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# Early School Adjustment and Educational Attainment

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*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 middle-childhood capacities and subsequent schooling outcomes. Using a 20-year longitudinal data set, this study estimates the association between children’s academic skills, antisocial behaviors, and attention problems—all averaged across middle childhood—and their long-term educational outcomes. After adjusting for family and individual background measures, we find that high average levels of math and reading achievement, and low average levels of antisocial behavior problems, are positively associated with later attainment. Associations between attention problems and attainment are small. Associations are attenuated somewhat*

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*when sibling differences in these skills and behaviors are related to sibling differences in attainment outcomes.*

**KEYWORDS:** achievement gap, early childhood, policy, poverty

Educational attainment is important for later life success and health (Lochner, 2011). Dropping out of high school is costly to both individuals and society and is associated with lower lifetime earnings, higher rates of unemployment and social benefit receipt, and worse health (Levin, Belfield, Muennig, & Rouse, 2007). College attendance is increasingly seen as a required qualification for many middle-class jobs (Duncan & Murnane, 2011). For society, much of the economic gains of the 20th century have been attributed to the increasingly educated workforce (Goldin & Katz, 2009). However, in recent years, the expansion of education has stalled, leaving questions about what more can be done to increase the educational outcomes of youth.

Educational attainment is a cumulative process that results from ongoing engagement in learning institutions. As a result, educational attainment reflects the successful mastery of academic skills, such as reading and mathematics, as well as behavioral skills, such as sustaining attention throughout the school day, participating in learning activities, and getting along with teachers and fellow classmates (Alexander, Entwisle, & Olson, 2014; Pungello, Kupersmidt, Burchinal, & Patterson, 1996). Despite conceptualizing educational attainment as the result of a lengthy engagement (or disengagement) process, much of the empirical evidence on its determinants is derived from longitudinal surveys beginning in adolescence (Farkas, 2003). This focuses attention on how characteristics and contexts experienced during the middle and high school years predict educational outcomes. In contrast, the earlier foundations of educational attainment have remained relatively unexamined, in part because of a lack 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 a large longitudinal national data set, this study describes the associations between children's longer-term educational outcomes and four academic and behavioral skills—math, literacy, antisocial behavior, and attention skills—during middle childhood. In doing so, it seeks to inform a conceptual model that better portrays how early skills and behavior contribute to the cumulative process of educational attainment.

## Background

Education research, and particularly research on educational attainment, has pointed to the importance of understanding the characteristics of

individual students as well as the communities in which they live and the schools they attend. Drawing upon the considerable theoretical work on educational attainment, Rumberger (2011) summarized explanatory mechanisms as consisting of both individual and institutional characteristics that separately and in combination explain why some students succeed in completing high school and attend a postsecondary school whereas others do not. Grounded in both the psychological literature on school engagement (Skinner, Kindermann, Connell, & Wellborn, 2009) and the sociological literature on persistence (Tinto, 1988), Rumberger summarizes work on the attitudes, behaviors, and school performance that contribute to school engagement and, ultimately, educational attainment. These factors interact with a variety of institutional school-related processes, such as curriculum tracks and relational support (Rumberger & Palardy, 2004).

As noted by Dupéré and colleagues (2015), this model and much of the related empirical work does not theoretically integrate long-term factors that may contribute to the disengagement process with specific short-term precipitating events. Dupéré et al. argue for a developmental life course approach, which recognizes the developmental underpinning of educational trajectories that begin earlier in life and seeks to better explain how these interact with later-occurring proximal factors.

Both theoretical and empirical efforts have been hampered by a piecemeal, stage-specific approach to studying the life course. Two developmental models highlighted by Finn (1989)—the frustration-esteem model and the participation-identification paradigm—argue for reinforcing cycles in which behavioral aspects of engagement or participation lead to better school-related success, which in turn generates a sense of belonging or self-worth. Reviewing theoretical and empirical work, Finn argues that these models are similar in many ways, including their emphasis on the importance of understanding that the antecedents to educational attainment are found in early school performance and behavioral aspects of engagement. Despite the call for studying developmental processes in the early years, only a handful of subsequent studies have risen to the challenge. As a result, we know little about how children's academic skills and behavior in middle childhood contribute to their eventual educational attainment.

### **Reading and Math Skills**

Scholarly research on school engagement highlights the importance of cognitive elements of academic engagement and learning (Fredricks, Blumenfeld, & Paris, 2004). Thus, the conceptual importance of early academic skills is that they provide the necessary cognitive skills that support ongoing engagement in learning throughout the later years of schooling. Although high levels of early academic skills may be insufficient for later educational success, research on how children acquire reading and math

skills indicates that specific early academic skills do serve as the foundation for later learning. In particular, general cognitive skills, such as 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 importance of early skills may also be derived from the fact that early school success may breed greater identification or participation in learning and school-related success. Thus, early success creates a positive feedback cycle in which subsequent successes become possible (Finn, 1989). Empirical evidence in support of the importance of early skills in setting children on a path for later educational success comes from the relative stability of children's academic achievement throughout childhood and adolescence (Catterall, 1998; Kowaleski-Jones & Duncan, 1999; Pungello et al., 1996) as well as the strong associations between school-entry and later-school achievement (Duncan et al., 2007). And yet, few studies have followed children's achievement long enough to establish the magnitude of these associations with educational attainment, and none has controlled for genetic factors associated with attainment (Domingue, Belsky, Conley, Harris, & Boardman, 2015).

Indirect evidence of an association between early achievement skills and educational attainment is found in preschool follow-up studies. Several evaluations 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, 2010). However, given that these programs might have affected multiple aspects of children's skills and behavior, as well as their family environments in some cases, it is difficult to attribute the increase in high school completion only to their increased early skills (Reynolds, Ou, & Topitzes, 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 study was based on the theoretical work of Rumberger and Finn, and intended to describe how early school transition contributed to the process of educational stratification. Their analysis of a 1982 cohort of first-grade children in Baltimore, Maryland, found that a composite of first-grade 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 some aspects of early academic skills.

