

# **Mental Health in Childhood and Human Capital**

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### **Abstract:**

Although mental disorders are common among children, we know little about their long term effects on child outcomes. This paper examines U.S. and Canadian children with symptoms of Attention Deficit Hyperactivity Disorder (ADHD), depression, conduct disorders, and other behavioral problems. Our work offers a number of innovations. First we use large nationally representative samples of children from both countries. Second, we focus on “screeners” that were administered to all children in our sample, rather than on diagnosed cases. Third, we address omitted variables bias by estimating sibling-fixed effects models. Fourth, we examine a range of outcomes. Fifth, we ask how the effects of mental health conditions are mediated by family income and maternal education. We find that mental health conditions have large negative effects on future test scores and schooling attainment, regardless of family income and maternal education.

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The prevalence and importance of child mental health problems have been increasingly recognized in recent years. The MECA Study cited in the 1999 U.S. Surgeon General's Report on Mental Health states that approximately one in five children and adolescents in the U.S. exhibit some impairment from a mental or behavioral disorders, 11 percent have significant functional impairments, and 5 percent suffer extreme functional impairment. (Shaffer et al., 1996; U.S. DHHS, 1999).<sup>1</sup> These are very large numbers of children.

It is surprising then that there is relatively little longitudinal research documenting the long-term effects of children's mental health problems, and virtually no research attempting to identify the types of mental health problems that are most deleterious to children's future prospects. Instead, most studies assume that childhood mental health problems will have negative effects and work to document the prevalence of these conditions, examine the efficacy of specific interventions (usually in small and non-experimental settings), or examine the factors that might be related to the development of mental health conditions.

Our work aims to fill this gap in the literature by examining the relationship between several common mental health conditions and future outcomes using large samples of children from the Canadian National Longitudinal Survey of Children and Youth (NLSCY), and the American National Longitudinal Survey of Youth (NLSY). The most common mental health disorders of childhood are anxiety and mood disorders such as depression, and what the Surgeon general's report refers to as "disruptive disorders". ADHD is the largest single diagnosis within the second category followed by aggression or conduct disorders. Hence, we examine indicators

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<sup>1</sup> MECA stands for "Methodology for Epidemiology of Mental Disorders in Children and Adolescents". Similarly, Offord et al. (1987) report that in the Canadian province of Ontario, 18% of children have moderate to severe emotional or behavioral problems.

for these three types of disorders (depression/anxiety, ADHD, and conduct disorders) in addition to a more general index of behavior problems.

Our work makes several contributions to the existing literature. First, we use “screeener” questions that were asked of all children. It is problematic to rely on diagnosed cases, because mental illness may be either over-diagnosed (if for example parents seek to justify their child’s poor outcomes, or schools have incentives to get low achieving children into special education, Cullen (2003)) or under-diagnosed (given stigma) relevance to its true prevalence. Screener questions focus on specific behaviors that are not linked to any specific mental condition in the questionnaires, and hence are less likely to yield biased responses. While a high score on a screening questionnaire is not equivalent to a clinical diagnosis, in most cases the first step in diagnosing a mental illness would be to administer such a screener to the parents of the troubled child.

Second, existing longitudinal studies that examine the effects of mental health conditions on child outcomes suggest that they are associated with significantly worse outcomes. But it is possible that poorer outcomes reflect other problems suffered by children with these conditions (or possibly even the effects of other problems which contributed to their poor mental health). For example, in the U.S., the estimated prevalence of ADHD is almost twice as high in families with income less than \$20,000 compared to families of higher income (Cuffe et al. 2003).<sup>2</sup> The Surgeon General’s report concludes that the risk of developing a mental health disorder is higher for children who are prenatally exposed to drugs, alcohol or tobacco, low birth weight children, and those who suffer from abuse or exposure to traumatic events. All of these circumstances are

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<sup>2</sup> Other studies that find a relationship between income and ADHD prevalence include: Korenman, Miller and Sjaastad (1995), McLeod and Shanahan (1993) Dooley et al., (1998), Dooley and Stewart (2003), Phipps and Curtis (2003), and Lipman et al. (1994).

more likely in poor families and may have independent effects on child outcomes. Hence, we use sibling comparisons in order to try to control for omitted factors that might be correlated with both poorer outcomes and mental health conditions.

Third, poor children with mental health conditions may also receive less effective treatment than other children, and thus be at “double jeopardy” for ill effects. Hence, we ask whether the effects of mental health conditions differ by family income, or by mother’s education.

We find that behavior problems have a large negative effect on future educational outcomes. The most consistent effects across the two countries are found for ADHD. In models that include sibling fixed effects, anxiety/depression is found to increase grade repetition but has no effect on the other outcomes we examine (such as test scores), suggesting that depression acts through a mechanism other than decreasing cognitive performance. Conduct disorders are also found to have broadly negative effects in the U.S., while in Canada, they reduce the probability that 16-19 year old youths are in school but do not have significant effects on other outcomes. We find no evidence that these effects are modified by family income or maternal education. Our results are robust to excluding children with other diagnosed learning disabilities, and to different ways of handling treated children.

## **II. Background**

Three strands of the previous literature are relevant to our study. First, and perhaps most similar to our work, are studies that look at the longer term consequences of behavior problems in relatively large samples. Kessler et al. (1995) uses data from the U.S. National Comorbidity Study which surveyed 8,098 respondents 15 to 54 years old from 1990 to 1992 and assessed their

current psychiatric health as well as collecting information about past diagnoses of mental problems. Using retrospective questions about onset, they find that those with early onset psychiatric problems were less likely to have graduated from high school or attended college.

Farmer (1993, 1995) uses data from the British National Child Development Survey (the NCDS) which follows the cohort of all British children born in a single week in March 1958, to examine the consequences of childhood “externalizing” behavioral problems on men’s outcomes at age 23. She finds that children who fell into the top decile of an aggregate behavior problems score at ages 7, 11, or 16 had lower educational attainment, earnings and probabilities of employment at age 23.<sup>3</sup> Gregg and Machin (1998) also use the NCDS data and find that behavioral problems at age 7 are related to poorer educational attainment at age 16, which in turn is associated with poor labor market outcomes at ages 23 and 33.

A similar study of a cohort of all New Zealand children born between 1971 and 1973 in Dunedin found that those with behavior problems at age 7 to 9 were more likely to be unemployed at age 15 to 21 (Caspi et al., 1998). Miech et al. (1999) examine adolescents from this cohort who met diagnostic criteria for four types of disorders: anxiety, depression, hyperactivity, and conduct disorders when they were evaluated at age 15, and who were followed up to age 20. They find that youths with hyperactivity and conduct disorders obtained significantly less schooling, while anxiety and depression had little effect on schooling levels.

More recently, McLeod and Kaiser (2004) use the NLSY data to show that children who had behavior problems at ages 6 to 8 are less likely to graduate from high school or to attend college, even after conditioning on maternal characteristics. Like Miech et al. they find that in

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<sup>3</sup> Her regressions control for parent’s aspirations for the child, the type of school attended, the ability group of the child, and whether they are in special education. Hence, her analysis attempts to measure the effects of externalizing behavior over and above its effects on these determinants of educational attainment.

models that included both “internalizing” and “externalizing” behavior problems, only the latter were significant predictors of future outcomes. One limitation of this study is that it focuses on a relatively small number of children who, given the design of the NLSY, were born primarily to young mothers.

Several studies focus on particular “externalizing” mental health conditions. Mannuzza and Klein (2000) review three studies of the long-term outcomes of children with ADHD. In one study, children diagnosed with ADHD were matched to controls from the same school who had never exhibited any behavior problems and had never failed a grade; in a second study, controls were recruited at the 9-year follow up from non-psychiatric patients in the same medical center who had never had behavior problems; and in a third study, ADHD children sampled from a range of San Francisco schools were compared to non-ADHD children from the same group of schools.

