

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

Greg J. Duncan, University of California, Irvine

Katherine Magnuson, University of Wisconsin - Madison

Prepared for the conference, “Rethinking the Role of Neighborhoods and Families on Schools and School Outcomes for American Children,” to be held November 19-20, 2009. The authors are grateful to the Spencer Foundation and Russell Sage Foundation for supporting the conference and to the Foundation for Child Development and the NSF-supported Center for the Analysis of Pathways from Childhood to Adulthood (Grant # 0322356) for additional research support.

Contents:

Chapter draft.....	2
Proposed web-based appendix.....	35

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

Greg J. Duncan, University of California, Irvine

Katherine Magnuson, University of Wisconsin - Madison

I. 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, Perry children averaged 80 on an IQ test normed to a population mean of 100. Shortly after these children completed the program, and around the time they entered kindergarten, their scores had jumped to 95. For the Ypsilanti 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.¹

It is tempting to draw two conclusions from this Perry evidence. First, 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 Perry'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 Perry improved key literacy and numeracy skills which, 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 Perry 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 Perry children's ability to pay attention and become more engaged with their school tasks. A few years after Perry ran its preschools, Walter Mischel and

¹ These data are taken from Schweinhart et al. (1993) and Schweinhart et al. (2005). 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 Perry and in an independent reanalysis of the Perry data (Heckman et al., 2009).

colleagues (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.

Or perhaps Perry taught children inclined toward aggressive behavior how to get along better with their peer 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). Regrettably, the Perry evaluation cannot answer these important questions because it failed to measure either self regulation skills or anti-social behavior in the children's early grades.

Our chapter sheds light on the Perry and many 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. We begin with a conceptual framework for understanding the early skills. We argue that the skill categories of "cognitive" and "non-cognitive" used by many economists are both too simplistic and inaccurate. "Cognitive" skills mix together mental acuity (i.e., IQ) with concrete achievement skills such as knowing letters, beginning word sounds and numbers. "Noncognitive" skills encompass a wide variety of diverse capacities such as paying attention (an inherently cognitive task!), getting along with classmates and teachers, and good mental health. We propose and defend the early-skill trichotomy of: *achievement, attention and problem behavior and mental health*, while at the same time acknowledging that each of these broad categories are related, and can be broken down further into more narrowly defined component parts.

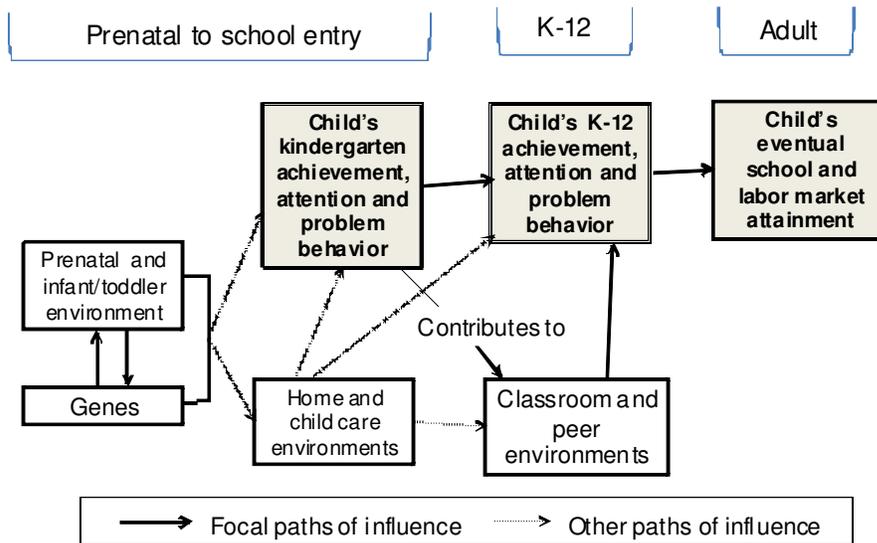
Next, we summarize what is known about the developmental course of each of these capacities. Cross-time achievement correlations tend to be higher than correlations for either attention or behavior, but this may be due in part to the fact that achievement is measured more reliably (Kowleski-Jones & Duncan, 1999). Interesting work on behavior problems identified upon school entry show that they persist for a small but significant number of children, but that many behavior problems in adolescence have no precursors and also fail to persist much beyond the adolescent period (Campbell et al 2000; Moffit, 1993).

The heart of our chapter is a review of associations – we aspire to casual associations – between early achievement, attention and behavior skills and later school achievement and such late-adolescent schooling outcomes as drop-out and college attendance. We also consider early-adult criminal behavior as measured by the likelihood they have been arrested. School attainment and avoiding a criminal record are key stepping stones for success in adulthood and could well be a product of early achievement, attention and behavior skills. For example, to complete high school or attend college, students need more than a modicum of concrete achievement skills, a capacity to engage in the curriculum, and an ability to get along with teachers and avoid dysfunctional peers. Yet, not much is known about the importance of these skills and, most important for our purposes, the extent to which such skills developed by middle childhood have a beneficial effect on later school attainment.

II. The nature of early achievement, attention and problem behavior

Conceptual model. We focus on three “skill” domains: achievement, attention and behavior. Figure 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 & Morris, 1998). As depicted in the figure, children

Figure 1: Skills, behaviors and attainment across childhood



enter school with a set of skills that are 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 extensively studied

(Shonkoff and Phillips, 2000), and is not the focus of our chapter.

Children’s skills at school entry facilitate the acquisition of the 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 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 their instruction to meet the needs of more children with advanced skills. In response, this 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, Heckman, Lochner, & Masterov, 2005; Entwistle, Alexander, & 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, anti-social behaviors may lead to suspensions or expulsions, with obvious detrimental consequences for student attainment. Such transactional and recursive models of development are a staple of developmental theory (Sameroff & Fiese, 2000).

A broader conception of our classroom environment box in Figure 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, curricular placement into more or less academically challenging tracks has been linked to students’ later outcomes. As sorting students within schools is more central to later schooling experiences, it is featured in the chapter by Farkas.

Achievement, attention and problem behavior. Instead of “cognitive” and “noncognitive,” we find “achievement,” “attention” and “problem behavior and mental health” to be a productive way of categorizing the general domains of children’s school-related functioning (Figure 2). By “achievement” we mean concrete academic skills. “Attention” refers

to the ability to control impulses and focus on tasks. “Problem behaviors and mental health” consists of two important dimensions – the ability to get along with others and sound mental health.

Figure 2: A Taxonomy of Skills and Behaviors

	<u>Achievement</u>	<u>Attention</u>	<u>Problem behaviors and mental health</u>
	Concrete academic skills	Ability to control impulses and focus on tasks	i) Ability to get along with others ii) Sound mental health
	Knowing letters and numbers; beginning word sounds, word problems	Can’t sit still; can’t concentrate; score from a computer test of impulse control	i) Cheats or tells lies, bullies, is disobedient at school ii) Is sad, moody
	IRT (in ECLS-K) or PIAT (in NLSY) composite reading and math scores	Approaches to Learning index (in ECLSK; combines attention and some behavior items)	i) Externalizing behavior problems (in ECLS-K and NLSY) ii) Internalizing behavior problems (in ECLSK and NLSY)

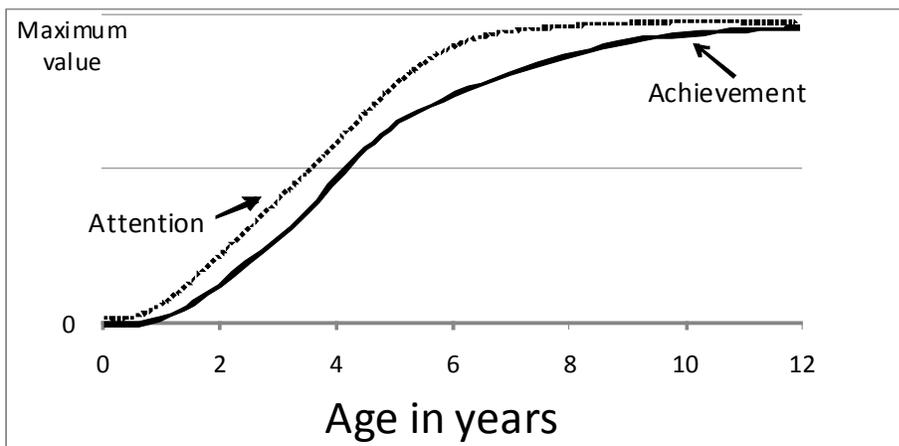
Notably absent from this schema are students’ own aspirations, goals and attitudes. In part, this omission is appropriate given

our focus on younger children, who lack strongly differentiated aspirations, goals and attitudes about academics, and even a well developed “sense of self”. This is not to say that children don’t have beliefs about their ability to perform, rather these beliefs are not strongly associated with children’s behavior (Davis-Kean et al., 2008). “Self” constructs develop during the early school years as do their goals and aspirations, 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 the importance of these constructs appears in the chapter by Farkas (this volume).

Below, we detail our achievement, attention and behavior constructs and their trends during middle childhood. We also offer a brief discussion of why these skills at school entry might be related to subsequent schooling outcomes. In the second half of the chapter we use two large, nationally representative datasets to describe and evaluate the empirical importance of early skills and behaviors for later achievement, attainment and criminal activity.

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 identifying upper and lower case letters as well as decoding skills such as beginning to associate sounds with letters at the beginning and ending of words. Most early reading problems reflect poor code-related skills and low levels of phonological awareness, such as a poor ability of being able to breakdown words into component sounds. As children progress

Figure 3: Age-related Development of Achievement and Attention



through childhood, reading skills include recognizing words by sight, understanding words in context, and being able to make literal inferences from passages. By the end of elementary school students are developing reading comprehension and evaluation skills, which include the ability to identify main points in a passage as well as understand an

author’s intentions and the adequacy and logical consistency of supporting evidence. Writing skills, specifically a child’s ability to express their ideas in written form, develop in concert with reading skills.