## **Attention and Behavior Problems**

Developmental models of educational attainment all prominently feature behavioral aspects of engagement in education and learning. 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, Stabile, Manivong, & Roos, 2010; Duncan et al., 2007; Howse, Lange, Farran, & Boyles, 2003; McClelland, Morrison, & Holmes, 2000; Rabiner & Coie, 2000; Raver et al., 2011; Yen, Konold, & McDermott, 2004).

Some evidence suggests a link between attention problems and lower levels of educational attainment (Mannuzza & Klein, 2000). Vitaro, Brendgen, Larose, and Tremblay (2005) found that attention problems at age 6 predicted later high school noncompletion among a Quebec community-based sample. These analyses held constant children's aggression but did not control for differences in early academic skills. In a sample of adoptees, McClelland, Acock, Piccinin, Rhea, and Stallings (2013) found that attention span persistence predicted later college completion after accounting for later academic test scores. Currie and Stabile (2006) take a more comprehensive look at links between hyperactivity and later schooling success using nationally representative data from both the United States (a portion of the National Longitudinal Survey of Youth [NLSY] data used in the current paper) and Canada and both ordinary least squares (OLS) and sibling fixed-effects models. 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 (e.g., being in school between ages 16 and 19).

In theory, children's problem behaviors, particularly, externalizing or antisocial behavior, 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). It may also follow from children's frustration in poor performance, signaling the beginning of disengagement.

Despite these reasons to expect associations between problem behavior and academic outcomes, empirical support is mixed. In studies separating externalizing problems from attention, attention problems are found to be more predictive of later achievement than are more general problem behaviors (Barriga et al., 2002; Hinshaw, 1992; Konold & Pianta, 2005; Ladd et al., 1999; Normandeau, 1998; Rapport, Scanlan, & Denney, 1999; Trzesniewski,

Moffitt, Caspi, Taylor, & Maughan, 2006). When Duncan and colleagues (2007) examined six longitudinal data sets, they failed to find evidence that school-entry externalizing behaviors were associated with achievement during middle childhood once attention skills and prior achievement were taken into account.

Turning from educational achievement to attainment, the focus of the current article, early problem behavior might be expected to matter more for attainment. Finishing high school and attending at least some college require a combination of achievement, engagement, and perseverance. Studies have found that adolescent behavior problems 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 (2009) find mixed evidence for links between antisocial behaviors between ages 4 and 11 and school enrollment between ages 16 and 19.

Another possibility is that the developmental trajectories of problem behavior across childhood are more important for attainment than school-entry levels of behavior problems. Studies have consistently shown that meaningful trajectories of behavior can be identified, with between 5% and 10% of children 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 noncompletion, 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’ model included few controls. 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 children’s early 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, suggests that there is much more to be learned. This study presents a new and rigorous analysis of data from

a large-scale longitudinal data set to provide a more complete understanding of the determinants of children's educational success. The analyses describe the associations of children's academic and behavioral skills with children's long-term educational outcomes using measures of early skills and behaviors averaged across their early school years and unusually comprehensive child and family background controls. In doing so, we shed light on the formative role children's early school experiences may have in shaping their life chances.

### **Analytic Approach**

Estimating the importance of middle-childhood academic skills and socio-emotional behaviors for eventual school attainment is challenging. The experiment we would like to approximate would be a factorial design in which different levels of each of the skills or behaviors of interest were randomly assigned to different groups of children—an impossible task. Instead, we employ multiple regression methods with extensive family and child control measures. Key prior child and family controls include the child's school-entry receptive vocabulary (used in other studies as a proxy for early verbal intelligence) and maternal-rated sociability scores; the mother's education, cognitive skills, and teenage problem behavior; a school-entry assessment of the home environment; and family structure and poverty status between birth and school entry. This approach will yield unbiased estimates if the observed control measures are specified so as to fully capture all confounding differences between children with varying levels of achievement and behavior.

A primary concern with the OLS approach is that some relevant differences across children are not observed. An alternative strategy for reducing bias arising from children's differing family backgrounds is to estimate sibling fixed-effects models, which relate sibling differences in educational attainment to sibling differences in the middle-childhood skills and behaviors of interest. A key advantage of this approach is that its estimates are based exclusively on within-family variation, so any features of family or neighborhood environments or genetic endowments shared by siblings, whether measured or not, are differenced out and therefore do not bias regression coefficients on our key skills and behavior measures. Disadvantages of this sibling fixed-effects approach are that the samples are restricted to multiple-sibling families and the smaller variation in the sibling differences compared with child-based measures of achievement, behaviors, and eventual attainment. In addition, measurement error is also a greater concern in these models, and in combination with lower variation, the precision of coefficient estimates is typically lower than for OLS models.

An additional analytic concern is the possibility of bias arising from unreliability in the measurement of skills and behavior. Although our



averaging measures over as many as four measurement occasions across middle childhood help to increase reliability, it remains the case that our measures of antisocial behaviors and hyperactivity are less reliable than our measures of academic skills. We provide estimates of OLS regression models that adjust for this differential reliability by using an errors-in-variance procedure in which we decrease the assumed reliability from 1.00 to 0.80 (which is consistent with our estimates of internal reliability) for our measures of antisocial behaviors and hyperactivity. Unfortunately, such reliability adjustment methods cannot be implemented in sibling fixed-effect models.

## Data and Measures

The data are drawn from the NLSY, a multistage stratified random sample of 12,686 individuals ages 14 to 21 in 1979. Black, Hispanic, and low-income youth were overrepresented in the sample. Annual interviews (through 1994) and biennial after that with sample members, and relatively 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. With its biennial measurement interval, the NLSY yields two independent samples of children across middle childhood: those observed at ages 5, 7, 9, and 11 and those observed at ages 6, 8, 10, and 12. We group these ages into four categories: ages 5–6, 7–8, 9–10, and 11–12. Given the nature of the sample, it is noteworthy that early cohorts of the child sample were born disproportionately to young mothers, while the latest cohorts were born to mothers as old as 33. Our target sample consists of 9,182 children who were age 5 or 6 before 1984 ( $n = 837$ ) or age 5 or 6 in 1984 ( $n = 911$ ), 1986 ( $n = 1,321$ ), 1988 ( $n = 1,418$ ), 1990 ( $n = 1,331$ ), 1992 ( $n = 1,239$ ), 1994 ( $n = 1,210$ ), 1996 ( $n = 915$ ), or 1998 ( $n = 748$ ). These children were observed at ages 20 or 21 in the interviewing years through 2012. Table 1 provides descriptive information for both the full sample and for the sample subsets defined by whether one or more siblings were also present in the data.

