while BSS results are provided in the bottom panel. Bearing in mind that all four skill and behavior measures are standardized within the analysis samples, the -.051 coefficient on parent reports of antisocial behavior in the first column and row of Table 3 has the interpretation that a standard deviation increase in first grade antisocial behavior is associated with a 5.1 percentage point drop (i.e., from 79% [see Table 1] to about 72%) in the probability of timely high school completion in the NLSY sample.

All of the bivariate coefficients shown in Tables 3 and 4 are statistically significant, in the expected direction, modest to more substantial in size and, for the most part, increase between our two early primary grade-time points. Taken together, these results support almost any modest claim regarding the predictiveness of early skills and behaviors for successful completion of high school.

Regression-adjusted Associations

Probit regression results in the second column of Tables 3 and 4 adjust bivariate associations for prior family and background controls (but not for concurrent skills and behaviors). The associations fall considerably – often by half and occasionally to the point of statistical insignificance. Thus, it appears that important portions of the simple associations between high school completion and primary school attention skills, reading and math achievement are the result of their mutual correlation with family circumstances and, in the case of the NLSY, prior cognitive ability and temperament.[5]

Results presented in the third column (Tables 3 and 4) adjust the bivariate associations for concurrent skills and behaviors, but not prior family and child characteristics. Again, coefficients fall substantially in most cases, particularly for early attention skills.

Presented in the fourth column (Tables 3 and 4) are our preferred estimates of the "effects" of early skills and behaviors taken from models that adjust for both concurrent skills and for prior family and child characteristics. For both the beginning and middle of

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[5] The inclusion of children's early temperament and receptive vocabulary as controls does little to further reduce the association of age 5 achievement and behavior measures, once our comprehensive set of family characteristics are controlled.

primary school, antisocial behavior has a significant, negative, albeit modest effect on high school completion. Early math and reading skills are inconsistently predictive, while early attention skills are significant.

The final column of Tables 3 and 4 presents probit regression results for college attendance in the NLSY and OLS regression results for years of completed schooling in the BSS.[6] Background controls and concurrent skills and behaviors are included in all of these regressions. For age 5 and first grade skill and behavior measures (Table 3), math skills are significant predictors of both outcomes, while attention problems are predictive of completed schooling in the BSS. Curiously, age 8 and fourth grade measures of math and attention problems do not replicate these results. On the other hand, age 8 and fourth grade reading skills are significant in both samples (Table 4), although they had not been predictive of high school completion in the BSS. Taken together, the results show no consistent and strong early predictors of our school outcomes.[7]

For completeness, we also examine the predictiveness of problem behaviors and achievement measures taken in early adolescence (ages 13 and grade 9; Table 5). Antisocial behavior and, especially, math achievement emerges as consistently strong and significant predictors of all of the outcomes in both data sets.

Patterns Across Childhood

To obtain the most complete picture of the relative importance of skills and behaviors across childhood, we estimated the equivalent of our full-control (column 4) model using all possible age groups in the two datasets. In all cases, we adjusted for prior family and child characteristics as well as concurrent attention and achievement skills. Results are displayed in the first four rows of Table 6. They show that although there is a negative association between early antisocial behavior and high school completion, the association is neither large nor consistently significant until about age 10. We find that attention problems are not a consistently significant predictor of high school completion at any age.

The results for math and reading are less clear. There appears to be some indication of a tradeoff between math and reading for prediction. For example, at ages 6 and 8, reading appears to be more predictive than math; whereas at ages 7 and 9, math appears to be more predictive than reading. Suspecting that the substantial correlation between reading and math achievement may be producing these patterns, we calculated a composite measure of reading and math and substituted it for its two components. Results presented in the fifth row of Table 6 show the predictive association of a standard deviation change in the achievement composite, controlling for both behavior measures and a full set of controls, on the probability of high school completion.

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[6] Recall that with completed school measured in years, the OLS coefficients are not comparable to the probit coefficients and reflect the change in years of school associated with a standard deviation increase in the given early behavior or skill.

[7] About 30% of the NLSY five-year-olds have not yet entered regular school; when we remove these children from our sample, we do not find that coefficients change substantially from those reported in Table 2.

Comparing results in row 5 to those in rows 3 and 4, it can be seen that the predictiveness of the achievement composite is consistently a little less than the sum of the predictiveness of its component parts. This leads the composite to be an almost consistently significant predictor of achievement. (The exception is in the BSS sample at grade 1, where the coefficient is in the expected direction but too small to be statistically significant at conventional levels in the BSS sample.) Moreover, the marginal effect appears to increase until about age 7, after which point it remains roughly steady.

Are Persistent Problems More Predictive than Transitory Problems?

Because many children with behavior, reading, and math learning problems in the very early grades may learn to master the self-regulation and other skills needed to compensate for them, we investigated the comparative predictive power of longitudinal patterns of problems across the primary grades. Our interest is in whether it is possible to identify children at highest risk for high school dropout from these early patterns. As described above, we did this by taking the first three primary school observations in each of the two datasets. In the case of the NLSY, this was at ages 6, 8, and 10. For the BSS, it was first, second, and fourth grade.

Bivariate and regression-adjusted probit estimates relating these profiles to our education outcomes are shown for the NLSY in Table 7 and for the BSS in Table 8. In all cases, children in the "no problem" profile group serve as the reference category, and coefficients for the other groups show changes in the probability of the schooling outcomes (or years of completed schooling) associated with being in that group relative to the reference group. Bivariate results presented in the first column of both tables show very strong schooling associations for all of the problem categories, but the strongest associations between the persistent problem and the no problem reference group.

