A slightly revised version of this paper was published as a chapter:

Greg J. Duncan and Katherine Magnuson, "The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems", in Greg J. Duncan and Richard J. Murnane (eds.), Whither Opportunity: Rising Inequality, Schools, and Children's Life Chances, New York: Russell Sage, 2011, pp. 47-69.

Chapter 3

The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems

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The authors are grateful to the Spencer Foundation, the Russell Sage Foundation, the Foundation for Child Development, and the NSF-supported Center for the Analysis of Pathways from Childhood to Adulthood (grant no. 0322356) for research support.

Executive Summary

Our chapter investigates links between young children's skills and behaviors and their later attainments. We begin with a conceptual framework for understanding early skills. We argue that the skill categories of "cognitive" and "noncognitive" used by many economists are both too simplistic and inaccurate. "Cognitive" skills mix mental acuity (IQ) with concrete achievements such as knowing letters, beginning word sounds, and numbers. "Noncognitive" skills encompass diverse capacities such as paying attention (an inherently cognitive task), getting along with classmates and teachers, and maintaining good mental health. We propose and defend the early-skill classification of *achievement, attention, behavior problems* and *mental health* while at the same time acknowledging that these broad categories are related and can be broken down further into more narrowly defined component parts.

Children from different social groups enter school with very different skills and behaviors. Comparing children in the bottom and top quintiles of socioeconomic status (SES), we show that low-SES children are 1.3 standard deviations lower than high-SES children in their kindergarten-entry math skills, nearly two-thirds of a standard deviation below in teacher ratings of attention skills, and one-fourth of a standard deviation worse in terms of teacher-reported antisocial behavior. None of these gaps shrinks over the course of elementary school, and in the case of antisocial behavior, the SES-based gap nearly doubles. More than half of the SES gaps occurred *within* schools, which suggests that the very different kinds of schools attended by poor and affluent children do not begin to account for all of the gaps.

Next, we summarize what is known about the developmental course of these capacities. Cross-time achievement correlations tend to be higher than correlations for either attention or behavior, but this may be due in part to the fact that achievement is measured more reliably than attention or behavior. Interesting work on behavior problems identified upon school entry shows that they persist for a small but significant number of children. Behavior problems that arise in adolescence also generally fail to persist much beyond the adolescent period.

The heart of our chapter is a review of associations between early achievement, attention, and behavior and later school achievement and such late-adolescent schooling outcomes as dropping out and college attendance. We also consider early-adult criminal behavior as measured by the likelihood of having been arrested.

We find that although school-entry achievement skills prove quite predictive of later school achievement, the *persistence* dimension of early skills and behavior problems matters most for later attainment and crime. Point-in-time assessments of primary school children are, at best, weakly predictive of where children will end up in late adolescence or early adulthood. Associations between skills and outcomes were generally stronger after age ten than before. Using measures based on persistent problems across elementary school boosts the explanatory power of early measures considerably. Children with either persistent math problems or behavior problems were much less likely to graduate from high school or attend college. In the case of early-adult crime, early antisocial behaviors were most predictive. But even when we judged persistent early skill and behavior problems to have strong effects on our outcomes, there were still many exceptions to the rule.

The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems

Introduction

During the 1960s, the High/Scope Perry preschool intervention program provided one or two years of high-quality part-day educational services and home visits to three- and four-year-old low-income, low-IQ African American children in Ypsilanti, Michigan. At program entry, the Perry children averaged 80 on an IQ test normed to a population mean of 100.[1] Shortly after these children completed the program, and around the time they entered kindergarten, their scores had jumped to 95. For the children randomly assigned to a control group, scores increased very little, from 79 to 84. The differential Perry advantage amounted to nearly one standard deviation—a huge advantage. Perry children went on to get better grades, complete more schooling, commit fewer crimes, and, through middle age, enjoy higher earnings and rely less on social services.[2]

It is tempting to draw two conclusions from the Perry evidence. The first is that the skills children develop prior to school entry can have important impacts on lifelong success. Abundant theory and evidence from neuroscience and developmental psychology, as well as evaluations of a number of intensive early-childhood interventions, support the contention that early skills and behavior can indeed matter a great deal for later academic achievement and attainment.

A second possible conclusion is that boosting childhood IQ was the key reason for the Perry program's long-run successes. This is likely false: by third grade, the average IQs of Perry children had fallen to 88—a statistically insignificant single IQ point higher than the third-grade IQs of control-group children. If not IQ, then what other skill or behavior, consequential alone or in combination with early cognitive skills, conveyed the benefits from the Perry "treatment"?

One possibility is that the Perry program improved key literacy and numeracy skills that, independently of pure cognitive ability, can lay the foundation for future success in school and beyond. In fact, measures of school achievement continued to show significant advantages for the Perry children well beyond third grade, although later achievement impacts were certainly smaller than early impacts. Early cognitive and achievement gains might have helped children to avoid early school failure; indeed, children who attended the Perry program were also less likely to receive special education services or to have been retained. Progressing through the early school years without being held back or placed in special education increased the likelihood that they would later go on to complete high school (Deming 2009).

Perhaps it was something about the Perry children's ability to pay attention and become more engaged with their school tasks. A few years after the Perry study ran its preschools, Mischel, Shoda, and Rodriguez (1989) measured impulse control by observing whether four-year-olds from affluent Californian families, when left alone with a marshmallow, could wait long enough before eating it to earn a second marshmallow. He found that children who were better able to control their impulses went on to get higher SAT scores, graduate from better colleges, and have better adult outcomes. Regrettably, the Perry evaluation did not measure children's self-regulation skills, so it cannot answer this question.

Or perhaps Perry taught children inclined toward aggressive behavior how to get along better with their peers and teachers. A number of longitudinal studies have found that adults who commit crimes repeatedly were much more likely to have been aggressive as young children than adults with no criminal records (Leschied et al. 2008). Analyses of the Perry evaluation by Cunha and Heckman (2009) consider whether children's misbehavior during elementary school as measured in the Perry evaluation accounted for reductions in later crime and achievement. They find that improvement in participants' behavior does explain some of the program's effects on crime and income. However, most of the effects remain unexplained.

Our chapter sheds light on the Perry effect and other school-entry puzzles by turning to theory as well as other empirical studies investigating links between young children's skills and behaviors and their later attainments.

The Nature of Early Achievement, Attention, and Behavior

Conceptual Model

We focus on three "skill" domains: achievement, attention, and behavior. Figure 3.1 presents our theoretical model of how biology and environments interact to produce later school outcomes. It draws from a Bronfenbrennerian perspective in which children are embedded in multiple contexts and their development is shaped by their interactions within and across these contexts (Bronfenbrenner and Morris 1998). As depicted in the figure, children enter school with a set of skills determined by interactions between their own endowments (genetic and otherwise) as well as the quality of their early experiences, including, for example, interactions in home and child care settings. How school-entry skills develop is a vital question, has been studied extensively (Shonkoff and Phillips 2000), and is not the focus of our chapter.

<!Fig. 3.1!>

Children's skills at school entry facilitate the acquisition of later, more sophisticated skills. But they also shape children's environments, particularly interactions with teachers and classmates, school experiences such as placement into ability groups, and interactions with family members. These environments in turn can affect children's learning and skill development throughout the school years.

For example, strong letter identification skills at school entry may enhance a child's ability to map letters onto corresponding sounds, and thus provide a strong foundation for developing reading skills. The presence of highly skilled children, if clustered in the same classroom, may also enable a teacher to target and pace instruction to meet the needs of more children with advanced skills. This instruction may lead the child to enjoy reading and to read more during free-play time in the classroom and with family members. This in turn further builds a child's vocabulary, thus improving language and reading learning. Thus, by influencing both the child and his or her social environment, early academic skills can be linked to subsequent academic achievement because they provide the foundation for positive classroom adaptation (Cunha et al. 2005; Entwisle, Alexander, and Olson 2007).

Negative feedback loops are also possible. A student's early difficulties paying attention or getting along with teachers and classmates can lead to fewer learning-related interactions with teachers and social ostracism from classmates. Classroom disruptions can also interfere with

classmates' opportunity to learn. In later grades, antisocial behaviors may lead to suspensions or expulsions, with obvious detrimental consequences for student achievement. Such transactional and recursive models of development are a staple of developmental theory (Sameroff and Fiese 2000).

A broader conception of the classroom environment box in figure 3.1 would include the institutional practices of schools—specifically the ways in which children are sorted across schools and also "tracked" within schools. For example, placement into more or less academically challenging curricular tracks has been linked to students' later outcomes. As the sorting of students within schools is more central to later schooling experiences, it is addressed in the chapter by Farkas.

Achievement, Attention, and Behavior Problems and Mental Health

Instead of "cognitive" and "noncognitive," we find "achievement," "attention," and "behavior problems and mental health" to be a productive way of categorizing the general domains of children's school-related functioning (table 3.1). By "achievement" we mean concrete academic skills. "Attention" refers to the ability to control impulses and focus on tasks. "Behavior problems and mental health" consists of two important dimensions—the ability to get along with others and sound mental health.

<!Table 3.1!>

Notably absent from this schema are students' own aspirations, goals, and attitudes. In part, this omission is appropriate given our focus on younger children, self-constructs, goals, and aspirations develop during the early school years, and as they become more differentiated and complex, they also become more closely associated with children's behavior and performance (Davis-Kean et al. 2008). For this reason, a discussion of these constructs appears in the chapter by Farkas in this volume.

Achievement Skills. "Achievement" in the preschool and middle-childhood years refers mainly to a set of reading- and math-related skills. For preschoolers, reading-related skills encompass identification of upper- and lowercase letters as well as decoding skills such as beginning to associate sounds with letters at the beginning and end of words. Most early reading problems reflect poor decoding skills and low levels of phonological and phonemic awareness, such as a poor ability to break down words into component sounds. As children progress through childhood, reading skills include recognizing words by sight, understanding words in context, and making literal inferences from passages. By the end of elementary school, students are developing reading comprehension and evaluation skills, which include identifying the main points in a passage as well as understanding an author's intentions and evaluating the adequacy and logical consistency of supporting evidence. Writing skills, specifically a child's ability to express ideas in written form, develop in concert with reading skills.

Rudimentary math skills can be detected in children as young as six months (Posner and Rothbart 2007). Concrete math skills begin with the ability to recognize numbers and shapes and to compare relative sizes. Counting and sequencing skills are followed by the ability to perform addition and subtraction tasks, as well as multiplication and division tasks. Understanding numerical properties such as proportions, fractions, integers, and decimals also develops, as do measurement skills and an understanding of geometry.

These pre-academic and academic skills develop as a result of learning opportunities embedded in everyday activities and specific instruction, which is especially important for code-related reading skills and computational mathematical skills. Achievement trajectories are steepest in the early years of school, as children rapidly learn many new skills and improve existing ones. Although learning continues into later school years, the rate of gaining new skills declines over time as more focus is placed on elaborating and improving existing skills.

More general cognitive skills also play a role in skill development. For example, oral language skills facilitate the acquisition of reading skills such as identifying letter sounds, and they are increasingly important as children make the transition from "learning to read" to "reading to learn." Likewise, a strong foundation of basic number concepts such as one, two, and three dimensions becomes increasingly important as children advance from basic computational tasks to more complex mathematical problems that require flexible problem-solving techniques (Baroody 2003; Hiebert and Wearne 1996).

Although many prior studies have focused on IQ as an important determinant of scholastic skills, we do not discuss IQ per se for several reasons. Many IQ measures include items that are related to the acquisition of basic early reading and math skills and thus overlap with our "achievement" domain. Measures of IQ free of such "content" reflect the speed of cognitive processing, for example, or the ability to recognize patterns. But these types of assessments are rarely included in large studies, and although they may be influenced by instruction, most intervention programs target achievement and behavior rather than IQ.

Attention Skills and Cognitive Self-Regulation. Self-regulation has been defined as the "processes by which the human psyche exercises control over its functions, states, and inner processes" (Baumeister and Vohs 2004, 1). It involves the ability to evaluate the steps and actions required to meet a desired goal and to control behavior deliberately in order to reach that goal. Current theory and research on young children's self-regulation subdivides the construct in a variety of ways, but almost all works in this area separate cognitive (cool) and emotional components (hot) (Eisenberg, Sadovsky, and Spinrad 2005; Raver 2004; Raver et al. 2005). We too distinguish between hot and cold self-regulation, placing cognitive self-regulation into our "attention" category and emotional self-regulation into our "behavior problems and mental health" category.