These comparisons consistently show that the ADHD children had worse outcomes in adolescence and young adulthood than control children. For example, they had completed less schooling and were more likely to have continuing mental health problems. However, by excluding children with any behavior problems from the control groups, the studies might overstate the effects of ADHD. Also, the studies do not address the possibility that the negative outcomes might be caused by other factors related to a diagnosis of ADHD, such as poverty, the presence of other learning disabilities, or the fact that many people diagnosed with ADHD end up in special education.<sup>4</sup>

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<sup>4</sup> These studies do not address the question of whether outcomes were better for ADHD children who were treated—in fact, there appears to be virtually no research examining the longer-term effects of treatment on achievement (Wigal et al., 1999).

Currie and Stabile (2006) address these problems by examining the effects of ADHD in sibling fixed effects models. This study builds on the previous one by considering a broader range of mental health problems that might be correlated with ADHD (and so might have contributed to the estimated effects of ADHD in our previous paper).

Perhaps the most widely known studies of the long-term effects of aggression or conduct disorders are associated with Richard Tremblay who tracked a group of 1037 boys from Kindergarten to age 15 in Montreal, Canada. He found that boys that were highly aggressive in Kindergarten were much more likely to be persistently aggressive, and that this was most true of children of young or less educated mothers (c.f. Nagin and Tremblay, 1999). Campbell et al. (2006) use data from the NICHD Study of Early Child Care and Youth Development to track children from 24 months to 12 years of age, and find that children who persist in moderate or high levels of physical aggression past Kindergarten have higher levels of externalizing problems as pre-teens.

A third strand of related research examines the importance of “non-cognitive skills”. For example, Blanden, Gregg, and Macmillan (2006) ask whether rising returns to non-cognitive skills can explain growing income inequality. In their analysis of the 1958 and 1970 British birth cohort data sets, they include characteristics such as “hyper” and “anxious” as well as measures such as “self esteem” and “extrovert” as measures of non-cognitive skills and find that rising returns to positive mental characteristics does indeed account for some of the increase in inequality between the two cohorts. However, Heckman, Stixrud, and Urzua (2006) conceptualize non-cognitive skills as innate traits (similar to native ability) and measure them using the Rotter Locus of Control Scale and the Rosenberg Self Esteem Scale. They conclude that such non-cognitive skills are important determinants of academic and economic success. It



seems clear that these measures of non-cognitive skills are likely to capture some aspects of mental health as well as innate character traits. In this paper, we focus on identifiable mental health problems, and their long-term impacts.

Our work differs from previous work using longitudinal data sets by emphasizing sibling fixed-effects models to control for omitted variables bias, and by examining interactions between parental SES and the impact of mental health conditions. Fixed effects methods offer a powerful way to control for unobserved or imperfectly measured characteristics of households that might be associated with both with a higher probability of both mental health problems and with outcomes. We also investigate outcomes in a more recent cohort of children than many of the previous studies, and offer a comparison between the U.S. and Canada.

The comparison between the U.S. and Canada is interesting because one might expect the underlying propensities to have mental health conditions to be similar in the U.S. and Canada although the reported incidence of diagnosed mental health conditions is lower in Canada and children are less likely to be treated for mental health conditions in Canada than in the United States.<sup>5</sup> Hence, it is of interest to see whether these conditions have similar effects on the prospects of children in the two countries. Moreover, the conditions we focus on are measured

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<sup>5</sup> Currie and Stabile (2006) report that both the NLSY and the NLSCY have information about drug and psychiatric treatment for mental health conditions. In 1994, only 1.4 percent of the Canadian children reported drug treatment compared to 3.3 percent of the American children. The NLSCY asks specifically about Ritalin, tranquilizers and nerve pills, whereas the NLSY asks a more general question about medications used to control activity levels or behavior. The Canadian children were also less likely to have seen a psychiatrist, resulting in overall treatment rates of 4.7 percent compared to 9.6 percent for the American children. These differences in mean rates of treatment are surprising in view of differences in the insurance regimes in the two countries: In Canada, psychiatric treatment is covered under public health insurance, and all of the provinces have drug plans for low-income families. In the U.S., many private insurance plans severely restrict the coverage of mental health treatment, and Medicaid (the public system of health insurance for low income children) offers only limited coverage of psychiatric treatment. The low treatment rates in Canada may reflect greater stigma attached to mental illness, less faith in the efficacy of treatment, or both.

slightly differently in the two countries, so the comparison also offers a way to determine whether the results are sensitive to slight differences in the screener questions used.

### **3. Data**

We use data from the Canadian National Longitudinal Survey of Children and Youth (NLSCY) and from the American NLSY. The NLSCY is a national longitudinal data set which surveyed 22,831 children ages 0 to 11 and their families beginning in 1994. Follow up surveys were conducted biannually up to 2002. We restrict our sample to those children between the ages of 4 and 11 in 1994, since only parents of children in this age range completed the ADHD screener. This restriction yields 5604 children. For analyses that use Canadian math test scores we have a smaller sample of approximately 2293.<sup>6</sup> We use the NLSCY data to ask how mental health screener scores in 1994 affect outcomes in 2002.

The NLSY began in 1979 with a survey of approximately 6,000 young men and 6,000 young women between the ages of 14 and 21. These young people have been followed up every year up to the present. In 1986, the NLSY began assessing the children of the female NLSY respondents at two year intervals. Given the differences in the design of the two studies, and the large amounts of missing data in the NLSY, we use the NLSY data to see how the average hyperactivity score measured over the 1990 to 1994 period affects the average outcomes of children in the 1998 to 2004 waves.<sup>7</sup> This procedure yields a maximum sample of 3,758

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<sup>6</sup> In cycle 5 the response rate for the mathematics test was 81%. Currie and Stabile (2006) discuss an analysis of the non-responses to the NLSCY math tests for previous cycles performed by Statistics Canada which reports little difference between responders and non-responders at that time. In the cycle 5 codebook, Statistics Canada notes that the response rate is lower in higher grades, and higher among students who performed well on previous cycle math tests.

<sup>7</sup> We also tried using the average for 2000 to 2004, but found that this reduced the sample size by at least half.

children. We restrict the age range of the NLSY children to be greater than 4 and less than 12 years of age in 1994 to make the Canadian and U.S. samples more comparable.

The mothers of the NLSY children represented a nationally representative cohort of 14 to 21 year old women in 1978. Since women of lower socioeconomic status tend to have children at younger ages, the NLSY sample of children is disadvantaged relative to a nationally representative cross section of children, although this is a less of a problem after we have deleted the oldest children.

The measurement of mental health conditions is key for our analysis. The diagnostic criterion for the mental health conditions we examine are laid out in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 1994). In order to be diagnosed, a child must exhibit several symptoms over some period of time, and must suffer impairment from those symptoms. The measures available in our surveys, as in most surveys, are questions that are asked to parents about symptoms. These questions are subsets of the questions that appear in the DSM-IV for each disorder.

We do not have information whether the symptoms are causing impairments, but given the way that mental health conditions are diagnosed, it is likely that children who are having problems in school are more likely to be judged to be “impaired” by their symptoms in the school setting than those who are not. Hence, whatever the underlying symptoms, there is likely to be a spurious relationship between schooling achievement and mental health problems, particularly those “externalizing” problems that are likely to be disruptive in a school setting. Given this problem, it is useful to focus on answers to screeners that are administered to all children rather than on diagnosed cases. The administration of parental questionnaires that are

similar (though more detailed) than the screeners we use here is almost always the first step in the diagnosis of child mental health conditions.

In the NLSCY data, the parents of all children aged 4 through 11 in 1994 were asked a series of questions about the child's behavior (we list the questions in the data appendix). The responses to these questions are categorized by disorder, and then added together to determine a hyperactivity score (8 questions), an emotional behavior score (8 questions), and an aggressive behavior score (6 questions) for the child. We use these three measures separately, as well as creating a combined Behavior Problems Index based on the three measures above plus an indirect aggression score, a prosocial behavior score and a property offence score. This measure is meant to be similar to the overall Behavior Problems Index in the NLSY.