Rudimentary math skills can be detected in children as young as six months of age (Posner and Rothbart, 2007). Concrete math skills begin with the ability to recognize numbers, shapes, and compare relative sizes. Counting and sequencing skills are followed by addition and subtraction computational skills, as well as multiplication and division skills. Understanding numerical properties such as proportions, fractions, integers, and decimals also develop 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 (Figure 3). 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 conventional 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 dimensionality becomes increasingly important as children advance from basic computational tasks to more complex mathematical problems that require flexible problem solving techniques (Baroody, 2003; Ferrari & Sternberg, 1998; Hiebert & 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 measures of IQ 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 that are more “content” free reflect the speed of cognitive processing as well as the ability to recognize patterns and the like. But these are rarely included in large-scale datasets, and though they may be influenced by instruction (and practice), most intervention programs target achievement and behavior rather than IQ.

Attention 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 & Vohs, 2004, p. 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 separate cognitive (cool) and emotional components (hot) (Eisenberg, Sadovsky, & Spinrad, 2005; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005; Raver, 2004; Raver, Smith-Donald, Hayes, & Jones, 2005). We too distinguish between hot and cold self-regulation, placing cognitive self-regulation into our “attention” category and emotional self-regulation into our “problem behavior 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,” although emphasize their diverse nature. Research has shown that the signs of attention and impulsivity can be detected as early as age 2 ½, but continues to develop until reaching relative stability between ages 6 and 8 (Figure 3; Olson, Sameroff, Kerr, Lopez, & Wellman, 1999; Posner & Rothbart, 2000). It is widely accepted that some dimensions of executive functioning system undergo rapid development during adolescence.

Cognitive self control can be measured by both direct assessments of particular components as well as more general descriptions of children’s behaviors (especially in structured classroom contexts). 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 with little emotional work. For example, the pencil tap task requires children to tap a pencil once if the assessor taps a pencil twice, and twice if the assessor taps just once. Other “cold” measures include variations on the “Simon says” game as well as the “Stroop test,” in which colors are written in non-matching ink and the child must identify the color of the ink stop themselves from reading the word out loud.

More general parent and teacher reports of children's cognitive self regulation presumably 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 at tasks, persist at a task despite minor setbacks or frustrations, listen and follow directions, and ability to work independently or conversely whether they are, for example, easily distracted, over-active, or forgetful.

Attention and cognitive self-regulation skills 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 problem-solve. 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; Alexander, Entwisle, & Dauber, 1993; McClelland, Morrison, & Holmes, 2000; Yen, Konold, & McDermott, 2004; Howse, Lange, Farran, & Boyles, 2003; Brock et al., 2009).

Problem behaviors and mental health. Perhaps because these are easily identified by the frequently used Child Behavior Check List (CBCL, Achenbach 1991, 1992), developmentalists often distinguish between two broad dimensions of problem behavior – externalizing and internalizing. Externalizing behavior problems refer 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 it 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 research attention has been devoted to externalizing behavior than internalizing behavior, likely because of its obvious disruptive consequences in the classroom.

Although children's problem behaviors and mental health is 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, & Ganiban, 2004, p. 340). It includes ability to control anger, sadness, joy, and other emotional reactions, which predict such behavior as aggression and internalizing problems (e.g., social withdrawal, anxiety) (Eisenberg et al., 2005). Emotional self-regulation is measured by tasks that require children to control (typically descalate) 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 them.

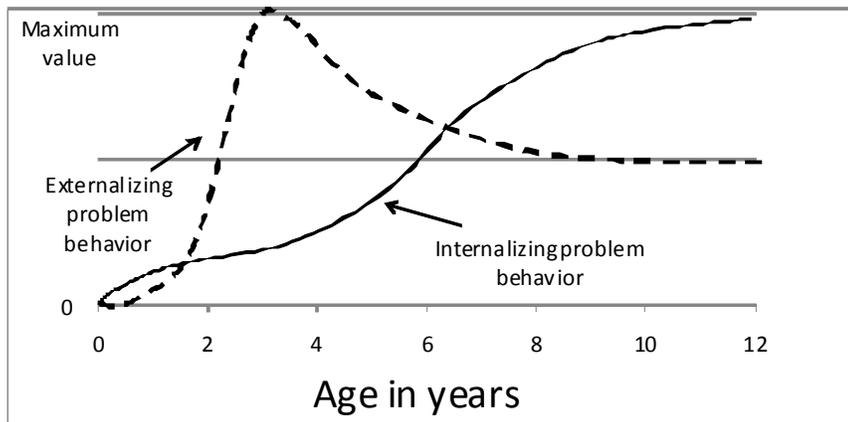
Poor emotional regulation is not the only reason for poor mental health or behavior problems. Indeed, children differ in the strength of their emotional reactivity to experiences, including the underlying physiological reactions. Children also differ along dimensions of emotional positivity and negativity (Posner and Rothbart, 2007). Furthermore, a large body of evidence points to the importance of deviant social information processing as an important contributory factor to anti-social behavior. This includes cognitive biases such as a hostile attributional bias and a greater tendency as seeing aggressive behavior as morally appropriate and effective as a means of achieving social goals (Crozier et al., 2008).

Among young children, externalizing behavior problems are assessed by asking parents and teachers about the frequency of, for example, how often children argue, 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 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 non-aggressive 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 of their environment to compensate for their own nascent communication skills (Figure 4).

Figure 4: Age-related Development of Externalizing and Internalizing Behavior Problems



As children’s ability to communicate, self-regulate, and problem solve 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 et al., 2000; Moffit, 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 sad or irritable mood, whether they demonstrate low self-esteem or low energy. Anxiety captures 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 (Figure 4). Research suggests that anxiety may be relatively constant over time, although it takes different forms at different ages. Depressive behaviors, however, increases over time, and do so more for girls than boys (Bongers et al., 2003).

Children’s problem behaviors are also expected to affect both individual learning and classroom dynamics. Externalizing skills promote child-teacher conflict and social exclusion (Newcomb, Bukowski, & Pattee, 1993; Parker & Asher, 1986), and these stressors may reduce

children’s participation in collaborative learning activities and adversely affect achievement (Ladd et al., 1999; Pianta & 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., in press;). Evidence of this negative effect of problem behavior on achievement, however, is mixed, with correlational evidence pointing to a detrimental effect, but more controlled models yielding no or much smaller associations. Indeed, in studies in which cognitive self regulation is controlled, measures of emotional control are not predictive of later learning in the early school years. One possible explanation is that teachers do not yet expect children to be able to manage their emotional responses well, and thus use instructional approaches that minimize children’s need to do so independently (Brock et al., 2009).

III. Skills and behaviors at school entry and beyond

The Early Childhood Longitudinal Survey Kindergarten Cohort of 1998 (ECLS-K) is a natural choice for illustrating basic empirical properties of achievement, attention and behavioral skill measures owing to its large and representative national sample of kindergartners, its longitudinal nature and the quality of its measures. As detailed in the appendix, the ECLS-K’s school-entry reading measures assess skills such as identifying upper- and lower-case letters of the alphabet by name, associating letters with sounds at the beginning and end of words, and recognizing

common words by sight. Its math measures reflect ability to identify one and two digit numerals, recognize geometric shapes, count up to ten objects and recognizing the next number in a sequence.

Attention and problem behavior 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 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 the apparent presence of anxiety, loneliness, low self-esteem, and sadness.

Kindergarten and cross-time correlations. Kindergarten correlations among these measures are shown in Figure 5. Instead of the usual matrix, which is provided in Appendix

Figure 5: Kindergarten correlations among achievement, attention and behaviors

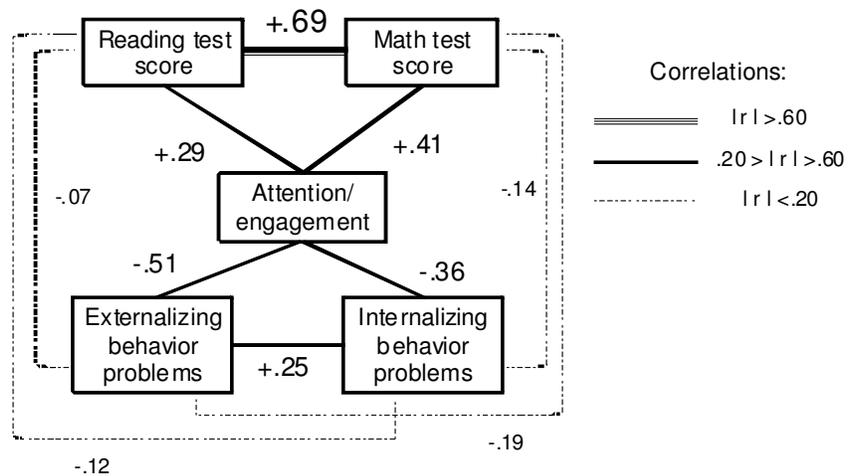
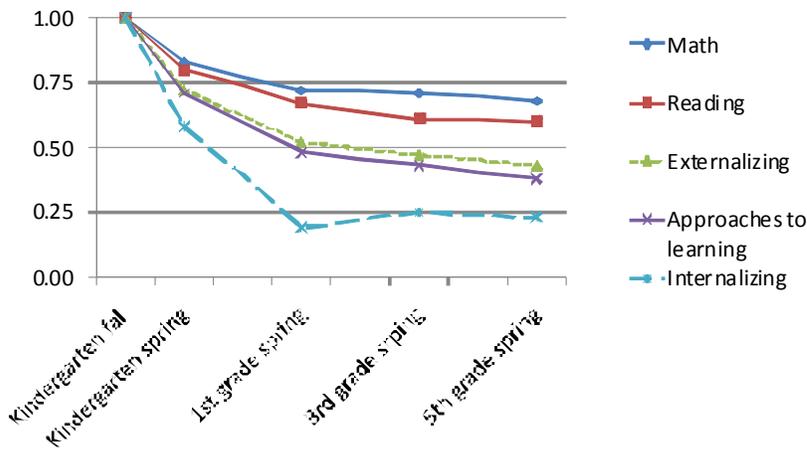


Table 1, the correlation structure is shown with different kinds of lines connecting the measures depending on the size of the (absolute value of the) correlations. At +.69, reading and math achievement have the highest correlation. But while both reading and math scores correlate substantially with attention skills, higher achieving kindergarteners are almost as likely to exhibit behavior problems as low achievers. In contrast, attention skills are moderately correlated with both achievement and problem behavior – all four of the correlations are in or near the .3 to .5 range.