Cognitive self-regulation is a broad construct including such overlapping subcomponents as executive function, planning, sustaining attention, task persistence, and inhibition of impulsive responses. We classify this collection of skills as "attention" but emphasize their diverse nature. Research has shown that attention and impulsivity can be detected as early as age two and a half but continue to develop until reaching relative stability between ages six and eight (Posner and Rothbart 2000). It is widely accepted that some dimensions of executive functioning undergo rapid development during adolescence.

Cognitive self-control can be measured by both direct assessments of particular components and more general descriptions of children's behaviors (especially in structured classroom contexts).[3] Parent and teacher reports of children's cognitive self-regulation assess the behavioral consequences of children's self-regulatory skills. For example, items indicate the extent to which children are able to sit still, concentrate on tasks, persist at a task despite minor setbacks or frustrations, listen and follow directions, and work independently or, conversely, whether they are easily distracted, overactive, or forgetful.

Attention skills and cognitive self-regulation are thought to be consequential to children's learning because they increase the time children are engaged and participating in academic endeavors and increase children's ability to solve problems. Studies have consistently found positive associations between measures of children's ability to control and sustain attention with academic gains in the preschool and early elementary school years (Raver et al. 2005; McClelland, Morrison, and Holmes 2000; Yen, Konold, and McDermott 2004; Brock et al. 2009).

Behavior Problems and Mental Health. Perhaps because these are easily identified by the frequently used Child Behavior Checklist (CBCL; Achenbach 1991, 1992), developmentalists often distinguish between two broad dimensions of behavior problems—externalizing and internalizing. Externalizing behavior refers to a cluster of related behaviors including antisocial behavior, conduct disorders, and more general aggression. Attention problems are also included in most externalizing behavior scales, although we suggest that they should be separated from other forms of behavior problems. Internalizing behavior refers to a similarly broad set of constructs including anxiety and depression as well as somatic complaints and withdrawn behavior. In terms of understanding how behavior shapes children's schooling, greater attention has been devoted to externalizing behavior than to internalizing behavior, likely because of its obvious disruptive consequences in the classroom.

Although children's behavior problems and mental health are predicted by their capacity to regulate emotions, these constructs are not the same. Emotional regulation refers to the ability to "modulate the experience and expression of positive and negative emotions" (Bridges, Denham, and Ganiban, 2004, 340). It includes the ability to control anger, sadness, joy, and other emotional reactions, which predict such behavior as aggression and internalizing problems (for example, social withdrawal, anxiety) (Eisenberg, Sadovsky, and Spinrad 2005).[4] Poor emotional regulation is not the only reason for poor mental health or behavior problems. Indeed, children differ in the strength of their emotional reactivity to experiences, including the underlying physiological reactions. Children also differ along dimensions of emotional positivity and negativity (Posner and Rothbart 2007). Furthermore, a large body of evidence points to the importance of deviant social information processing, including hostile attribution and other cognitive biases, as an important contributory factor to antisocial behavior (Crozier et al. 2008).

Among young children, externalizing behavior problems are assessed by asking parents and teachers, for example, how often a child argues, fights, or throws tantrums; gets angry; acts impulsively; and disturbs ongoing activities. Aggression refers to behaviors such as bragging, teasing, fighting, and attacking and is closely related to antisocial behavior, which refers to behavior that harms another person, whether by imposing physical or mental harm or by creating property loss. Antisocial behaviors also encompass nonaggressive harmful behaviors such as lying and cheating. In this chapter we focus on antisocial behavior, in particular, as a particularly important dimension of externalizing behavior.

Externalizing behavior is quite common in young children. Reports of aggression and other forms of externalizing behavior typically peak in the preschool and early school years, as children use aggression as a way to assert control over their environment to compensate for their own nascent communication skills. As children's abilities to communicate, self-regulate, and solve problems effectively increase, their aggressive and antisocial behavior typically decreases. However, research suggests that for a small proportion of children, hostile, aggressive, and antisocial behavior remains high throughout childhood and adolescence (Campbell, Shaw, and

Gilliom 2000; Moffitt, 1993). Boys are more likely to display these "life-course persistent" patterns of behavior than girls.

Depressive behavior is measured by questions that ask how frequently children appear to be in a sad or irritable mood and whether they demonstrate low self-esteem or low energy. Anxiety captures a set of factors including children's fears related to separation from caregivers, obsessive/compulsive behavior, and social reticence. Social withdrawn behavior refers to a child's specifically social anxiety and avoidance of social interactions.

Internalizing behavior problems increase over the course of childhood. Research suggests that anxiety may be relatively constant over time, although it takes different forms at different ages. Depressive behaviors, however, increase over time, and do so more for girls than boys (Bongers et al. 2003).

Children's behavior problems are also expected to affect both individual learning and classroom dynamics. Externalizing behaviors promote child-teacher conflict and social exclusion (Newcomb, Bukowski, and Pattee 1993; Parker and Asher 1987), and these stressors may reduce children's participation in collaborative learning activities and adversely affect achievement (Ladd, Birch, and Buhs 1999; Pianta and Stuhlman 2004). Likewise, depressive symptoms and anxiety may also reduce children's engagement in classroom group learning activities (Fantuzzo et al. 2003; Fantuzzo et al. forthcoming). Evidence of this negative effect of behavior problems on achievement, however, is mixed, with correlational evidence pointing to a detrimental effect but more controlled models yielding no or much smaller associations. One possible explanation is that teachers do not yet expect children to manage their emotional responses well and thus use instructional approaches that minimize children's need to do so independently (Brock et al. 2009).

Skills and Behaviors at School Entry and Beyond

The Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K) is a natural choice for illustrating basic empirical properties of achievement, attention, and behavioral measures owing to its large and representative national sample of kindergartners, its longitudinal nature, and the quality of its measures. As detailed in the online appendix, the ECLS-K's school-entry reading measures assess skills such as identifying upper- and lowercase letters by name, associating letters with sounds at the beginning and end of words, and recognizing common words by sight. Its math measures reflect the ability to identify one- and two-digit numerals, recognize geometric shapes, count up to ten objects, and recognize the next number in a sequence.

Attention and behavior problem measures are based on teacher reports. The attention and cognitive self-regulation scale in the ECLS-K is called "approaches to learning" and includes items that assess the child's attentiveness, task persistence, eagerness to learn, learning independence, flexibility, and organization. The externalizing behavior problems index rates the frequency with which a child argues, fights, gets angry, acts impulsively, and disturbs ongoing activities, while the internalizing behavior problem index covers anxiety, loneliness, low self-esteem, and sadness.

Kindergarten and Cross-Time Correlations

Kindergarten correlations among the ECLS-K measures are shown in table 3.A1. At .69, reading and math achievement have the highest correlation. But while both reading and math scores correlate substantially with attention, the correlation between achievement and behavior problems is much lower. Attention is moderately correlated with both achievement and behavior problems—all four correlations are in or near the .3 to .5 range.

By fifth grade, virtually all the correlations have grown, some substantially (table 3.A1). Most notably, correlations between the two achievement and the two behavior measures are all above .2 (in absolute value). Although part of the increased correlations may come from better measurement, the early school years may be a time in which children become somewhat more differentiated into groups with higher achievement and good behavior and with lower achievement and poor behavior.

Skill and Behavior Stability across Primary School

Although stability is the norm, some children do demonstrate both transitory fluctuations and fundamental shifts in their achievement trajectories (Kowaleski-Jones and Duncan 1999; Pungello et al. 1996). A look at the temporal persistence of the ECLS-K's five achievement, attention, and behavior measures shows a clear ranking of these correlations, with both time-dependent math and reading test score correlations always above .6, externalizing behavior problem and attention correlations falling to about .50 by first grade but then falling only modestly after that, and internalizing behavior problem correlations dropping the most (tables 3.A2 to 3.A4). The pattern in the attention and behavior problem measures may reflect, in part, the lower reliability of the internalizing behavior problem index ($\alpha = .80$ in kindergarten) compared with externalizing behavior problems ($\alpha = .90$) and attention ($\alpha = .89$ for the ECLS-K's "approaches to learning" scale).

Skill and Behavior Differences across Groups

Based on the detailed look provided in tables 3.A5 and 3.A6, figures 3.2 to 3.4 plot differences in math scores,[5] attention, and externalizing behavior problems across socioeconomic, racial/ethnic, and gender groups in both kindergarten and fifth grade. These figures show simple differences across groups; tables 3.A5 and 3.A6 also shows counterpart differences *within classroom* (that is, adjusting for classroom fixed effects), which account for the way students are clustered within schools and classrooms and, in the case of the attention and behavior measures, in the way individual teachers respond to the scales.

<!Fig. 3.2!>

<!Fig. 3.3!>

<!Fig. 3.4!>

Overall, SES differences in skills and behaviors are larger than racial/ethnic differences. In the case of math achievement, income gaps far exceed racial/ethnic and gender gaps. On average, students in the bottom SES quintile (with average family income of about $15,500) scored well over one standard deviation below children in the top SES quintile (average family income of $100,000). This result mirrors those found in the Reardon chapter, which also uses data from the ECLS-K. As shown in table 3.A5, SES gaps are roughly half as large for children in the same schools as for children overall, suggesting that SES-based family selection into schools accounts for some, but by no means all, of the achievement gaps.

The picture for attention and behavior problems is relatively favorable for Hispanics; attention gaps between Hispanics and whites virtually disappear by the end of primary school, and behavior problem differences between these two groups are very small through middle childhood. But while achievement gaps do not increase, Hispanic fifth graders still lag far (half a standard deviation) behind their white counterparts.

Most worrisome are the growing skill and behavior gaps between the SES groups and by race. By fifth grade, non-Hispanic black children and children from low-SES families have closed none of their achievement gap with children from white and more-advantaged families, and have fallen further behind in terms of attention and behavior problems.

SES and Young Adult Outcomes

SES differences in early skills and behavior are worrisome because they may be an important way in which SES is transmitted from parent to child. We turned to data from the children of the National Longitudinal Survey of Youth (NLSY; details about the data are provided in the online appendix) to examine the mediation role of early skills and behavior. Mother's SES is measured by mother's highest grade of completed schooling when the child was age five or six. Outcomes are measured around age twenty and include the probability of being arrested, completing high school, and attending college.

Bivariate models suggest that, relative to children in the top SES quintile, children in the bottom SES quintile have arrest rates 15 percentage points higher, high school completion rates 31 percentage points lower, and college attendance rates 40 percentage points lower (figure 3.5; online appendix table 3.A7). Adding measures of children's achievement and behavior at age six explains about one-fourth of the arrest differences and one-eighth of the two sets of schooling differences.[6] Next we added the children's average level of achievement and behavior at ages eight, ten, and twelve. These more persistent skill and behavior measures accounted for more of the SES differences, but in no case did they account for as much as half of them. This suggests that mechanisms and pathways not involving early skills play an important role in the intergenerational transmission of SES.

<!Fig. 3.5!>

School-Level Measures of Skill Distribution

As the description of achievement, attention, and behavior problem gaps suggests, low skill levels are disproportionately concentrated among disadvantaged populations. Given the geographic concentration of disadvantage, low-skilled children are more concentrated in schools that serve disadvantaged children. This imparts a double disadvantage to many low-skilled children—they have low skills and encounter classroom environments where concentrations of achievement and behavior problems pose difficult classroom management challenges for teachers.

We examined the possible scope of problem-laden classrooms using ECLS-K data. We defined math and attention problems as being in the most problematic 25 percent of the national distribution on each of these measures. We tried to do the same for externalizing behavior, but the discrete nature of the measure led us to draw the line at the eighteenth percentile of its distribution. Taken as a whole, some 5 percent of kindergarteners exhibit problems in all three dimensions (table 3A.8).

We then characterized schools by the percent of children qualifying for the federal free school lunch program, the percent of racial or ethnic minority children, and population density (urban vs. suburban). Income-based contrasts are striking, with four times as many triple-problem children in poor (8 percent) as opposed to affluent (2 percent) schools. More generally, the data suggest that schools with higher proportions of low-income or minority children have a greater concentration of low math skills and significant behavior and attention problems. Differences between urban and suburban schools are considerably smaller but still apparent. With most peer-effect studies concentrating on the consequences of low- or high-achieving classmates (for example, Betts and Zau 2004; Hanushek et al. 2003; Hoxby and Weingarth 2007), we know relatively little about possible tipping points surrounding the number of multiple-problem classmates it takes for individual problems to become collective problems.

Nor do we know how the concentration of these problems affects the other half of the sorting process—of teachers across schools. Schools serving more affluent children typically have more economic resources and, it would appear from table 3.A8, more easily managed classrooms. Little wonder they are able to attract and retain more highly qualified teachers than poor schools (Phillips and Chin 2004). Even within a large urban school district, principals of lower-achieving schools assign classroom management skills a much higher priority in looking for new teachers than do principals of higher-achieving schools (Engel 2007).