The NLSY Behavior Problems Index is asked to parents of children 4 to 14. There are 26 questions asked to all children, and 2 questions asked only to children who have been to school. Five of the questions can be used to create a hyperactivity subscale, six can be used to form a conduct disorder subscale, and 5 can be used to form an anxiety/depression subscale. These scores are standardized by the child's age. We convert this standardized score to one that has the same range as the scores in the Canadian data. In addition to the specific subscales, we also estimate models using the overall behaviour problems index. More information about how these scores are computed in both samples is available in the data appendix.

In the NLSY, parents were also asked whether their children had any conditions that limited their normal activities. If they answered in the affirmative, parents were asked to identify the limitation. This suite of questions was used to identify children who had been diagnosed with a "learning disability". In the Canadian NLSCY we use a question on whether the child has been diagnosed with a learning disability that is asked in the series of questions on chronic

conditions. Below, we examine the effects of mental health problems in a sample of children that excludes those with diagnosed learning disabilities, in an effort to isolate the effects of particular mental health conditions themselves.

We focus on a set of outcomes that are intended to capture the child's human capital accumulation, broadly defined. These include: Grade repetition, mathematics scores, reading scores, and special education. We also examine delinquency, which one might think of as a measure of "negative human capital" since children who are delinquent might be viewed as building capital in anti-social or criminal activities. Further details about the construction of these variables are available in the data appendix, but some general discussion is warranted here.

Grade repetition is an important outcome, in that it is predictive of eventual schooling attainment. Since whether or not someone has ever repeated a grade is a cumulative measure, we ask whether the child repeated a grade between 1994 (when hyperactivity is measured) and 2004. Mathematics and reading scores are two more immediate measures of schooling achievement. The NLSY assesses children using the Peabody Individual Achievement Tests (PIATs) for mathematics and reading recognition. These tests are administered in the home. In the NLSCY, mathematics tests were administered in schools to children in grades two through ten and are based on the Canadian Achievement Tests. The NLSCY began collecting a reading test score in its first three cycles but dropped this measure in subsequent cycles. Therefore, we are only able to include a math test score from the Canadian data for the 2002 cycle. We convert all of the test scores to Z-scores in order to facilitate comparisons.

The special education variable is available only in the NLSY and not the NLSCY for the years used in this study. Special education is an important variable to consider, because special

education children tend to lag behind their peers throughout their schooling and are more likely to drop out.

The measure of delinquency that we construct using NLSY data corresponds closely to that used by the U.S. Department of Justice (DIJ) for this age group. The DIJ definition includes illegal drug use or sales, “destroyed property”, “stolen something worth more than \$50”, “committed assault”, and whether they have ever been arrested (Puzzanchera, 2000). The NLSCY measure is slightly broader in that it also includes questions about whether children have been questioned by police, or have run away from home. Questions about drug use and delinquency are answered by the child in both surveys. Because the questions pertaining to different age groups of children are somewhat different, we estimate models separately for 10 to 14 year olds and 15 and older children in the NLSY, and for children less than 16 and 16 to 19 in the NLSCY. For simplicity we present delinquency results only for children 16-19 years old.<sup>8</sup>

We use total *permanent* household income as our measure of income. This variable is constructed by taking the mean income for all available waves in the NLSCY, and for waves from 1990 to 2004 in the NLSY. We average income over all waves for two reasons. First, child outcomes are likely to be more strongly affected by permanent than by transitory income. Second, the impact of random measurement error in income will be attenuated by averaging.<sup>9</sup>

Means of all of our measures are shown for all children with non-missing mental health scores are shown in columns 1 and 4 of Table 1. Columns 2 and 5 show means for the sample of

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<sup>8</sup> Results for the younger children are available from the authors upon request.

<sup>9</sup> In cases where the household income is not reported, the NLSCY imputes it. We include a dummy variable for the imputation of household income in all of our analyses. We also re-estimated all our analyses omitting individuals for whom income had been imputed in order to be sure that there was nothing peculiar about the income imputation process. Our analyses are robust to these checks.

children with siblings, who will be the focus in our fixed effects models. In the NLSY, all siblings in sampled households are interviewed, whereas in the NLSCY, one randomly chosen sibling of the target child is interviewed. Columns 3 and 6 show the number of siblings with a within-family difference in the variable in question, since these are the children who will identify the effects of hyperactivity in our models.

This table suggests that the sibling sample is quite similar to the “full” sample of children, and that there are sufficient numbers of siblings with differences in outcomes to pursue a fixed effects strategy for most of our outcomes. The table highlights similarities and differences between the U.S. and Canadian samples. The U.S. children are slightly older and born to somewhat younger mothers on average, as one would expect. They are also more likely to have mothers who are depressed or who have an activity limitation. All of these differences as well as differences in other observable variables in the two data sets are controlled for in our Ordinary Least Squares (OLS) models, and many of them will be absorbed by family fixed effects in the fixed effects models.

A comparison of the distributions of NLSCY and NLSY scores are shown in Table 2. Across all measures the children in the NLSCY sample are more likely have scores in the lowest part of the distribution. For the BPI, for example, approximately 30% of the Canadian sample has a score of 0 through 2, whereas approximately 11 % of the US sample falls in this range. While the ninetieth percentile of the hyperactivity distribution is similar across the two samples (9 out of 16 for NLSCY and 10/16 for the NLSY) the ninetieth percentile for the conduct/aggression scores and the depression/emotional scores are lower in Canada. This is also reflected in the BPI score distributrion, which include these scores as component parts. While the measures are reasonably correlated with one another, there does appear to be unique information

about the child in each measure. The correlations between hyperactivity, conduct disorder, and depression are all approximately 0.5. The correlations between the BPI, which includes these measures, and any one measure are considerably higher, between 0.7 and 0.8.

An important question is whether we expect the effect of mental health symptoms to be roughly linear, or whether scores above some threshold have much more deleterious effects? People often think about illness in terms of thresholds—only people with blood pressure above a set cut off are diagnosed with high blood pressure, and only people whose insulin function is subject to a certain degree of impairment are diagnosed with diabetes. However, in both of these examples, recent research has shown that persons with readings below the relevant thresholds for diagnosis still suffer from negative effects. This could also be the case with mental health problems.

Figure 1 shows non-parametric Lowess plots of outcomes against our behavior scores for the U.S. and Canada. There are two striking things about these pictures. First, for grade repetition, math score, and delinquent behavior they are remarkably similar for the U.S. and Canada despite differences in samples, educational systems, variable definitions and so on. Second, all of the outcomes except delinquency and remaining in school change approximately linearly with mental health scores. This observation suggests that even children with scores low enough that they would never be diagnosed with a problem may nevertheless suffer ill effects of certain behaviours. Hence, in what follows, we focus on the linear scores.

#### **4. Methods**

We begin by estimating OLS models of the relationship between our behavioral scores in 1994 and future outcomes, controlling for a wide range of other potentially confounding



variables, including permanent income; maternal health status, education and family structure (in 1994); child age (single year of age dummies), whether the child is first born, and sex. These models have the following form:

$$(1) outcome_i = \alpha + \beta MENTAL94_i + \lambda X94_i + \varepsilon_i$$

where *outcome* is one of the outcomes described above, *MENTAL94* is a vector of the three child mental health scores and *X* is the vector of covariates described above. If high scores on the screener are positively correlated with other factors that have a negative effect on child outcomes, then these estimates will overstate the true effect of poor mental health.