The presence of siblings in the data provides us with an opportunity to compare estimates from conventional OLS models to estimates from sibling fixed-effects models. Sibling fixed-effects estimates rely exclusively on within-family variation in key independent and dependent variables. For example, in relating completed schooling to antisocial behavior in middle childhood, the fixed-effects estimator in effect relates sibling differences in completed schooling to sibling differences in antisocial behavior. A key advantage of sibling fixed-effects procedures is that they remove the

Table 1  
Descriptive Statistics

Variable	Full Sample ( <i>n</i> = 9,930)		Children Without Siblings ( <i>n</i> = 1,011)		Children With Siblings ( <i>n</i> = 8,919)	
	<i>M</i> or %	<i>SD</i>	<i>M</i> or %	<i>SD</i>	<i>M</i> or %	<i>SD</i>
Dependent variables						
Highest grade completed (age 21/22)	12.6	1.7	12.9	1.6	12.6	1.7
Completed high school (age 19/20)	84.0%		87.6%		83.7%	
Attend college (age 20/21)	39.8%		45.8%		39.4%	
Predictor variables (average between ages 5 and 12)						
Math	99.7	11.7	102.5	11.2	99.5	11.7
Reading	103.4	12.6	107.2	11.5	103.0	12.6
Antisocial	0.3	0.3	0.2	0.2	0.3	0.3
Hyperactive	0.4	0.3	0.5	0.3	0.4	0.3
Covariates						
Black	28.4%		24.1%		28.9%	
Hispanic	18.9%		11.2%		19.7%	
Female	48.9%		48.3%		49.0%	
Child age 5/6						
Poverty status	29.9%		18.7%		77.7%	
Urban residence	77.7%		76.8%		31.2%	
Mother's education	12.8	2.6	13.2	2.2	12.8	2.6
PPVT score	87.6	20.7	93.8	20.1	87.0	20.6
Sociability score	11.9	2.7	12.1	2.7	11.8	2.7
HOME score	9.6	1.6	10.1	1.3	9.6	1.7
Mother's marital status						
Mother was divorced, separated, or widowed	18.6%		21.3%		18.3%	

(continued)

Table 1 (continued)

Variable	Full Sample ( <i>n</i> = 9,930)		Children Without Siblings ( <i>n</i> = 1,011)		Children With Siblings ( <i>n</i> = 8,919)	
	<i>M</i> or %	<i>SD</i>	<i>M</i> or %	<i>SD</i>	<i>M</i> or %	<i>SD</i>
Mother never married	13.9%		20.2%		13.2%	
Fraction of years between age 0 and 5 In poverty	32.0%		19.9%		33.3%	
Mother was divorced, separated, or widowed	13.3%		13.8%		13.2%	
Mother never married	21.8%		27.8%		21.1%	
Urban residence	77.8%		77.2%		77.9%	
Mother's AFQT score	35.0	27.2	42.9	27.4	34.1	27.0
Mother's age at child birth	24.1	4.6	24.1	4.6	24.1	4.6
Mother substance composite	1.4	1.3	1.7	1.3	1.3	1.3
Mother ever fight	18.5%		15.7%		18.8%	
Mother ever steal	2.0%		3.1%		1.8%	

Note. PPVT = Peabody Picture Vocabulary Test; HOME = Home Observation Measurement of the Environment-Short Form; AFQT = Armed Forces Qualifying Test.

possibility of bias from any family or genetic characteristics that is shared by siblings, whether measurable or not.

### **Educational Attainment**

Educational attainment is a heterogeneous process, with the determinants of success in completing high school likely to differ from the determinants of entry into and completion of college or other postsecondary schooling. We account for this by estimating separate models for measures of years of completed schooling, high school graduation, and college entry, all of which are measured from child reports of completed years of schooling. Many of our sample children were not observed long enough to report on their college or advanced degree completion.

Years of completed schooling is a continuous measure that is reported by youth at age 21 or 22. The high school graduation measure indicates whether students had completed high school by either age 19 or 20 (defined from their reports of obtaining a high school degree but not a general education degree [GED]). For this measure, we consider the students to have completed high school if, in their age 19 or 20 interviews, they were currently enrolled in a regular high school. We make this exception because the NLSY interview may have occurred when students were still enrolled but just a few months shy of graduation. Our final dependent variable—also dichotomous—is whether they reported ever attending college by age 20 or 21. The rate of high school completion ranges across NLSY cohorts averaged 84.0% and ranged between 83.0% and 84.9%. College attendance by age 20 or 21 averaged 39.7% and ranged between 35.2% and 44.5% across the sample cohorts (Table 1).

### **Academic Skills and Behavior**

Our key independent variables consist of assessments of academic skills (specifically, reading and math achievement) as well as two dimensions of problem behavior, antisocial behavior and hyperactivity. The biennial nature of the surveys allowed for the pooling of two samples of children such that responses for achievement and behaviors were available at child ages 5, 7, 9, and 11 or ages 6, 8, 10, and 12. We restricted our sample to children observed in at least two of these four time points and averaged responses across as many of the four time points as were available. Of those who reported their years of completed schooling by either age 21 or 22, 86.7% to 92.6% of the children reported at least two measures of our key independent variables between ages 5 and 12. Descriptive statistics for achievement and behavioral measures are provided in Table 1; correlations among these measures are presented in Table 2.