Consequences of Skills and Behaviors for School Achievement

We turn now to the "so what?" question for early skills and behaviors: what difference do they really make for later success in school and beyond? Here we review existing evidence linking school-entry skills and behaviors to later school achievement and then generate new evidence on links to early-adult school attainment and crime.

School-Entry Skills and Later Achievement

A number of experiments provide encouraging evidence that specially designed intervention programs that target preschool children "at-risk" for school failure produce cognitive and academic achievement gains; long-term reductions in referral for special education services, grade retention, and dropping out; and increases in adult educational attainment (for a review, see Blau and Currie 2006). But most of these programs had a broad curriculum designed to enhance academic and social skills, so it is not possible to disentangle impacts of the self-regulation, behavior, and academic components of the programs.

Another shortcoming of the experimental literature is that interventions that focus more narrowly on just one aspect of skills or behaviors do not consider cross-domain effects. Relatively few studies of behavioral interventions also estimate impacts on later academic outcomes. Durlak et al.'s (forthcoming) review suggests that at least some of those do find positive impacts on achievement.

Duncan et al. (2007) provide the most comprehensive nonexperimental assessment of the associations between school-entry achievement, attention, and behavior and later school achievement. Using six longitudinal data sets,[7] they regressed reading and mathematics achievement (from tests and, where available, teacher ratings) on kindergarten-entry measures of reading and math achievement, attention, antisocial behavior, and internalizing behavior problems. Importantly, controls for child IQ, behavior, and temperament and parent education and income, all of which were measured prior to kindergarten entry, were included in the

regressions. To establish comparability across studies, dependent-variable measures of achievement as well as school-entry skills and behaviors were standardized in all studies using full-sample standard deviations. All postkindergarten reading and math achievement outcome measures available in the six data sets were treated as dependent variables in separate regressions.

To summarize their results, they conducted a formal meta-analysis of the 236 standardized regression coefficients emerging from the individual study regressions. Average coefficients from the regressions involving math and reading outcomes are presented in table 3.2. A clear conclusion is that only three of the five school-entry skill categories predict subsequent reading and math achievement: reading, math, and attention.[8] Neither behavior problems nor mental health problems were associated with later achievement, holding constant achievement as well as child and family characteristics. Indeed, none had a standardized coefficient that averaged more than .01 in absolute value.

<!Table 3.2!>

Not surprisingly, early reading skills were stronger predictors of later reading achievement than later math achievement. Less expected was that early math skills (adjusting for prior IQ in five of the six studies) were as predictive of later reading achievement as were early reading skills. Children's attention appeared equally important (and several dimensions of socioemotional behaviors appeared uniformly unimportant) for reading and math achievement.[9] These findings did not differ systematically by gender or family SES.

All in all, the Duncan et al. (2007) analysis provides a clear answer to one question involving the relative role of school-entry skills and behavior: for later school *achievement*, early academic skills correlate most strongly, even after adjusting for differences in the fact that early achievers score higher on tests of cognitive ability and come from more-advantaged families. A student's school-entry ability to pay attention is modestly predictive of later achievement, while early behavior problems and other dimensions of social skills and mental health problems are not predictive, once the student's initial levels of achievement are taken into account.[10]

Middle-Childhood Skills and High School Completion

It is far from clear whether early academic skills matter as much and early behaviors as little for adolescent and early-adult school attainment as they do for middle-childhood reading and math proficiency. Finishing high school likely requires a combination of achievement, engagement, and perseverance. Antisocial behaviors in primary school may lead to inconsequential trips to the principal's office, while such behaviors in middle or high school may lead to suspension, expulsion, or even criminal prosecution. Moreover, the far-from-perfect temporal correlations in achievement and behaviors shown in appendix tables 3.A2 to 3.A4 mean that many children perform and behave better and worse over time.

Magnuson et al. (2009) used the NLSY and Baltimore Beginning School Study (BSS) to study links between middle-childhood skills and behavior problems and high school completion. Here we reproduce and expand upon their NLSY-based results and note that the BSS data produced very similar patterns of effects.

As detailed in the appendix, the NLSY measures reading and math achievement in its biennial child survey. Attention/self-regulation in the NLSY is drawn from the hyperactivity

subscale of the parent-reported Behavior Problems Index (BPI). Antisocial behavior and anxiety scales are drawn from the BPI as well.

Although the NLSY surveys children every other year, it provides concurrent measurements on math, reading, and attention skills as well as internalizing and externalizing behavior problems for school-age children of every age between five and fourteen. To investigate when skills and behaviors begin to predict high school completion, we ran a series of probit regressions that related high school completion to preschool measures of child cognitive skills, temperament, and family background (see the online appendix for a complete list) and middle-childhood skills and behaviors. The first regression measured these skills and behaviors at age five, the second at age six, and so on, up to age fourteen. Regression results are presented in online appendix table 3.A9.

In seeking to understand the role of early skills in determining later outcomes, we adopt a regression method that includes our measures of concurrent skills as well as measures of child and family characteristics from birth through age five. For comparative purposes we also provide bivariate models that provide a sense of the magnitude of associations between each domain and later outcomes. Such simple associations show uniformly significant prediction from all the measures to later educational (and crime) outcomes, albeit larger associations in the later years compared with the earlier years (columns 1 and 11 of online appendix tables 3.A9 and 3.A11). This finding is not surprising, and it confirms the common observation that early skill deficits across a range of domains are linked to later outcomes. Such bivariate associations, however, may be simply proxying for other skills or family circumstances that are the true cause of later outcomes. For this reason, we focus on results from regression models that hold constant not only other important domains but also family and child characteristics.

In models with a full set of controls, math and reading skills have uniformly positive but often statistically insignificant effects on high school completion, with neither being consistently more predictive than the other (top panel of online appendix table 3.A9). When combined into a single, standardized composite, however, achievement effects became uniformly significant (figure 3.6 and bottom panel of online appendix table 3.A9).[11] Standard deviation increases in the achievement composite are generally associated with smaller increases in the probability of high school completion before age 10 than after.

<!Fig. 3.6!>

For the attention and behavior problem measures, only the measure of antisocial behavior is consistently predictive of high school completion (in-text figure 3.7 and online appendix table 3.A10). Once antisocial behavior is taken into account, attention skills and anxiety/depression do not predict high school completion. As with the achievement composite, behavior problems become more predictive around age ten. Increases of one standard deviation in externalizing behavior problems for ages ten to fourteen are associated with reductions of five to ten percentage points in high school completion rates.

<!Fig. 3.7!>

Persistent Problems and High School Completion

Prior research has suggested that a student's trajectory of behavior problems may be more important than the 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, attention, 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 (ages six, eight, and ten in the NLSY). In light of prior empirical work, we chose the seventy-fifth percentile to demark a "high" level of behavior problems and the twenty-fifth percentile as the threshold for low achievement.

We then sorted children in the NLSY data into three groups—*never, intermittent,* and *persistent*—depending on whether the child fell into the worst quarter of a given measure's distribution on zero, one or two, or all three measurement occasions. Bivariate associations between high school completion and all five of the skill and behavior measures are very strong (first column of online appendix table 3.A10), with the contrasts between the "persistent" and "never" groups associated with drops of twenty to thirty percentage points in high school completion rates. As with the single-year measures, regression adjustments left only the achievement and antisocial behavior problem measures to be predictive of high school completion (table 3.3). Persistent early math achievement and antisocial behavior problems are associated with drops of thirteen to sixteen percentage points in high school completion rates. Surprisingly, persistent early reading problems are *not* predictive of high school completion, nor are persistent attention or anxiety problems. Extending the outcomes to college attendance produces similar patterns, with persistent math problems associated with a 34 percentage point drop in the probability of college attendance.

<!Table 3.3!>

We considered whether the association between both levels and patterns of achievement, attention, and behavior problems differed across several relevant subgroups defined by SES, race, and gender. We found some variation but little systematic differences by SES and race. Associations did, however, differ by gender. In particular, antisocial behavior was more predictive of schooling attainment for boys than for girls.

Crime

Although educational attainment is an important measure of young adults' successful transition into adulthood, it is not the only one. To broaden the scope of our study of adolescent and early-adult outcomes, we repeated the NLSY-based analyses using reports of whether a child had ever been arrested by age twenty. Duncan et al. (2009) show that results from NLSY parallel those for the Beginning School Study sample and its measure of incarceration by age twenty or twenty-one and the Infant Health and Development sample and its measure of arrest by age eighteen.

As with high school completion, we ran a series of probit regressions, all of which related high school completion to preschool measures of child IQ, temperament, and family background as well as middle-childhood skills and behaviors. Regression results are presented in table 3.A10. Again, results from the bivariate models uniformly indicated that the achievement, attention, and behavior problem domain measures all predicted later arrests. Turning to the fully controlled models, only the antisocial behavior reports were predictive of later crime. Year-by-year patterns are shown in figure 3.8. Coefficient sizes are generally modest (although statistically significant) until age ten, at which point they roughly double. The sample mean is about 22 percent, so a three percentage point coefficient amounts to about a 15 percent increase relative to the base rate, and a six percentage point coefficient increases the base rate by about 30 percent.

<!Fig. 3.8!>

Although the individual-year effects of behavior problems from ages five to ten are only modestly predictive of later crime, persistent early antisocial behavior is very predictive. As in the high school completion analysis, we sorted the NLSY data into *never*, *intermittent*, and *persistent* groups depending on whether the child fell into the worst quarter of a given measure's distribution on zero, one or two, or all three measurement occasions (table 3.A12). Children exhibiting persistent early antisocial behavior had nearly double the chance of being arrested. As shown in table 3.A12, this effect is somewhat larger for males than for females.[12]

In sum, most of the action in predicting early adult crime is within the domain of antisocial behavior. Persistent antisocial behavior problems in primary school are quite predictive; persistent achievement, attention, or anxiety problems are not.

Summary

We motivated our chapter with the Perry puzzle: if not cognitive skills, what other skills or positive behaviors might the Perry preschool intervention have promoted that kept Perry children on track in school, in good jobs, and out of jail? Our bivariate NLSY-based analyses do little to narrow the field of important skills; virtually all of our skill and behavior problem measures have significant correlations with the later outcomes. Holding constant family background and concurrent skills produces a much more selective picture.

In the case of early-adult crime, our guess is that Perry reduced antisocial behavior problems in the intervention group. Our longitudinal analyses consistently point to early antisocial behavior problems, but not early achievement, attention, or internalizing behavior problems, as being strong predictors of arrests and incarceration, especially among boys. Children who persistently display such problems between ages six and ten had double the chance (roughly 40 percent rather than 20 percent) of ever having been arrested or incarcerated—a result replicated in three data sets in Magnuson et al. (2009). The impressive explanatory power of early antisocial behavior problems for later crime stood in marked contrast to the *in*ability of even persistent early reading, math, attention, or mental health problems to predict later criminal arrest, once such behavior and family background are taken into account.[13]

Speculating about the early-skills antecedents behind Perry's success in promoting school attainment is more tenuous. Here our longitudinal analyses suggest that both early achievement and positive behaviors help children negotiate their way through successful completion of high school and that both may be even more important in distinguishing those who enroll in postsecondary education.

We close with a number of observations. First, although school-entry skills proved quite predictive of later school achievement, the *persistence* of early achievement and behavior problems mattered most for later attainment and crime. Single assessments of primary school children are, at best, relatively weakly predictive of where children will end up in late adolescence or early adulthood. Repeating these assessments over a number of years boosts the explanatory power of at least some of them considerably.

Second, we were somewhat surprised that early attention did not matter more than it did for long-run outcomes. Much has been written recently about the importance of a child's ability

to regulate attention, plan tasks, and engage in the demands of a school curriculum (Baumeister and Vohs 2004). While our measures of attention leave much to be desired, they appear about as reliably measured as antisocial behaviors, which proved to be predictors of later outcomes. One possibility is that our attainment measures (high school completion and on-time college attendance) focus on the lower end of the attainment distribution and attention skills may be more consequential for persistence and attainment at the higher end. It may also be that attention skills developed by the early grades matter much less than higher-level attention skills that emerge during the transition to adolescence.

Third, we noted, but were unable to test for, how one child's achievement or behavior problems might prove detrimental to his or her classmates. We found that high-poverty classrooms have four times the concentrations of academic, attention, and behavior problems as low-poverty classrooms. Although prior research has produced mixed evidence on spillover effects for low achievers, we know much less about the classroom implications of substantial numbers of children with behavior problems.