Turning to the full-control models starting in column 4, Table 7 suggests that NLSY children with "early only" attention, reading, or behavior problems are not significantly more likely to have lower schooling attainment than are children in the "no problem" group. BSS results (Table 8) are not as uniform, with early attention and math problems being at least marginally predictive of completed schooling. In only one case (high school completion in the NLSY) are "early only" behavior problems predictive of our outcomes. Analysis of both datasets suggests that children who outgrow early reading problems by the middle of primary school are not at higher risk of completing less schooling.

Turning to the "persistent" groups, there is at least some evidence to support links between attainment and the persistence of all four types of problems. Persistent antisocial behavior problems across the early grades are consistently predictive of high school completion, although not of eventual completed schooling in the BSS. Persistent attention problems are significant predictors in only one case — completed schooling in the BSS. Persistent reading problems are predictive in the NLSY but not the BSS. Persistent math problems are less predictive of high school dropout than of college attendance and completed schooling.

Race, Income, and Gender Differences

The relatively large NLSY sample size enabled us to estimate our point-in-time and persistence models for both Black and low-income children (with low-income being defined as the bottom 25% of the income distribution for this sample, approximately an average income-to-needs ratio of 1.3 or less during early childhood). Results, shown in Appendix Table 2, suggest no consistent differences by race. Some evidence emerges that antisocial behavior may be more predictive of high school completion for low-income children, but this is primarily for the age 8 and age 13 time points. Gender-based subgroup models shown in Appendix Table 3 also show no consistent differences for the NLSY children. For the BSS children, there were somewhat larger effects on early attention problems for boys than girls (Appendix Table 4). The lack of consistency across samples leads us to be cautious about interpreting any of the differences found in one study as particularly meaningful.

Discussion and Next Steps

This study set out to better understand the relative contribution of children's early academic skills and two dimensions of early behavior problems (antisocial behavior and inattention) to later schooling outcomes. By using two large longitudinal datasets, with similar (although not identical) measures, we sought to discover replicable findings across diverse populations and measures. Such replication builds confidence that associations are meaningful, rather than due to either the peculiarities of a particular population or set of variables. This approach yielded both some interesting consistencies and inconsistencies, which will be the focus of additional work in the coming months.

First, we highlight a general pattern in our findings. When taken individually and in the absence of any controls, all of the early skills and behaviors we examine are modestly predictive of later attainment. The strength of these associations, however, is reduced drastically when all of these measures, and a host of background characteristics, are included as covariates. The intercorrelation among these measures argues against studies that seek to assess the predictive power of any single domain, but fail to control for the others.

The clearest finding to emerge from our study is the lack of consistent prediction of early attention problems to high school completion. Even persistently high levels of inattention fail to predict later high school completion, holding constant patterns of early skills and antisocial behavior problems. Given that early attention has been found to be a consistent and substantial predictor of later achievement (Duncan et al., 2007), this reinforces the idea that the determinants of attainment and achievement are not one and the same (Currie & Stabile, 2006).

With respect to antisocial behavior, we do not find that early behavior problems (prior to about age 10) are strongly linked to high school completion or other educational outcomes. Even persistently high levels of antisocial behavior during the early primary school years failed to significantly predict later high school completion consistently, although we note that the estimated magnitude of effects was in both cases sizable. After age 10, at the point of entrance into early adolescence, higher levels of antisocial behavior begin to be more consistently predictive of high school completion. Thus, behavior problems early in the school year do not appear to have large long-lasting

consequences for attainment, but behavior that continues into or begins in early adolescence is more likely to matter.

In the absence of other controls, reading and math skills are consistently significant predictors of later schooling in the early years and throughout childhood. Adjusting for covariates produces a much less consistent story. In particular, the predictiveness of reading achievement is highly variable across ages, with assessments from some time points even suggesting that lower reading is beneficial for high school completion.

When we measure achievement as a composite, however, it appears that the association between early academic skills and later high school completion is more consistent over middle childhood. The magnitude of the association increases until age 7, at which point it appears to fluctuate but not necessarily increase monotonically. Should we consider 7 years old a turning point at which point children's academic skills become particularly consequential for their later attainment? We hesitate to make such a claim from our data, as the fluctuation in prediction from measures at later ages introduces uncertainty in this proposition.

What inconsistencies arose from this analysis? First, early measures in the BSS sample were often more predictive than counterpart measures in the NLSY. We explored several explanations for such a pattern, but ultimately are still uncertain as to how to account for these differences. First, we might think that such differences can be attributed to differences in the composition of the samples. The BSS was slightly more disadvantaged and had a higher proportion of African-American children than the NLSY. Yet, the subgroup analyses presented in Appendix Tables 2 and 3 do not indicate that African-American students in the NLSY have a stronger pattern of associations than the larger sample. The evidence for the low-income sample is a bit mixed, measures at the later time points (ages 8 and 13), are indeed a bit larger, and closer to those found in the BSS, but power is sacrificed, and the estimated effect at early time point is not larger (age 6).