We next attempt to control for unobserved heterogeneity by estimating family fixed effects models:

$$(2) outcome_{if} = \alpha + \beta MENTAL94_{if} + \lambda Z94_{if} + \mu_f + \varepsilon_{if}$$

In these models, the *Z* vector is similar to *X* but omits factors common to both siblings, and the *f* subscript indexes families. A comparison of (1) and (2) will indicate whether OLS estimates are driven by omitted variables at the family level. Evidently, there may be individual-level factors that are important and which will not be captured by family fixed effects. However, it is impractical to estimate models with child fixed effects because externalizing mental health problems like ADHD and conduct disorder often manifest themselves before the child's 7<sup>th</sup> birthday and exhibit considerable stability over time.<sup>10</sup> Given the crudeness of our measures, changes in these scores over time for the same child could easily reflect measurement error, rather than true changes in mental health status. One of the most important individual-level

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<sup>10</sup> For a diagnosis of ADHD, symptoms have to have been manifest before the child was 7 years old. While conduct disorder is often diagnosed later, Kim-Cohen et al. (2005) use the DSM-IV guidelines to assess conduct disorder in a

factors is likely to be whether the child has other learning disabilities. We deal with this problem by re-estimating models excluding children with other diagnosed learning disabilities below.

If a high mental health problem score for one sibling has negative effects on the achievement of other siblings in the household, then the difference between the two siblings will provide an under-estimate of the effects of the deleterious effects of mental health problems. Estimates of (2) may also be biased downwards by random measurement error in the mental health scores. Measurement error is a potentially important problem in this and all of the past studies relying on parental reports of children's mental health disorders (c.f. Offord et al., 1988; Garrett, 1996; Glied et al, 1997).

One way to judge the importance of measurement error is to compare the OLS and fixed effects estimates. If we believe that mental health status is likely to be similar between siblings, then the measured within family variation may be more "noisy" than the between family variation. In this case we might expect increased attenuation bias in the fixed effects estimates. However, as we show below, the OLS and fixed effects estimates are generally similar so that measurement error (or potential spillover effects, as noted above) may not be such an important problem.

A third potential problem is that a small number of children in our samples are being treated for behaviour problems, but it is difficult to tell using our data exactly what they are being treated for. To the extent that treatment is effective in altering behavior, children who are being treated will have lower behaviour problem scores than they otherwise would have. But if treatment has no consistent impact on cognitive outcomes such as test scores (as the Surgeon General's report concludes, and see also Wigal et al. (1999)) then failing to account for treatment

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large sample of 4 1/2 to 5 year olds and find that those who had 3 or more symptoms at age 5 (about 6.6 percent of

will bias our estimates. For example, if all ADHD children were treated, it might appear that even low ADHD scores were associated with significantly poorer outcomes, and our results would be biased upwards.

It would be extremely interesting to be able to conduct our own analysis of the impact of treatment on outcomes. However, the very small number of children who are treated (especially in Canada) and the endogenous nature of treatment decisions (along with the lack of plausible instruments for treatment) make this difficult. Instead, we take two alternative approaches to the problem of treated children. First, we simply exclude the treated children. If treatment were applied randomly to the population of children, then these estimates would provide an unbiased estimate of the effects of untreated mental health problems on outcomes. Second, in models that use the overall behaviour problem index, we impute the 90<sup>th</sup> percentile BPI score to all of the treated children. This is equivalent to assuming that only children with high scores are treated. As we will show, neither alternative has much impact on our estimates, given the small numbers of children being treated.

Finally, we turn to an investigation of the extent to which the effects of mental health problems are mediated by income. The OLS models we estimate have the following form:

$$(3) \text{ outcome}_i = \alpha + \beta(\text{income})_i + \phi \text{income}_i * \text{MENTAL94}_i + \chi \text{MENTAL94}_i + \lambda X94_i + \varepsilon_i$$

where now income has been broken out of the X vector, and interacted with a mental health score. A positive coefficient on the interaction term (in the case of a positive outcome) would

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the sample) were significantly more likely than other children to also have conduct disorder at age 7.

suggest that the negative effects of mental health problems were mitigated in high income children.

## 5. Results

Table 3 presents our baseline OLS estimates of the effects of mental health problems on child outcomes in the U.S. and Canada along with the corresponding fixed effects estimates. We present both OLS and FE estimates for the combined BPI index, and for each of the three individual scores.

Table 3 indicates that children with higher hyperactivity scores have worse academic outcomes, though perhaps surprisingly, there is little effect on delinquency once household fixed effects are included in the model. A one unit change in the hyperactivity score increases the probability of grade repetition by very similar amounts in Canada and the U.S. (0.8 to 1 percentage point) and reduces math scores by 4 to 7 percent of a standard deviation. Where they can be compared, the estimates in the U.S. and Canada are quite similar. The U.S. estimates also show that hyperactivity increases the probability that the child is in special education by about 1 percentage point, and reduces standardized reading scores. The similarity between the OLS and fixed effects estimates suggests that measurement error is not driving the estimates, as discussed above.<sup>11</sup> In fact, the fixed effects estimates often exceed the OLS ones.

One way to think about the size of these effects is to compare them with the effect of income, which has consistently significant effects,. Appendix Table 1 shows all of the

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<sup>11</sup> Random measurement error would be expected to reduce the size of the fixed effects estimates relative to the OLS estimates. Correlated errors (for example, if the mother tended to consistently exaggerate reports of a particular behavior for both children) would lead to much larger fixed effects estimates. If, on the other hand, parents exaggerate differences between siblings, the fixed effects estimates could theoretically be smaller than the OLS estimates.

coefficient estimates for OLS models that included the overall behavior problem index. They show that each \$100,000 increase in permanent income would decrease the probability of grade repetition by 1.9 percentage points, which is only slightly larger than the effect of reducing the hyperactivity score by one point, according to our estimates. On the other hand, the estimated effect of having a mother with greater than a high school education is consistently larger than \$100,000 in permanent income. At the mean BPI score of 6.8, the effect is much larger than the effect of either education or income.

In Canada, each \$100,000 worth of permanent income is associated with a 7 percentage point decrease in the probability that a child repeats a grade between 1994 and 2002. Having a mother with more than a high school education is associated with a decrease in the probability of repeating a grade of approximately 5 percentage points. But a Canadian child with a score of only 4 out of 16 on the BPI index (around the mean) would be 8 percentage points more likely to have repeated a grade. Thus, in both the American and Canadian samples, the effect of behavior problems is large relative to the effect of income or mother's education.

The next two panels of Table 3 show results for conduct disorder. In OLS models, conduct disorders have negative effects across the board. In models using sibling fixed effects, the effects remain statistically significant for delinquency, grade repetition, and test scores in the U.S. In Canada, the "aggression" measure is marginally significant (at the 10 percent level) for grade repetition, and is significant at conventional levels for the probability that a youth 16-19 is in school. Since conduct disorder covers a broader spectrum of behaviors than "aggression" it is possible that this accounts for the different results.

The next section of Table 3 examines the effects of anxiety/depression. High depression scores increase the probability of grade repetition in both the U.S. and Canada although since

there is no effect on test scores, this appears to be through some mechanism other than impairing a child's cognitive functioning.

Finally, the last panel of Table 3 shows estimates from models that include all of the mental health scores. This specification demands a lot of the data, but allows for the fact that the incidence of different mental health problems tends to be correlated across individuals. The fixed effects coefficients are less precisely estimated, but are broadly consistent with the estimates discussed above. In the U.S., hyperactivity is estimated to reduce test scores and increase special education. In Canada, hyperactivity also reduces test scores, and increases the probability of grade repetition. In the U.S., conduct disorder appears to have little effect once the other measures are included, while in Canada, aggression increases the probability of delinquency and reduces the probability that a 16-19 year old child is in school. Finally, in the U.S., the depression score predicts grade repetition (although it is only marginally significant even at the 10 percent level). The total behavior problem index is not statistically significant in these models, suggesting that the overall effect of behavior problems is accounted for by the information in the three included subscales, especially hyperactivity.