Finally, none of the links between middle childhood skills and adult success appeared to be all-determining. Associations between skills and outcomes were generally stronger after age ten than before. And even when we judged persistent early skill problems to have strong effects on our outcomes, there were still many exceptions to the rule.

An optimistic interpretation is that teachers and parents are somehow able to prevent most early skill and behavior problems from translating into long-run attainment problems. Alternatively, perhaps the course of children's development is sufficiently variable, and subjected to so many positive and negative shocks, that cross-time skill/attainment correlations fall quickly to modest levels.

But low correlations do not necessarily mean that early interventions designed to boost skills, attention, or behavior are ill considered. The appropriate policy test involves costs and benefits rather than correlation size. High-quality, intensive interventions like the Perry preschool program have proven their worth. Whether larger-scale early interventions can do so remains a vital policy question.

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Table 3.1: A Taxonomy of Skills and Behaviors

Skills/ behavior domain:	Achievement	Attention	Problem behaviors	Mental health
Description:	Concrete academic skills	Ability to control impulses and focus on tasks	Ability to get along with others	Sound mental health
Example test areas or question wording:	Knowing letters and numbers; beginning word sounds, word problems	Can't sit still; can't concentrate; score from a computer test of impulse control	Cheats or tells lies, bullies, is disobedient at school	Is sad, depressed, moody
Commonly used index names:	IRT (in ECLS-K) or PIAT (in NLSY) composite reading and math scores	Approaches to Learning index (in ECLSK) and Attention Problems (NLSY)	Externalizing behavior problems (in ECLS-K and NLSY)	Internalizing behavior problems (in ECLSK and NLSY)

Table 3.2: Effect sizes of School-entry Skills and Behaviors on Later Achievement; Meta-analysis of 236 Coefficients

School-entry:	Grades 1 to 8:	
	Math achievement	Reading achievement
Reading	.09*	.24*
Math	.41*	.26*
Attention	.10*	.08*
Externalizing (- expected)	.01 ns	.01 ns
Internalizing (- expected)	.01 ns	-.01 ns

* p<.05; n=236 estimated coefficients; Source: Duncan et al. (2007). Meta-analytic estimates control for time to test, test/teacher outcome and study fixed effects; coefficients are weighted by inverse of their variances.

Table 3.3: Effect of Persistent and Intermittent Problems at Ages 6, 8 and 10 on the Probabilities of High School Graduation and College Attendance

Problem area:	Problem frequency	HS completion	College attendance
Reading	Intermittent	-.08* (.04)	-.12* (.05)
	Persistent	-.08 (.07)	-.09 (.10)
Math	Intermittent	-.06† (.03)	-.10* (.05)
	Persistent	-.13* (.07)	-.34** (.08)
Anti-social behavior	Intermittent	-.07 (.04)	-.05 (.05)
	Persistent	-.16* (.07)	-.17 † (.10)
Inattention	Intermittent	-.02 (.03)	-.05 (.05)
	Persistent	.03 (.05)	-.01 (.09)
Anxiety	Intermittent	-.02 (.03)	-.05 (.05)
	Persistent	-.08 (.07)	-.11 (.09)

** p<.01 *p<.05 †p<.10; "problem" is defined as being in the worst quartile of distribution at a given age; N=1,437 for HS completion and N=1,081 for college attendance.