Another difference between the BSS and the NLSY is in who reports information about the children's behavior. In the BSS we use teacher reports of problem behavior and in the NLSY we use parent reports. The lower coefficients in the NLSY suggest the possibility that parent reports are less reliable indicators of the dimensions of antisocial behavior (that is, more error prone, and these measures do have lower levels of internal consistency). We are able to use additional information from the BSS to explore this concern. In second grade (but not first or fourth grade), the BSS administered the same social maturity scale to parents as to teachers. Thus, we could check directly if parent responses to the same items provide a lower level of prediction. These parent scales have a lower level of internal consistency (alphas of .59 for antisocial and .57 attention problems) than the teacher scales. Despite this lower level of reliability, results presented in Appendix Table 4 suggest that, if anything, parent reports of antisocial behavior, and to a lesser extent attention problems, are more predictive of high school dropout and educational attainment than teacher reports. This suggests that the lower prediction in the NLSY is not primarily due to its reliance on parent report information.

Some important limitations to our study should be noted. First, we chose to consider associations among only two dimensions of behavior problems — antisocial behavior and inattention. Other dimensions of early behavior may be more important than these two domains that we have examined. In particular, early task persistence and work habits, as well as anxiety, may be important predictors of later educational attainment. The NLSY and BSS did not collect consistent measures of these areas during early and middle childhood, and so they are not included in our study. Second, the measures of behavior typically had lower levels of internal consistency than the measures of achievement. This measurement error may have limited our ability to detect effects. We hope to explore this possibility further in future research. Third, we will also explore whether the use of multiple imputation affected our findings.

Finally, we have not considered how school or classroom experiences may interact with children's early skills and behaviors to promote or inhibit children's later success. In general, we might conjecture that positive early classroom experiences may be protective for students with low levels of academic skills and high levels of behavior problems, and thus may moderate associations between these early measures and later attainment. For example, teacher-child relationships in the early school years appear to be important for later school success, and this association is particularly pronounced for children with higher levels of behavior problems. Thus, support from teachers in the early years of school may be especially protective for children who are at risk of school failure (Hamre & Pianta, 2005). Unfortunately, the NLSY does not contain school or classroom information and the BSS has only a very limited set of relevant information. Nevertheless, we hope to use BSS data to examine such a pattern of moderation in future work.

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Table 1. **Descriptive Statistics for Key Variables**

	Mean (SD) or %, NLSY, Age 5 Sample	Mean (SD) or %, NLSY, Age 8 Sample	Mean (SD) or %, BSS, Grade 1	Mean (SD) or %, BSS, Grade 4
Outcomes				
High School Completion	79%	77%	63%	63%
Ever Attending College (Age 20/21)	48%	44%	---	---
Years of Schooling (Age 28/29)	---	---	13.57 (2.98)	13.57 (2.98)
Key Independent Variables				
Antisocial	-.03 (.96)	.03 (1.03)	2.25 (3.64)	3.03 (4.07)
Attention	-.02 (.98)	.00 (1.01)	2.32 (2.90)	2.47 (2.57)
Reading	.13 (1.13)	.03 (1.03)	339.7 (45.2)	452.9 (71.1)
Math	-.06 (1.08)	-.02 (1.04)	340.9 (36.5)	444.4 (55.8)
Demographic Characteristics				
Male	52%	49%	50%	50%
African American	30%	31%	55%	55%
Hispanic	21%	22%	---	---
Age 0-5: Years in Poverty	.18 (.27)	.19 (.28)	---	---
SES Composite	---	---	-.05 (.80)	-.05 (.80)
Family Characteristics				
Age 0-5: Years Never Married	.24 (.40)	.25 (.41)	---	---
Age 0-5: Years Divorced	.12 (.26)	.13 (.26)	---	---
Single Parent	---	---	34%	34%
Mothers Age at Child's Birth	22.5(3.0)	21.8(3.0)	23.9 (5.6)	23.9 (5.6)
Age 0-5: Ave # Children	2.21 (1.04)	2.25 (1.08)	---	---
Number of Siblings	---	---	1.5 (1.4)	1.5 (1.4)

BSS Notes:
"Antisocial" is the sum of 4 items, scaled 0-5.
"Attention" is the sum of 2 items, scaled 0-5.
Reading and Math scores are from the California Achievement Test.
Background characteristics were typically collected in Grade 1.
SES Composite includes parents' education levels, occupational levels, and whether or not the child qualified
   for a subsidized lunch.
NLSY Notes:
"Antisocial" scale is comprised of 6 items, scaled 0-6, then standardized with means of 0 and SDs of 1.
"Attention" scale is creadted from 5 items, scaled 0-5, then standardized with means of 0 and SDs of 1.
Each reading and math score consists of 84 items, then standarized with means of 0 and SDs of 1.

Table 2. **Percent of Imputed Sample in each Persistence Category**

	Antisocial		Attention		Reading		Math	
	NLSY	BSS	NLSY	BSS	NLSY	BSS	NLSY	BSS
Early Problems	6.6%	7.8%	8.1%	6.2%	11.5%	9.8%	9.5%	8.2%
Mixed Problems	27.3%	27.3%	24.6%	31.4%	21.2%	27.5%	26.2%	23.4%
Persistent Problems	9.0%	9.1%	6.7%	7.5%	11.0%	5.9%	9.4%	9.6%
No Problems	57.2%	55.9%	60.7%	54.9%	56.3%	56.8%	54.9%	58.8%
Sample Size	1,887	838	1,887	838	1,887	838	1,887	838

Note: NLSY captures persistence across ages 6, 8, & 10.
BSS captures persistence across grades 1, 2, and 4.
Thresholds set at 75th percentile for antisocial and attention and at the 25th percentile for reading and math achievement.