The analysis in Table 3 suggests that if our aim was only to identify young children who were at risk of future problems because of mental health conditions, then the overall behavior problems index would be a sensible initial indicator. Hence, in the remainder of the paper we focus on this measure.

Table 4 shows several specification checks estimated using the overall behavior problems index. First, we try excluding children with other diagnosed learning disabilities. Second, we exclude treated children. Third, we impute a high (90<sup>th</sup> percentile) BPI score to these children. For the most part, these alternative ways of handling the treated children produce

estimates that are very similar to those shown in Table 3. The main exception is that excluding treated children results in an insignificant coefficient on BPI in the equation for grade repetition in the NLSY, suggesting that, at least in the U.S., the children who are treated are also the most likely to have repeated a grade.

Table 5 reports estimates of equation (3), which include interactions between BPI scores and income. Given that we are using permanent income, the interaction terms in these fixed effects models are identified by the fact that BPI scores vary within families. What the interaction term tells us is whether the difference between the high and low BPI score children within a family is bigger in a low income household than in a high income household. That is, if the high income household is able to do a better job assisting the high BPI score child than the low income household, then the interaction will be significant.

Panel 1 shows that in OLS models using the NLSY, the interactions with income are of the expected sign (that is, higher income appears to mitigate the effects of behavior problems in the equations for grade repetition, reading scores, and special education). However, in the fixed effects models none of the interactions are statistically significant. Interactions with maternal education are not significant even in the OLS models. Using the Canadian NLSCY, we find a negative and significant interaction with both income and mother's education for grade repetition, but, as with the U.S. results, all but one of the interactions are insignificant in the fixed effects models. The exception is the interaction with mother's education for our in-school models, where the coefficient is insignificant in the OLS models but significant and the wrong sign in the fixed effects models. We conclude then that there is little conclusive evidence that maternal education or family income mitigate the negative effects of childhood mental health

conditions, though it should be noted that the standard errors in the fixed effects models are large.

## **6. Discussion and Conclusions**

Children with mental health problems suffer large negative consequences in terms of their achievement test scores and schooling attainment. Hyperactivity appears to have the broadest, and most consistently negative effects, followed by conduct disorders. These results are consistent with previous research suggesting that “externalizing” behavior problems are more likely to lead to negative outcomes than “internalizing problems”. We do however find that anxiety/depression increases the probability of grade repetition, presumably through a mechanism other than that captured through lower achievement on cognitive tests. While it is interesting to examine the impact of specific problems, our results also suggest that if one merely wanted to identify children at risk of bad outcomes because of their mental health problems, then the overall Behavior Problems Index would be as good if not better than the individual subscales.

We also find that a given level of symptoms has similar effects on the test scores of rich and poor children. This is surprising in that one might expect richer children to have access to superior treatment as well as other advantages. This result may speak to the fact that treatment for most childhood mental health problems is in its infancy, so that it is not at all clear that richer parents are able to identify, let alone purchase, the most effective treatments.