Figure 3.1: Skills, behaviors and attainment across childhood

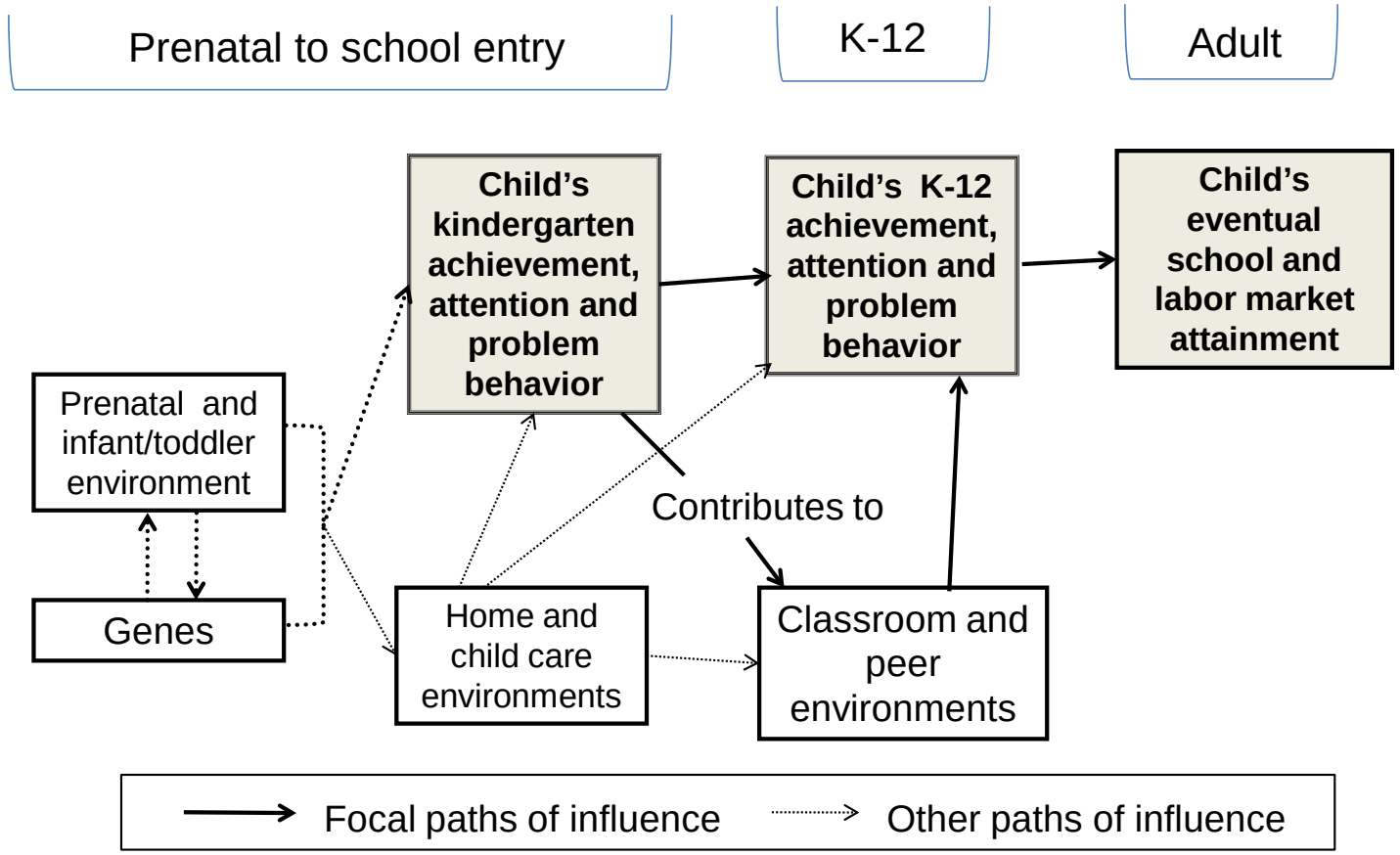


Figure 3.2: Math gaps in kindergarten and fifth grade

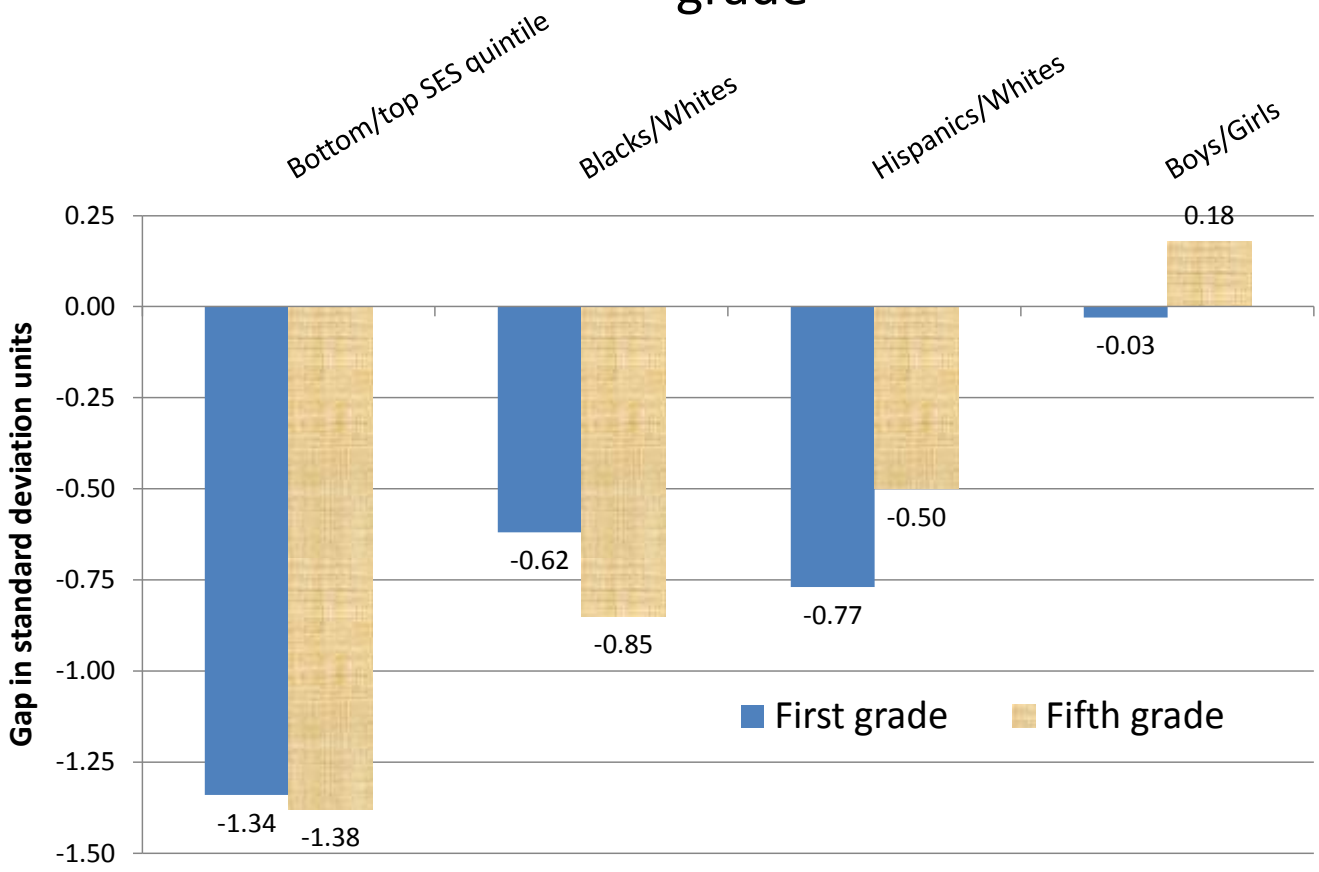


Figure 3.3: Attention/engagement gaps in kindergarten and fifth grade

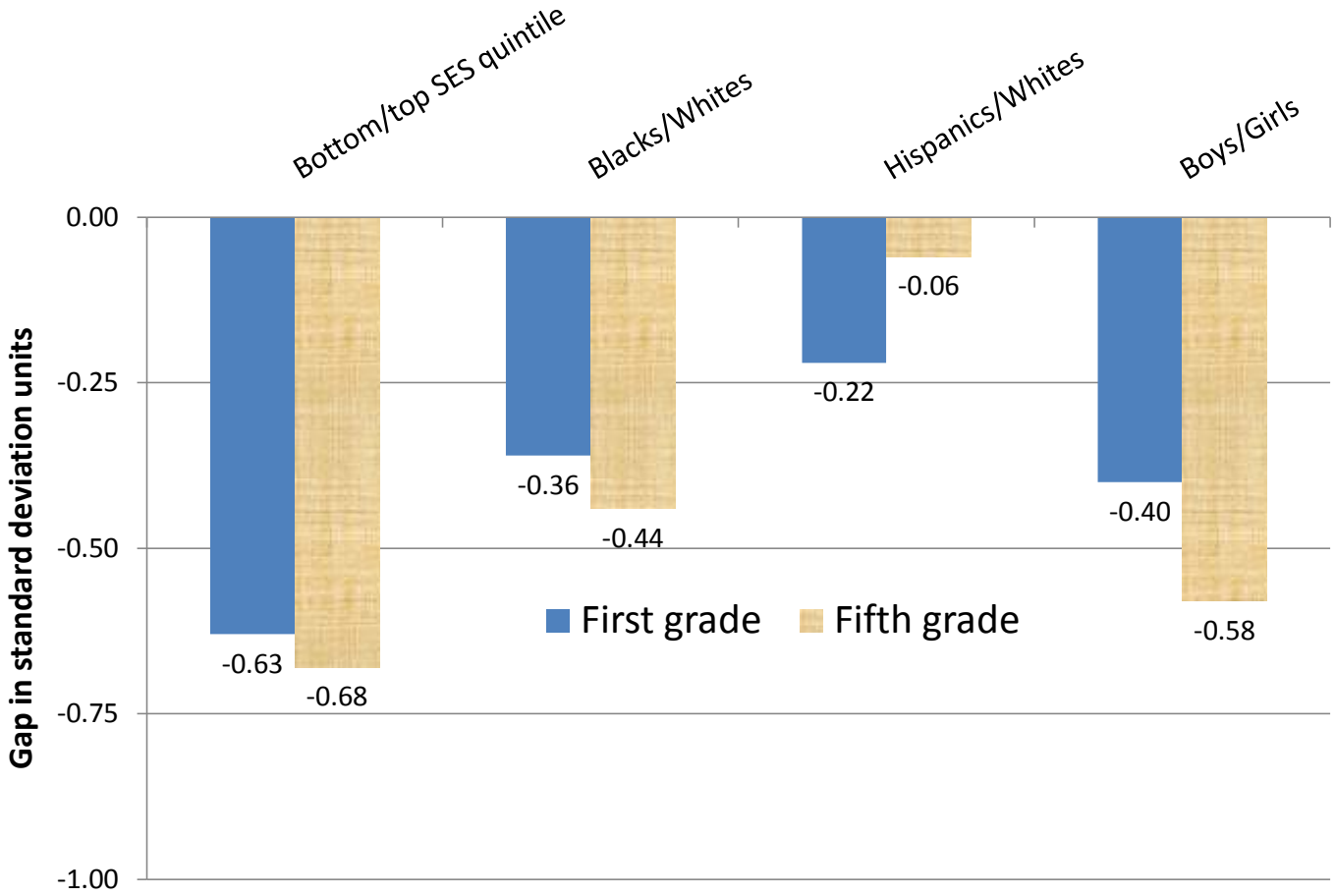


Figure 3.4: Anti-social behavior differences in kindergarten and fifth grade

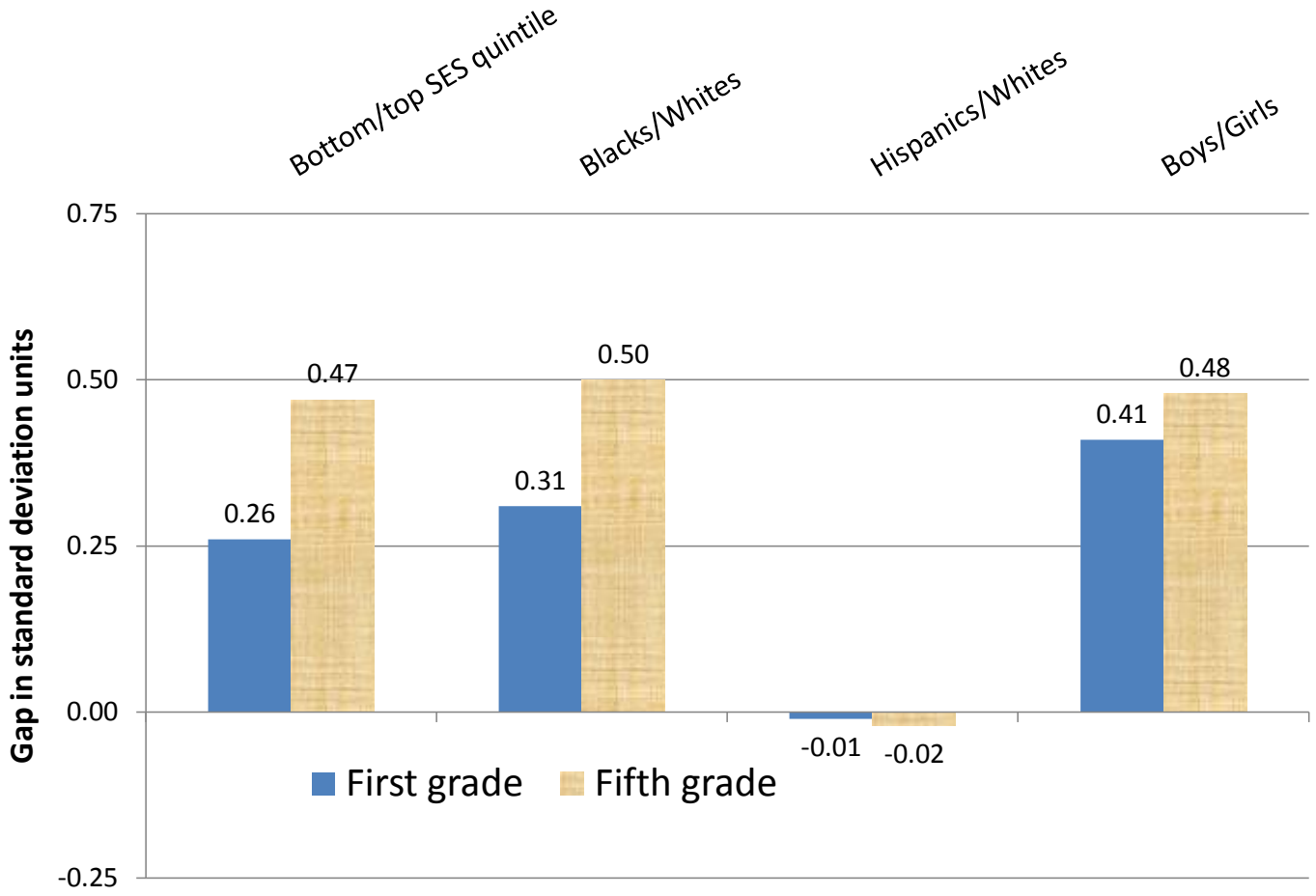


Figure 3.5: Accounting for the association between bottom and top SES quintiles in early-adult outcomes

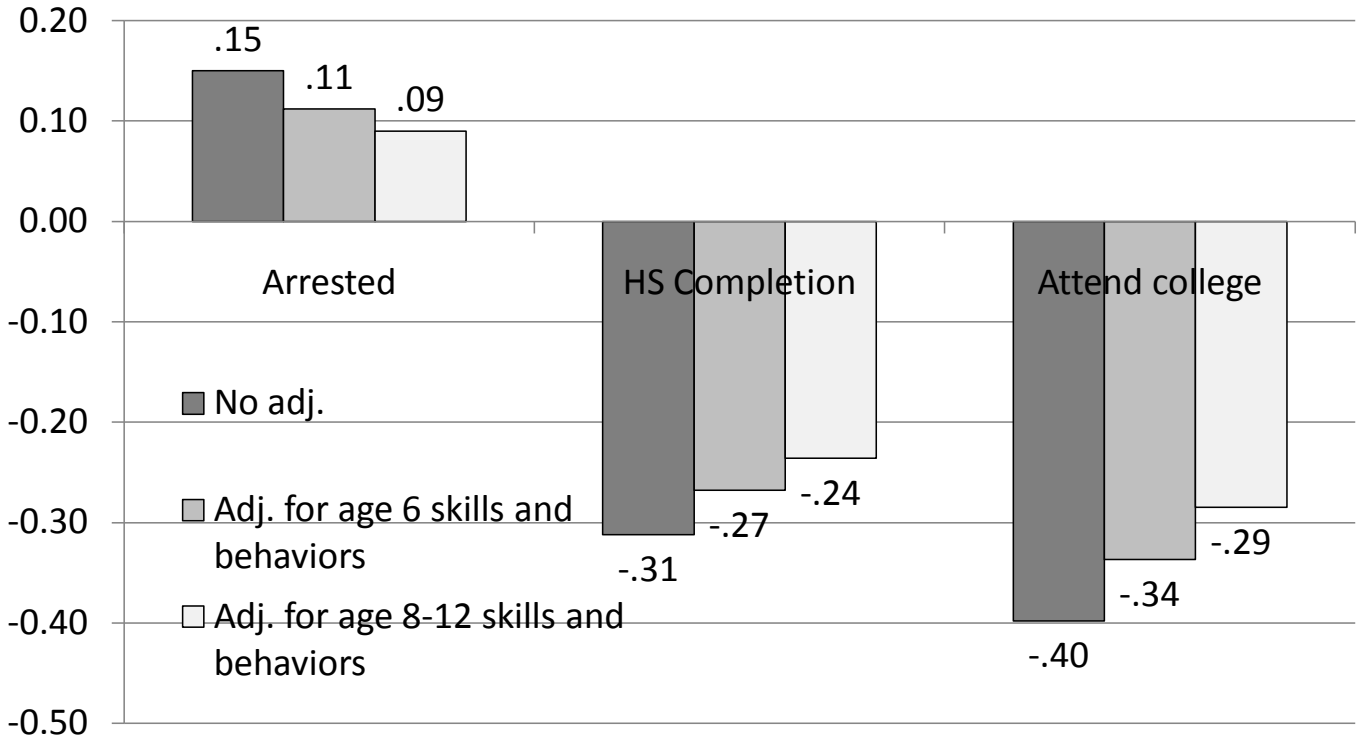
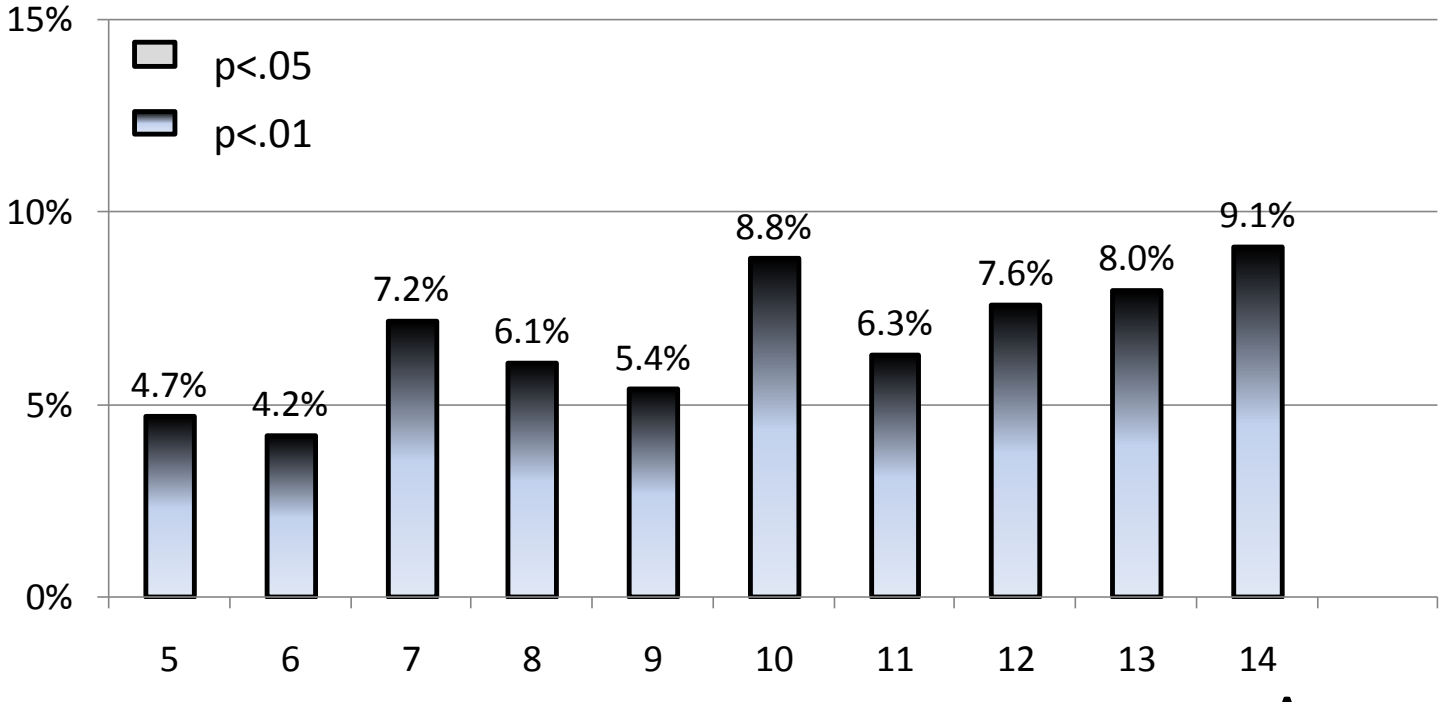
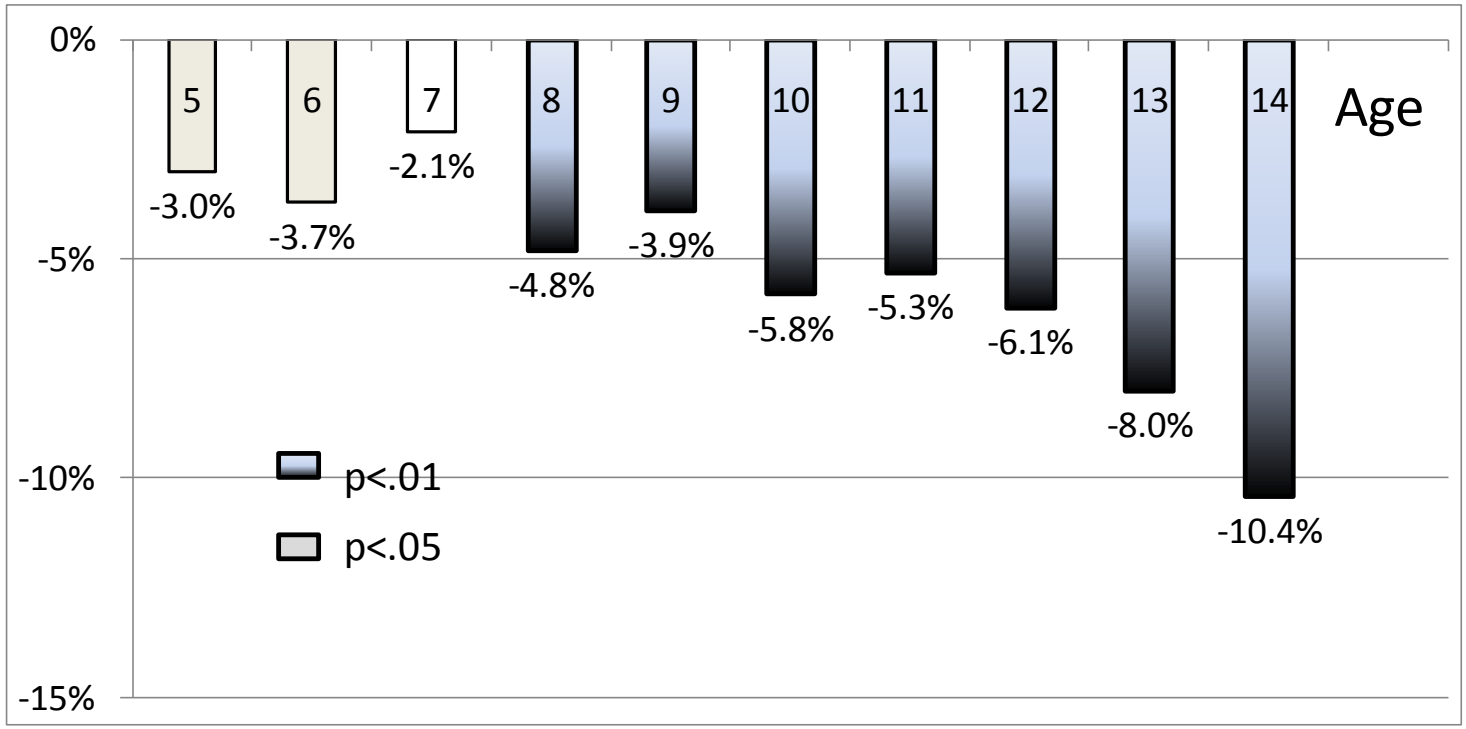