By fifth grade, virtually all of the correlations have grown, some substantially (shown only in Appendix Table 1). Correlations between the two achievement and two behavior measures are now all above .2 (in absolute value) while the attention skills correlation with externalizing behavior problems increases from -.51 to -.61. This suggests that the early school years are a time in which children become somewhat more differentiated into groups with higher achievement and good behaviors and with disengagement and lower achievement.

Skill and behavior stability across primary school. Although stability is more the norm, some children do demonstrate both transitory fluctuations and fundamental shifts in their achievement trajectories (Kowleski-Jones & Duncan, 1998; Pungello et al., 1996). The temporal persistence of the ECLS-K’s five achievement, attention and behavior measures are shown in Figure 6. With its periodic measurement across elementary school and consistent scoring of these

Figure 6: Cross-time correlations for kindergarten-entry skills and behaviors



measures, the ECLS-K is well-suited to provide this information. Figure 6 shows a clear ranking for 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 problems correlations dropping the most. The pattern for 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 problems ($\alpha=.90$) and attention ($\alpha=.89$ for the ELCS-K’s “approaches to learning” scale).

Skill and behavior differences across groups. Based on the detailed look provided in Appendix Tables 5 and 6, Figures 7-9 (placed at the end of the paper) plot differences in math,² attention and externalizing behavior problems across socioeconomic, race/ethnic and gender groups in both first and fifth grade. These figures show simple differences across groups; the appendix table also shows counterpart differences *within classroom* (i.e., adjusting for classroom fixed effects), which account for differences across schools and classrooms in the way students are clustered within schools and, in the case of the attention and behavior measures, in the way individual teachers respond to the scales.

In the case of math achievement, income gaps far exceed race/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 whose family incomes were in the top SES quintile (average family income of \$100,000). If anything, that gap increased over the course of primary school. As detailed in Fryer and Levitt (2006), both non-Hispanic Blacks (-.62 sd) and Hispanics (-.77 sd) score well below their white counterparts in kindergarten in math, with the gap growing over the next five years for Blacks but shrinking for Hispanic children. School selection is implicated in accounting for some, but not nearly all of these differences – comparing children to their classroom peers the black-white difference is -.40 sd in kindergarten classrooms and -.56 sd in fifth grade classrooms (Appendix Tables 5 and 6). Gender-based math gaps favoring boys emerge over the course of elementary school.

As shown in Figure 8, disadvantaged groups also score much worse on the ECLS-K's measure of attention skills – two-thirds standard deviations lower for bottom vs. top SES quintile children, one-third lower for blacks relative to whites and one-fifth lower for Hispanic relative to non-Hispanic children.³ As with the math gaps, only the Hispanic differences shrink over the course of primary school. In contrast to math achievement, girls are rated much higher on the attention scale than boys. By fifth grade, the gender gap had grown to more than half a standard deviation.

Growing gaps also characterize the time course of externalizing behavior problems (Figure 9). Lowest SES quintile children begin kindergarten averaging about a quarter standard deviation higher in such problems. By sixth grade, the gap has nearly doubled to about half a standard deviation. Patterns are similar for Black-White gaps in externalizing behavior. As might be expected, boys start school with higher levels of externalizing behavior problems than girls (.41 sd more problems) and this difference increases just slightly by fifth grade. Interestingly, Hispanic children are as well behaved as White children, on average, in both kindergarten and fifth grade.

For internalizing behavior problem gaps shown in the appendix, SES is the only characteristic that differentiates levels of problem behavior. Children in the low SES income quintile score about one-third standard deviations higher on this problem index in both kindergarten and fifth grade than those in the highest SES quintile.

² We chose math over reading owing to second-language complications with early reading scores; the appendix tables show that the patterns for math and reading are broadly similar.

³ With the attention measures reported by teachers, there is more risk of teacher differences in the scoring of attention than the in the achievement test scores. Remarkably, the income gap in kindergarten does not change at all in the teacher fixed effects estimates presented in the appendix.

All in all, SES differences in skills and behaviors are larger than race/ethnic differences. In fact, the picture for attention and behavior problems is relatively favorable for Hispanics; attention skill 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 their attention skills and problem behaviors.

School level measures of skill distribution. As the description of achievement, attention, and problem behavior gaps suggest, low levels of skills are disproportionately concentrated among disadvantaged populations. Given the geographic concentration of disadvantage, low-skilled children are more concentrated in schools that served disadvantaged children. This imparts a double disadvantage to many low-skill children – they have low skills and encounter classroom environments where concentrations of achievement and behavior problems pose

difficult classroom management challenges for teachers.

Table 1: School-level Concentrations of Kindergarten Achievement, Attention and Behavior Problems

	School Characteristics					
	All	Free Lunch Eligibility >50%	Free Lunch Eligibility <5%	Student Population = 50% Minority	Urban School District	Suburban School District
Percent of children with...						
Low math skills	25%	38%	10%	32%	23%	25%
Significant attention problems	24%	32%	17%	29%	23%	25%
Significant behavior problems	18%	24%	15%	23%	17%	20%
All three problems	5%	8%	2%	7%	4%	5%
Percent of full sample	100%	24%	15%	13%	48%	32%

Notes: "Low reading 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

We examined the possible scope of problem-laden classrooms using data from the ECLS-K. We defined math and attention problems as being in the most problematic 25% 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 18th percentile of its distribution. Taken as a whole, some 5% of kindergarteners are problematic in all three dimensions (Table 1).

We then characterized schools by their percent of children qualifying for federal free lunch school program, the percent of racial or ethnic minority children, as well as population density (urban vs. suburban). Class-based contrasts are striking, with four times as many triple-problem children in poor (8%) as opposed to affluent (2%) schools. More generally, the data

suggest that schools with higher proportions of low-income or minority children have a greater concentration low math skills and significant behavior and attention problems. Differences between urban and suburban schools are considerably smaller. With most peer-effect studies concentrating on the consequences of low- or high-achieving classmates (e.g., 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 1, 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 (Chicago in this case), principals of the 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).

IV. 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 pre-school children “at-risk” for school failure produce cognitive and academic achievement gains and long-term reductions in referral for special education services, grade retention, school drop-out and increases in adult educational attainment (Lazar & Darlington, 1982; for a review see Blau & 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 program. For example, the Fast Track prevention program provided a number of services to children who were identified as disruptive in kindergarten, including direct tutoring in reading skills in first grade (Conduct Problems Prevention Research Group, 2002).

Another short-coming of the experimental literature is that interventions that are more narrowly focused on just one aspect of skills or behaviors do not consider cross-domain effects. Only few behavioral interventions also estimate impacts on later academic outcomes. Dolan et al. (1993) report results from a behavioral intervention targeted to both aggressive and shy behaviors among first graders. A random- assignment evaluation showed short-run impacts on both teacher and peer reports of aggressive and shy behavior, but no crossover impacts on reading achievement. The most recent study, by Tremblay et al. (1995), randomly assigned some of the 166 disruptive kindergarten boys in their study to a two-year treatment consisting of both school-based social skills training and home-based parent training in effective child rearing. Treatment/control differences in delinquency were evident through age 15. Although they did not test their subjects for academic skills, they did track whether the boys were placed in regular classrooms. In this case, impacts of the behavioral intervention on classroom placement were apparent until age 12, after which treatment/control differences faded.

Duncan et al. (2007) provide the most comprehensive non-experimental assessment of the associations between school-entry achievement, attention and behavior skills and later school achievement. Using six longitudinal data sets,⁴ they regressed reading and mathematics achievement (from tests and, where available, teacher ratings) on kindergarten-entry measures of reading and math achievement, attention, anti-social 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 the point of 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 post-kindergarten reading and math achievement outcome measures available in the six data sets were treated as dependent variables in separate regressions.

Table 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.

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 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.⁵ Behavior problems were not 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.

Not surprisingly, 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.

⁴ The data sets included: the Children of the National Longitudinal Survey of Youth (NLSY), the NICHD 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]).

⁵ 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 unproductive of later school achievement.

Children's attention skills appeared equally important (and several dimensions of socioemotional behaviors appeared uniformly unimportant) for reading and math achievement.⁶

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 problem behavior and other dimensions of social skills and mental health problems are were not predictive.⁷

Middle-childhood skills and high school completion. It is far from clear whether early academic skills will 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. Anti-social 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 Figure 6 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 problem behaviors and high school completion. Here we reproduce and expand upon their NLSY-based results and note that the BSS data produced remarkably similar patterns of effects.