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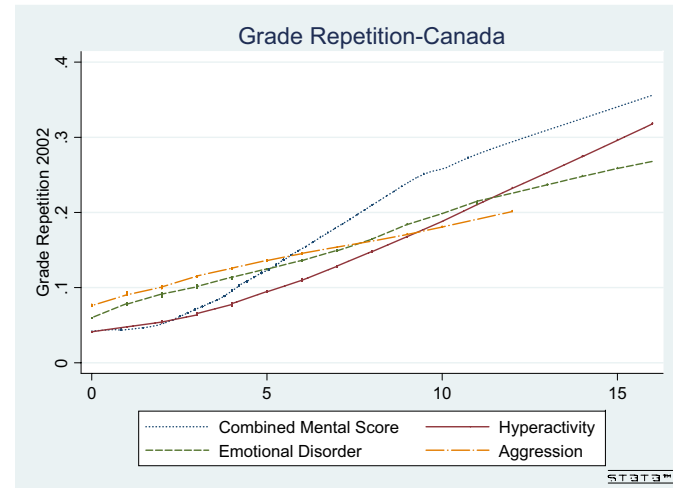
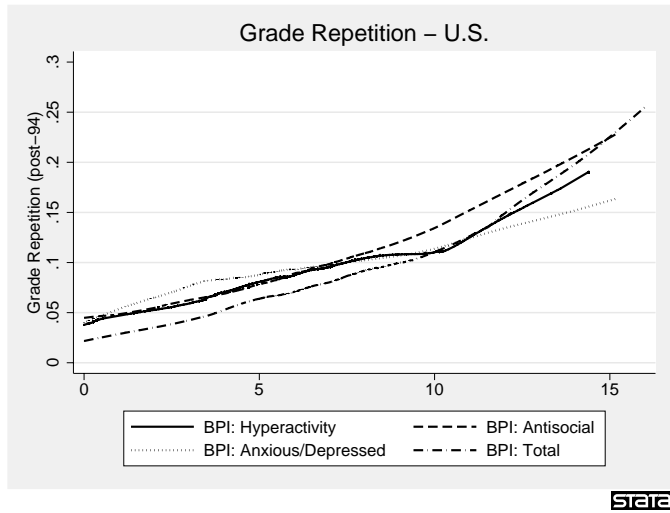
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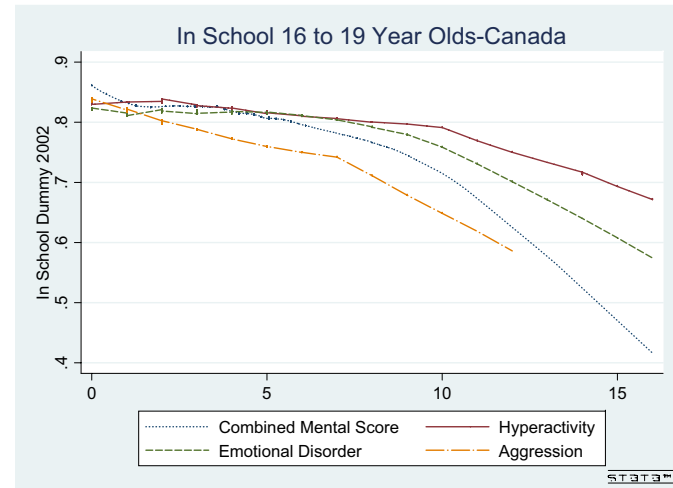
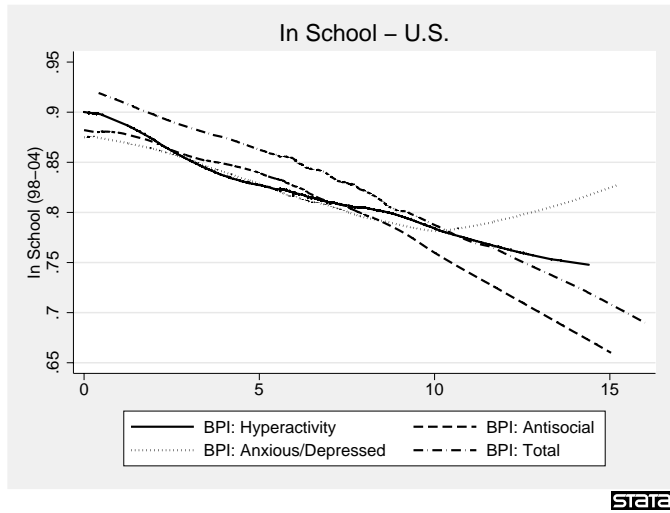
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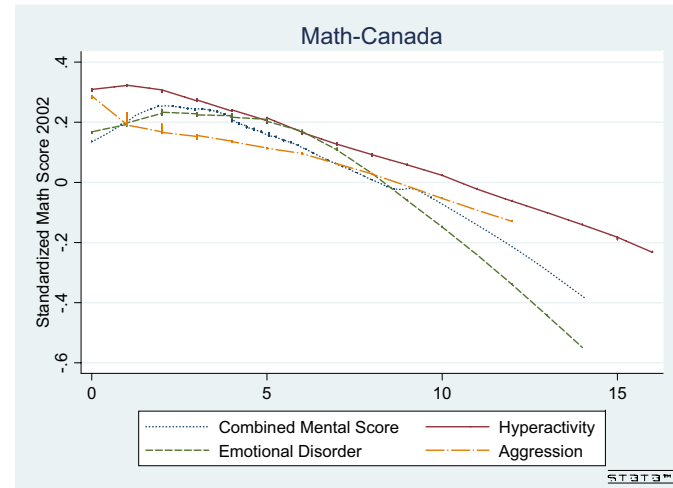
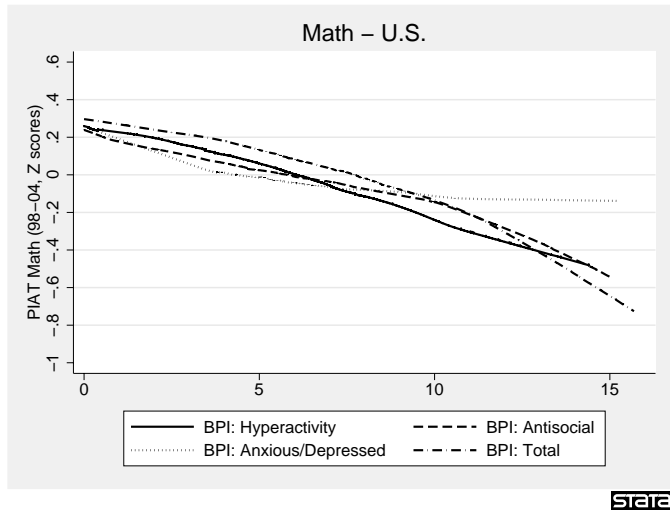
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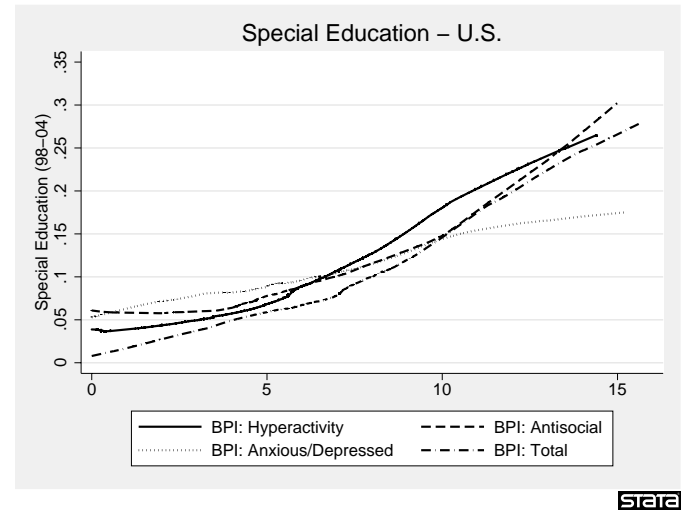
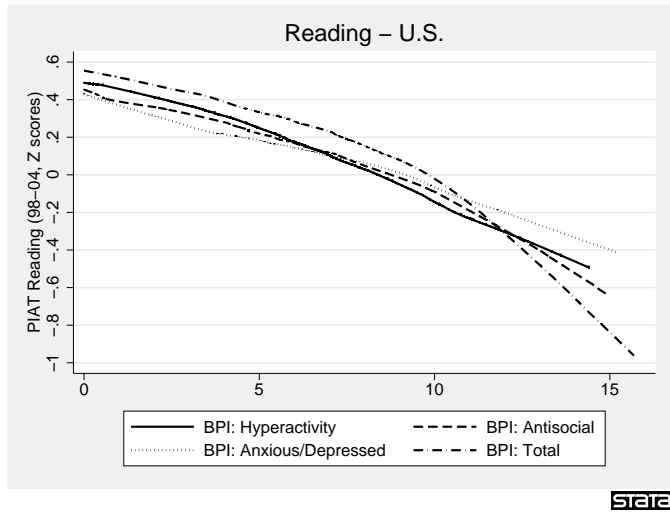
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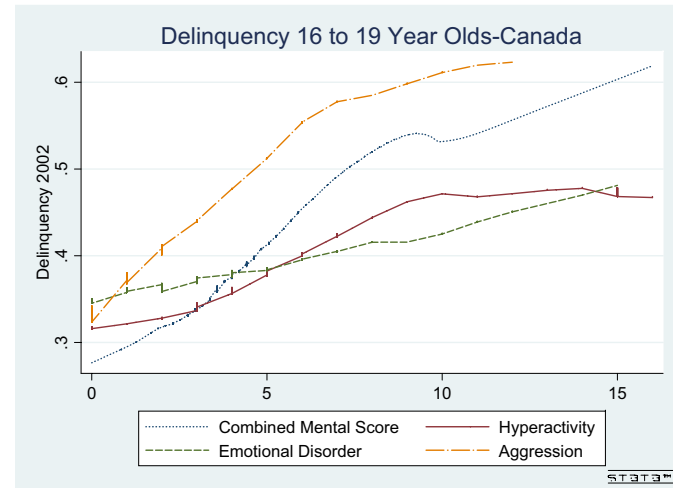
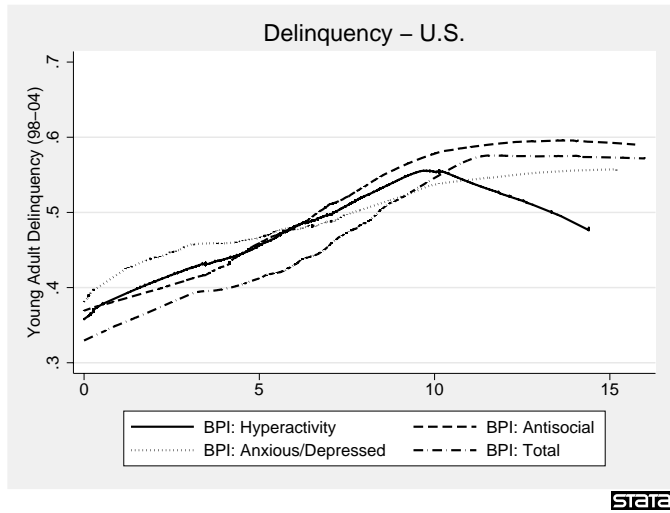












**Table 1**  
**Means Table for Sample of Children with All Behavioral Scores Non-Missing**

	U.S.			Canada		
	Complete Sample	Sibling Sample	Sibling Differences	Complete Sample	Sibling Sample	Sibling Differences
<b>U.S./Canada Behavioral Scores (1994)</b>						
Total/Combined	6.837	6.833	2340	3.862	3.845	2260
Hyperactivity	5.150	5.023	2300	4.648	4.404	2040
Antisocial/Aggression	4.865	4.943	2291	1.439	1.504	1546
Depressed/Emotional Disorder	4.529	4.553	2316	2.562	2.419	1820
<b>Outcomes</b>						
Young Adult Delinquency	0.462	0.459	888	0.368	0.359	152
Grade Repetition	0.081	0.083	348	0.096	0.082	280
In School	0.833	0.835	322	0.818	0.834	106
Standardized Math Score	0.034	0.007	1346	0.195	0.258	412
Standardized Reading Score	0.213	0.156	1340			
Enrolled in Special Education	0.085	0.087	200			
<b>Robustness Covariates (1994)</b>						
Child Undergoing Any Treatment	0.093	0.094	337	0.045	0.042	176
Child Has Learning Disability	0.025	0.026	122	0.025	0.026	116
<b>Other Covariates (1994)</b>						
Age of Child	8.114	8.129		7.310	7.273	
Male Child	0.514	0.514		0.494	0.495	
First Born Child	0.385	0.297		0.456	0.362	
Permanent Income (/\$100,000)	0.522	0.523		0.651	0.686	
Mother > High School Education	0.382	0.372		0.568	0.580	
Ln(Family Size)	1.434	1.525		1.429	1.495	
Mother Teen at Child's Birth	0.039	0.044		0.042	0.027	
Mother's Age at Child's Birth	24.854	24.762		27.476	27.551	
Mother Depressed or Activity Limit	0.232	0.223		0.156	0.146	
Mother Is Immigrant	0.080	0.085		0.074	0.075	
Two Parent Household	0.830	0.847		0.878	0.912	
Number of children in sample	3758	2358		5604	2374	

We measure all behavioral scores, robustness covariates and other covariates in 1994 for Canadian data and over the 1990-1994 interval for U.S. data. Outcomes are measured in 2002 for Canadian data and over the 1998-2004 interval for U.S. data (except for permanent income, which is averaged for both countries over all available years). For further details on the definitions and constructions of these variables, see the Data Appendix.