Figure 3.6: Effect of a 1 sd Increase in Composite Achievement at Various Ages on the Probability of High School Graduation, Full Controls



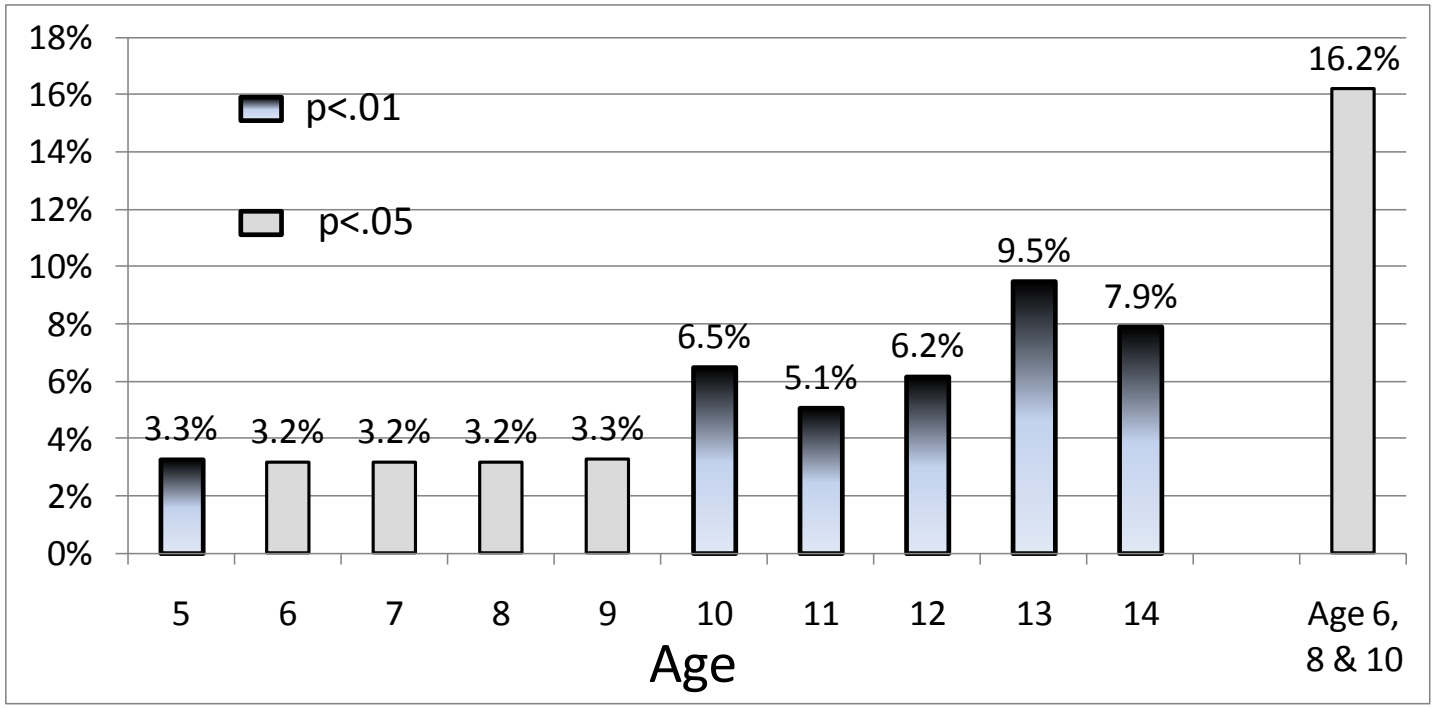
Source: NLSY

Figure 3.7: Effect of a 1 sd Increase in Anti-social Behavior at Various Ages on the Probability of High School Graduation, Full Controls



Source: NLSY

Figure 3.8: Effect of a 1 sd Increase in Anti-social Behavior at Various Ages on the Probability of Ever Arrested, Full Controls



Source: NLSY

APPENDICES on DATA SETS AND TABLES

Appendix on ECLS-K

The Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K) has followed a nationally representative sample of 21,260 children who were in kindergarten in the 1998-99 school year. The ECLS-K uses a multistage probability design. The primary sampling units were counties or groups of counties. The second sampling stage was public and private schools with kindergartens and the third stage sampled children of kindergarten age within each school. On average at baseline, there were six children per classroom. The study thus far has released six waves of data: fall of kindergarten and spring of kindergarten, first, third, fifth, and eighth grades. Data were collected from multiple sources, including direct cognitive assessments of children, interviews with parents and surveys of teachers and school administrators

Achievement. Achievement tests were administered in all study waves. The battery of achievement tests given in kindergarten covered language and literacy as well as early math skills. The children pointed to answers or gave verbal responses and were not asked to write or explain their reasoning. The tests were administered using a computer-assisted interviewing methodology. Not all children were given the same items. A set of "routing" items were used to assess whether children should subsequently receive more or less difficult items. For this reason, the cognitive assessment scores provided in the data are item response theory (IRT) scores. We reports results of analyses using standardized values of these latent ability scores. Reliabilities reported for the overall IRT scores in reading and mathematics are over .9.

In the fall of kindergarten the reading assessment evaluated children's ability to identify upper- and lower-case letters of the alphabet by name, associate letters with sounds at the beginning and end of words, and recognize common words by sight. The math skills measured include the ability to identify one and two digit numerals, recognize geometric shapes, count up to ten objects and recognize the next number in a sequence.

In fifth grade, children were again assessed on their mathematics and reading skills. These fifth grade assessments required students to complete workbooks and open-ended mathematics problems. Reading passages and questions were provided to children so that they could reference the passages when answering questions. However, all questions were read to the students in both reading and math. In math, all answer choices were read to the students; in reading, the students read the answer options.

The fifth grade mathematics assessment included items tapping the following areas: simple multiplication and division and recognizing complex number patterns; demonstrating an understanding of place value in integers to hundreds place; using knowledge of measurement and rate to solve word problems; solving problems using fractions; and solving word problems involving area and volume. The fifth grade reading assessment included the following skill areas: making literal inferences, extrapolation, understanding homonyms, and evaluation. Skills measured exclusively in fifth grade tested students ability to evaluate nonfiction.

The ECLS-K also asked teachers to complete academic rating scales (ARS) on student reading and mathematics achievement in all survey waves. Teacher's rated children's proficiency in particular skills on a scale that ranges from "not yet (1)" to "proficient (5)." In kindergarten,

the reading scale combined ratings of student's speaking, listening, early reading, writing, and computer literacy. The kindergarten math assessment asked about student's proficiency with five skills: number concepts, solving number problems, using math strategies, data analysis (graphing), and measurement.

In fifth grade, teacher ratings of proficiency in expressing ideas, use of strategies to gain information, reading on grade level, and writing were combined to measure reading skills. In mathematics, teachers' rating of student's understanding of number concepts (place value, fractions, and estimation), measurement, operations, geometry, application of mathematical strategies, and beginning algebraic thinking were combined.[1] At all time points, these measures had high levels of reliability (internal consistency).

Attention and Behavior Problems. Measures of children's attention and problem behavior were constructed from teacher responses to self-administered questionnaires. The responses categories for all items range 1 "never" to 4 "very often".

The ELCS-K's "Approaches to Learning" scale, which we use as the measure of attention skills, includes six items that measure the child's attentiveness, task persistence, eagerness to learn, learning independence, flexibility and organization. This measure has a reliability of .89 in the fall of kindergarten.

The teacher-reported measure of externalizing problem behaviors consists of five items that rate the frequency with which a child argues, fights, gets angry, acts impulsively, and disturbs ongoing activities. The four items that make up the measure of internalizing behaviors ask about the apparent presence of anxiety, loneliness, low self-esteem, and sadness. The reliabilities for externalizing and internalizing problem behaviors are .90 and .80, respectively.

SES. The ECLS-K measured family SES by a combination of parents' education and occupation prestige, as well as household income. Each of the five measures were standardized to have a mean of 0 and standard deviation of 1. For families in which two parents were present, the composite SES variable was constructed by averaging of five measures (two measures of parental education and occupational prestige and one measure of household income). In cases where only one parent is present, an average of three measures was constructed (parent's education, occupational.

Missing Data. Although baseline data were collected from over 21,000 children, missing data reduced our analysis samples to approximately 17,600 in kindergarten fall and 11,265 children in the spring of fifth grade. Some of the missing data are deliberate, since the ECLS-K study randomly sampled half of children who changed schools and compensated for the losses with adjustments to the sampling weights. We use pair-wise deletion in calculating the correlations in appendix tables 1-4. All analyses use appropriate weights to account for non-response and attrition.

Appendix on NLSY

The National Longitudinal Survey of Youth is a multi-stage stratified random sample of 12,686 individuals aged fourteen to twenty-one in 1979. Black, Hispanic, and low-income youth were over-represented in the sample. Annual (through 1994) and biennial (between 1994 and

[1] Reading ARS scores are available for the full sample, but only half of the teachers were asked to rate students in mathematics.

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 approximately 5, 7, 9, etc. and those observed at approximately 6, 8, 10, etc.).