Table 3. **Summary of Regression Results of Schooling Outcomes on Age 5 or Grade 1 Predictors**

	(1)	(2)	(3)	(4)	(5)
			NLSY (*N*=2,005)		
		High School Completion (probit)			Ever Attending College (probit)
Problem Behavior, Age 5					
Antisocial, parent report	-.051***	-.023*	-.026*	-.021†	-.029
	(.011)	(.011)	(.012)	(.012)	(.025)
Attention, parent report	-.048***	-.013	-.021	-.001	.002
	(.011)	(.012)	(.014)	(.014)	(.027)
Academic Achievement, Age 5					
Reading	.067***	.025*	.044***	.019	.032
	(.008)	(.012)	(.014)	(.013)	(.024)
Math	.060***	.020†	.031*	.012	.049*
	(.011)	(.011)	(.013)	(.012)	(.023)
Family & Child Characteristics		yes		yes	yes
			BSS (*N*=838)		
		High School Completion (probit)			Years of Schooling (OLS)
Problem Behavior, Grade 1					
Antisocial, teacher report	-.117***	-.077***	-.084***	-.049*	-.049
	(.021)	(.021)	(.023)	(.023)	(.122)
Attention, teacher report	-.116***	-.077***	-.038†	-.040	-.365**
	(.018)	(.021)	(.022)	(.025)	(.124)
Academic Achievement, Grade 1					
Reading	.052*	-.008	-.019	-.050†	-.187†
	(.022)	(.025)	(.027)	(.029)	(.111)
Math	.136***	.078**	.124***	.081*	.582***
	(.021)	(.026)	(.028)	(.031)	(.138)
Family & Child Characteristics		yes		yes	yes

Notes: *** *p*<.001; ** *p*<.01; * *p*<.05; † *p*<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of high school completion associated with unit changes in the given independent variable

Column 1 coefficients represent simple bivariate relationships.

Column 2 adjusts these bivariate relationships for only background characteristics.

Columns 3-4 include all covariates simultaneously.

Column 5 for NLSY represents marginal effects from probit regression of attending college at age 20/21 (N=960).

Column 5 for BSS represents coefficients from a standard OLS regression of years of schooling by Age 28/29.

BSS controls are sex, age, whether African American, a composite of SES indicators, whether a child of a single parent, mother's age at birth, & number of siblings.

NLSY controls include a rich set of child and mother characteristics, children's temperament at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family charateristics between birth and age 5 and at age 5/6.

Table 4. **Summary of Regression Results of Schooling Outcomes on Age 8 or Grade 4 Predictors**

	(1)	(2)	(3)	(4)	(5)
	NLSY (*N*=1,840)				
	High School Completion (probit)				Ever Attending College (probit)
Problem Behavior, Age 8					
Antisocial, parent report	-.078***	-.042***	-.049***	-.032**	-.088***
	(.012)	(.010)	(.015)	(.012)	(.027)
Attention, parent report	-.070***	-.034**	-.022	-.012	-.046†
	(.013)	(.012)	(.016)	(.014)	(.025)
Academic Achievement, Age 8					
Reading	.092***	.047***	.065***	.044**	.095**
	(.010)	(.013)	(.014)	(.015)	(.035)
Math	.070***	.018	.018	-.007	.030
	(.010)	(.011)	(.013)	(.013)	(.028)
Family & Child Characteristics		yes		yes	yes
	BSS (*N*=838)				
	High School Completion (probit)				Years of Schooling (OLS)
Problem Behavior, Grade 4					
Antisocial, teacher report	-.117***	-.090***	-.056†	-.063*	-.140
	(.017)	(.022)	(.029)	(.031)	(.229)
Attention, teacher report	-.122***	-.077*	-.030	-.014	-.219
	(.022)	(.032)	(.035)	(.049)	(.293)
Academic Achievement, Grade 4					
Reading	.158***	.079***	.071*	.000	.377†
	(.021)	(.021)	(.032)	(.034)	(.203)
Math	.155***	.093***	.066†	.066	.282
	(.022)	(.024)	(.037)	(.040)	(.186)
Family & Child Characteristics		yes		yes	yes

Notes: *** *p*<.001; ** *p*<.01; * *p*<.05; † *p*<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of high school completion associated with unit changes in the given independent variable

Column 1 coefficients represent simple bivariate relationships.

Column 2 adjusts these bivariate relationships for only background characteristics.

Columns 3-4 include all covariates simultaneously.

Columns 1-4 represents marginal effects from probit regression of high school completion.

Column 5 for NLSY represents marginal effects from probit regression of attending college at age 20/21 (N=852).

Column 5 for BSS represents coefficients from a standard OLS regression of years of schooling by Age 28/29.

BSS controls are sex, age, whether African American, a composite of SES indicators, whether a child of a single parent,
    mother's age at birth, & number of siblings.

NLSY controls include a rich set of child and mother characteristics, children's temperament
    at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family charateristics
    between birth and age 5 and at age 5/6.

