Early School Skills and Behaviors: Precursors to Young Adult Crime?

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Abstract

We investigate primary school precursors to criminal involvement in early adulthood. Two large longitudinal datasets, Children of the National Longitudinal Youth Study (NLSY) and the Beginning School Study (BSS), provide us with estimates of the association between criminal involvement by around age 21 on the one hand and four primary school indicators—reading and math skills, attention problems, and antisocial behavior problems—on the other. Looking first at bivariate associations, we find significant correlations between early-adult crime and all of our early measures of skills and behaviors. Controls for either a handful of family background measures or concurrent primary-school skills and behaviors reduce all but the early antisocial behavior measure to statistical insignificance. Our detailed look at the *persistence* of early antisocial behavior problems show that children, particularly boys, with antisocial behavior that begins early and persists beyond age 10 or 11 are at the highest risk of later arrest or incarceration.

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Introduction

A vast and increasing number of Americans are involved in the correctional system. Counting incarcerated offenders as well as those on probation or parole, a recent estimate suggested that one in every 31 Americans was presently a member of the correctional population (Pew Center on the States, 2009). The costs to society associated with crime and corrections, particularly incarceration, are exceedingly large: past estimates have suggested annual spending of over $1.3 trillion (Anderson, 1999), which is likely an underestimate of current spending given the recent increasing rates incarceration.

Prior research has a variety of ways to reduce crime, including sentencing and drug policy reforms (Tonry, 1999; Dills, Miron, & Summer, 2008). Many have argued for adopting a prevention framework that would target the early causes in order to reduce the later emergent risk for later for offending. The present paper works within this prevention approach in an effort to pinpoint the ages and developmental domains that are most consequential for later offending.

Much of the existing research on criminal trajectories focuses on the proximal conditions and events in adolescence that are associated with later criminal involvement. Of particular interest in this field, often referred to as developmental criminology, is the question of how to predict whether adolescents will persist or desist once they have initiated offending (Sampson & Laub, 2005). Yet, evaluations of intensive early childhood interventions have suggested that crime can be reduced by intervening in early childhood, long before such behavior has begun. In particular, Perry Preschool, an early education program for disadvantaged preschoolers reduced criminal activity in adulthood (Belfield, Nores, Barnett, & Schweinhart, 2006). Unfortunately, how Perry Preschool or other early interventions programs shape subsequent offending is not well understood, and in general, the early childhood precursors to later criminal activity are largely unexamined. This study explores the extent to which early childhood is a formative developmental period in the production of subsequent crime.

One of the clearly identified adolescent predictors of later crime is antisocial behavior. Youth with higher levels of such problem behavior are far more likely to commit crimes than youth without such behavior problems, and often delinquent activity is itself a proxy for antisocial behavior. More than 15 years ago, Moffit (1993) proposed that antisocial behavior from early childhood through adolescence could be characterized by two patterns: life-course persistent and adolescent-limited. Empirical studies have produced conflicting evidence on the number and nature of distinct trajectories (Nagin and Tremblay, 2005; Piquero, 2008), and have often included groups exhibiting behavior problems early but not later in childhood (e.g., Odgers, 2008). Research suggests that both life course persistent and adolescent delimited antisocial trajectories may be linked with criminal activity in young adulthood (although the severity of the crimes may differ across these groups). Less clear, is whether early antisocial behavior is also linked to later crime. To the extent that early antisocial behavior persists and is characterized as the beginning stages of a life course persistent pattern, we might well expect links between early antisocial behavior and later crime. If, however, a large percentage of young children who demonstrate early antisocial behavior do not persist with such behavior, than links

between early antisocial behavior and later criminal activity may be weak or non-existent.

As these trajectory studies suggest, most of the literature on early precursors of adult crime has focused on various types of antisocial or conduct disorder behavior problems, as these are strongly associated with crime. A less studied, but potentially important dimension of problem behavior is inattention or hyperactivity. Although sparse, the literature linking early attention problems to later crime suggests an increased risk of subsequent arrest, conviction, and incarceration for boys with clinical levels of attention difficulties and without comorbid conduct problems (Farrington, Loeber, & van Kammen, 1990; Mannuzza, Klein, & , 2008). Evidence, however, is not conclusive. Currie and Stabile (forthcoming) take a comprehensive look at links between hyperactivity and early adult delinquency using nationally-representative data from both the U.S. and Canada, and sibling fixed effects as well as more conventional individual-based models.[1] They find linkages in their individual models but not in their sibling fixed effects models.

Achievement is another early childhood domain which might have lasting links with later criminal activity. Numerous studies have demonstrated an association between low achievement in early schooling and conduct problems in adolescence (e.g., Maguin & Loeber, 1996), although fewer have followed participants into early adulthood to examine criminal outcomes. Among those studies that include adult outcomes, literacy has received more attention than numeracy (see Vanderstaay, 2008, for a review). Furthermore, while poor reading skills are associated with crime, independent of socioeconomic status, these associations are rarely tested alongside the potentially covarying factors of attention and conduct problems. Thus, based on prior research it is difficult to assess whether early achievement, specifically low levels of achievement, independently predict criminal activity in young adulthood.

This study takes a broad look at the primary school precursors to criminal involvement in early adulthood. The policy issue that motivates us is whether one can predict later crime on the basis of behaviors, attention and achievement skills in the early elementary-school grades. Prior literature leads us to expect that early antisocial behaviors will be more predictive than will attention or achievement problems, and that the early persistence antisocial behavior across childhood will be the dimension that matter the most.

It is important to note that although we use data on behavior problems spanning middle childhood through late adolescence, our goals differ from those of the trajectory analysts. We seek to discover patterns in the *early* primary grades that predict to early-adult criminal outcomes. We also take a comparative perspective to assess the predictive power of an assortment of early behaviors and capacities (antisocial behavior, attention skills and achievement) in predicting later crime.

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

Data

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

National Longitudinal Study of Youth

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.

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 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 5, 7, 9, etc. and those observed at 6, 8, 10, etc.). Table 1 provides descriptive information (described below) at age for the first of these two samples and age-8 information for the second.

Beginning School Study

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

Many children attending Baltimore public schools in the early 1980s came from disadvantaged families, although not as uniformly disadvantaged as the children in many urban school districts today. Table 1 provides sample characteristics from information gathered in grades 1 and 4.