Dependent variables. In our analyses, we use both measures of educational attainment and criminal activities as outcomes. Our primary measure of educational attainment is a dichotomous indicator of whether a child completed high school at age 19 or 20. We characterize students who are still enrolled in regular school at this age as having completed high school. We make this exception for students who because of the timing of the interview may be a few months shy of graduating. The rate of high school completion is between 77-79%. For the NLSY's three oldest cohorts, we used data collected at age 20 or 21 to measure whether the participant has ever attended college. Since it is taken early in adulthood, this is a dichotomous indicator of "on time" college attendance, and available for only three of the four cohorts for which we have high school completion data. About 45-48% of the sample had attended college by this age.

To measure criminal activity we use a self-report indicator, taken at age 19 or 20, of whether the youth had ever been arrested for a crime. Some 22-24% of the NLSY sample reported that they had been arrested.

Key predictors. We use as key independent variables the assessments of academic skills, specifically reading and math achievement, as well as three dimensions of behavior – inattention and two aspects of problems behavior anxiety/depression and antisocial behavior. These are measured every two years in the NLSY data (ages 5/6, 7/8, 9/10, 11/12).

Reading and math achievement. 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 tests 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 highly correlated (*r* ranges from .36 at age 13 to .60 at age 8/9).

Antisocial behavior, inattention, and anxiety/depression. 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 Behavior Problems Checklist as well as other established measures (Baker et al., 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). Three of the 6 behavior problem subscales are used in this study—attention problems (hyperactivity), antisocial, and depression/anxiety. 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 comprised 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 anti-social subscale has adequate reliability (alpha of .67).

The anxious/depressed scale consists of 5 items that indicate how often the child: has sudden changes in mood or feeling, feels or complains that no one loves him/her, is too fearful or anxious, feels worthless or inferior, and is unhappy, sad or depressed. The reliability of this scale is also adequate (alpha of .65). The attention and antisocial subscales are highly correlated, with correlations in the .45 -.55 range.[2]

[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 in analyses results parallel those found for the antisocial measure. The anxiety/depression scale is part of the larger internalizing scale.

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 and crime.

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 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 children's HOME environment 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.

The NLSY measures an array of child and mother background characteristics, which are used as covariates in analyses. These variables include, for example, measures of the child's race (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]

Missing data. The longitudinal nature of data collection results in missing data. In the NLSY, between a quarter and a third of a particular age cohort of children is missing information on key outcome variable (ever arrested). Missing data on key predictors (achievement and behavior problems) 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 expected rates of missing data increase over time so that by age 13, about 30% of the sample has missing data on the predictor variables. We handle this missing data by using multiple imputation techniques to create and analyze five datasets in STATA. However, our estimation results are similar if we use only cases with

[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 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 NLSY 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 (2007) 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 anti-social 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.

complete data. This approach assumes that data were missing at random (conditional on observed characteristics).

Appendix Table 3.A1: Bivariate Correlations Among Achievement, Attention and Behavior in Kindergarten and Fifth Grade, ECLS-K

	1	2	3	4	5
1. Reading	--	.75**	.38**	-.25**	-.20**
2. Math	.69**	--	.37**	-.22**	-.22**
3. Approaches to Learning	.29**	.41**	--	-.61**	-.40**
4. Externalizing Behavior	-.07**	-.14**	-.51**	--	.30**
5. Internalizing Behavior	-.12**	-.19**	-.36**	.25**	--

Note. Correlations below the diagonal are for kindergarten and above the diagonal are for fifth grade. **p<.01.

Appendix Table 3.A2: Bivariate Correlations Among Math and Reading Scores, Kindergarten through Fifth Grade, ECLS-K

	1	2	3	4	5
1. Kindergarten-Fall	--	.83**	.72**	.71**	.68**
2. Kindergarten-Spring	.80**	--	.79**	.76**	.73**
3. First Grade-Spring	.67**	.78**	--	.79**	.76**
4. Third Grade-Spring	.61**	.66**	.77**	--	.88**
5. Fifth Grade-Spring	.60**	.65**	.73**	.86**	--

Note. Correlations below the diagonal are for reading and above the diagonal
are for math. **p<.01.

Appendix Table 3.A3: Bivariate Correlations Among Externalizing and Internalizing Behavior Scores, Kindergarten through Fifth Grade, ECLS-K

	1	2	3	4	5
1. Kindergarten-Fall	--	.58**	.19**	.25**	.23**
2. Kindergarten-Spring	.72**	--	.25**	.28**	.21**
3. First Grade-Spring	.52**	.56**	--	.32**	.25**
4. Third Grade-Spring	.47**	.50**	.56**	--	.31**
5. Fifth Grade-Spring	.43**	.47**	.47**	.55**	--

Note. Correlations below the diagonal are for externalizing behavior and above the diagonal are for internalizing behavior. **p<.01.

Appendix Table 3.A4: Bivariate Correlations Among Approaches to Learning Scores, Kindergarten through Fifth Grade, ECLS-K

	1	2	3	4	5
1. Kindergarten-Fall	--				
2. Kindergarten-Spring	.71**	--			
3. First Grade-Spring	.48**	.53**	--		
4. Third Grade-Spring	.43**	.48**	.55**	--	
5. Fifth Grade-Spring	.38**	.41**	.48**	.55**	--

Note. **p<.01.

Appendix Table 3.A5: Gaps in Children's Academic and Behavior Skills in the Fall of Kindergarten, ECLS-K

	Reading		Math		Approaches to Learning		Lack of Externalizing Behavior[a]		Lack of Internalizing Behavior	
	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE
Boys/Girls	0.17	0.15	0.03	0.01	0.40	0.39	0.41	0.39	0.06	0.05
Black/White	0.43	0.30	0.62	0.40	0.36	0.30	0.31	0.28	0.06	0.04
Hispanic/White	0.53	0.29	0.77	0.36	0.22	0.14	-0.01	-0.07	0.05	0.03
SES: 1st quintile/5th quintile	1.26	0.85	1.34	0.85	0.63	0.63	0.26	0.17	0.30	0.31
SES: 1st quintile/3rd quintile	0.59	0.45	0.72	0.46	0.36	0.35	0.14	0.08	0.21	0.23
SES: 3rd quintile/5th quintile	0.67	0.47	0.62	0.40	0.27	0.27	0.12	0.13	0.09	0.08

Note: All positive numbers represent gaps in reference to the advantaged group indicated on the right hand side of the first column (e.g., girls, on average, score 0.17sd higher than boys in reading). Negative numbers indicate that the left hand group has better scores, on average.

[a]For both externalizing and internalizing behaviors, a positive gap indicates better behavior (i.e., less externalizing and internalizing) for the advantaged group.

Appendix Table 3.A6: Gaps in Children's Academic and Behavior Skills in the Spring of 5th Grade, ECLS-K

	Reading		Math		Approaches to Learning		Externalizing Behavior[a]		Internalizing Behavior	
	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE	Unadj.	Teacher FE
Boys/Girls	0.13	0.06	-0.18	-0.26	0.58	0.51	0.48	0.41	0.12	0.07
Black/White	0.71	0.43	0.85	0.56	0.44	0.34	0.50	0.37	0.03	-0.08
Hispanic/White	0.58	0.21	0.50	0.23	0.06	0.15	-0.02	0.01	-0.05	-0.01
SES: 1st quintile/5th quintile	1.43	0.66	1.38	0.65	0.68	0.55	0.47	0.19	0.30	0.36
SES: 1st quintile/3rd quintile	0.80	0.27	0.71	0.21	0.18	0.21	0.11	0.06	0.08	0.16
SES: 3rd quintile/5th quintile	0.63	0.39	0.67	0.38	0.5	0.32	0.37	0.23	0.22	0.16

Note: In this table, all positive numbers represent gaps in reference to the advantaged group indicated on the right hand side of the first column (e.g., girls, on average, score 0.13 sd higher than boys in reading). Negative numbers indicate that the left hand group has better scores, on average. [a]For both externalizing and internalizing behaviors, a positive gap indicates better behavior (i.e., less externalizing and internalizing) for the advantaged group.

Appendix Table 3.A7. Summary of Probit Regressions of Ever Arrested, HS completion, and Attending College on Patterns of Childhood Antisocial Behavior, NLSY, Ages 8, 10, and 12

	Ever Arrested (N=1,466)			HS Completion (N=1,466)			Attending College (N=1,134)		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
SES (ref: lowest quintile)									
SES quintile 2	.003	.005	.007	.058	.050	.042	.085†	.075	.060
	(.040)	(.040)	(.041)	(.037)	(.037)	(.037)	(.050)	(.052)	(.054)
SES quintile 3	-.075*	-.058	-.049	.153***	.126***	.106**	.210***	.164**	.131*
	(.034)	(.036)	(.038)	(.031)	(.034)	(.034)	(.048)	(.052)	(.053)
SES quintile 4	-.125***	-.098**	-.080*	.235***	.198***	.170***	.314***	.252***	.215***
	(.035)	(.038)	(.040)	(.031)	(.034)	(.035)	(.041)	(.046)	(.048)
SES quintile 5	-.150***	-.112**	-.090*	.312***	.268***	.236***	.398***	.337***	.285***
	(.033)	(.037)	(.039)	(.025)	(.028)	(.032)	(.036)	(.042)	(.046)
At age 6,									
Antisocial Problem		.054***	.011		-.040*	.001		-.044†	.000
		(.016)	(.018)		(.017)	(.020)		(.024)	(.026)
Attention Problem		.015	.014		-.026	-.001		-.032	.019
		(.017)	(.018)		(.018)	(.019)		(.028)	(.030)
Anxious Problem		-.006	-.003		-.006	-.012		-.019	-.033
		(.014)	(.015)		(.018)	(.020)		(.020)	(.024)
Achievement Composite		-.023	-.028		.067***	.022		.125***	.028
		(.016)	(.019)		(.017)	(.021)		(.022)	(.030)
Age 8-10-12									
<u>Antisocial Problems</u>									
Average age 8-10-12			.124***			-.095***			-.104***
			(.023)			(.024)			(.030)

Attention Problems									
Average age 8-10-12			-.020			-.035			-.071†
			(.023)			(.028)			(.041)
Anxious Problems									
Average age 8-10-12			-.023			.028			.037
			(.020)			(.026)			(.041)
Achievement Composite									
Average age 8-10-12			.016			.067**			.163***
			(.020)			(.024)			(.036)
Family & Child Characteristics	no	no	no	no	no	no	no	no	no

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 ever being arrested associated with unit changes in the given independent variable.

Column 1 coefficients represent simple bivariate relationships between ses composite and dependent variable.

Column 2 adds antisocial, attention, anxiety, and achievement composite at age 6.

Column 3 adds averages of each measure at age 8, 10, and 12.

Appendix Table 3.A8: School-level Concentrations of Kindergarten Achievement, Attention and Behavior Problems

		School Characteristics				
	All	Free Lunch Eligbility >50%	Free Lunch Eligbility <5%	Student Population ≥ 50% Minority	Urban School District	Suburban School District
Percent of children with …						
Low math skills	25%	38%	10%	32%	28%	20%
Significant attention problems	24%	32%	17%	29%	26%	22%
Significant behavior problems	18%	24%	15%	23%	19%	17%
All three problems	5%	8%	2%	7%	6%	3%
Percent of full sample	100%	24%	15%	13%	39%	37%

Notes:"Low math skills" are scoring in the bottom 25% of the math IRT distribution.
"Significant attention problems" are scoring in the bottom 25% of the attention scale
"Significant behavior problems" are scoring in the top 18% of the externalizing behavior problem scale