As detailed in the appendix, NLSY measures reading and math achievement in its biennial child survey. Attention and problem behavior measures are based on parent reports. Attention/self-regulation in the NLSY is drawn from the hyperactivity subscale of the Behavioral Problem Index (BPI). Anti-social 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 on school-age children for every age between 5 and 14. To investigate when skills and behaviors begin to predict high school completion, we ran a series of probit regressions, all of which related high school completion to preschool measures of child cognitive skills, temperament and family background (see Appendix for a complete list) and middle-childhood skills and behaviors. The first regression measured these skills and behaviors at age 5,

⁶ Key results from the meta-analysis appeared robust to a host of potential problems: (a) adjustments for error in measuring attention and socioemotional skills had little impact on the results; (b) maternal reports of attention and behavior were nearly as predictive as teacher reports of later academic achievement; (c) worries proved unfounded that the models may overcontrol for achievement-related impacts of attention and socioemotional skills; (d) bias from shared-method variance was not a concern because test scores were just as predictive of later teacher-reported as test-based achievement measures; (e) the relative importance of school-entry factors was similar for immediate (e.g., first grade) and later (e.g., fifth grade) measures of achievement; and (f) impacts of behavior problems were no larger for entering students with the most problems.

⁷ It is important to note that 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 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.

the second at age 6 and so on, all the way up to age 14. Regression results are presented in Appendix Table 8.

In seeking to understand the role of early skills on later outcomes, we adopt a regression method that includes all of our measures of concurrent skills as well as measures of child and family characteristics from birth through age 5. 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 of 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 Appendix Tables 8 and 10). This is not surprising, and confirms the common observation that early skill deficits across a range of domains are linked to later outcomes. Such bivariate associations, however, fail to indicate that these dimensions really matter for later outcomes, they may be simply proxying for other skills or family circumstances that are the true cause of later outcomes. For this reason, we focus most of our discussion on results from regression models to 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 Appendix Table 8). When we combined these two measures into a single, standardized composite, however, the effects became uniformly significant⁸ (Figure 10 and bottom panel of Appendix Table 8). Up to age 9, standard deviation increases in the achievement composite are associated with 3 to 5 percentage point increases in the probability of high school completion. With about 78 percent high school completion rates in the sample, this means an increase from about 78 percent to 82 percent. Beginning at age 10, the coefficients are generally in the 5 to 7 percentage point range.

For the attention and problem behavior measures, only the measure of antisocial problems is consistently predictive of high school completion (Figure 11 and Appendix Table 8). Once antisocial behavior is taken into account, attention and anxiety/depression do not predict high school completion. As with the achievement composite, behavior problems become more predictive around age 10. Standard deviation increases in age 10-14 externalizing problem behaviors are associated with 3 to 6 percentage point reductions in high school completion.

Persistent problems and high school completion. Prior research has suggested that a student's trajectory of behavior problems may be more important than their level of behavior problems at any single age in predicting later educational attainment (Kokko et al., 2006). This might also be true for achievement trajectories. To test whether the *persistence* of academic, 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 (age 6, 8, 10 in the NLSY). Based on prior empirical work we chose the 75th percentile to demark a "high" level of behavior problems, and likewise chose the 25th percentile as the threshold for low achievement.

⁸ The shading on the bars in Figure 10 indicate levels of statistical significance, with no shading indicating $p > .05$, light shading indicating $p < .05$ and darker shading indicating $p < .01$.

We then formed three groups – *never*, *intermittent* and *persistent* – depending on whether the NLSY child fell into the worst quarter of a given measure’s distribution zero, one or two, or all three measurement occasions. Bivariate associations between high school completion and all five of our skill and behavior measures were very strong (first column of Appendix Table 9), with the contrasts between the “persistent” and “never” groups associated with 20 to 30 percentage-point drops in high school completion. As with the single-year measures, regression adjustment led only the achievement and anti-social behavior problem measures to be predictive of high school completion (Table 3). Persistent early math achievement and anti-social behavior problems were associated with 10-13 percentage point drops in high school completion. Surprisingly, persistent early reading problems were *not* predictive, nor were persistent attention or anxiety problems. Extending the outcome to college attendance produces similar patterns but one exception – persistent early anxiety problems had a marginally significant negative coefficient.

Table 3: Effect of Persistent and Intermittent Problems at Ages 6, 8 and 10 on the Probabilities of High School Graduation and College Attendance, Full Controls, n=1,433

Problem area:	Problem frequency	HS completion	College attendance
Reading	Intermittent	-.03 (.03)	-.13 [†] (.07)
	Persistent	-.05 (.06)	-.06 (.12)
Math	Intermittent	-.05 [†] (.03)	-.14* (.07)
	Persistent	-.13* (.06)	-.29** (.09)
Anti-social behavior	Intermittent	-.07* (.03)	-.10 (.06)
	Persistent	-.10 [†] (.05)	-.24* (.10)
Inattention	Intermittent	-.01 (.03)	-.09 (.06)
	Persistent	.01 (.05)	-.05 (.15)
Anxiety	Intermittent	-.01 (.03)	-.08 (.06)
	Persistent	-.03 (.05)	-.18 [†] (.09)

** p<.01 *p<.05 †p<.10; “problem” is defined as being in the worst quartile of distribution at a given age

We considered whether the association between both levels and patterns of achievement, attention, and problem behaviors differed across several relevant subgroups defined by SES, race and gender. There was 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 our scope of the adolescent and early-adult outcomes, we repeated these NLSY-based analyses using reports of whether a child had ever been arrested by age 19 or 20. Duncan et al. (2009) show that results from NLSY parallel those for the Beginning School Study sample and its measure of incarceration by age 20 or 21 and the Infant Health and Development sample and its measure of arrest by age 18.

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 and middle-childhood skills and behaviors. Regression results are presented in Appendix Table 10. Results are easily summarized: again, we found that results from the bivariate models

uniformly indicated that measures of all of the achievement, attention, and behavior problem domains predicted later arrests. Turning to the fully controlled models, only the anti-social behavior reports were predictive of later crime. Year by year patterns are shown in Figure 12. Coefficient sizes are generally modest (although statistically significant) until age 10, at which point they roughly double. The sample mean is about 22%, so a three percentage point coefficient amounts to a 15 percent increase relative to the base rate and a six percentage point coefficient increasing the base rate by 30 percent.

Although the individual year effects of age 5-10 behavior problems are only modestly predictive of later crime, persistent early anti-social behavior is very predictive. As in the high school completion analysis, we formed *never*, *intermittent* and *persistent* groups depending on whether the NLSY child fell into the worst quarter of a given measure's distribution zero, one or two, or all three measurement occasions (Appendix Table 11). Children exhibiting persistent early anti-social behavior problem had nearly double the chance of being arrested. As shown in the Appendix Table 11, this effect is somewhat larger for males than females.

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

VI. 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 problem behavior measures have significant correlations with the later outcomes. Holding constant family background and concurrent skills produces a much more selective picture (Table 4).⁹

In the case of early adult crime, our guess is that Perry reduced anti-social behavior problems in the intervention group. Our longitudinal analyses consistently point to early anti-social behavior problems, but not early achievement, attention or internalizing problems, as being strong predictors of arrests and incarceration. Children who persistently display such problems between ages 6 and 10 had a doubled chance (roughly 40 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 anti-social behavior problems for later crime stood in marked contrast to the *inability* of even persistent early reading, math, attention or mental health problems to predict to later criminal arrest. With crime, it would appear, there are few to no “crossover” effects from a child's development in a domain other than anti-social behavior, once such behavior and family background is taken into account.¹⁰

⁹ The summary in Table 4 characterizes effect sizes as “strong” and “modest.” In the case of the study we reviewed that related standardized measures of achievement to standardized measures of school-entry skills, “strong” means that the standardized coefficient was at least .20. In the case of our school dropout, college attendance and arrest regressions, “strong” means that the (absolute value of the) estimated change in probability of outcome occurring was at least 20 percentage points. “Modest” means statistically significant but with estimated effect sizes that were smaller than “strong.”

¹⁰ 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. non-violent). Second, although

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 post-secondary education.

Table 4: Summary of Skill and Behavior Associations with Later Outcomes

When measured:	Outcomes		
	Grade 1-8 school achievement	High school completion and college entry	Crime
School entry	Math: <i>Strong</i> Reading: <i>Strong</i> Attention: <i>Modest</i> Anti-social behavior: Anxiety:	[Estimates not available]	[Estimates not available]
Ages 6-9	[Estimates not available]	Math: <i>Strong if persistent</i> Reading: <i>Modest</i> Attention: Anti-social behavior: <i>Modest</i> Anxiety:	Math: Reading: Attention: Anti-social behavior: <i>Modest</i> Anxiety:
Ages 10-14	[Estimates not available]	Math: <i>Modest</i> Reading: <i>Modest</i> Attention: Anti-social behavior: <i>Modest</i> Anxiety:	Math: Reading: Attention: Anti-social behavior: <i>Strong</i> Anxiety:

Table note: “Strong” means standardized coefficient >.20 or estimated change in probability of outcome > 20 percentage points. “Modest” means statistically significant but with smaller estimated effects.