Dependent Variables

We use two measures of criminal activity as dependent variables. The NLSY provides a self-reported measure, taken at age 19 or 20, of whether the individuals had ever been arrested for a crime. Some 22-24% of the NLSY sample reported that they had been arrested. The BSS collected self-report information about whether, by age 20 or 21, a study participant has ever been incarcerated. About 16% of the BSS respondents responded affirmatively to this question.[2]

Key Predictors

For each study, we use assessments of achievement skills, specifically reading and math achievement, as well as two dimensions of problem behavior – attention problems and antisocial

[2] The reason for incarceration was not reported in the NLSY. In the BSS the vast majority of the respondents incarcerated by the age of 21 had reported previous arrests for drug/narcotic offenses (50%) or assault (37%).

behavior – as the key independent variables. These are measured every two years in the NLSY data (ages 5/6, 7/8, 9/10, 11/12). In the BSS we use assessments taken in grades 1, 2, 4 and 9.

Reading and math achievement. In the NLSY, children's academic skills (age 5/6) 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 to all children ages 5 through 13. 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 PIAT 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 & 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 reading and math PIATS are highly correlated (*r* ranges from .36 at age 13 to .60 at age 8/9).

In the BSS, math and reading skills are assessed by the California Achievement Test (CAT) reading comprehension and math concepts and application subscale (*r* between reading and math ranges from .48 in Grade 2 to .82 in Grade 4). These tests were administered by the school in May, close to the end of the school year during each year of the BSS study. The test scored based on national norms, and for the purposes of analysis, scores are standardized to have a mean of 0 and standard deviation of 1 (based on the BSS sample distribution).

Antisocial and attention behavior problems. 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 confirmatory factor analysis of the items. The process for creating these subscales and the reliability of each is reported in Baker et al. (1993). Two of the 6 behavior problem subscales are used in this study—attention problems (hyperactivity) and antisocial behavior. Given it national scope, the NLSY can be used to norm the behavior and attention scores of its various subsamples. With means close to 0 and standard deviations close to 1, it can be seen that the antisocial behavior and attention problems of our NLSY analysis samples differ little from national norms Table 1).

The attention problem and hyperactivity 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 antisocial subscale has adequate reliability (alpha of .67). The attention and antisocial subscales are highly correlated, with correlations ranging from .50 (age 5/6) to .55 (age 13).

In the BSS, information on children’s behavior was taken from teacher reports on a maturity scale administered in the spring of the school year. Teachers rated how indicative particular behaviors were of individual children, with responses ranging from 0 (“not at all like”) to 5 (“exactly like”). These measures were standardized to have a mean of 0, and standard deviation of 1 based on the BSS sample distribution.

We summed four items in the maturity scale to create an antisocial subscale. These items include: Fights too much, teases, picks on, or bullies other children; Rather high strung, tense, and nervous; Cheats, lies, is deceitful; Has a strong temper, loses it easily. The internal consistency of these items is adequate (alpha=.77, second grade). To capture inattention, we summed two items: Is awfully restless, fidgets all the time, can’t sit still; can’t concentrate, can’t pay attention for long. These two items also had adequate internal consistency (alpha=.79, second grade). The antisocial and attention problems measures are moderately correlated (*r* ranges from .56 in Grade 2 to .70 in Grade 4).

Covariates

To alleviate concerns that associations between children’s behavior and criminal involvement may be the result of omitted variable biases (e.g., Odgers, 2007), covariates are included in our empirical models. The NLSY data provides many more covariates than the BSS. Both datasets provide information on demographic family characteristics. Covariates from the NLSY data also include early childhood measures of children’s temperament, receptive language skills, the quality of family environments as well as maternal risk behaviors.

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

Maternal and interviewer reports of 2 relevant dimensions of children's temperament, sociability and compliance, are available for children at age 3 or 4.[3] The Peabody Picture Vocabulary Test- Revised (PPVT) is used to measure children's early receptive vocabulary at age 3/4. The PPVT consists of 175 vocabulary items which increase in difficulty. Nationally standardized scores are used in 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. However, some information was only consistently available when children were age 5/6 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 1).

The NLSY measures an array of child and mother background characteristics that we use as covariates. 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.

BSS covariates The BSS collected a much more limited set of background child and family characteristics in first grade. Parent report data are provided for the child's race/ethnicity (African American or white), mother's age at the child's birth, and the number of siblings in the household. Several indicators of the family's socioeconomic standing are also available including whether the primary caregiver was a single parent, both mother's and father's educational levels and occupational levels, as well as whether the child qualified for the Federal lunch subsidy program.

Comparing NLSY and BSS samples. As shown in Table 1, the unweighted NLSY sample has substantial fractions of both African-Americans and Hispanics, while the BSS sample is roughly equally divided between African-Americans and whites. Mothers' age at birth is relative young in the BSS and, especially, NLSY samples – the latter being a consequence of the sampling scheme that produces the NLSY sample children. Family sizes are slightly smaller in the NLSY than BSS.

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[3] The compliance measure was created by summing maternal ratings of the frequency of children's behavior on a five-point scale from almost never (1) to almost always (5). Taken together, the seven items capture how well the child follows directions. For example, questions include how often "the child obeys when told to go to bed" and "turns off the TV when asked." This measure has adequate reliability, with NLSY reporting the alpha of .59 for children of all ages (Baker et al., 1993). Summing 3 interviewer ratings of the child's cooperation during the assessment created the sociability scale. Children were rated on a scale of poor (1) to excellent (5). Items include, for example, the observer's rating of how cooperative the child was in completing the assessment and of the child's attitude toward being tested. This measure has a high reliability; the NSLY reports an alpha of .93 (Baker et al., 1993).Children who were age 5 or 6 in 1986 do not have early childhood measures of PPVT or temperament because the maternal and child interview was not conducted at an earlier age for these children. In addition, NLSY's restriction of the measurement of sociability to children over age 4 in 1990, resulted in a large number of missing data on this measure for children in cohort 4 that were age 3 in 1990. These data are imputed for children with missing observations.

Missing Data

The longitudinal nature of data collection results in missing data for both studies. To handle the missing data, we used multiple imputation techniques, implemented in STATA. For each study, 5 datasets were created and analyzed. This approach assumes that data were missing at random (conditional on observed characteristics).

In the NLSY, between a quarter and a third of a particular age cohort of children is missing information on 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.