Children's early academic skills are measured by scores from the Peabody Individual Achievement Tests (PIAT Reading Recognition and

*Table 2*  
**Correlation Matrix With Main Independent and Dependent Variables**

Variable	1	2	3	4	5
1. Highest grade completed	—				
2. Math	.43***	—			
3. Reading	.42***	.72***	—		
4. Antisocial	-.31***	-.27***	-.28***	—	
5. Hyperactive	-.28***	-.31***	-.32***	.65***	—

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

Math; Dunn & Markwardt, 1970). 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 PIAT. 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 five out of seven 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 1-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 test 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. It 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 that 1-month test-retest reliabilities from a national sample 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 .60 at age 8/9 to .36 at age 13).

### **Behavior and Attention**

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 and 2, respectively.

The NLSY staff created six subscales based on a factor analysis of the items. The process for creating these subscales and the reliability of each are reported in Baker et al. (1993). Two of the six behavior problem subscales are used in this study to measure antisocial behavior and hyperactivity. For the purposes of this study, we use trichotomous scores for the single-item questions in lieu of the original dichotomous classification in order to maximize variation. To facilitate interpretation, the raw scores are translated into standardized scores with a mean of 0 and standard deviation of 1.

The antisocial subscale is created from six 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. Using average of these items between ages 5 to 12 and trichotomous scoring, the antisocial subscale has adequate reliability as measured by internal consistency (Cronbach's alpha of .80).

The attention problems (hyperactivity) scale is composed of five 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, acting impulsively without thinking, and having trouble with obsessions. We find this subscale has adequate reliability (alpha of .82). The attention problems and antisocial subscales are correlated at .65.

Because the behavior problems scales were derived from maternal reports, one might expect that mothers would assess their children similarly or that there may not be enough variation between siblings. However, mothers consistently differentiated the behavioral problems of siblings. Cronbach's alpha for these sibling differences in each subscale was .72 for antisocial behavior and .77 for hyperactivity. The consistency of these sibling differences across items is only slightly lower than the internal consistency of each of the behavior problem subscales.

### **Control Variables**

To reduce bias in the associations between children's skills, behaviors, and later attainment in our OLS models, family background and other child

controls are included in our empirical models. An important strength of the NLSY is the depth and breadth of longitudinal information collected about families. Our selection of control variables was driven by the goal of selecting measures that might be confounded with middle-childhood skills and behavior but were not a part of the possible causal mechanism by which middle-childhood skills or behavior might affect later educational attainment. Thus, these characteristics include early individual characteristics, such as temperament, early vocabulary (a proxy for early verbal intelligence), aspects of children's early home environments, and early measures of other family background characteristics. A full list of these control measures and their summary statistics is provided in Table 1.

Maternal and interviewer reports of children's temperament are drawn from the children's age 5 or 6 interviews. The sociability subscale was used to account for child temperament. Children were rated on a scale of *poor* (1) to *excellent* (5) on items such as 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).

The child's Peabody Picture Vocabulary Test (PPVT), a measure of receptive vocabulary, consists of 175 items that increase in difficulty. Nationally standardized scores are used in our analyses. Children who were age 5 or 6 in 1986 do not have early childhood measures of PPVT or temperament because the maternal and child interviews were 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, who were age 3 in 1990. As explained below, missing data are multiply imputed.

Data on children's family environments were coded to correspond to two intervals—between birth and age 5 and at age 5/6. Birth to age 5 average measures include family income, family structure, and urban residence. The quality of children's home environments was measured using the Home Observation Measurement of the Environment—Short Form scale when children were age 5 or 6. Mother's education at child age 5/6 and mother's age at birth are also used as covariates.

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' young-adult risk-taking behaviors (drug and alcohol use) and other adolescent experiences are included as covariates.

## Missing Data

Due to the longitudinal nature of the NLSY, between a quarter and a third of each age cohort of children is missing information on a key outcome variable (e.g., high school completion). Missing data on key predictors (achievement and behavior) are quite low during the early school years and across middle childhood, with no more than 13% missing data on achievement or behavior averaged between ages 5 and 12 as achievement or behavior scores are averaged across two or more time points. Following recommended analytic practices (Allison, 2001; von Hippel, 2007), we used multiple imputation techniques to account for missing values in our main predictors and various covariates. Specifically, we use predictive mean matching to impute continuous variables, multinomial logistic regression for categorical variables, and logistic regression for binary variables. For each analysis, 50 data sets were created using chained equations in Stata 13 using the “mi impute” command and then analyzed. Cases with a missing dependent variable were used during the imputation process but deleted before the analysis following the MID method (von Hippel, 2007).

Appendix Table 1 in the online journal shows some noteworthy demographic differences between those who were missing age 20/21 educational outcomes and those who were not. Children lacking educational attainment measures were more likely to reside in poor households and to be White. On the other hand, maternal AFQT and child PPVT scores were quite similar across the two groups. The differences between children with complete data and those missing the age 20/21 educational outcomes underscore the importance of modeling missing data. The availability of rich longitudinal data make multiple imputation the best approach for us to handle missing data in our analyses.

## Results

We first consider the association between early skills and behavior and the most general measure of educational attainment—children’s years of completed schooling by age 21 or 22. The first column of Table 3 shows estimates from four bivariate regression models in which each measure of achievement and problem behavior is entered by itself, without any other predictors. The .74 coefficient on the math measure indicates that, in the absence of any controls, an increase of one standard deviation in average math scores measured over middle childhood is associated with about an additional three quarters of a year of completed schooling. All variables in these bivariate regressions are statistically significant, but middle-childhood math and reading scores have the strongest bivariate associations with years of schooling, followed by antisocial and hyperactivity problem behaviors.