We close with a number of observations. First, although school-entry achievement skills proved quite predictive of later school achievement, the *persistence* dimension of early skills and problem behaviors mattered most for later attainment and crime. Single assessments of primary school children are, at best, relatively weak 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 skills did not matter more than they 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 (e.g., Baumeister & Vohs, 2004). While our measures of attention skills leave much to be desired, they appear about as reliably measured as anti-social behaviors, which proved to be predictors of later outcomes. One possibility is our attainment measures (high school completion and on-time

Head Start programs rarely match the intensity of models programs such as Perry, Deming’s (2009) sibling-based analysis of Head Start showed long run impacts on arrests but not shorter-run impacts on behavior problems.

college attendance) focus on the lower end of the attainment distribution and attention skills may be more consequential for the persistence and attainment at the higher end. It may also be that attention skills developed by the early grades matter much less than the 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 10 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 of this fact 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 skill, attention or behavior are ill-considered. The appropriate policy test involves costs and benefits rather than correlation size. High quality, intensive interventions like Perry Preschool have proven their worth. Whether larger-scale early interventions can do so remains a vital policy question.

References

- Achenbach, T. (1991). *Manual for the Child Behavior Checklist /4-18 and 1991 profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Achenbach, T. (1992). *Manual for the Child Behavior Checklist/2-3 and 1992 profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Alexander, K. L., Entwisle D. R., & Dauber, S. L. (1993). First grade classroom behavior: Its short- and long-term consequences for school performance. *Child Development, 64*, 801-514.
- Baker, P. C., Keck, C. K., Mott, F. L., & Quilan, S. V. (1993). *NLSY Child Handbook, Revised Edition: A guide to the 1986-1990 NLSY child data*. Columbus, Ohio: The Ohio State University, Center for Human Resource Research.
- Baroody, A. J. (2003). The development of adaptive expertise and flexibility: The integration of conceptual and procedural knowledge. In A. J. Baroody & A. Dowker (Eds.), *The Development of Arithmetic Concepts and Skills: Constructing Adaptive Expertise Studies*. Mahwah, N.J. : Lawrence Erlbaum Associates, Inc.
- Baumister, R. & Vohs, K. 2004 *Handbook of self-regulation: Research, theory, and applications* Guilford Press.
- Betts, J. R., and A. Zau (2004): Peer Groups and Academic Achievement: Panel Evidence from Administrative Data," Working paper.
- Blau, D. & Currie, J. (2006). Pre-school, day care, and after-school care: Who's minding the kids?" *Handbook of the Economics of Education*, Elsevier.
- Bongers. IL., Koot, H. M., van der Ende, J. & Verhulst, F. C. (2003). The normative development of child and adolescent problem behavior. *Journal of Abnormal Psychology, 112*, 179-192.
- Bridges, L. J., Denham, S. A., & Ganiban, J. M. (2004). [Definitional issues in emotion regulation research](#). *Child Development, 75*(2):340-5.
- Brock, L. Rimm-Kaufman, S. E., Nathanson, L. & Grimm, K. J. (2009). The contributions of hot and cool executive function to children's academic achievement, learning-related behaviors, and engagement in kindergarten. *Early Childhood Research Quarterly, 24*, 337-349.
- Bronfenbrenner, U. & Morris, P.A. (1998). The ecology of developmental processes. In R. Lerner (Vol. Ed.) *Handbook of child psychology: Theoretical models of human development*. (5th Ed., Vol. 1, pp 993-1028). New York, N.Y.: John Wiley.
- Campbell, S. B. (1995). Behavior Problems in Preschool Children: A Review of Recent Research. *Journal of Child Psychology and Psychiatry, 36*, 113 – 149.
- Campbell, F. A., Ramey, C., Pungello, E. P., Sparling, J. J., & Miller-Johnson, S. (2002). Early childhood education: Young adult outcomes from the Abecedarian Project. *Applied Developmental Science, 6*, 42-57.

- Campbell, S. B., Shaw, D. S., & Gilliom, M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later adjustment. *Development and Psychopathology*, 12, 467-488.
- Conduct Problems Prevention Research Group (2002). Evaluation of the first three years of the Fast Track Prevention Trial with children at high risk for adolescent conduct problems. *Journal of Abnormal Child Psychology*, 30, 19-35.
- Cunha, F., Heckman, J., Lochner, L., & Masterov, D. (2005) Interpreting the evidence on life cycle skill formation. In E. Hanushek & F. Welch (Eds.) *Handbook of the Economics of Education*, North Holland.
- Crozier, J.C., Dodge, K., Bates, J. E., Pettit, G. S., Levenson, R. W. (2008). Social information processing and cardiac predictors of adolescent anti-social behavior. *Journal of Abnormal Psychology*, 117, 253-267.
- Davenport, B. M. (1976). A comparison of the Peabody Individual Achievement Test, the Metropolitan Achievement Test, and the Otis-Lennon Mental Ability Test. *Psychology in the Schools*, 13, 291-297.
- Davis-Kean, P. E., Huesmann, L. R., Jager, J., Collins, W. A., Bates, J. E., & Lansford, J. (2008). Changes in the relation of beliefs and behaviors during middle childhood. *Child Development*, 79, 1257-1269.
- Deming, D. (2009). Early childhood intervention and life-cycle skill development: Evidence from Head Start. *American Economic Journal: Applied Economics*, 1(3): 111-34.
- Diamond A, Barnett W, Thomas J, Munro S. Preschool program improves cognitive control. *Science* 2007 318:1387-8.
- Dolan, L., Kellam, S., Brown, C., Werthamer-Larsson, L., Rebok, G., Mayer, L., et al. (1993). The short-term impacts of two classroom-based preventive interventions on aggressive and shy behaviors and poor achievement. *Journal of Applied Developmental Psychology*, 14, 317-345.
- Duncan, G., Dowsett, C., Classens, A., Magnuson, K., Huston, A., Klebanov, P., Pagani, L., Feinstein, L., Engel, Brooks-Gunn, J., Sexton, H., Duckworth, K and Japel, C. (2007). School Readiness and Later Achievement. *Developmental Psychology*, 43, 1428-1446.
- Duncan, G., Lee, Y. Magnuson, K. & Metzger, M. Early school skills and behaviors: Precursors to young adult crime? Paper presented at the Society for Research in Child Development, 2009.
- Dunn, L.M., & Dunn, L.M. (1981). *Peabody Picture Vocabulary Test-Revised*. Circle Pines, MN: American Guidance Service.
- Dunn, L. M., & Markwardt, F. C. Jr. (1970). *Peabody Individual Achievement Test Manual*. Circle Pines, MN: American Guidance System.
- Eisenberg, N., Sadovsky, A. & Spinrad, T. L. (2005) Associations of emotion-related regulation with language skills, emotion knowledge, and academic outcomes. *New directions for child and adolescent development*, 109, 109-18.

- Entwisle, D. R., Alexander, K. L., & Olson, L. S. (2007). Early schooling: The handicap of being poor and male. *Sociology of Education*, 80, 114–138.
- Fantuzzo, J., Bulotsky, R., McDermott, P., Mosca, S., & Lutz, M. N. (2003). A multivariate analysis of emotional and behavioral adjustment and preschool educational outcomes. *School Psychology Review*, 32, 185-203.
- Fantuzzo, J., Shearer, R., Frye, D., McDermott, P., McWayne, C., & Perlman, S. (In press). Investigation of dimensions of social-emotional classroom behavior and school readiness for low-income urban preschool children. *School Psychology Review*.
- Fryer, R. & Levitt, S. (2006), The Black-White Test Score Gap Through Third Grade, *American Law and Economics Review* 8(2), 249-281.
- Hanushek, E. A., J. F. Kain, J. M. Markman, and S. G. Rivkin (2003): Does Peer Ability Affect Student Achievement?," *Journal of Applied Econometrics*, 18(5).
- Hiebert, J., & Wearne, D. (1996). Instruction, understanding, and skill in multidigit addition and subtraction. *Cognition and Instruction*, 14, 251-283.
- Howse, R. B., Lange, G., Farran, D. C., & Boyles, C. D. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. *The Journal of Experimental Education*, 71, 151-174.
- Hoxby, C. M., and G. Weingarth (2007): Taking Race Out of the Equation: School Reassignment and the Structure of Peer Effects," Working paper.
- Kellam, S.G., Mayer, L.S., Rebok, G.W., & Hawkins, W.E. (1998). Effects of improving achievement on aggressive behavior and of improving aggressive behavior on achievement through two preventative interventions: An investigation of causal paths. In B.P. Dohrenwend (Ed.), *Adversity, stress, and psychopathology*. New York: Oxford University Press.
- Kokko, K., Tremblay, R. E., LaCourse, E., Nagin, D., & Vitaro, F. (2006). Trajectories of prosocial behavior and physical aggression in middle childhood: Links to adolescent school dropout and physical violence. *Journal of Research on Adolescence*, 16(3), 404-428.
- Kowaleski-Jones, L., & Duncan, G.J. (1999). The structure of achievement and behavior across middle childhood. *Child Development*, 4, 930-943.
- Ladd, G. W., Birch, S. H. & Buhs, E. (1999). Children's social and scholastic lives in kindergarten: Related spheres of influence? *Child Development*, 70, 1373-1400.
- Lazar, I. & Darlington, R. B. (1982). Lasting effects of early education. *Monographs of the Society for Research in Child Development*, 47.
- Leschied, A., Chiodo, D., Nowicki, E., & Rodger, S. (2008). Childhood predictors of adult criminality: A meta-analysis drawn from the prospective longitudinal literature. *Canadian Journal of Criminology and Criminal Justice*, 50, 435-467.
- Magnuson, K., Duncan, G. Metzger, M & Lee, Y. Early School Adjustment and High School Dropout. Paper presented at the Society for Research in Child Development, 2009.