Score	Total/Combined		Hyperactivity		Antisocial/Aggression		Depressed/Emot. Dis.	
	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	Canada
0	0.93	1.00	11.63	10.30	8.30	43.18	17.03	24.52
1	2.34	8.12	6.17	11.71	13.84	22.84	4.34	18.72
2	3.19	14.10	7.13	11.22	8.14	12.92	7.53	15.95
3	5.06	24.18	9.90	10.76	7.45	7.74	7.00	11.92
4	8.46	21.32	10.40	9.92	12.59	4.93	18.65	8.74
5	11.12	13.95	6.95	8.64	8.99	3.48	9.50	6.28
6	15.43	7.48	13.60	9.08	7.82	2.44	7.69	5.30
7	15.22	4.84	7.08	7.73	11.07	1.09	11.20	3.23
8	11.26	2.57	11.15	6.51	5.96	0.59	5.30	2.57
9	10.24	0.00	4.60	4.39	4.39	0.32	4.15	1.20
10	6.17	1.34	4.28	3.14	4.66	0.20	3.62	0.64
11	4.63	0.50	3.17	2.11	2.63	0.15	1.57	0.29
12	2.90	0.36	1.92	1.28	1.57	0.12	1.57	0.37
13	1.17	0.16	1.30	1.23	1.68	0.00	0.48	0.18
14 to 16	1.86	0.09	0.72	1.98	0.91	0.00	0.37	0.10

Canadian children are assigned integer scores from 0 to 16. American children's scores have been scaled to fit in this range, then rounded to the nearest integer for purposes of this table. For further details, see the Data Appendix.

	Total	Hyperactivity	Antisocial	Depressed	Learning Disability
Total	1.00				
Hyperactivity	0.80	1.00			
Antisocial	0.78	0.57	1.00		
Depressed	0.77	0.52	0.49	1.00	
Learning Disability	0.16	0.18	0.11	0.10	1.00

**Table 3**  
**The Effects of Behavioral Scores on Various Outcomes: OLS vs. Fixed Effects**

	Young Adult Delinquency		Grade Repetition		In School		Standardized Math Score		Standardized Reading Score	Special Ed. Education
	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	U.S.
<b>OLS</b>										
Total/Combined Score	0.016***	0.023***	0.008***	0.020***	-0.006**	-0.008**	-0.030***	-0.022*	-0.049***	0.013***
	[4.90]	[4.05]	[4.45]	[8.20]	[2.35]	[1.96]	[5.02]	[1.91]	[7.02]	[6.09]
R <sup>2</sup>	0.09	0.08	0.05	0.07	0.11	0.20	0.22	0.09	0.18	0.06
N	3204	2185	3566	5594	2467	2493	2559	2293	2559	2715
<b>Fixed Effects</b>										
Total/Combined Score	0.007	0.019	0.013***	0.016***	-0.005	-0.008	-0.047***	-0.078**	-0.047***	0.013***
	[0.88]	[0.96]	[3.15]	[3.47]	[0.69]	[0.64]	[3.59]	[2.07]	[3.22]	[2.76]
R <sup>2</sup>	0.75	0.93	0.69	0.86	0.80	0.95	0.86	0.94	0.86	0.79
N	3226	2185	3592	5594	2484	2493	2577	2293	2577	2736
<b>OLS</b>										
Hyperactivity Score	0.010***	0.010***	0.006***	0.014***	-0.004*	-0.006***	-0.033***	-0.025***	-0.047***	0.012***
	[3.87]	[3.28]	[3.73]	[10.28]	[1.79]	[2.73]	[6.48]	[4.14]	[8.01]	[6.30]
R <sup>2</sup>	0.09	0.08	0.05	0.07	0.11	0.20	0.23	0.10	0.19	0.06
N	3204	2278	3566	5822	2468	2599	2558	2380	2558	2716
<b>Fixed Effects</b>										
Hyperactivity Score	0.006	0.008	0.008***	0.010***	-0.009	-0.005	-0.041***	-0.073***	-0.038***	0.013***
	[1.08]	[0.79]	[2.67]	[4.69]	[1.60]	[0.88]	[4.51]	[4.11]	[3.69]	[3.93]
R <sup>2</sup>	0.75	0.93	0.70	0.86	0.80	0.95	0.86	0.94	0.86	0.79
N	3226	2278	3591	5822	2485	2599	2575	2380	2575	2736
<b>OLS</b>										
Antisocial/Aggression Score	0.015***	0.023***	0.007***	0.008***	-0.006**	-0.015***	-0.019***	-0.022**	-0.034***	0.009***
	[5.54]	[3.88]	[4.52]	[3.64]	[2.53]	[3.38]	[3.76]	[2.09]	[5.79]	[4.60]
R <sup>2</sup>	0.09	0.08	0.05	0.05	0.11	0.20	0.22	0.09	0.18	0.05
N	3197	2278	3559	5816	2465	2598	2554	2377	2554	2709
<b>Fixed Effects</b>										
Antisocial/Aggression Score	0.010*	0.034	0.008***	0.008	-0.007	-0.034*	-0.023**	-0.047	-0.026**	0.005
	[1.73]	[1.40]	[2.60]	[1.79]	[1.20]	[2.35]	[2.52]	[1.40]	[2.50]	[1.37]
R <sup>2</sup>	0.75	0.93	0.70	0.86	0.80	0.95	0.86	0.94	0.86	0.78
N	3220	2278	3586	5816	2482	2598	2573	2377	2573	2731
<b>OLS</b>										
Depressed/Emot. Dis. Score	0.009***	0.007	0.006***	0.009***	-0.005*	-0.001	-0.019***	-0.001	-0.031***	0.007***
	[3.05]	[1.74]	[4.04]	[5.38]	[1.89]	[0.20]	[3.48]	[0.07]	[5.06]	[3.52]
R <sup>2</sup>	0.08	0.08	0.05	0.06	0.11	0.20	0.22	0.09	0.17	0.05
N	3207	2281	3571	5831	2469	2603	2562	2386	2562	2719
<b>Fixed Effects</b>										