For the BSS, interviewing rules limited the sample size in some years. In the Grade 2, the study only followed children attending the originally-sampled schools. This resulted in 36% missing data on social-emotional items and 20% missing data on math and reading. By fourth grade, the study was following students as long as they attended Baltimore public schools. Increased efforts to track and include all members of the original data result in lower rates of missing data in 9th grade. Finally, about 79 percent of the sample had information on incarceration at age 20 or 21.

Analysis Plan

We estimated comparable probit regression models across the NLSY and BSS data, in which later criminal involvement, specifically incarceration (BSS) and arrest (NLSY), are related to prior reading and math skills as well as attention problems and antisocial behavior. We take measures at three time points which are chosen to be roughly comparable across the datasets: age 5 (NLSY) and first grade (BSS); age 8 (NLSY) and second grade (BSS); and age 13 (NLSY) and grade nine (BSS). To facilitate interpretation for the probit models, we present marginal effects, which represent the percentage point change in the crime-related outcome associated with a one standard deviation change in the independent variable of interest.

Point-in-time Models

We first present bivariate models, in which each measure of achievement and behavior is entered by itself without any other predictors. In the absence of measurement error and suppressor variables, this specification likely provides an upper bound of the link between early academic skills and behavior on later incarceration or arrest.

A key challenge in this analysis is ensuring that we have accounted for the possibility of omitted variable bias, which is likely to arise if unobserved family or child characteristics are correlated both with children's academic skills or behavior problems and their later crime. For this reason, we include as many prior measures of relevant child and family characteristics as possible in the second model. In the BSS this is a basic set of family and child characteristics. In the NLSY the controls include a similar basic set of basic family and child characteristics, as well as measure of the child's earlier temperament and receptive language skills as well as the mother's academic aptitude and health risk behaviors. Our second model includes all of these measures but not concurrent measures of behavior and achievement. Thus, to the extent that

skills and behaviors cluster, but exert independent effects, this specification might still overstate the unique predictiveness of young children's skills and behavior.

In our third model, we remove our set of covariates and enter all four concurrent measures of children's achievement and behavior. This approach parses out variance across these differing domains, but does not hold constant family background characteristics. If the measures of reading and math skills as well as attention and antisocial behavior problems reflect prior family experiences, than this model will reduce the potential for omitted variable bias. However, we cannot be certain that the set of concurrent achievement and behavior measures captures all of the important confounds, which leaves open the possibility that this approach will still produce biased estimates.

Our final and preferred specification includes all concurrent measures of achievement and behavior as well as the full set of controls. This specification should greatly reduce the potential for omitted variable biases.

Persistence Models

Prior research has suggested that a student's trajectory of behavior problems may be a more potent predictor of later criminal activity than their level of behavior problems at any single age. To test whether the persistence of behavior problems is a stronger predictor of later attainment than early behavior, we categorized children according to their pattern of scores during the early school years (age 6, 8, 10 in the NLSY and grades 1, 2, and 4 in BSS). Based on prior empirical work we chose the 75th percentile to demark a "high" level of behavior problems. We then formed four groups: 1) *early only* – the 6.6% and 7.8% of NLSY and BSS children, respectively (see Table 2), who fell into the top quarter in the first but neither second nor third of the behavior problem distributions; ii) *persistent* – the 9.0% and 9.1% of NLSY and BSS children who fell into the top quarter on all three measurement occasions; iii) *no problems* – the 57.2% and 55.9% of NLSY and BSS children who never fell into the top quarter of the three behavior problem distributions; and iv) *mixed* – a residual group composed of the 27.3% of both NLSY and BSS children who fell into the top quarter of the behavior problem distributions at least once but did not fit either the "early only" or "persistent" profiles.

Results

Bivariate Associations

We begin by examining bivariate relationships between the crime outcomes and the four key skill and problem behavior measures at age 5 (NLSY) or during first grade (BSS) (first column of Table 3) and age 8 (NLSY) or during second grade (BSS) (first column of Table 4). In both Tables 3 and 4, the top panel shows results for the NLSY while BSS results are provided in the bottom panel. Bearing in mind that all four skill and behavior measures are standardized within the analysis samples, the .055 coefficient on parent report of antisocial behavior (the first column and row of Table 3) can be interpreted as a standard deviation increase in first grade antisocial behavior being associated with a 5.5 percentage point increase in the probability of an arrest (i.e., from 22% [see Table 1] to over 27%).

All of the bivariate coefficients shown in Tables 3 and 4 are statistically significant, in the expected direction, modest to more substantial in size and, if anything, increase across the early

primary grades. Taken together, the results support almost any modest claim regarding the simple predictiveness of early skills and behaviors for later deviancy.

Regression-adjusted Associations

Next, we estimated probit models with our set of family and child covariates included. Results in the second column of Tables 3 and 4 indicate that inclusion of covariates considerably reduce the bivariate associations, and, with the exception of antisocial behavior, usually to the point of statistical insignificance. Thus, it appears that simple associations between later crime and early primary school attention skills, reading and math achievement result largely from their mutual correlation with family circumstances and, in the case of the NLSY, possibly prior cognitive ability and temperament.

We then estimated models with measures of concurrent skills and behaviors, but not prior family and child characteristics (column 3 in Tables 3 and 4). Again, for the most part, only early antisocial behavior maintains a significant association with later crime.

Estimates presented in the fourth column of Tables 3 and 4 are derived from our preferred model of the "effects" of early skills and behaviors on crime, which adjust the bivariate associations for both concurrent skills and for prior family and child characteristics. For both the beginning (age 5 and grade 1) and middle of primary school (age 8 and grade 2), antisocial behavior has a significant and increasing effect on later crime, while none of the other measures has a statistically significant coefficient. Yet, even the statistically significant effect sizes for antisocial behavior are modest. At age 8, for example, a standard deviation increase in antisocial behavior is associated with a 3 percentage point higher probability of arrest in the NLSY.

For completeness, we also present results (in the last two columns of Tables 3 and 4) from regressions in which the behaviors are adjusted for other behaviors but not achievement, and the achievement measures are adjusted for other achievement but not behavior. Of greatest interest is the fact that the coefficients on antisocial behavior hardly change when the achievement controls are removed.

We also examined the predictive power of our behaviors and achievement measures taken towards the end of primary school – age 10 in the NLSY and 4th grade in the BSS (Table 5). Apart from the curiously small BSS effect on antisocial behavior in the most complete (fourth column) model, the results parallel those in Tables 3 and 4.