- McClelland, M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly, 15*, 307-329.
- Mischel, W., Shoda, Y. & Rodriguez, M. (1989). Delay of gratification in children. *Science, 244*(4907), 933-938.
- Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review, 100*, 674-701.
- Newcomb, A. F., Bukowski, W. M., & Pattee, L. (1993). Children's peer relations: A meta-analytic review of popular, rejected, neglected, controversial, and average sociometric status. *Psychological Bulletin, 113*, 99-128.
- Olson, S. L., Sameroff, A. J., Kerr, D. C. R., Lopez, N. L., & Wellman, H. M. (2005). Developmental foundations of externalizing problems in young children: The role of effortful control. *Development and psychopathology, 17*, 25-45.
- Parker, J. G., & Asher, S. R. (1987). Peer relations and later personal adjustment: Are low-accepted children at risk? *Psychological Bulletin, 86*, 357-389.
- Phillips, M. & Chin, T. (2003). School inequality: What do we know? University of California, Los Angeles, Mimeo.
- Pianta, R., La Paro, K., & Hamre, B. K. (2005). Classroom Assessment Scoring System (CLASS). Unpublished measure, University of Virginia, Charlottesville, VA.
- Pungello, E. P., Kupersmidt, J. B., Burchinal, M. R., & Patterson, C. (1996). Environmental risk factors and children's achievement from middle childhood to adolescence. *Developmental Psychology, 32*, 755-767.
- Posner, M. & Rothbart, M. (2007). Educating the human mind. Washington, D.C.: The American Psychological Association.
- Raver, C. C. (2004). Placing emotional self-regulation in sociocultural and socioeconomic contexts. *Child Development, 75*, 346-353.
- Raver, C. C., Smith-Donald, R., Hayes, T., & Jones, S. M. (2005, April). *Self-regulation across differing risk and sociocultural contexts: Preliminary findings from the Chicago School Readiness Project*. Paper presented at the biennial meeting of the Society for Research in Child Development, Atlanta, GA.
- Sameroff, A.J., & Fiese, B.H. (2000). Transactional regulation: The developmental ecology of early intervention. In J.P. Shonkoff, & S.J. Meisels (Eds.), *Handbook of early childhood intervention*, (2nd Edition, pp. 135-159), New York: Cambridge University Press.
- Shonkoff, J., & Phillips, D. (Eds.). (2000) *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington, D.C.: National Academy Press.
- Schweinhart, L. and others (2005). *Lifetime Effects: The High/Scope Perry Preschool Study through Age 40*, Ypsilanti, Mich.: High/Scope Press.
- Schweinhart, L. and other (1993). *Significant Benefits: The High/Scope Perry Preschool Study through Age 27*, Ypsilanti, Mich.: High/Scope Press.

- Tremblay, R., Pagani-Kurtz, L., Mâsse, L., Vitaro, F., & Pihl, R. (1995). A bimodal preventive intervention for disruptive kindergarten boys: Its impact through mid-adolescence. *Journal of Consulting and Clinical Psychology, 63*, 560-568.
- Wikoff, R. L. (1978). Correlational and factor analysis of the Peabody Individual Achievement Test and the WISC-R. (1978). *Journal of Consulting and Clinical Psychology, 46*, 322-325.
- Yen, C., Konold, T. R., & McDermott, P. A. (2004). Does learning behavior augment cognitive ability as an indicator of academic achievement? *Journal of School Psychology, 42*, 157-169.