Table 5. **Summary of Regression Results of Schooling Outcomes on Age 13 or Grade 9 Predictors**

	(1)	(2)	(3)	(4)	(5)
			NLSY (*N*=1,832)		
		High School Completion (probit)			Ever Attending College (probit)
Problem Behavior, Age 13					
Antisocial, parent report	-.097***	-.052***	-.082***	-.050***	-.063*
	(.011)	(.009)	(.014)	(.010)	(.029)
Attention, parent report	-.062***	-.025†	-.006	.007	-.017
	(.014)	(.013)	(.015)	(.014)	(.030)
Academic Achievement, Age 13					
Reading	-.014	.048**	-.058***	.015	.098*
	(.011)	(.015)	(.012)	(.017)	(.048)
Math	.085***	.047***	.089***	.036**	.168***
	(.012)	(.013)	(.012)	(.013)	(.037)
Family & Child Characteristics		yes		yes	yes
			BSS (*N*=838)		
		High School Completion (probit)			Years of Schooling (OLS)
Problem Behavior, Grade 9					
Antisocial, teacher report	-.154***	-.110***	-.126**	-.118**	-.333†
	(.026)	(.028)	(.039)	(.040)	(.174)
Attention, teacher report	-.086*	-.047	.020	.037	.167
	(.034)	(.040)	(.053)	(.058)	(.280)
Academic Achievement, Grade 9					
Reading	.155***	.072*	-.072†	-.087*	.130
	(.024)	(.028)	(.039)	(.043)	(.181)
Math	.238***	.160***	.268***	.208***	.937***
	(.027)	(.030)	(.040)	(.042)	(.187)
Family & Child Characteristics		yes		yes	yes

Notes: *** $p<.001$; ** $p<.01$; * $p<.05$; † $p<.1$

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of high school completion associated with unit changes in the given independent variable

Column 1 coefficients represent simple bivariate relationships.

Column 2 adjusts these bivariate relationships for only background characteristics.

Columns 3-4 include all covariates simultaneously.

Columns 1-4 represents marginal effects from probit regression of high school completion.

Column 5 for NLSY represents marginal effects from probit regression of attending college at age 20/21 (N=855).

Column 5 for BSS represents coefficients from a standard OLS regression of years of schooling by Age 28/29.

BSS controls are sex, age, whether African American, a composite of SES indicators, whether a child of a single parent, mother's age at birth, & number of siblings.

NLSY controls include a rich set of child and mother characteristics, children's temperament at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family charateristics between birth and age 5 and at age 5/6.

Table 6. Summary of Results from Probit Regressions of High School Completion on Achievement and Behavior Problems across Middle Childhood, BSS & NLSY

	NLSY, 5	NLSY, 6	BSS, 6/7	NLSY, 7	NLSY, 8	NLSY, 9	BSS, 9/10	NLSY, 10	NLSY, 11	NLSY, 12	NLSY, 13	BSS, 14/15
Antisocial	-.021†	-.019†	-.049*	-0.019	-.032*	-.018†	-.063*	-.028*	-.036***	-.030*	-.050***	-.118**
Inattention	-0.001	-0.007	-.040	0.003	-0.012	0.004	-.014	-0.007	0.006	-.032*	0.007	.037
Reading	0.019	.035*	-.050†	.027†	.044**	0.01	.000	.024†	.032*	.034*	0.015	-.087*
Math	0.012	0.013	.081*	.032*	-0.007	.036*	.066	.038*	.025†	0.018	.036**	.208***
Achievement Composite	0.027*	.039**	0.019	.052**	.034**	.041**	.063*	.050**	.056**	.046**	.046**	.102***
Family & Child Char.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Sample Size	2005	1888	838	1751	1836	1759	838	1778	1834	1663	1828	838

Notes: *** p<.001; **p<.01; *p<.05; †p<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of high school completion associated with unit changes in the given independent variable

Results in rows 1-4 are similar to model 4 in Tables 2,3,4 ; all four achievement and behavior measures are entered simultaneously.

Results in row 5 , for the achievement composite, are from a model with full controls and both behavior measures.

BSS controls are sex, age, whether African American, a composite of SES indicators, whether a child of a single parent, mother's age at birth, & number of siblings.

NLSY controls include a rich set of child and mother characteristics, children's temperament at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family characteristics between birth and age 5 and at age 5/6.

Table 7. Results from Probit Regressions of Schooling Outcomes on Persistent Problems

NLSY, Ages 6, 8, and 10 (*N*=1,887)

	(1)	(2)	(3)	(4)	(5)
			High School Completion		Ever Attending College
Antisocial Problems					
Early	-.165**	-.090*	-.115*	-.086†	-.107
	(.048)	(.045)	(.049)	(.046)	(.099)
Mixed	-.145***	-.064*	-.102***	-.054†	-.156**
	(.031)	(.028)	(.032)	(.028)	(.058)
Persistent	-.241**	-.122*	-.157**	-.101†	-.271***
	(.046)	(.048)	(.052)	(.055)	(.063)
Attention Problems					
Early	-0.093*	.004	-.027	.026	-.023
	(.046)	(.035)	(.044)	(.032)	(.087)
Mixed	-.147***	-.059†	-.044	-.018	-.074
	(.030)	(.030)	(.030)	(.030)	(.062)
Persistent	-.162**	-.048	-.005	.015	.061
	(.053)	(.046)	(.050)	(.042)	(.108)
Reading Problems					
Early	.079*	-.045	-.042	-.029	-.111
	(.038)	(.040)	(.039)	(.039)	(.078)
Mixed	-.194***	-.088**	-.122***	-.063†	-.157**
	(.035)	(.031)	(.038)	(.035)	(.058)
Persistent	-.271***	-.124*	-.164***	-.083†	-.131
	(.043)	(.048)	(.050)	(.048)	(.084)
Math Problems					
Early	-.100*	-.040	-.060	-.029	-.060
	(.045)	(.042)	(.042)	(.040)	(.073)
Mixed	-.145***	-.055	-.069†	-.027	-.164**
	(.036)	(.034)	(.036)	(.036)	(.060)
Persistent	-.254***	-.120*	-.098*	-.066	-.244**
	(.043)	(.052)	(.046)	(.047)	(.082)
Family & Child Characteristics		yes		yes	yes