Patterns Across Childhood

With antisocial behavior emerging as the only early strong and consistent predictor of later crime, we estimated the equivalent of our full-control (column 4) model using all possible ages to measures of antisocial behaviors in two data sets. In all cases, we adjusted for prior (to kindergarten) family and child characteristics as well as concurrent attention and achievement skills. Results are displayed in Figure 1, with the height of the bar showing the coefficient estimate and the shading representing the levels of statistical significance. Interestingly, NLSY data show that a threshold of sorts appears around age 10, with effects of standard deviation increases in antisocial behaviors increasing the probability of the crime outcomes by 3-4% before age 10 and by 5-9% afterward. The single adolescent BSS observation fails to confirm such a threshold, however.

Is Persistent Early Antisocial Behavior Most Predictive?

Given that many children with behavior problems in the very early grades master the self-regulation skills needed to control them, we investigated the comparative predictive power of longitudinal patterns of behavior problems across the primary grades. Our interest is in whether it is possible to identify children at highest risk for lifelong deviancy from these early patterns.

As described above, we did this by taking the first three primary school observations on anti-social behavior in the two data sets and forming *early only*, *persistent*, *mixed* and *low* antisocial behavior problem groups. Bivariate and regression-adjusted probit estimates relating these profiles to later crime are shown for the NLSY in Table 6-8 and for the BSS in Table 9. In all cases children in the "low" antisocial behavior problem group serve as the reference category, and coefficients for the other groups show changes in the probability of the early-adult crime outcome associated with being in that group relative to the reference group.

Table 6 considers the even year cohort in the NLSY at ages 6, 8, and 10, and results provide strong evidence that children in the "early only" category are not at elevated risk of later crime, whereas children in the "persistent" and "mixed" categories clearly are. As with the earlier regression results, our preferred, full control estimates are presented in the fourth column. They show a highly significant 8.5 percentage point increase in the chance of early-adult arrest for the "mixed" group and almost a 20 percentage point increased chance relative to the low problem reference children for the "persistent" group. With baseline arrest rates, in the 22-24% range (Table 1), the latter figure amount to nearly a double chance of having been arrested by early-adulthood.

To investigate the robustness of these striking results within the NLSY sample, we ran the same analyses on the independent sample of children observed at ages 5, 7 and 9 (the odd-year cohort in the NLSY). The results, presented in Table 7, are dramatically different, with no statistically significant patterns of arrest probabilities across the four groups.

What is going on? One possibility is that the strong results for the ages 6, 8 and 10 analysis arose from chance. Another possibility, suggested by the apparent age-10 jump in the association between early behavior problems and later arrests shown in Figure 1, is that the age 6, 8 and 10 persistence pattern begins to pick up some of the more consequential antisocial behavior in early adolescence. In this case, the *persistence* dimension of early problem behavior does not raise arrest risk so much as the fact that a longitudinal definition of persistence begins to pick up the truly consequential antisocial behavior later in childhood. As an additional check on this, we estimated the NLSY arrest models on the even-year cohort using antisocial behavior measures taken at age 8, 10 and 12 (Table 8) and the odd-year cohort using the same measures at 7, 9, and 11 (Table 9). The results are a bit puzzling, with the pattern of associations for the 8-10-12 trajectories looking similar to the 6-8-10 patterns indicating that persistent antisocial behavior is strongly linked with later crime. In contrast, the 7-9-11 analysis most closely resembles the 5-7-9 patterns, indicating only at best a modest association between persistent behavior and later crime.[4]

[4] Our obsession with making sense out of the NLSY patterns led us to undertake additional analyses shown in Appendix Table 2. In the first half of Appendix Table 2 we explore whether our persistence dimension was really just reflecting high average levels of problem behavior. Being in the top quartile defined by these averages was indeed associated with a 5-7 percentage point increase in the probability of arrest, an effect that is considerably smaller than that found for the "persistent" group defined by age 6, 8 and 10 measurements. Taken together, results presented in Appendix Table 2 confirm the importance of

We turn to the BSS data, which provide an independent assessment of predictiveness of longitudinal patterns of early antisocial behavior, in this case using teacher-reported measurements at grades 1, 2 and 4. Results, presented in the fourth model in Table 10, suggest that persistence indeed appears to matter. Child reported to be in the top quartile of antisocial behavior on all three measurement occasions were 14 percentage points more likely to having been incarcerated by age 21. However, the smaller sample sizes in the BSS lead this coefficient to be, at best, at the margins of statistical significance.

Race, SES and gender differences. The relative large NLSY sample size enabled us to estimate our single year and persistence models for both Black and low-income children (defined as the bottom 25% of the average income-to-needs ratio during early childhood, corresponding to an income-to-needs ration of 1.3 or lower). Results, shown in Appendix Table 3, show few differences for these groups relative to the full-sample results discussed earlier. In contrast, the gender-based subgroup models shown in Appendix Table 4 typically show larger effects for boys than girls. For example, the persistence models show that boys with top-quartile antisocial behavior problem scores at ages 6, 8 and 10 have 23 percentage point higher incarceration probabilities than unproblematic boys. The corresponding difference for girls is only about half as large and not statistically significant at conventional levels.

BSS sample sizes limited subgroup estimates to boys and girls. Results from the single-year models for gender subgroups are presented in Appendix Table 5. Although with reduced sample sizes, the estimates are imprecise, the point estimates all suggest stronger links between antisocial behavior problems and incarceration among for boys than among girls.

Discussion

This study investigated the early academic and behavior precursors to crime in early adulthood. Our analyses of data from two large longitudinal datasets generally confirmed our hypotheses. Although all of our primary school skill and behavior measures had simple associations with arrest and incarceration, only antisocial behavior predicted later behavior problems in the presence of controls for family background and concurrent skill and behavior. Antisocial measures taken between age 5 and about 10 were modestly, but significantly predictive of later crime, with standard deviation increases in them associated with about a 3 percentage point increase in early-adult arrests or incarceration. Beyond age 10, this predictive association jumps to between 5 and 9 percentage points in our largest and most representative data set. The replication of findings across two datasets, with differing measures and populations, improves our confidence that these findings are substantively meaningful, rather than spurious.

Results indicate that the pattern of antisocial behavior overtime, particularly the *persistence* of antisocial behavior problems, was more consequential than a high level of behavior problems at any one point in time. Confirming results from prior studies, we find that many (roughly half in our two data sets) of the children starting school with high levels of antisocial behavior problems will not display such problems a few years later. Moreover, we find that children with these “early only” behavior problems are no more likely to engage in crime in their early adult years than children who never exhibit serious antisocial behavior in primary

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the longitudinal dimension of elevated problem behaviors for the prediction of early-adult crime outcomes.

school. At the risk of pushing our data a bit, it appears that even persistent antisocial behaviors in primary school that end before about age 10 do not increase risks of later crime significantly.