*Table 3*  
**Summary of Results From Ordinary Least Squares (OLS) Regressions of the Highest Grade Completed by Age 21/22 on Average of Middle Childhood Academic and Behavior Problems**

Standardized Predictor Variables Averaged Across Middle Childhood	Concurrent Problems and Full Set of Covariates					
	Bivariate (4 separate bivariate regressions)	Full Sample		Siblings Only		
		OLS	Errors-in-Variables Regressions <sup>a</sup>	OLS	OLS	Sibling FE
Math	.74*** (.02)	.27*** (.04)	.27*** (.04)	.26*** (.04)	.16** (.05)	
Reading	.71*** (.02)	.18*** (.03)	.18*** (.03)	.18*** (.04)	.11* (.05)	
Antisocial	-.53*** (.02)	-.19*** (.03)	-.32** (.07)	-.17*** (.03)	-.17*** (.04)	
Hyperactivity	-.48*** (.02)	-.02 (.03)	.08 (.07)	-.04 (.03)	-.06 (.04)	
Controls included?	No	Yes	Yes	Yes	Yes	
Observations	4,931	4,931	4,931	4,581	4,581	

*Note.* Standard errors in parentheses. FE = fixed effects. Full set of controls include race (Black, Hispanic); female; fraction of years between birth and age 5 of poverty status, mother's marital status (divorced, separated, or widowed; never married), and urban residence; child's Peabody Picture Vocabulary Test score at age 5/6; child's sociability score at age 5/6; Home Observation Measurement of the Environment—Short Form score at age 5/6; urban residence at age 5/6, mother's highest level of education at age 5/6; poverty status at age 5/6; mother's marital status at age 5/6 (divorced, separated, or widowed; never married); mother's age at birth of child; mother's Armed Forces Qualifying Test score; mother ever fought; mother ever stole; and mother's substance-use composite. Missing data were handled using multiple imputation.

<sup>a</sup>Reliabilities for antisocial and hyperactivity were adjusted from 1.00 to 0.80.

† $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

The second model shows estimates from an OLS regression model with a full set of controls, including the other achievement and problem behavior variables. The math coefficient falls to .27, which indicates that in the presence of controls for child reading skills, antisocial behavior and hyperactivity, as well as the host of child and family controls, an increase of one standard deviation in math skills is associated with about a quarter-year increase in completed schooling. With Table 1 showing that completed schooling has a standard deviation of 1.69, this .27 coefficient amounts to about one sixth of a standard deviation. Complete regression results are presented in Appendix Table 2 in the online journal. As might be expected, a comparison of coefficients the first two columns in Table 3 shows that all of the coefficients on the skill and behavior problem measures are reduced substantially, most by half or more, in the presence of observed control variables. At .27, the coefficient on middle-childhood math achievement is the most substantial, followed by reading (.18) and antisocial behavior (−.19). The coefficient on hyperactivity is smaller and falls below conventional levels of statistical significance.

A potential concern is the less reliable measurement of maternal reports of behavior problems relative to the test-based achievement measures. Using an errors-in-variables reliability adjustment, we decreased the assumed reliability of both antisocial behavior and hyperactivity from perfect reliability to a reliability of 0.80 on our model predicting highest grade completed on the full sample with concurrent skills and behaviors and the full set of covariates (Table 3, column 3). We find that these adjustments increase the estimated effect size of antisocial behavior to about the same magnitude as the effect size for math. Corresponding adjustments for hyperactivity change its insignificant coefficient by a small amount. These adjustments show that antisocial behavior across middle childhood may be just as predictive of completed schooling as achievement, if measurement concerns are taken into account.

For comparison with our sibling fixed-effects models, the fourth model repeats the OLS model shown in the second column but is run on the subset of children who have siblings. Coefficient estimates are very similar to those shown in the second column, suggesting that limiting the sample to siblings does not substantively change the estimated associations. Coefficient estimates in the final column are from sibling fixed-effect models and thus are based only on within-family variation. These adjustments remove bias from family conditions, whether measurable or not, shared by siblings. Compared with OLS estimates in column 2, the sibling fixed-effects coefficients are remarkably similar for antisocial behavior but somewhat smaller for the math and reading coefficients. A common analytic cost of these fixed-effects models is that estimates are based on comparisons with less variation, which increases standard errors. However, math, reading, and antisocial behavior are still statistically significant predictors of completed schooling.

Estimates from logistic regression models predicting high school completion by age 19 or 20 and college attendance by age 20 or 21 are presented in

Table 4. (The marginal probability coefficients corresponding to these log-odds coefficients are shown in Appendix Table 3 in the online journal.) Bivariate models show similar patterns of association as the prior OLS models predicting years of schooling, with middle-childhood math and reading scores having the highest associations, followed by antisocial and hyperactivity problem behaviors, for both high school graduation and college attendance. When introducing full controls, only math, reading, and antisocial behavior remain significantly associated with both high school graduation and college attendance. An increase of one standard deviation in math is associated with an increase in the odds of graduating high school of 41% and attending college of 65%. Antisocial behavior is also significantly associated with high school graduation. An increase of one standard deviation is associated with a 25% decrease in the odds of graduating from high school. Middle-childhood math achievement has by far the strongest association with college attendance, followed by reading, antisocial behavior, and hyperactivity.

Sibling fixed-effects models run on dichotomous outcomes can create analytic problems because sibling observations with the same outcome values are essentially excluded from the estimation (there is no variation between siblings to be predicted). In the case of high school graduation, although we have a sample of 5,798 siblings, only 985 differ on high school graduations outcomes. Appendix Table 4 in the online journal shows that the predictive power of math and reading fall when using logistic models for all siblings compared with siblings with differing graduation outcomes. In the case of college attendance, the corresponding drop in samples is from 5,366 to 1,324, and again the coefficients on math, reading and antisocial behavior all fall in (absolute) size. This raises concerns about the generalizability of the sibling-based fixed-effect adjustments for these two models.

With these caveats in mind, Table 4 shows that antisocial behavior emerges as having the strongest association with high school graduation in the sibling models. Middle-childhood math and reading scores are not strongly or significantly associated with high school graduation. An increase of one standard deviation in antisocial behavioral problems decreases the odds of high school graduation by 31%. Math, reading, and hyperactivity are significantly associated with college attendance. Math yielded the strongest association with college attendance, with a standard deviation increase in math predicting a 53% increase in the odds of attending college. Interestingly, antisocial behavior was not associated with college attendance in the sibling fixed-effects models.