Appendix Table 3.A9. Summary of Results from Probit Regressions of High School Completion on Achievement and Behavior Problems across Middle Childhood, NLSY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	`(12)
	Age 5		Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 14
	Bivariate										Bivariate	
Antisocial	-.063***	-.030*	-.037*	-.021	-.048***	-.039**	-.058***	-.053***	-.061***	-.080***	-.158***	-.104***
	(.011)	(.014)	(.016)	(.014)	(.015)	(.015)	(.016)	(.015)	(.016)	(.016)	(.016)	(.024)
Inattention	-.050***	.005	-.001	.006	-.013	.017	-.007	-.005	-.037†	.014	-.111***	-.007
	(.011)	(.014)	(.016)	(.017)	(.019)	(.015)	(.017)	(.017)	(.020)	(.019)	(.013)	(.017)
Anxious	-.028*	.004	-.003	-.011	.003	-.014	.014	.009	.026	-.017	-.092***	-.001
	(.011)	(.014)	(.017)	(.015)	(.015)	(.015)	(.017)	(.015)	(.017)	(.017)	(.013)	(.021)
Reading	.090***	.027*	.032†	.046***	.065***	-.001	.032	.029*	.047†	.017	.036**	.044†
	(.011)	(.014)	(.017)	(.014)	(.018)	(.014)	(.021)	(.014)	(.026)	(.021)	(.012)	(.023)
Math	.080***	.019	.011	.026†	-.005	.056***	.056**	.033*	.030	.056***	.118***	.046*
	(.012)	(.015)	(.019)	(.015)	(.019)	(.015)	(.019)	(.015)	(.018)	(.015)	(.014)	(.019)
Antisocial	-.063***	-.030*	-.037*	-.021	-.049***	-.039*	-.058***	-.053***	-.061***	-.080***	-.158***	-.104***
	(.011)	(.014)	(.016)	(.014)	(.015)	(.015)	(.016)	(.016)	(.016)	(.016)	(.016)	(.024)
Inattention	-.050***	.005	-.001	.006	-.014	.017	-.007	-.005	-.037†	.015	-.111***	-.007
	(.011)	(.014)	(.016)	(.017)	(.019)	(.015)	(.017)	(.017)	(.020)	(.019)	(.013)	(.017)
Anxious	-.028*	.004	-.003	-.011	.005	-.013	.015	.008	.026	-.018	-.092***	-.001
	(.011)	(.014)	(.017)	(.015)	(.015)	(.015)	(.017)	(.015)	(.017)	(.017)	(.013)	(.021)
Achievement Composite	.114***	.047**	.042**	.072***	.061***	.054***	.088***	.063***	.076***	.080***	.108***	.091***
	(.013)	(.016)	(.016)	(.017)	(.018)	(.015)	(.019)	(.017)	(.023)	(.017)	(.016)	(.026)
Family & Child Char.	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
Sample Size	2005	2005	1888	1764	1832	1774	1756	1828	1658	1803	1667	1667

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 the high school completion associated with unit changes in the given independent variable

Results in columns (1) and (11) are based on bivariate probit regressions

Results in columns (2)-(10) and (12) are from a model with full controls and both behavior measures.
Results in the top panel are based on regressions that include separate measures of reading and math achievement. Results in the bottom panel are based on regressions that include a single composition measure of achievement.

Family and child controls include race; Hispanic ethnicity; gender; age 0-5: % years in poverty,% years with middle income, % years with middle high income, % urban residence, % years mother never married, % years mother divorced, % years resided with grandmother, ave # children; child: age 3/4: PPVT standardized score, age 4/5: compliance, age 4/5: sociability; household age5/6: urban residence, number of children, mother's education, poverty, child's father present in household, mother never married, mother divorced , mother cohabiting with partner, mother married to partner, total home; mother: age at birth, mother academic aptitude (AFQT) , ever use alcohol, mother fight, mother steal, age mother first tried smoking, mother never smoke, marijuana use: occasional, marijuana use: moderate, drug use: occasional, drug use: high, mother lived with two parents at age, mother us born, mother drank alcohol during pregnancy, used prenatal care , mother smoked during pregnancy.

Appendix Table 3.A10. Summary of Probit Regressions of High School Completion on Patterns of Childhood Antisocial Behavior, NLSY Ages 6, 8, and 10 (*N*=1,437 for high school completion and 1,081 for college attendance)

	(1)	(2)	(3)	(4)
	High School Completion		Ever Attended College by age 21/22	
	Bivariate	Adjusted	Bivariate	Adjusted
Antisocial Problems				
Intermittent	-.164***	-.056	-.189***	-.048
	(.032)	(.036)	(.041)	(.053)
Persistent	-.346***	-.162*	-.354***	-.165†
	(.055)	(.068)	(.061)	(.098)
Attention Problems				
Intermittent	-.159***	-.023	-.185***	-.045
	(.033)	(.032)	(.043)	(.054)
Persistent	-.268***	.033	-.313***	-.011
	(.060)	(.054)	(.057)	(.091)
Anxiety Problems				
Intermittent	-.089**	-.023	-.109**	-.047
	(.030)	(.034)	(.039)	(.051)
Persistent	-.229***	-.075	-.232***	-.114
	(.055)	(.070)	(.063)	(.088)
Reading Problems				
Intermittent	-.206***	-.077*	-.264***	-.114*
	(.031)	(.035)	(.037)	(.052)
Persistent	-.319***	-.076	-.358***	-.092
	(.055)	(.066)	(.063)	(.099)
Math Problems				
Intermittent	-.168***	-.058†	-.211***	-.101*
	(.032)	(.034)	(.042)	(.051)
Persistent	-.314***	-.133†	-.438***	-.338***
	(.060)	(.073)	(.047)	(.076)
Family & Child Characteristics	no	yes	no	yes

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

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

Columns 1 and 3 show bivariate coefficients between intermittent and persistent behavior problem groups and the no problem reference group

Columns 2 and 4 include all listed variables, plus child and family controls simultaneously.

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

"Intermittent" reflects cases above the 75th percentile for at least 1 but not all 3 time points

Controls are listed in Appendix Table 9

Appendix Table 3.A11. Summary of Results from Probit Regressions of "Ever Arrested" on Achievement and Behavior Problems across Middle Childhood, NLSY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Age 5		Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	
	Bivariate										Bivariate	
Antisocial	.050***	.033**	.032*	.032*	.032*	.033*	.065***	.051***	.063***	.095***	.115***	.078***
	(.011)	(.012)	(.015)	(.015)	(.016)	(.014)	(.019)	(.013)	(.014)	(.013)	(.012)	(.015)
Inattention	.042***	.006	.007	.009	-.003	.011	-.016	.005	-.008	-.008	.082***	.007
	(.011)	(.014)	(.016)	(.015)	(.015)	(.015)	(.015)	(.015)	(.018)	(.016)	(.013)	(.017)
Anxious	.019†	-.005	-.011	-.008	-.008	-.009	-.008	-.002	-.003	-.018	.055***	-.006
	(.010)	(.013)	(.014)	(.014)	(.013)	(.015)	(.016)	(.014)	(.016)	(.016)	(.014)	(.015)
Reading	-.036***	-.008	-.016	-.004	-.005	-.003	-.007	.001	.007	-.023	-.049***	-.035
	(.011)	(.014)	(.015)	(.016)	(.017)	(.016)	(.017)	(.015)	(.019)	(.023)	(.012)	(.028)
Math	-.028*	-.010	.018	-.008	.003	-.001	.022	-.006	-.010	.010	-.039***	.014
	(.011)	(.014)	(.015)	(.016)	(.017)	(.015)	(.015)	(.015)	(.017)	(.014)	(.012)	(.017)
Antisocial	.050***	.033**	.032*	.032*	.032*	.033*	.065***	.051***	.062***	.095***	.115***	.079***
	(.011)	(.012)	(.015)	(.015)	(.016)	(.014)	(.019)	(.013)	(.014)	(.013)	(.012)	(.016)
Inattention	.042***	.006	.007	.009	-.003	.011	-.016	.005	-.008	-.007	.082***	.008
	(.011)	(.014)	(.016)	(.015)	(.015)	(.015)	(.015)	(.015)	(.018)	(.016)	(.013)	(.017)
Anxious	.019†	-.005	-.011	-.008	-.008	-.009	-.007	-.002	-.003	-.019	.055***	-.007
	(.010)	(.013)	(.014)	(.014)	(.013)	(.015)	(.016)	(.014)	(.016)	(.016)	(.014)	(.015)
Achievement Composite	-.043***	-.019	.003	-.011	-.002	-.004	.015	-.006	-.003	-.007	-.065***	-.011
	(.013)	(.017)	(.017)	(.016)	(.017)	(.015)	(.016)	(.018)	(.015)	(.018)	(.015)	(.024)
Family & Child Char.	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
Sample Size	2005	2005	1888	1764	1832	1774	1756	1828	1658	1803	1667	1667

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 ever being arrested associated with unit changes in the given independent variable.

Results in columns (1) and (11) are based on bivariate probit regressions
Results in columns (2)-(10) and (12) are from a model with full controls and both behavior measures.
Results in the top panel are based on regressions that include separate measures of reading and math achievement. Results in the bottom panel are based on regressions that include a single composition measure of achievement.

Appendix Table 3.A12. Summary of Probit Regressions of Ever Arrested on Patterns of Childhood Achievement, Attention and Behavior Problems at age 6, 8 and 10

NLSY (*N*=1,437 for All; 699 for Males only)

	(1)	(2)	(3)	(4)
	All		Males only	
	Bivariate	Adjusted	Bivariate	Adjusted
Antisocial Problems				
Intermittent	-.164***	-.056	-.212***	-.107†
	(.032)	(.036)	(.048)	(.057)
Persistent	-.346***	-.162*	-.395***	-.235**
	(.055)	(.068)	(.059)	(.083)
Attention Problems				
Intermittent	-.159***	-.023	-.180***	-.004
	(.033)	(.032)	(.042)	(.050)
Persistent	-.268***	.033	-.343***	-.007
	(.060)	(.054)	(.066)	(.088)
Anxious Problems				
Intermittent	-.089**	-.023	-.151***	-.061
	(.030)	(.034)	(.045)	(.059)
Persistent	-.229***	-.075	-.319***	-.115
	(.055)	(.070)	(.069)	(.103)
Reading Problems				
Intermittent	-.206***	-.077*	-.225***	-.079
	(.031)	(.035)	(.044)	(.058)
Persistent	-.319***	-.076	-.360***	-.111
	(.055)	(.066)	(.072)	(.104)
Math Problems				
Intermittent	-.168***	-.058†	-.198***	-.070
	(.032)	(.034)	(.045)	(.057)
Persistent	-.314***	-.133†	-.333***	-.097
	(.060)	(.073)	(.080)	(.114)
Family & Child Characteristics		yes		yes

Notes: *** p<.001; ** p<.01; * p<.05; † p<.1
Probit model coefficients and standard errors are expressed as "marginal effects" -- percentage point changes in the probability of ever being arrested associated with unit changes in the given independent variable

Columns 1 and 3 show bivariate coefficients between intermittent and persistent behavior problem groups and the no problem reference group

Columns 2 and 4 include all listed variables, plus child and family controls simultaneously.

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

"Intermittent" reflects cases above the 75th percentile for at least 1 but not all 3 timepoints
Controls are listed in Appendix Table 9.

Notes

1. These data regarding the Perry program are taken from Schweinhart et al. (2005).

2. To be sure, not all outcomes differed significantly between Perry and control children, but the long-run impacts are impressive, as reflected both in the evaluation reports written by the organization that ran the Perry study and in an independent reanalysis of the Perry data (Heckman et al. 2009).

3. Direct assessments of young children's inhibition require children to suppress a dominant or congruent response, yet measures differ in the extent to which the tasks also include an emotional component. A measure of cognitive self-regulation involves suppressions but little emotional work.

4. Emotional self-regulation is measured by tasks that require children to control (typically de-escalate) their emotions, usually their excitement. Most often these tasks for young children involve delaying the gratification of a desired reward—candy or a gift. For example, in one task a child is told not to peek as the assessor noisily wraps a present in front of the child.

5. We chose math over reading owing to second-language complications with early reading scores; the appendix tables show broadly similar patterns for math and reading.

6. For example, the unadjusted 13.8 percent difference between low and high SES and arrest rates falls to 10.2 percent, or by about one quarter.

7. The data sets included the Children of the National Longitudinal Survey of Youth (NLSY), the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (NICHD SECCYD), the 1970 British Birth Cohort (BCS), the Early Childhood Longitudinal Study Kindergarten Cohort (ECLS-K), the Infant Health and Development Program (IHDP), and the Montreal Longitudinal-Experimental Preschool Study (MLEPS).

8. This conclusion held both across studies as well as within each of the six data sets they examined. Their analysis included a sixth category—school-entry social skills—which also proved to be completely unpredictive of later school achievement.

9. Key results from the meta-analysis appeared robust to a host of potential problems related to measurement and modeling, including the inclusion of controls (see Duncan et al. 2007).

10. The Duncan et al. (2007) analysis was of population-based data sets that provided little to no ability to identify children with diagnosed conduct disorder, attention deficit disorder, or other behavioral conditions. It is best to think of their analyses as focusing on children with relatively high, but not clinical levels of learning, attention, and behavior problems.

11. The shading on the bars in figure 3.6 indicates levels of statistical significance, with light shading indicating $p < .05$ and darker shading indicating $p < .01$.

12. No consistently significant differences by family SES were found in either the attainment or crime analyses.

13. Two words of caution to this conclusion. First, arrest is an imperfect and incomplete way to measure criminal behavior, and it does not distinguish between types of criminal behavior

(violent vs. nonviolent). Second, although Head Start programs rarely match the intensity of model programs such as the Perry one, Deming's (2009) sibling-based analysis of Head Start showed long-run impacts on arrests but not shorter-run impacts on behavior problems.