This raises an important question about what creates a pattern of early, but not persisting, antisocial behavior. One simple, but likely incomplete explanation is that this pattern arises purely from chance measurement (or data entry) error. In the second panel of Appendix Table 2 we tested whether the persistence dimension merely reflected the reduction in measurement error that comes from averaging multiple longitudinal measurements. The idea here is that if measurement error reduction is driving the results, then defining high behavior problems using, say, proximal age 5 and 7 measures should be just as predictive as definitions based on age 5 and 9 measurements. Results show that averages of more distant measurements consistently out predict more proximal measurements, suggesting that measurement error alone is not likely to explain the relative prediction of the "persistent" vs. "early only" characterization.

An alternative explanation is that these children's self-regulation and control skills simply mature at a later age compared with other children. If this is the case, then remediation for these "short termers" may be warranted because of the immediate consequences (e.g., disrupted classrooms) of their behaviors, but intervention does not appear to be justified by the costs of any heightened chance of lifelong crime.

Finally, such an early pattern may result from the direct intervention of parents, teachers, or other professionals. In this light, the lack of an association between early only antisocial behavior problems and later crime is evidence that children's behavior problems are malleable and can be effectively remediated by intervention. Indeed, one of the key predictors of persistent behavior problem trajectories if family risk, suggesting that these children's behavior problems may be inadvertently reinforced by their environments. One way to adjudicate between the maturation and intervention explanation is to consider differences in the quality of parenting that children experience as well as the rate at which parents report seeking professional help for their children's behavior problems across the "early only" and the "persistent" category. We hope to consider this in our future work with NLSY.

Our analysis of the even cohort of NLSY children (ages 6, 8, 10, 12) suggests that antisocial behaviors that started early and persisted beyond age 10 or 11 were strongly linked with later crime. Indeed, boys in this category had a 10 percentage point higher chance of having been arrested by age 21 than did boys showing early but not persistent antisocial behaviors, and a 23 percentage point high chance arrests relative to boys who exhibited no antisocial behavior in the early primary grades. Yet, our analysis of the odd year cohort (ages 5, 7, 9, 11) failed to replicate this strong pattern of prediction from high levels of persisting anti-social behavior to later crime. This is a bit puzzling as prior studies have found that life-course persistent antisocial behavior is an important precursor of criminal involvement. We are uncertain what might account for the difference in findings across cohorts, other than chance, but we will try to better understand this inconsistency in future work.

It is important to note several limitations of this study. First, we chose to consider associations with only two (imperfect) measures of crime. Our outcomes capture not only criminal behavior, but also involvement with the criminal justice system, which may bias our findings in several important ways. Thus, we hope to extend our work to include other relevant outcomes that capture criminal activity, but do not reflect involvement with the justice system. In particular, we hope to replicate our findings with Infant Health and Development Program

(IHDP) data which collected information on arrests and incarceration, but also included a collection of self-report items that measure criminal or delinquent behaviors.

A second limitation is that the measures of behavior typically had relatively low levels of internal consistency, particularly in comparison to our measures of achievement. This may have limited our ability to detect effects by attenuating associations. We hope to explore this possibility further in future research. Finally, we will also explore whether the use of multiple imputation affected our findings.

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

	Mean (SD) or %, NLSY, Age 5 Sample	Mean (SD) or %, NLSY, Age 8 Sample	Mean (SD) or %, BSS, Grade 1	Mean (SD) or %, BSS, Grade 4
Outcomes				
Arrests	22%	24%	---	---
Incarceration by Age 21	---	---	16%	16%
Key Independent Variables				
Externalizing/Antisocial	-.03 (.96)	.03 (1.03)	2.25 (3.64)	3.03 (4.07)
Attention	-.02 (.98)	.00 (1.01)	2.32 (2.90)	2.47 (2.57)
Reading	.13 (1.13)	.03 (1.03)	339.7 (45.2)	452.9 (71.1)
Math	-.06 (1.08)	-.02 (1.04)	340.9 (36.5)	444.4 (55.8)
Demographic Characteristics				
Male	52%	49%	50%	50%
African American	30%	31%	55%	55%
Hispanic	21%	22%	---	---
Age 0-5: Years in Poverty	.18 (.27)	.19 (.28)	---	---
SES Composite	---	---	-.05 (.80)	-.05 (.80)
Family Characteristics				
Age 0-5: Years Never Married	.24 (.40)	.25 (.41)	---	---
Age 0-5: Years Divorced	.12 (.26)	.13 (.26)	---	---
Single Parent	---	---	34%	34%
Mothers Age at Child's Birth	22.5(3.0)	21.8(3.0)	23.9 (5.6)	23.9 (5.6)
Age 0-5: Ave # Children	2.21 (1.04)	2.25 (1.08)	---	---
Number of Siblings	---	---	1.5 (1.4)	1.5 (1.4)

BSS Notes:
"Externalizing" is the sum of 4 items, scaled 0-5.
"Attention" is the sum of 2 items, scaled 0-5.
Reading and Math scores are from the California Achievement Test.
Background characteristics were typically collected in Grade 1.
SES Composite includes parents' education levels, occupational levels, and whether or not the child qualified for a subsidized lunch.

NLSY Notes:
"Antisocial" is originally scaled 0-6, then standardized.
"Attention" is originally scaled 0-5, then standardized.
Reading and Math scores are also standardarized.

Table 2. **Percent of NLSY and BSS Sample in each Antisocial Behavior Category**

	NLSY	BSS
Early	6.6%	7.8%
Miscellaneous	27.3%	27.3%
Persistent	9.0%	9.1%
Low	57.2%	55.9%
Sample Size	1,887	838

Note: NLSY captures persistence across ages 6, 8, & 10.
BSS captures persistence across grades 1, 2, and 4.
Thresholds set at 75th percentile.