## Robustness Checks

We investigated whether the pattern of results might be sensitive to alternative specifications related to issues of both measurement and estimation. These efforts included distinguishing early and later measurement occasions

*Table 4*  
**Summary of Results From Logistic Regressions of High School Graduation by Age 19/20 and College Attendance  
 by Age 20/21 on Academic and Behavior Problems During Middle Childhood, Odds Ratios Presented**

Average Standardized Predictor Variable During Middle Childhood	High School Graduate			College Attendance		
	Concurrent Problems and Full Set of Covariates			Concurrent Problems and Full Set of Covariates		
	Bivariate (4 separate bivariate regressions)	Full Sample Logistic	Siblings Only Sibling FE	Bivariate (4 separate bivariate regressions)	Full Sample Logistic	Siblings Only Sibling FE
Math	1.97*** (0.08)	1.41*** (0.11)	1.09 (0.14)	2.69*** (0.11)	1.65*** (0.10)	1.53*** (0.19)
Reading	1.91*** (0.08)	1.13+ (0.07)	1.21+ (0.14)	2.49*** (0.09)	1.34*** (0.07)	1.29* (0.14)
Antisocial	0.58*** (0.02)	0.75*** (0.04)	0.69*** (0.07)	0.53*** (0.02)	0.83*** (0.04)	0.91 (0.10)
Hyperactivity	0.64*** (0.02)	1.04 (0.06)	0.99 (0.10)	0.55*** (0.02)	0.89* (0.04)	0.80* (0.08)
Controls included?	No	Yes	Yes	No	Yes	Yes
Observations	5,798	5,798	985	5,366	5,366	1,324

*Note.* Standard errors in parentheses. Results are exponentiated coefficients or presented in odds ratios. FE = fixed effects. Full set of controls include race (Black, Hispanic); female; fraction of years between birth and age 5 of poverty status, mother's marital status (divorced, separated, or widowed; never married), and urban residence; child's Peabody Picture Vocabulary Test score at age 5/6; child's sociability score at age 5/6; Home Observation Measurement of the Environment–Short Form score at age 5/6; urban residence at age 5/6; mother's highest level of education at age 5/6; poverty status at age 5/6; mother's marital status at age 5/6 (divorced, separated, or widowed; never married); mother's age at birth of child; mother's Armed Forces Qualifying Test score; mother ever fought; mother ever stole; and mother's substance-use composite. Missing data were handled using multiple imputation.

†  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

within middle childhood, testing for whether persistently low or high scores added to the explanatory power of our average measures, testing for the associations between attainment and other behavioral measures, assessing whether our models suffered from collinearity, and testing models of achievement that did not include behaviors and vice versa.

A number of school readiness studies (e.g., Duncan et al., 2007; Entwisle et al., 2005) measured achievement and socioemotional behavior around the time of school entry, while many other studies draw their measures from one time point during elementary school (e.g., Hernandez's [2011] look at third-grade reading problems and high school dropout). We examined the sensitivity of our findings to the timing of the achievement and behavior predictors, with special attention to the implications of averaging over up to four time periods versus a single-year measure. Measures of average levels over multiple time periods may capture two dimensions of skills and behavior. Our average measure will reduce the variation in measurement, smoothing out both random measurement error and any perturbations that may be substantively real but transitory. However, if the trends in behavioral patterns over time are more important than average levels, then this approach will obscure important temporal patterns of association. Treating each measure independently, however, treats all the variation in the measure as relevant, including random measurement error, transitory fluctuations, and developmental trends.

The last four columns of Table 5 shows that the associations between antisocial behavior and completed schooling grows stronger with age, with standard deviation changes in age 11 or 12 antisocial behavior having nearly the same coefficient as the four-measurement average. We interpret these findings as suggesting that variation in problem behavior that occurs before the end of middle childhood to be less consequential than either persistently high levels of problem behavior or high levels of behavior problems at the end of middle childhood.

Math coefficients also generally increase with age, although the upward pattern is neither as strong nor as monotonic as it is for antisocial behavior. The patterns for reading scores are quite nonmonotonic, with the strongest associations for age 7 or 8 scores. This provides some support for the idea that third-grade reading proficiency may be a good marker for later attainment problems and deserves a closer look.

Duncan and Magnuson's (2011) analysis of NLSY data focuses on the persistence of achievement and behavior problems across middle childhood, which they defined as being persistently in the bottom third of the distribution of a given skill or behavior on three measurement occasions. To assess whether persistent problems might capture something that our average measures do not, we estimated the full-sample OLS and logistic models shown in Tables 3 and 4 but added a set of dummy variable indicators for whether the child's achievement or behavior problems were persistent as

Table 5  
**Summary of Results From Ordinary Least Squares Regressions  
of the Highest Grade Completed by Age 21/22 Regressed on  
Academic and Behavior Problems at Measured at Varying Times**

Standardized Predictor Variable	Highest Grade Completed by Age 21/22				
	Ages 5–12 (Average)	Age 5 or 6	Age 7 or 8	Age 9 or 10	Age 11 or 12
Math	.27*** (.04)	.16*** (.04)	.12*** (.03)	.21*** (.03)	.26*** (.03)
Reading	.18*** (.03)	.14*** (.03)	.26*** (.03)	.16*** (.03)	.15*** (.03)
Antisocial	-.19*** (.03)	-.05+ (.03)	-.07** (.03)	-.18*** (.03)	-.18*** (.03)
Hyperactivity	-.02 (.03)	-.07* (.03)	-.06* (.03)	-.02 (.03)	-.08** (.03)
Controls included?	Yes	Yes	Yes	Yes	Yes
Observations	4,931	4,931	4,931	4,931	4,931

*Note.* Standard errors in parentheses. Full set of controls include race (Black, Hispanic); female; fraction of years between birth and age 5 of poverty status, mother’s marital status (divorced, separated, or widowed; never married), and urban residence; child’s Peabody Picture Vocabulary Test score at age 5/6; child’s sociability score at age 5/6; Home Observation Measurement of the Environment–Short Form score at age 5/6; urban residence at age 5/6, mother’s highest level of education at age 5/6; poverty status at age 5/6; mother’s marital status at age 5/6 (divorced, separated, or widowed; never married); mother’s age at birth of child; mother’s Armed Forces Qualifying Test score; mother ever fought; mother ever stole; and mother’s substance-use composite. Missing data were handled using multiple imputation.