Figure 7: Math gaps in kindergarten and fifth grade

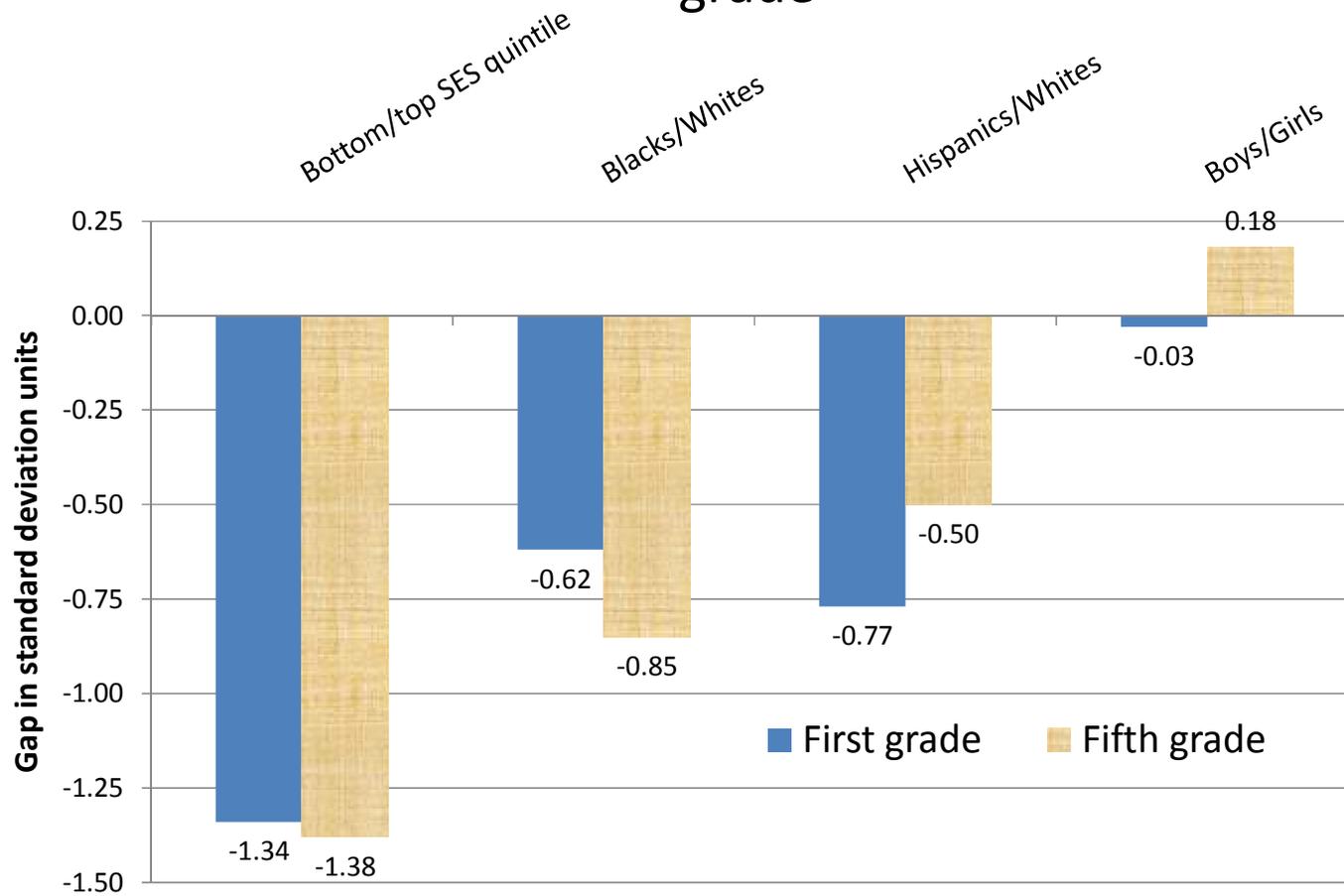


Figure 8: Attention/engagement gaps in kindergarten and fifth grade

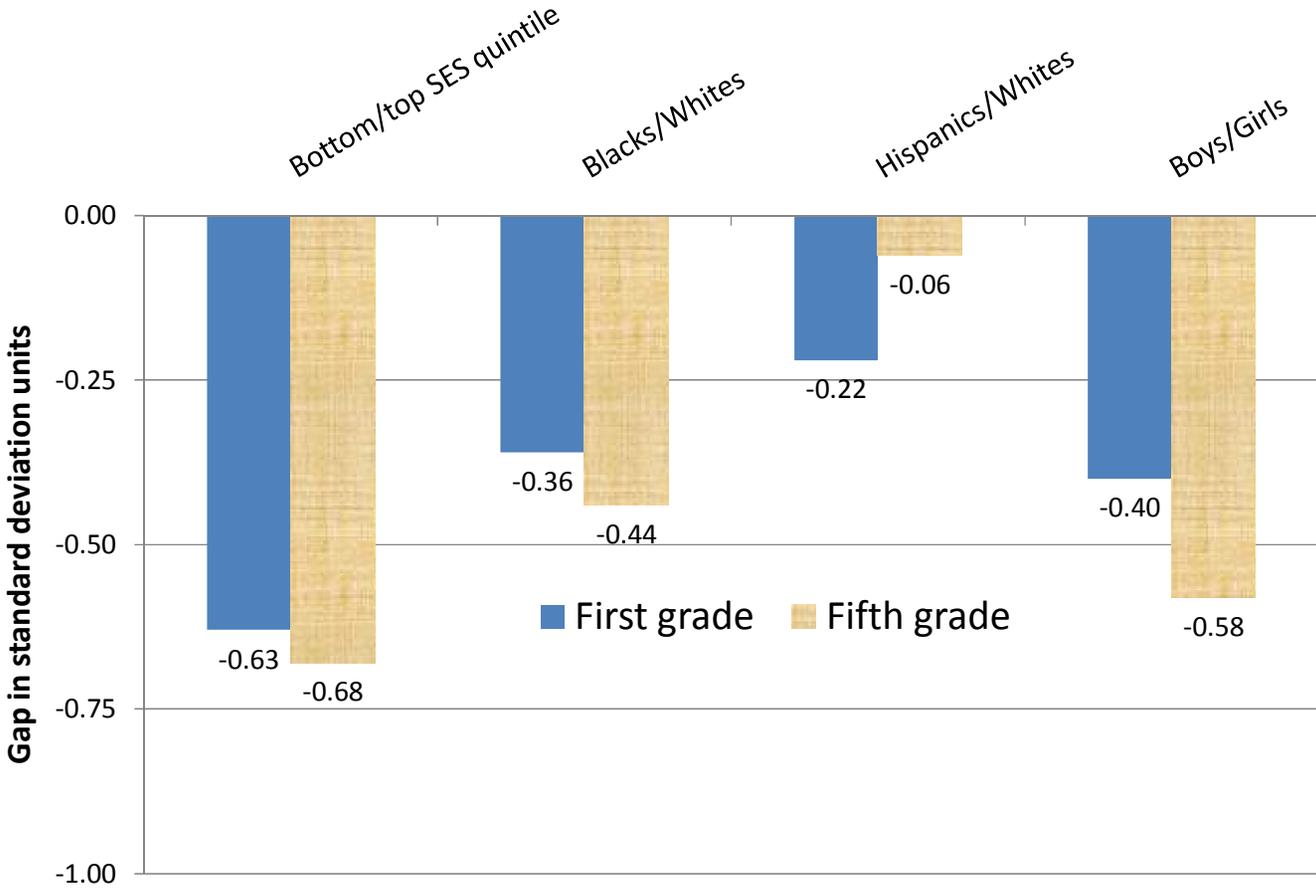


Figure 9: Anti-social behavior differences in kindergarten and fifth grade

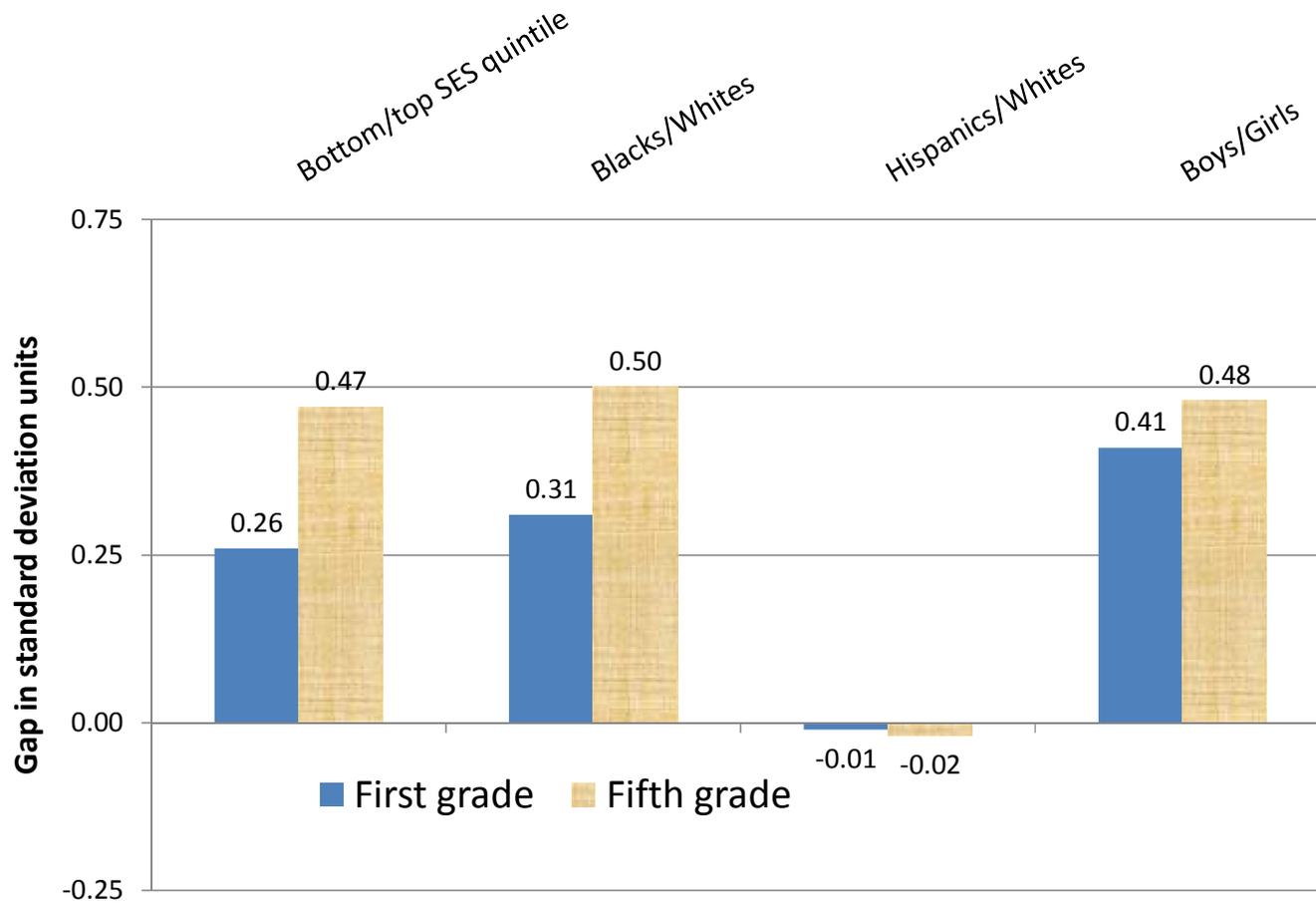
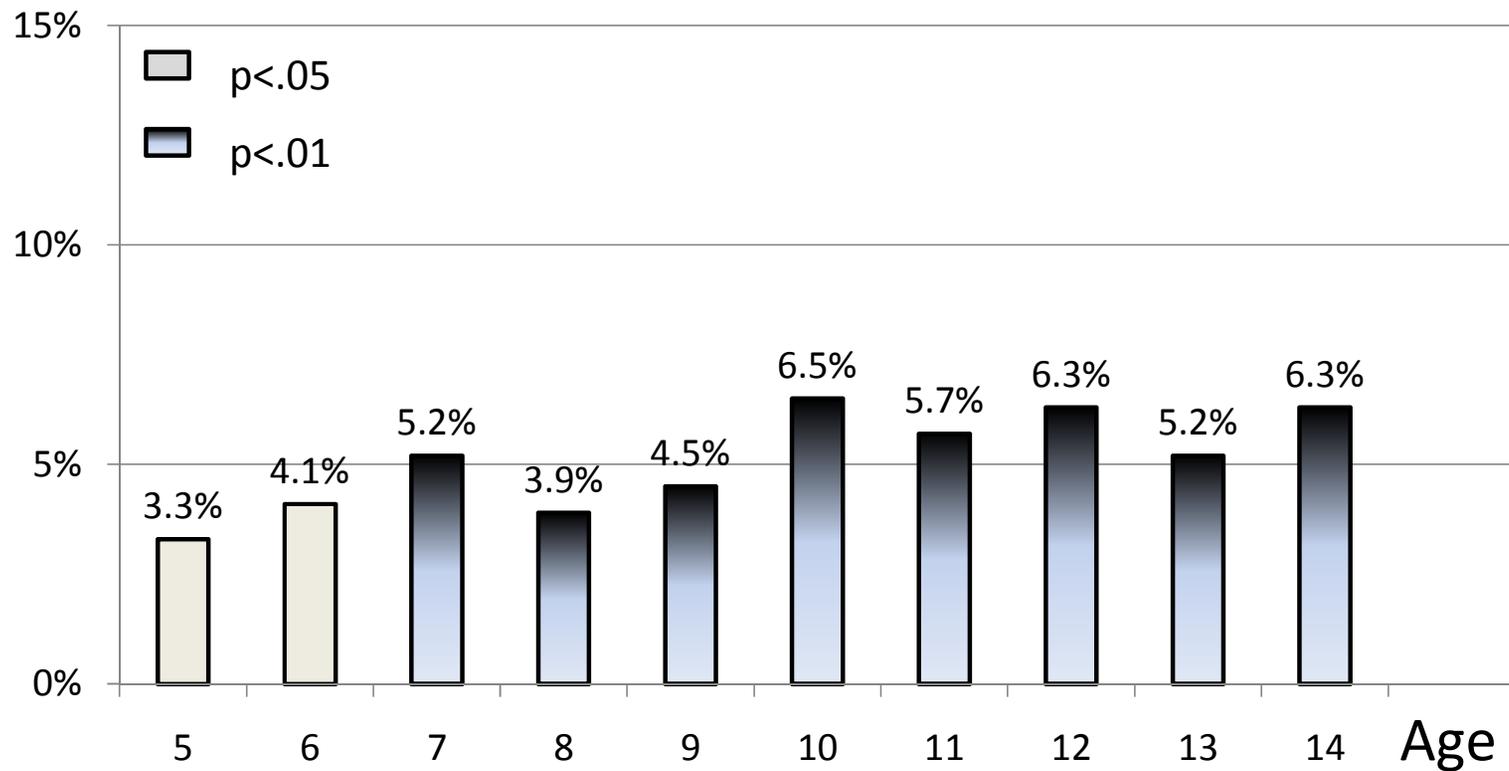


Figure 10: Effect of a 1 sd Increase in Composite Achievement at Various Ages on the Probability of High School Graduation, Full Controls



Source: NLSY

Figure 11: Effect of a 1 sd Increase in Anti-social Behavior at Various Ages on the Probability of High School Graduation, Full Controls