Table 3. **Probit Regressions of Crime on Age 5 and Grade 1 Achievement and Behavior**

	(1)	(2)	(3)	(4)	(5)	(6)
	NLSY, Age 5 Predictors (*N*=2,005) Dependent Variable: Ever Arrested					
Problem Behavior						
Antisocial, parent report	.055***	.040**	.038**	.036**	.037**	
	(.010)	(.010)	(.012)	(.012)	(.012)	
Attention, parent report	.047***	.024	.023	.006	.007	
	(.014)	(.015)	(.018)	(.018)	(.017)	
Academic Achievement						
Reading	-.033**	-0.015	-.019	-.006		-.010
	(.011)	(.013)	(.012)	(.013)		(.013)
Math	-.028**	-.017	-.011	-.014		-.013
	(.010)	(.011)	(.011)	(.011)		(.012)
Controls		yes		yes	yes	yes
	BSS, Grade 1 Predictors (*N*=838) Dependent Variable: Ever Incarcerated					
Problem Behavior						
Externalizing, teacher report	.083***	.046***	.061***	.033*	.033*	
	(.013)	(.011)	(.016)	(.013)	(.014)	
Attention, teacher report	.077***	.044***	.035†	.021	.023	
	(.014)	(.012)	(.019)	(.017)	(.015)	
Academic Achievement						
Reading	-.028†	-.006	-.006	.006		.004
	(.015)	(.013)	(.019)	(.015)		(.015)
Math	-.040**	-.024†	-.012	-.012		-.026
	(.015)	(.014)	(.020)	(.019)		(.017)
Controls		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships.

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

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

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

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

Table 4. **Probit Regressions of Crime on Age 8 and Grade 2 Predictors**

	(1)	(2)	(3)	(4)	(5)	(6)
	NLSY, Age 8 Predictors (*N*=1,840) Dependent Variable: Ever Arrested					
Problem Behavior						
Antisocial, parent report	.068***	.029**	.060***	.032*	.033*	
	(.011)	(.011)	(.013)	(.013)	(.013)	
Attention, parent report	.043***	.010	.0001	-.007	-.007	
	(.012)	(.011)	(.015)	(.014)	(.014)	
Academic Achievement						
Reading, age 8	-.049***	-.008	-.033*	.003		-.007
	(.011)	(.013)	(.013)	(.014)		(.014)
Math, age 8	-.033**	-.003	-.002	-.001		.0003
	(.010)	(.013)	(.012)	(.013)		(.013)
Controls		yes		yes	yes	yes
	BSS, Grade 2 Predictors (*N*=838) Dependent Variable: Ever Incarcerated					
Problem Behavior						
Externalizing, teacher report	.090***	.046***	.073**	.041*	.044**	
	(.012)	(.011)	(.021)	(.018)	(.015)	
Attention, teacher report	.070***	.031*	.018	.007	.004	
	(.015)	(.012)	(.023)	(.018)	(.016)	
Academic Achievement						
Reading	-.061***	-.012	-.023	.010		.003
	(.015)	(.013)	(.018)	(.016)		(.016)
Math	-.055**	-.025†	-.022	-.024		-.027†
	(.016)	(.013)	(.019)	(.015)		(.016)
Controls		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships.

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

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

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

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

Table 5. **Probit Regressions of Crime on Age 10 and Grade 4 Predictors**

	(1)	(2)	(3)	(4)	(5)	(6)
	NLSY, Age 10 Predictors (*N*=1,778) Dependent Variable: Ever Arrested					
Problem Behavior						
Antisocial, parent report	.090***	.053***	.094***	.065***	.065***	
	(.012)	(.013)	(.014)	(.016)	(.017)	
Attention, parent report	.043***	.009	-.016	-.022	-0.025	
	(.012)	(.013)	(.015)	(.016)	(.016)	
Academic Achievement						
Reading, age 8	-.045***	-.001	-.040*	-.009		-.012
	(.012)	(.016)	(.017)	(.021)		(.020)
Math, age 8	-.016	.015	.021	.022		0.021
	(.011)	(.015)	(.015)	(.019)		(.020)
Controls		yes		yes	yes	yes
	BSS, Grade 4 Predictors (*N*=838) Dependent Variable: Ever Incarcerated					
Problem Behavior						
Externalizing	.068***	.028*	.048*	.026	.030	
	(.014)	(.013)	(.022)	(.019)	(.019)	
Attention	.062***	.019	.008	-.009	-.002	
	(.016)	(.017)	(.029)	(.028)	(.025)	
Academic Achievement						
Reading	-.066***	-.023†	-.040	.008		.006
	(.014)	(.014)	(.032)	(.025)		(.025)
Math	-.058***	-.031*	-.002	-.031		-.035
	(.014)	(.013)	(.033)	(.025)		(.024)
Controls		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships.

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

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

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

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

Table 6. **Probit Regressions Ever Arrested on Patterns of Antisocial Behavior at ages 6, 8, and 10, NLSY (N=1,887)**

	(1)	(2)	(3)	(4)	(5)	(6)
Patterns of Antisocial Behavior (Ages 6,8,10)						
Early	.114†	0.05	.092	.052	.047	
	(.058)	(.057)	(.060)	(.058)	(.056)	
Mixed	.152**	.083***	.137***	.085**	.083**	
	(.026)	(.026)	(.026)	(.028)	(.026)	
Persistent	.327**	.186***	.299***	.196***	.190***	
	(.046)	(.054)	(.054)	(.061)	(.055)	
Attention, Age 6	.049***	.013	.011	-.005		.013
	(.011)	(.011)	(.013)	(.013)		(.011)
Reading, Age 6	-.055***	-.016	-.044**	-.023	-.022	-.023
	(.016)	(.020)	(.021)	(.024)	(.023)	(.023)
Math, Age 6	-.030*	.008	.007	.021	.021	.018
	(.012)	(.013)	(.017)	(.016)	(.016)	(.016)
Background characteristics		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships (with the exception of rows 1-3, which are entered simultaneously).

Column 2 repeats Column 1, but controlling for background characteristics.

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

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

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

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

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

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

Table 7. **Probit Regressions of Ever Arrested on Patterns of Antisocial Behavior at ages 5,7, and 9, NLSY (N=1,642)**

	(1)	(2)	(3)	(4)	(5)	(6)
Patterns of Antisocial Behavior (Ages 5,7,9)						
Early	.020	.021	-.004	.009	.019	
	(.051)	(.053)	(.048)	(.050)	(.053)	
Mixed	.108**	0.053†	.082*	.044	.051	
	(.033)	(.031)	(.034)	(.033)	(.032)	
Persistent	.173**	.079	.117*	.057	.075	
	(.051)	(.049)	(.059)	(.056)	(.049)	
Attention, Age 5	.046**	.023	.026	.015		.022
	(.015)	(.016)	(.018)	(.018)		(.016)
Reading, Age 5	-.032**	-.017	-.017	-.009	-.011	-.010
	(.011)	(.016)	(.013)	(.016)	(.016)	(.016)
Math, Age 5	-.026*	-.017	-.008	-.012	-.012	-.012
	(.011)	(.012)	(.012)	(.012)	(.012)	(.012)
Background Characteristics		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships (with the exception of rows 1-3, which are entered simultaneously).