<sup>†</sup> $p < .10$ . \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

defined in Duncan and Magnuson. In no case were the coefficients on any of these persistence dummies statistically significant at conventional levels. Thus, we conclude that the picture provided by our average measures is similar to that provided by persistence-based measures.

The Behavior Problems Index in our NLSY data provides some additional dimensions of problem behaviors—maternal ratings of anxious/depressed, headstrong behaviors, dependence on adults, and peer adjustment problems. When these subscales were added to our OLS regressions of completed schooling, only the coefficient on the anxious/depressed subscale was close to conventional levels of statistical significance, but the direction of the coefficient was unexpectedly positive. Despite their positive correlations with the two behavior problem subscales included in our analysis, their inclusion had virtually no effect on the estimated coefficients for antisocial behavior and hyperactivity shown in Table 4. This suggests that

our estimates are not biased by the omission of these other dimensions of children's behavior.

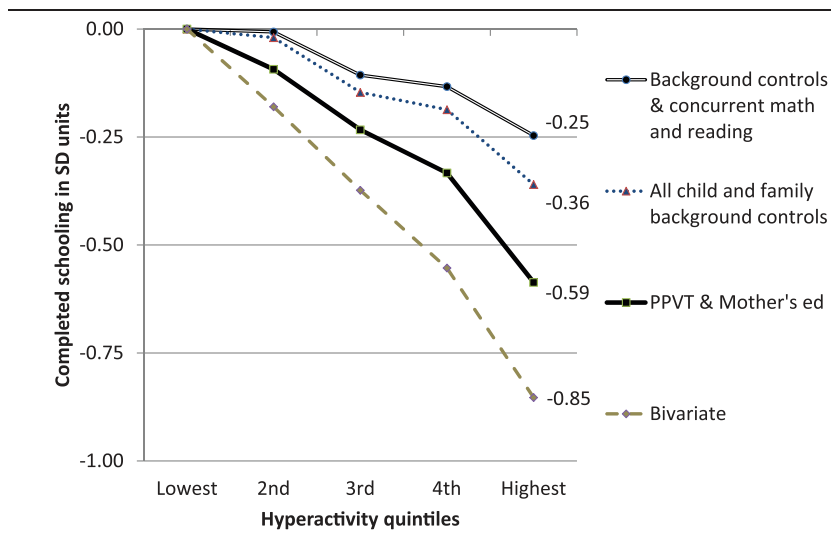
Given the moderately high correlations between the two aspects of behavior problems, we ran a postestimation check to account for the threat of collinearity in our OLS models. We evaluated the centered variance inflation factors (VIFs) for the independent variables specified in a linear regression model for highest grade completed using listwise deletion. The largest VIF that we encountered was 2.42, which is below the cutoff value of 4 or 10—values sometimes given for regarding a VIF as high or indicative of collinearity (Gordon, 2010). The absence of multicollinearity problems can also be seen in how little the standard errors in Tables 4 and 5 increase as additional groups of predictor variables are added into the equation. The biggest increases are for estimates in the sibling fixed-effect models, which are based on smaller samples and within-family variation.

Another worry is about the timing of influences among our predictors. For example, if early attention and socioemotional skills affect later achievement primarily by affecting school-entry achievement skills, we are in some sense robbing the nonachievement measures of some of their explanatory power. An overcontrol argument applies equally to the achievement as to the nonachievement measures, since early success in learning reading and math skills may alter subsequent behavior. To investigate this possibility more systematically, we estimated a series of OLS models of years of completed schooling using baseline demographic controls without concurrent skills and behaviors and with age 5 or 6 skill and behavior controls. Results are shown in Appendix Table 5 in the online journal.

It is clear that the respective .27, .18, and  $-.19$  coefficients on math, reading, and antisocial behavior shown in the OLS column of Appendix Table 5 drop to those levels in the presence of just early childhood controls and that the inclusion of age 5 or 6 skills or behaviors has little additional effect. More of an adjustment occurs in the case of attention skills, but in all cases, its coefficient is much smaller than the others.

A final question has to do with the magnitude of comparisons at differing points in the distribution of attention problems and whether our linear approach underestimates the association between attention problems and educational attainment. In a prior study, Moffitt et al. (2011) relate a composite measure of hyperactivity, impulsivity, and inattention a host of adult outcomes. Their regression-adjusted comparisons of children in the top versus bottom quintiles of the self-control distribution showed .5 to .8 standard deviation differences in early adult attainment measures, such as adult income, socioeconomic status, and financial planfulness. Our use of continuous measures has the potential to underestimate these kinds of differences.

We classified the children in our NLSY sample according to their quintiles of average hyperactivity across middle childhood. A bivariate comparison of the (standardized) completed schooling children in the top and



**Figure 1. Summary of regression results of completed schooling regressed on quantiles of hyperactivity measured in middle childhood with varying levels of control variables.**

bottom quintiles showed .85 standard deviations lower attainment for high levels of hyperactivity (Figure 1; the standard errors on these and subsequent top/bottom quintile comparisons are about .06 standard deviations). When we adjust for a measure of family socioeconomic status (years of mother’s schooling) and cognitive ability (the child’s PPVT score at age 5 or 6), the schooling difference drops to .59 standard deviations—a difference that is comparable to the .5 to .8 standard deviation differences found by Moffitt et al. (2011) for their other measures of early adult attainment. However, when a fuller set of child and family controls are added, the top/bottom quintile differences is reduced to .36 standard deviations. Controlling for concurrent academic skills (but not antisocial behavior) reduces the top/ bottom quintile difference to .25 standard deviations, and the addition of measures of concurrent antisocial behavior problems reduces the difference to a statistically insignificant .10 standard deviations (not shown on Figure 1).

## Discussion

We have examined to what extent completed schooling outcomes measured in late adolescence and early adulthood are associated with academic skills and behaviors averaged across the entire period of middle childhood. We find that antisocial behavior scores averaged across middle childhood are



as strongly associated with completed schooling as average math and reading test scores. In addition, attention problems as measured by the hyperactivity subscale of the Behavior Problems Index are not associated with educational attainment in our fully controlled regression models.