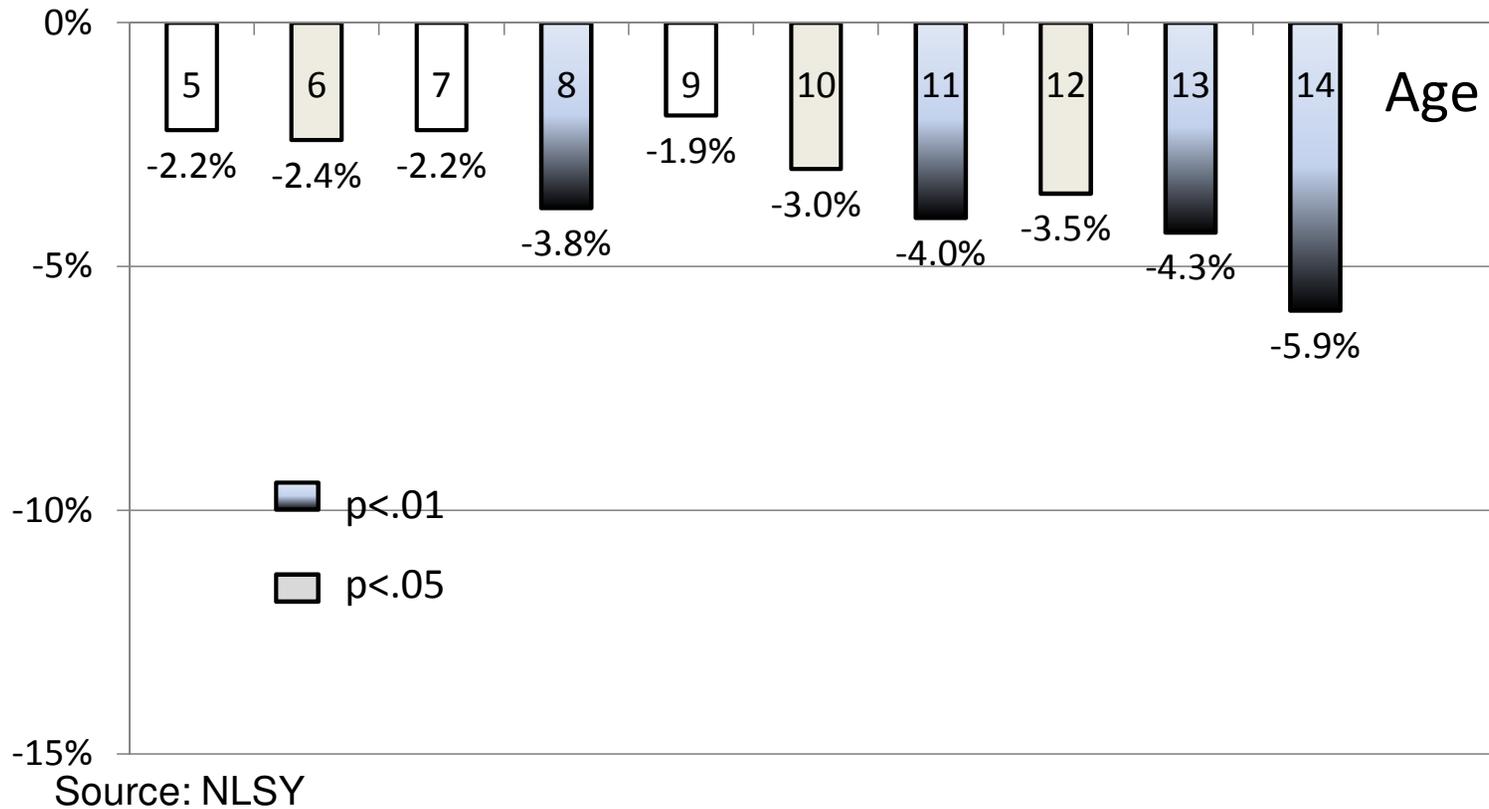
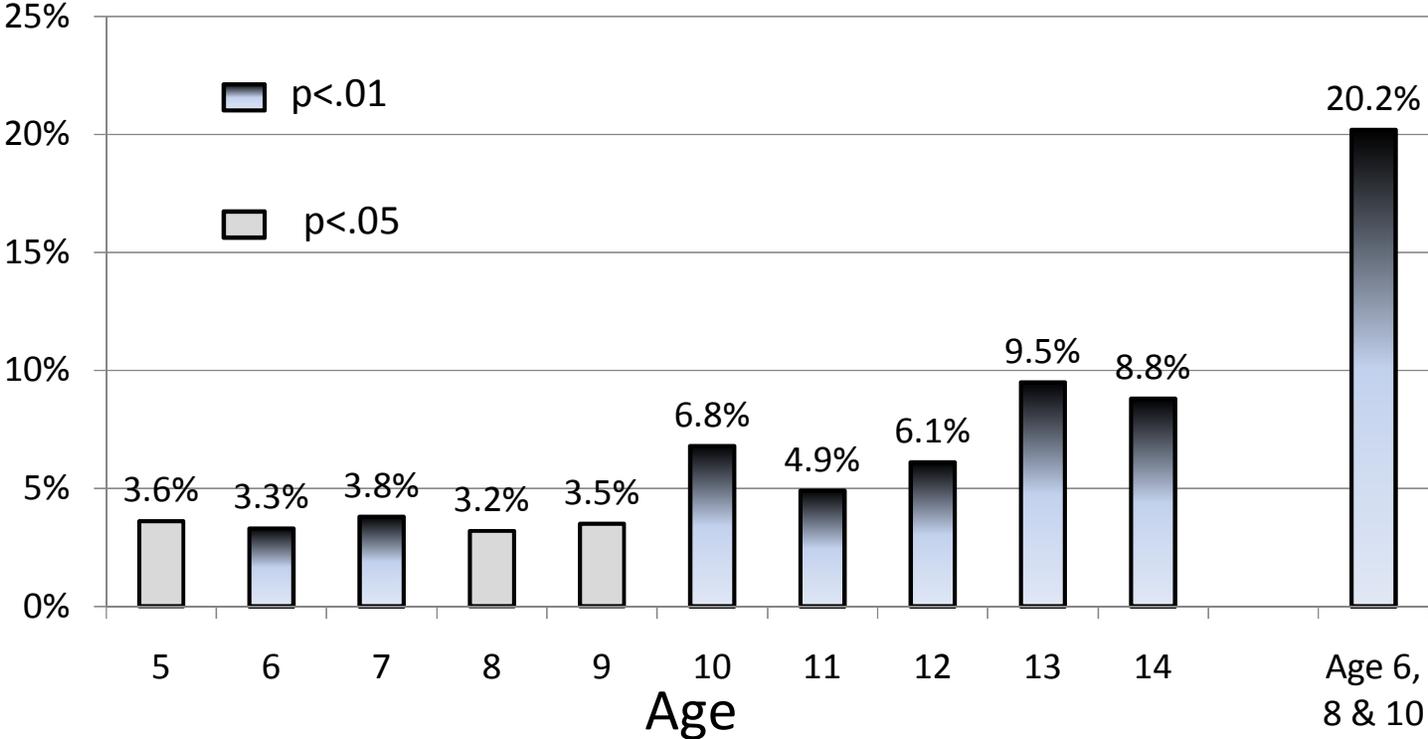


Figure 12: Effect of a 1 sd Increase in Anti-social Behavior at Various Ages on the Probability of Ever Arrested, Full Controls



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.¹¹ 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.

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 (Center for Human Resource Research, 2004). Black, Hispanic, and low-income youth were over-represented in the sample. Annual (through 1994) and biennial (between 1994 and 2000) interviews with sample members, and very low cumulative attrition in the study, contribute to the quality of the study's data.

¹¹ Reading ARS scores are available for the full sample, but only half of the teachers were asked to rate students in mathematics.

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. 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.¹²

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

¹² 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.

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.¹³ 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 (See Appendix Table 8).

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.¹⁴

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

¹³ 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.

¹⁴ Currie and Stabile's (forthcoming) analysis takes advantage of the fact that the NLSY provides observations on siblings by estimating fixed-effect sibling models. They find very similar coefficients on early attention and 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.

Appendix Table 1: Bivariate Correlations Among Achievement, Attention and Behavior in Kindergarten and Fifth Grade.

	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 2: Bivariate Correlations Among Math and Reading Scores, Kindergarten through Fifth Grade

	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: Bivariate Correlations Among Externalizing and Internalizing Behavior Scores, Kindergarten through Fifth Grade

	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 4: Bivariate Correlations Among Approaches to Learning Scores, Kindergarten through Fifth Grade

	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 5: Gaps in Children's Academic and Behavior Skills in the Fall of Kindergarten

	<u>Reading</u>		<u>Math</u>		<u>Approaches to Learning</u>		<u>Lack of Externalizing Behavior^a</u>		<u>Lack of Internalizing Behavior</u>	
	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: 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 0.17sd higher than boys in reading). Negative numbers indicate that the left hand group has better scores, on average. ^aFor both externalizing and internalizing behaviors, a positive gap indicates better behavior (i.e., less externalizing and internalizing) for the advantaged group.

Appendix Table 6: Gaps in Children's Academic and Behavior Skills in the Spring of 5th Grade

	<u>Reading</u>		<u>Math</u>		<u>Approaches to Learning</u>		<u>Externalizing Behavior^a</u>		<u>Internalizing Behavior</u>	
	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 lefthand group has better scores, on average. ^aFor both externalizing and internalizing behaviors, a positive gap indicates better behavior (i.e., less externalizing and internalizing) for the advantaged group.

Appendix Table 7: School-level Concentrations of Kindergarten Achievement, Attention and Behavior Problems

	School Characteristics					
	All	Free Lunch Eligibility >50%	Free Lunch Eligibility <5%	Student Population ≥ 50% Minority	Urban School District	Suburban School District
Percent of children with ...						
Low math skills	25%	38%	10%	32%	23%	25%
Significant attention problems	24%	32%	17%	29%	23%	25%
Significant behavior problems	18%	24%	15%	23%	17%	20%
All three problems	5%	8%	2%	7%	4%	5%
Percent of full sample	100%	24%	15%	13%	48%	32%

Notes: “Low reading 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