Column 2 repeats Column 1, but controlling for background characteristics.

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

"Early" reflects cases above the 75th percentile at Age 5 only.

"Persistent" reflects cases above the 75th percentile at Ages 5, 7, and 9.

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

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

Table 8. **Probit Regressions of Arrests on Patterns of Antisocial Behavior at ages 8,10, and 12, NLSY (N=1,642)**

	(1)	(2)	(3)	(4)	(5)	(6)
Patterns of Antisocial Behavior (Ages 8,10,12)						
Early	.097	.062	.088	.063	.065	
	(.074)	(.067)	(.069)	(.065)	(.065)	
Mixed	.186***	.113**	.166***	.111**	.113**	
	(.036)	(.038)	(.038)	(.039)	(.039)	
Persistent	.363***	.226***	.328***	.225***	.229***	
	(.049)	(.057)	(.055)	(.061)	(.058)	
Attention, Age 5	.056***	.021†	.020	.005		.021†
	(.012)	(.012)	(.013)	(.013)		(.012)
Reading, Age 5	-.060***	-.020	-.043†	-.025	-.026	-.025
	(.018)	(.024)	(.023)	(.027)	(.027)	(.027)
Math, Age 5	-.041**	.003	.005	.020	.020	.015
	(.015)	(.016)	(.019)	(.018)	(.018)	(.018)
Background Characteristics		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships (with the exception of rows 1-3, which are entered simultaneously).

Column 2 repeats Column 1, but controlling for background characteristics.

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

"Early" reflects cases above the 75th percentile at Age 8 only.

"Persistent" reflects cases above the 75th percentile at Ages 8, 10, and 12.

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

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

Table 9. **Probit Regressions of Ever Arrested on Patterns of Antisocial Behavior at ages 7, 9 and 11, NLSY (N=1,610)**

	(1)	(2)	(3)	(4)	(5)	(6)
Patterns of Antisocial Behavior (Ages 7,9, 11)						
Early	-.063	.037	.052	.028	.032	
	(.058)	(.060)	(.062)	(.061)	(.060)	
Mixed	-.159***	.073*	.109**	.067†	.071†	
	(.025)	(.037)	(.040)	(.039)	(.036)	
Persistent	-.294***	.099†	.183***	.088	.095†	
	(.051)	(.052)	(.055)	(.057)	(.053)	
Attention, Age 5	.045**	.019	.019	.009		.018
	(.015)	(.016)	(.017)	(.018)		(.016)
Reading, Age 5	-.038**	-.019	-.022	-.002	-.013	-.013
	(.013)	(.017)	(.014)	(.017)	(.017)	(.017)
Math, Age 5	-.028*	-.017	-.006	-.012	-.012	-.012
	(.011)	(.013)	(.012)	(.012)	(.012)	(.012)
Background Characteristics		yes		yes	yes	yes

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

Probit model coefficients and standard errors are "marginal effects" -- percentage point changes
in the probability of high school completion associated with unit changes in the given independent variable
Column 1 coefficients represent simple bivariate relationships (with the exception of rows 1-3, which are entered simultaneously).
Column 2 repeats Column 1, but controlling for background characteristics.
Column 3 include concurrent but not background controls.
Columns 4-6 include all covariates simultaneously.
"Early" reflects cases above the 75th percentile at Age 7 only.
"Persistent" reflects cases above the 75th percentile at Ages 7, 9, and 11.
"Miscellaneous" reflects cases above the 75th percentile for at least 1 timepoint, excluding the "Early" and "Persistent" patterns.
NLSY controls include a rich set of child and mother characteristics, children's temperament
at age 3/4, the Peabody Picture Vocabulary Test- Revised (PPVT) at age 3/4, and family charateristics
between birth and age 5 and at age 5/6.

Table 10. **Probit Regressions of Incarceration on Patterns of Externalizing Behavior in grades 1,2, and 4,BSS (N=838)**

	(1)	(2)	(3)	(4)	(5)	(6)
Patterns of Externalizing Behavior (grades 1,2, & 4)						
Early	.134	.090	.094	.061	.085	
	(.086)	(.082)	(.081)	(.076)	(.079)	
Mixed	.150***	.082*	.117**	.063†	.079*	
	(.039)	(.034)	(.041)	(.034)	(.035)	
Persistent	.406***	.213**	.297**	.139†	.205**	
	(.068)	(.068)	(.086)	(.073)	(.071)	
Attention, Grade 1	.077***	.044***	.037†	.024		.042**
	(.014)	(.012)	(.019)	(.016)		(.014)
Reading, Grade 1	-.028†	-.006	.000	.009	.007	.008
	(.015)	(.013)	(.019)	(.015)	(.015)	(.015)
Math, Grade 1	-.040**	-.024†	-.011	-.011	-.017	-.011
	(.015)	(.014)	(.020	(.019)	(.016)	(.019)
Background characteristics		yes		yes	yes	yes

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

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

Column 1 coefficients represent simple bivariate relationships (with the exception of rows 1-3, which are entered simultaneously).

Column 2 repeats Column 1, but controlling for background characteristics.

Column 3 include concurrent but not background controls.

Columns 4-6 include all covariates simultaneously.

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

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

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

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

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

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

Also included as controls are indicators for cohort membership (86,88, or 90-- 92 is the reference category.