Why would antisocial behavior be associated with subsequent educational attainment? Completing schooling requires competence in both understanding and mastering what is being taught as well as persistent engagement in the learning activities and meeting specified requirements. It is also likely that problem behaviors evoke negative institutional responses, such as school suspensions or expulsion, or other forms of punishment, which not only potentially disrupt students' learning but also set the stage for students' disengagement with school, out of either frustration or an increasing lack of identification with the school (Finn, 1989). During the later years, problem behavior may also result in involvement with a juvenile justice system that can be unforgiving in doling out penalties that interfere with an offending adolescent's orderly completion of schooling. That antisocial behavior proved to be more powerful in predicting high school completion than college attendance is consistent with this line of thinking and provides support for thinking about developmental models of educational attainment that point to early developmental processes shaping these outcomes later in life.

At the same time, our detailed analyses of the timing of antisocial behavior in Table 5 showed a much stronger association with completed schooling when those behaviors were measured at ages 11 or 12 than at ages 5 or 6. We know from the trajectory work of Moffitt (1993), Nagin and Tremblay (1999) and Odgers et al. (2008) that a great deal of antisocial behavior exhibited around the point of school entry is transitory and quickly outgrown. However, as children move through middle childhood, those continuing to exhibit high levels of antisocial behavior appear most likely headed for trouble and are most in need of effective interventions. Although promising interventions have been developed for early-grade children with clinical levels of behavior problems (Webster-Stratton, 2014), ambitious behavioral interventions targeted at a broader group of children at high risk for developing persistent behavior problems have struggled to produce durable impacts (e.g., Conduct Problems Prevention Research Group, 2011). The call for greater attention to behavioral aspects of school success is not new but is certainly reinforced by our analysis showing that childhood problem behavior constitutes an important risk to later educational attainment.

Although theoretical models might argue that academic problems are caused by attention problems and therefore should not be included in models assessing the importance of attention problems, the reverse might also be the case if emerging academic problems lead children to disengage from classroom learning. Our findings that middle-childhood skills and behavior are associated with later educational attainment lend support to theoretical models that suggest such outcomes are the result of processes that begin

early in development rather than those that occur primarily in later adolescence. We note that though the associations we uncover between middle-childhood reading, math, and antisocial behavior with later attainment are strong, they are not determinative. Thus our work also supports Dupéré et al.'s (2015) call for more attention to the intersection of early vulnerabilities and later disruptive events more proximal to the educational outcomes being studied.

An obvious extension of our work it is to investigate and model dynamic models of developmental processes, including skills and behavior, across the middle-childhood period and into adolescence to better elucidate how processes of disengagement contribute to educational attainment. In addition, because educational attainment is increasingly spread over the early adult years, and characterized by second chances, it is important to understand how these skills and behaviors are linked to qualitatively different pathways to educational attainment. A shortcoming of the NLSY data is that academic skills are not consistently measured during the adolescent years, and the sample is still in early adulthood so we do not have full information about respondents' eventual educational attainment. New research will require not only additional conceptual and theoretical work but also attention to constructing data sources that span developmental periods and include measures of skills and behaviors, at multiple points in development, as well as complete data on school attendance and attainment.

The large coefficient reductions between our unadjusted and sequence of adjusted models also serve as a more general warning against drawing strong conclusions from bivariate associations between early skills and behaviors and school attainment. Hernandez (2011) analyzes reading and high school completion data from the same NLSY data set as we do. When he defines "below-basic" third-grade reading achievement as being in the bottom third of the reading achievement distribution, he finds that some 16% of below-basic children fail to graduate from high school by age 19, a rate 4 times higher than for those with higher reading scores. But when these same data are used in our analysis, we see that this association is not unique to reading but instead should be attributed to the cluster of academic skills and behaviors.

Our bivariate models of average reading levels and high school dropout also show big gradients—the odds of completing high school increase by 91% with every standard deviation increase in middle-childhood reading achievement. But this odds ratio difference falls to 13% in the full-control models and to 21% in the sibling models. This indicates the importance of accounting for the fact that poor readers also tend to have other school problems and family background factors that influence their eventual attainment. Reading is still associated with attainment, but in none of our models is it the strongest association. Though scholars are frequently fluid in making this

distinction, it is of great importance for translating findings such as these into the basis for curricular interventions.

Our ability to compare estimates from conventional OLS and sibling fixed-effects models provides valuable insights into how much weight should be accorded to commonly used OLS methods. By controlling for shared unobserved characteristics of the home and community environment and genetic endowments, sibling fixed-effects estimates provide less biased estimates of the associations between middle-childhood skills and behaviors and educational attainment. It is therefore not surprising that sibling fixed-effects models produce smaller coefficients than OLS models, although most of the key coefficients retain their statistical significance. Disadvantages of the sibling models include that they generate less precise coefficient estimates and are more affected by measurement error than are OLS models. In addition, despite controlling for shared genetic influences within sibling pairs, they cannot fully rule out polygenetic explanations for the observed associations when measures of the endophenotype explanations are unobserved (Domingue et al., 2015).

Finally, we caution that we have not accounted for school processes that may increase or decrease the predictive power of our skill and behavior measures. Models of educational attainment argue for the importance of interactions between these individual skills and behaviors and the educational institutions that they attend (Rumberger, 2011). Suppose, for example, that unremediated reading problems are enormously consequential for school attainment but that, by and large, middle and high schools are relatively effective at identifying and helping struggling readers get back on track. In that case, our analysis would show weak correlations between middle-childhood reading achievement and completed schooling. Of course, many failing readers never get back on track, but this example illustrates some of the hazards in drawing strong policy conclusions from our analysis.

Despite these potential drawbacks, our results provide a useful assessment of the possible links between emerging academic and behavioral competencies and later school attainment. Basic academic skills clearly matter, particularly for entry into postsecondary schooling. But behavior problems—in particular, the development of persistent antisocial behaviors—also may matter, particularly in decisions and events associated with dropping out or completing high school.

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