Notes: *** p<.001; ** p<.01; * p<.05; † p<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of high school completion associated with unit changes in the given independent variable

Column 1 coefficients represent comparisons between early, miscellaneous, and persistent behavior problems and the no problem referer

Column 2 represents these comparisons when controlling only for background characteristics.

Columns 3-5 include all covariates simultaneously.

Columns 1-4 represents marginal effects from probit regression of high school completion.

Column 5 represents marginal effects from probit regression of attending college at age 20/21.

"Early" reflects cases above the 75th percentile at Age 6 only.

"Persistent" reflects cases above the 75th percentile at Ages 6, 8, and 10.

"Mixed" reflects cases above the 75th percentile for at least 1 timepoint, excluding the "Early" and "Persistent" patterns.

5.41%, 13.88%, and 22.05% of antisocial behaviors are imputed at age 6, 8, and 10, respectively.

Table 8. **Regression Results from Regressions of Schooling Outcomes on Persistent Problems**

BSS, Grades 1, 2, & 4 (*N*=838)

	(1)	(2)	(3)	(4)	(5)	(6)
	High School Completion (probit)				Attending College (probit)	Years of Schooling (OLS)
Antisocial Problems						
Early	-.123†	-.102	-.106	-.080	.002	-.197
	(.073)	(.082)	(.072)	(.081)	(.120)	(.442)
Mixed	-.209***	-.156*	-.148*	-.121†	-.029	-.368
	(.054)	(.061)	(.059)	(.062)	(.057)	(.273)
Persistent	-.410***	-.287**	-.324**	-.234*	-.117	-.341
	(.072)	(.100)	(.101)	(.116)	(.095)	(.434)
Attention Problems						
Early	-.164*	-.139	-.055	-.071	-.040	-.695†
	(.076)	(.092)	(.079)	(.094)	(.104)	(.355)
Mixed	-.210***	-.148**	-.084	-.070	-.016	-.786*
	(.051)	(.055)	(.057)	(.054)	(.055)	(.351)
Persistent	-.340***	-.227*	-.099	-.075	.017	-1.145*
	(.085)	(.096)	(.120)	(.106)	(.127)	(.531)
Reading Problems						
Early	.013	.060	.052	.073	-.052	-.101
	(.078)	(.080)	(.080)	(.081)	(.076)	(.391)
Mixed	-.277***	-.150**	-.169**	-.103	-.099	-.326
	(.047)	(.053)	(.063)	(.064)	(.076)	(.306)
Persistent	-.259*	-.121	-.106	-.046	-.147	-.388
	(.104)	(.125)	(.115)	(.116)	(.116)	(.655)
Math Problems						
Early	-.173	-.102	-.150	-.095	-.082	-1.151*
	(.107)	(.114)	(.121)	(.127)	(.106)	(.563)
Mixed	-.200***	-.098*	-.084	-.031	-.092	-.683†
	(.044)	(.050)	(.055)	(.059)	(.092)	(.412)
Persistent	-.309***	-.158	-.121	-.042	-.193*	-.837†
	(.075)	(.096)	(.096)	(.101)	(.092)	(.507)
Family & Child Characteristics		yes			yes	yes	yes

Notes: *** *p*<.001; ** *p*<.01; * *p*<.05; † *p*<.1

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes in the probability of high school

completion associated with unit changes in the given independent variable

Column 1 coefficients represent comparisons between early, miscellaneous, and persistent behavior problems and the no problem reference group

Column 2 represents these comparisons when controlling only for background characteristics.

Columns 3-6 include all covariates simultaneously.

Column 1-4 coefficients represent marginal effects from probit regression of high school completion.

Column 5 coefficients represent marginal effects from probit regression of attending some college by age 20/21.

Column 6 represents coefficients from a standard OLS regression of years of schooling by Age 28/29.

"Early" reflects cases above the 75th percentile in 1st grade only.

"Persistent" reflects cases above the 75th percentile in 1st, 2nd, and 4th grades.

"Mixed" reflects cases above the 75th percentile in at least one grade, excluding the "Early" and "Persistent" patterns.

Controls are sex, age, whether African American, a composite of SES indicators, whether a child of a single parent, mother's age at birth, & number of siblings.