***Appendix Table 2*. Summary of Marginal Effects from Probit Regressions of Crime, NLSY**

	M 1	M 2	M 3	M 4	M 5	M 6
Antisocial, Early	.009	.052	.028			
	(.050)	(.058)	(.061)			
Antisocial, Miscellaneous	.044	.085**	.067†			
	(.033)	(.028)	(.039)			
Antisocial, Persistent	.057	.196***	.088			
	(.056)	(.061)	(.057)			
Average Antisocial, age 5, 7, and 9				.047**		
				(.016)		
Average Antisocial, age 6, 8, and 10					.069***	
					(.018)	
Average Antisocial, age 7, 9, and 11						.049**
						(.017)
Attention, age 5/6	.015	-.005	.009	.006		.004
	(.018)	(.013)	(.018)	(.019)		(.018)
Reading, age 5/6	-.009	-.023	-.012	-.009	-.012	-.012
	(.016)	(.024)	(.017)	(.016)	(.013)	(.017)
Math, age 5/6	-.012	.021	-.012	-.012	-.021	-.012
	(.012)	(.016)	(.012)	(.012)	(.023)	(.012)
Background characteristics	yes	yes	yes	yes	yes	yes
N	1642	1887	1610	1642	1887	1610

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

M1: age 5, 7, and 9; M2: age 6, 8, and 10; M3: age 7, 9, and 11; M4: average antisocial over age 5, 7 , and 9; M5: average antisocial over age 6, 8, and 10; M6: average antisocial over age 7, 9, and 11

***Appendix Table 2*. Summary of Marginal Effects from Probit Regressions of Crime, NLSY (Continued)**

	M 7	M 8	M 9	M 10	M 11	M 12	M 13
Average Antisocial, age 5 and 7	.037*						
	(.016)						
Average Antisocial, age 5 and 9		.050**					
		(.016)					
Average Antisocial, age 6 and 8			.052***				
			(.016)				
Average Antisocial, age 6 and 10				.065***			
				(.019)			
Average Antisocial, age 7 and 9					.035*		
					(.014)		
Average Antisocial, age 7 and 11						.045*	
						(.018)	
High Average Antisocial, age 6, 8, and 10							.225***
							(.062)
Middle Average Antisocial, age 6, 8, and 10							.068*
							(.031)
Attention, age 6	.008	.003	-.007	-.012	.009	.005	-.009
	(.019)	(.018)	(.013)	(.013)	(.017)	(.018)	(.013)
Reading, age 6	-.010	-.009	-.023	-.021	-.012	-.012	-.024
	(.016)	(.016)	(.023)	(.023)	(.017)	(.017)	(.024)
Math, age 6	-.012	-.012	.020	.019	-.012	-.011	.021
	(.012)	(.012)	(.016)	(.016)	(.012)	(.012)	(.016)
Background characteristics	yes	yes	yes	yes	yes	yes	yes
N	1642	1642	1887	1887	1610	1610	1887

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

M7: average antisocial over age 5 and 7; M8 : average antisocial over age 5 and 7;
M9 : average antisocial over age 5 and 7; M10 : average antisocial over age 6 and 10;

***Appendix Table 3*. Summary of Marginal Effects from Probit Regressions of Crime-- Black and Low income subgroups, NLSY**

	Age 5		Age 8		Age 10		Age 6, 8, 10	
	black	**low income**	**black**	**low income**	**black**	**low income**	**black**	**low income**
Problem Behavior								
Antisocial, parent-report, age 5, 8	.037†	.082*	.052*	.035	.059**	.067*		
	(.021)	(.031)	(.025)	(.034)	(.025)	(.033)		
Antisocial, Early							.094	.060
							(.110)	(.134)
Antisocial, Mixed							.045	.057
							(.051)	(.071)
Antisocial, Persistent							.290**	.148
							(.113)	(.102)
Attention, parent-report, age 5, 8 (age6)	.005	-.029	-.011	-.021	-.012	-.034	.0004	.007
	(.020)	(.031)	(.023)	(.031)	(.024)	(.037)	(.022)	(.031)
Achievement Skills								
Reading, age 5, 8 (age 6)	-.006	-.028	-.016	-.005	-.034	-.017	-.051	-.005
	(.023)	(.032)	(.031)	(.038)	(.031)	(.039)	(.037)	(.055)
Math, age 5, 8 (age 6)	-.040†	-.019	-.002	-.020	.046	.019	.054*	-.024
	(.021)	(.032)	(.025)	(.036)	(.028)	(.043)	(.026)	(.039)
Background characteristics	yes	yes	yes	yes	yes	yes	yes	yes
N	602	484	576	461	560	454	604	477

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

Appendix Table 4 **. Marginal Effects from Probit Regressions of Crime, Gender Subgroups, NLSY**

	Age 5		Age 8		Age 10		Age 6, 8, 10	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Problem Behavior								
Antisocial, parent-report, age 5, 8	.034†	.037*	.041*	.024	.087***	.041*		
	(.019)	(.015)	(.020)	(.018)	(.022)	(.021)		
Antisocial, Early							.124	-.028
							(.093)	(.054)
Antisocial, Miscellaneous							.085†	.092*
							(.045)	(.039)
Antisocial, Persistent							.229***	.131
							(.071)	(.088)
Attention, parent-report, age 5, 8 (age6)	.028	-.014	-.006	-.008	-.044*	-.001	-.021	.012
	(.024)	(..017)	(.024)	(.016)	(.021)	(.022)	(.020)	(.014)
Achievement Skills								
Reading, age 5, 8 (age 6)	-.016	.004	-.017	.002	-.030	.009	-.027	-.022
	(.020)	(.014)	(.030)	(.019)	(.038)	(.018)	(.030)	(.025)
Math, age 5, 8 (age 6)	-.020	-.008	.014	-.009	.035	.014	.027	.016
	(.019)	(.015)	(.021)	(.018)	(.032)	(.018)	(.025)	(.018)
Background characteristics	yes	yes	yes	yes	yes	yes	yes	yes
N	1047	958	905	931	882	896	936	951

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

Appendix Table 5. **Marginal Effects from Probit Models of Incarceration, Gender Subgroups BSS**

	Grade 1, Boys	Grade 1, Girls	Grade 2, Boys	Grade 2, Girls	Grade 4, Boys	Grade 4, Girls
Problem Behavior						
Externalizing	.056†	.012	.079*	.012	.072	.010
	(.032)	(.007)	(.039)	(.008)	(.044)	(.008)
Attention	.057	.002	.029	.004	-.065	-.003
	(.038)	(.006)	(.041)	(.008)	(.064)	(.011)
Academic Achievement						
Reading	.001	-.001	.052	.005	-.042	.002
	(.030)	(.005)	(.044)	(.007)	(046)	(.008)
Math	-.031	-.005	-.066†	-.0004	-.053	-.009
	(.032)	(.006)	(.039)	(.008	(.058)	(.009)
Controls	yes	yes	yes	yes	yes	yes

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

30% of males and 4% of females had been incarcerated by Age 21;

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

Figure 1: Marginal effects estimates of externalizing or antisocial behavior on the likelihood of arrest or incarceration