Appendix Table 1. Means for Control Variables For Age 5 and Age 8 Sample, NLSY

	Age 5		Age 8	
	Mean	**SD**	**Mean**	**SD**
Child characteristics				
Age at 19/20 interview	18.86	.56	19.72	.53
Age at 5/6 interview	5.46	.29	8.42	.28
Black	.30	.46	.31	.46
Hispanic	.21	.41	.22	.42
Boy	.52	.50	.49	.50
Early year characteristics: Age 0-5				
% Years in poverty	.18	.27	.19	.28
% Years with middle income	.24	.27	.24	.27
% Years with middle high income	.15	.21	.16	.21
% Urban residence	.76	.39	.77	.39
% Years mother never married	.24	.40	.25	.41
% Years mother divorced	.12	.26	.13	.26
% Years resided with grandmother	.16	.28	.19	.30
Ave # Children	2.21	1.04	2.25	1.08
Temperament and achievement				
Age 3/4: PPVT standardized score	86.67	20.22	83.41	21.50
Age 4/5: Compliance	22.31	4.63	22.76	4.51
Age 4/5: Sociability	10.71	3.32	11.31	3.28
Houseold Characteristics: Age 5/6				
Urban residence	.73	.44	.75	.43
Number of kid	2.47	1.18	2.51	1.22
Mother's education	11.98	2.15	11.84	2.17
Poverty	.17	.37	.18	.39
Child's father present in household	.59	.49	.57	.50
Mother never marry	.15	.35	.15	.36
Mother divorced	.20	.40	.20	.40
Mother cohabiting with partner	.03	.18	.04	.19
Mother married to partner	.06	.23	.07	.26
Total HOME	1.95	.37	1.88	.41
Mom characteristics				
Age of mother at birth	22.54	3.00	21.83	2.97
Mother academic aptitude (AFQT)	.32	.25	.31	.25
Ever use alcohol	.85	.36	.84	.37
Mother fight	.36	.81	.36	.82
Mother steal	.07	.25	.06	.23
Age mother first tried smoking	10.90	6.42	10.98	6.44
Mother never smoke	.23	.42	.23	.42
Marijuana use: occational	.14	.35	.14	.35
Marijuana use: moderate	.28	.45	.28	.45
Drug use: occational	.09	.28	.08	.27
Drug use: high	.08	.28	.08	.27
Mother lived with two parents at age 13	.53	.50	.52	.50
Mother US born	.93	.26	.92	.27
Mother drank alcohol during pregnancy	.43	.50	.41	.49
Used prenatal care	.99	.11	.98	.13
Mom smoked during pregnancy	.35	.48	.34	.48
Sample Size	2005		1834	

Also included as controls are indicators for cohort membership

Appendix Table 2. **Summary of Marginal Effects from Probit Regressions of Schooling Outcomes, Black and Low Income Subgroups in the NLSY**

	High School Completion					
	Age 5		Age 8		Age 13	
	Black	Low Income	Black	Low Income	Black	Low Income
Problem Behavior						
Antisocial, parent-report	-.017	-.011	-.040†	-.065†	-.061**	-.101*
	(.022)	(.035)	(.021)	(.035)	(.020)	(.039)
Attention, parent-report	.007	-.025	-.022	-.022	-.011	-.003
	(.023)	(.038)	(.022)	(.038)	(.023)	(.043)
Academic Achievement						
Reading	.027	.024	.055†	.095*	-.074	-.039
	(.022)	(.052)	(.030)	(.038)	(.049)	(.058)
Math	-.019	.010	-.030	-.001	.049†	.059
	(.024)	(.040)	(.033)	(.046)	(.030)	(.047)
Family & Child Characteristics	yes	yes	yes	yes	yes	yes
Sample Size	602	483	576	464	548	408

	Ever Attending College					
	Age 5		Age 8		Age 13	
	Black	Low Income	Black	Low Income	Black	Low Income
Problem Behavior						
Antisocial, parent-report	-.017	.015	-.134**	-.070**	-.056	-.025
	(.037)	(.028)	(.048)	(.025)	(.047)	(.026)
Attention, parent-report	.080†	.020	-.027	.014	-.002	-.018
	(.046)	(.106)	(.049)	(.018)	(.050)	(.028)
Academic Achievement						
Reading	.068†	.016	.115†	.046†	.034	.013
	(.040)	(.034)	(.059)	(.027)	(.108)	(.042)
Math	-.012	.053	.013	.021	.223***	.086*
	(.038)	(.034)	(.055)	(.029)	(.069)	(.043)
Family & Child Characteristics	yes	yes	yes	yes	yes	yes
Sample Size	320	269	306	249	286	227

Notes: *** p<.001; **p<.01; *p<.05; †p<.1

The threshold of low income set at 25th percentile.

76% of black (79% of non-black) and 78% of low income (81% of non-low income) completed high school.

42% of black (48% of non-black) and 41% of low income (60% of non-low income) ever attended college at age 20/21.

Controls include a rich set of child and mother characteristics, children's temperament
    at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family charateristics
    between birth and age 5 and at age 5/6.

Appendix Table 3. **Probit Regressions of Schooling Outcomes, Gender Subgroups in the NLSY**

	High School Completion					
	Age 5		Age 8		Age 13	
	Boys	Girls	Boys	Girls	Boys	Girls
Problem Behavior						
Antisocial, parent-report	-.019	-.021	-.042*	-.025	-.021	-.020
	(.017)	(.015)	(.020)	(.016)	(.017)	(.013)
Attention, parent-report	-.007	.007	-.016	-.007	.011	.001
	(.022)	(.013)	(.029)	(.013)	(.016)	(.012)
Academic Achievement						
Reading	.025	.010	.052*	.035*	.021	.018
	(.018)	(.014)	(.023)	(.018)	(.021)	(.016)
Math	.018	.007	-.017	-.001	.049	.035*
	(.016)	(.016)	(.022)	(.015)	(.031)	(.015)
Family & Child Characteristics	yes	yes	yes	yes	yes	yes
N	1047	958	905	931	942	886

	Ever Attending College					
	Age 5		Age 8		Age 13	
	Boys	Girls	Boys	Girls	Boys	Girls
Problem Behavior						
Antisocial, parent-report	-.012	-.042	-.086*	-.107*	-.021	-.064
	(.033)	(.038)	(.039)	(.046)	(.044)	(.048)
Attention, parent-report	-.006	.010	-.029	-.066†	.026	-.035
	(.034)	(.038)	(.037)	(.037)	(.037)	(.043)
Academic Achievement						
Reading	.021	.049	.093*	.094†	.066†	.123*
	(.029)	(.037)	(.038)	(.055)	(.038)	(.060)
Math	.043	.041	.024	.034	.125*	.180**
	(.028)	(.035)	(.042)	(.039)	(.051)	(.063)
Family & Child Characteristics	yes	yes	yes	yes	yes	yes
N	513	464	406	460	437	432

Notes: *** p<.001; **p<.01; *p<.05; †p<.1
74% of males and 82% of females completed high school.
37% of males and 55% of females ever attended college at age 20/21.
Controls include a rich set of child and mother characteristics, children's temperament
    at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family charateristics
    between birth and age 5 and at age 5/6.

Appendix Table 4. **Regressions of Schooling Outcomes, Gender Subgroups in the BSS**

	High School Completion (probit)					
	Grade 1		Grade 2		Grade 4	
	Boys	Girls	Boys	Girls	Boys	Girls
Problem Behavior						
Externalizing	-.051	-.043	-.063	-.025	-.058	-.066†
	(.032)	(.038)	(.042)	(.034)	(.041)	(.035)
Attention	-.072*	-.009	.016	-.010	-.029	-.003
	(.036)	(.039)	(.038)	(.032)	(.047)	(.064)
Academic Achievement						
Reading	-.076†	-.025	.089*	.092**	-.003	-.0004
	(.042)	(.034)	(.042)	(.032)	(.053)	(.045)
Math	.070	.087*	-.015	-.018	.066	.065
	(.045)	(.035)	(.044)	(.031)	(.050)	(.051)
Family & Child Characteristics	yes	yes	yes	yes	yes	yes

	Total Years of Schooling (OLS regression coefficients)					
	Grade 1		Grade 2		Grade 4	
	Boys	Girls	Boys	Girls	Boys	Girls
Problem Behavior						
Externalizing	-.054	-.026	-.041	.211	-.161	-.137
	(.145)	(.226)	(.182)	(.198)	(.264)	(.315)
Attention	-.441**	-.270	-.084	-.332	-.144	-.280
	(.154)	(.187)	(.192)	(.231)	(.402)	(.270)
Academic Achievement						
Reading	-.235	-.159	.430*	.112	.395	.338
	(.154)	(.159)	(.189)	(.216)	(.280)	(.305)
Math	.530**	.659***	.276	.515*	.212	.411
	(.185)	(.176)	(.173)	(.204)	(.213)	(.306)
Family & Child Characteristics	yes	yes	yes	yes	yes	yes

Notes: *** $p<.001$; ** $p<.01$; * $p<.05$; † $p<.1$

57% of males (n=419) and 70% of females (n=419) completed high school.

Mean (SD) years of schooling was 13.1 (3.0) for males and 14.0 (3.2) for females.

BSS controls are age, whether African American, a composite of SES indicators, whether a child of
a single parent, mother's age at birth, & number of siblings.

	(1)	(2)	(3)	(4)	(5)
	BSS Parent Reports (*N*=838)				
	High School Completion				Years of Schooling
Problem Behavior, Grade 2					
Externalizing	-.140***	-.096***	-.108***	-.077**	-.255†
	(.022)	(.025)	(.024)	(.027)	(.140)
Attention	-.108***	-.078***	-.017	-.026	-.289*
	(.018)	(.020)	(.020)	(.022)	(.137)
Academic Achievement, Grade 2					
Reading	.158***	.083***	.122***	.079*	.204
	(.019)	(.020)	(.030)	(.032)	(.161)
Math	.108***	.044*	.014	-.020	.382**
	(.018)	(.020)	(.031)	(.032)	(.128)
Family & Child Characteristics		yes		yes	yes
	BSS Teacher Reports (*N*=838)				
	High School Completion				Years of Schooling
Problem Behavior, Grade 2					
Externalizing	-.089***	-.051*	-.072**	-.046†	.058
	(.021)	(.022)	(.026)	(.025)	(.147)
Attention	-.090	-.049*	.012	.002	-.199
	(.017)	(.019)	(.022)	(.024)	(.169)
Academic Achievement, Grade 2					
Reading	.156***	.087***	.139***	.093***	.254
	(.019)	(.021)	(.025)	(.026)	(.163)
Math	.107***	.045†	.015	-.017	.414**
	(.019)	(.024)	(.024)	(.029)	(.135)
Family & Child Characteristics		yes		yes	yes

Notes: *** $p<.001$; ** $p<.01$; * $p<.05$; † $p<.1$

Column 1 coefficients represent simple bivariate relationships.

Column 2 represents these bivariate relationships when controlling only for background characteristics.

Columns 3-4 include all covariates simultaneously.

Column 5 for NLSY represents marginal effects from probit regression of attending college at age 20/21

Column 5 for BSS represents coefficients from a OLS regression of years of schooling by Age 28/29

BSS controls are sex, age, whether African American, a composite of SES indicators, single parent, mother's age at birth, & number of siblings

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