Depressed/Emot. Dis. Score	-0.002 [0.27]	0.006 [0.41]	0.008*** [2.64]	0.006 [1.87]	0.002 [0.41]	-0.001 [0.12]	-0.014 [1.37]	0.039 [1.33]	-0.017 [1.48]	0.002 [0.40]
R <sup>2</sup>	0.75	0.93	0.70	0.86	0.80	0.95	0.86	0.94	0.86	0.78
N	3230	2281	3598	5831	2486	2603	2581	2386	2581	2741
<b>OLS</b>										
Total/Combined Score	0.004 [0.40]	0.014 [1.37]	-0.004 [0.80]	0.010** [2.11]	-0.002 [0.26]	0.005 [0.56]	0.017 [0.98]	0.049** [2.17]	0.021 [0.98]	0.009 [1.50]
Hyperactivity Score	0.002 [0.50]	0.003 [0.85]	0.003 [1.02]	0.010*** [5.46]	0.000 [0.02]	-0.007** [2.06]	-0.038*** [4.29]	-0.041*** [4.53]	-0.044*** [4.38]	0.007** [2.35]
Antisocial/Aggression Score	0.011** [2.57]	0.010 [1.51]	0.006*** [2.68]	-0.007** [2.30]	-0.005 [1.09]	-0.014** [2.36]	-0.008 [0.97]	-0.029** [1.96]	-0.018* [1.93]	0.001 [0.28]
Depressed/Emot. Dis. Score	-0.002 [0.32]	-0.006 [1.30]	0.004* [1.83]	0.001 [0.38]	0.000 [0.10]	0.005 [1.48]	-0.006 [0.70]	0.007 [0.58]	-0.012 [1.23]	-0.004 [1.31]
R <sup>2</sup>	0.09	0.26	0.05	0.08	0.11	0.20	0.23	0.10	0.19	0.06
N	3181	2625	3540	5594	2459	2494	2537	2293	2537	2693
<b>Fixed Effects</b>										
Total/Combined Score	-0.010 [0.53]	-0.063 [1.76]	-0.006 [0.62]	0.003 [0.33]	0.010 [0.53]	0.033 [1.08]	-0.012 [0.37]	0.051 [0.66]	-0.004 [0.10]	0.008 [0.74]
Hyperactivity Score	0.007 [0.80]	0.012 [0.93]	0.005 [1.26]	0.009** [2.44]	-0.012 [1.49]	-0.007 [0.70]	-0.034** [2.35]	-0.089*** [3.08]	-0.032** [1.98]	0.012** [2.18]
Antisocial/Aggression Score	0.011 [1.39]	0.065** [2.50]	0.005 [1.29]	-0.003 [0.45]	-0.007 [0.90]	-0.047** [2.01]	-0.007 [0.53]	-0.039 [0.82]	-0.010 [0.67]	-0.002 [0.44]
Depressed/Emot. Dis. Score	-0.001 [0.15]	0.011 [0.83]	0.007 [1.64]	0.001 [0.25]	0.004 [0.46]	-0.004 [0.31]	0.004 [0.27]	0.053 [1.57]	-0.003 [0.17]	-0.006 [1.08]
R <sup>2</sup>	0.75	0.93	0.70	0.86	0.80	0.95	0.86	0.94	0.86	0.78
N	3203	2625	3565	5594	2476	2494	2554	2293	2554	2713

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01. The absolute value of each t-statistic (clustered at the household level for OLS) is in brackets. Covariates included in these regressions are the same as those in the OLS regressions shown in the Appendix.

**Table 4**  
**Fixed Effects Robustness Checks of the Effects on Behavioral Scores on Various Outcomes**

	Young Adult Delinquency		Grade Repetition		In School		Standardized Math Score		Standardized Reading Score	Special Education
	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	U.S.
<i>Dropping Children Diagnosed with Learning Disabilities</i>										
Total/Combined Score	0.006	0.015	0.014***	0.013***	-0.005	0.006	-0.043***	-0.067*	-0.043***	0.011**
	[0.81]	[0.65]	[3.37]	[2.89]	[0.58]	[0.41]	[3.28]	[1.70]	[2.93]	[2.32]
R <sup>2</sup>	0.75	0.93	0.71	0.87	0.81	0.95	0.86	0.94	0.86	0.78
N	3141	2110	3504	5452	2410	2401	2532	2272	2532	2683
<i>Excluding Treated Children</i>										
Total/Combined Score	0.010	0.001	0.007	0.015***	-0.012	0.006	-0.042***	-0.077**	-0.047***	0.009*
	[1.11]	[0.02]	[1.44]	[3.18]	[1.29]	[0.41]	[2.87]	[2.00]	[2.90]	[1.70]
R <sup>2</sup>	0.76	0.94	0.72	0.87	0.81	0.95	0.87	0.94	0.87	0.79
N	2904	2046	3256	5338	2196	2337	2372	2231	2371	2521
<i>Assigning Treated Children the 90th Percentile Score</i>										
Total/Combined Score	0.005	0.007	0.010***	0.014***	-0.005	-0.003	-0.047***	-0.093**	-0.042***	0.010**
	[0.70]	[0.31]	[2.60]	[3.11]	[0.74]	[0.24]	[3.73]	[2.54]	[2.91]	[2.14]
R <sup>2</sup>	0.75	0.93	0.69	0.86	0.80	0.95	0.86	0.94	0.86	0.79
N	3225	2185	3591	5594	2484	2493	2576	2293	2576	2735

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01. The absolute value of each t-statistic is in brackets.

**Table 5**  
**Interactions of Income and Mother's Education with Total/Combined Behavioral Score**

	Young Adult Delinquency		Grade Repetition		In School		Standardized Math Score		Standardized Reading Score	Special Ed. Education
	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	U.S.
<b>OLS - Income</b>										
Income * Total/Combined Score	-0.004 [0.55]	-0.017 [1.01]	-0.009*** [3.81]	-0.036*** [6.00]	0.003 [0.82]	-0.009 [0.68]	0.025* [1.90]	0.001 [0.02]	0.036*** [2.78]	-0.007** [2.38]
Total/Combined Score	0.017*** [3.84]	0.033*** [2.92]	0.012*** [4.95]	0.041*** [8.07]	-0.008** [2.09]	-0.003 [0.30]	-0.043*** [4.93]	-0.023 [1.04]	-0.066*** [6.91]	0.017*** [5.52]
Income	0.036 [0.79]	0.01 [1.62]	0.027** [2.17]	0.053*** [2.61]	0.044 [1.55]	0.118*** [2.64]	0.076 [0.95]	0.339*** [2.72]	0.022 [0.28]	0.013 [0.94]
R <sup>2</sup>	0.09	0.08	0.05	0.07	0.11	0.20	0.22	0.09	0.19	0.06
N	3204	2185	3566	5594	2467	2493	2559	2293	2559	2715
<b>Fixed Effects - Income</b>										
Income * Total/Combined Score	0.009 [0.60]	0.061 [0.96]	-0.005 [0.68]	-0.015 [0.99]	0.005 [0.40]	-0.03 [0.73]	0.005 [0.21]	0.102 [0.85]	-0.007 [0.24]	-0.003 [0.34]
Total/Combined Score	0.003 [0.29]	-0.024 [0.48]	0.015*** [2.80]	0.025** [2.40]	-0.008 [0.78]	0.012 [0.40]	-0.049*** [2.79]	-0.131* [1.79]	-0.043** [2.19]	0.015** [2.30]
R <sup>2</sup>	0.75	0.93	0.69	0.86	0.80	0.95	0.86	0.94	0.86	0.79
N	3209	2185	3572	5594	2471	2493	2563	2293	2563	2719
<b>OLS - Mother's Education</b>										
Mother's Education * Total/Combined Score	0.008 [1.27]	-0.003 [0.31]	-0.006* [1.72]	-0.010** [2.02]	0.005 [0.98]	0.001 [0.13]	0.017 [1.39]	-0.023 [1.04]	0.011 [0.83]	-0.007 [1.57]
Total/Combined Score	0.013*** [3.25]	0.024*** [3.21]	0.010*** [4.13]	0.025*** [6.49]	-0.008** [2.29]	-0.009 [1.39]	-0.037*** [4.95]	-0.009 [0.56]	-0.053*** [5.87]	0.016*** [5.14]
Mother's Education	-0.068 [1.45]	-0.023 [0.53]	-0.012 [0.54]	-0.011 [0.61]	0.002 [0.04]	0.055* [1.68]	0.166* [1.87]	0.345*** [3.53]	0.212** [2.13]	0.014 [0.53]
R <sup>2</sup>	0.09	0.08	0.05	0.07	0.11	0.20	0.22	0.09	0.18	0.06
N	3204	2185	3566	5594	2467	2493	2559	2293	2559	2715
<b>Fixed Effects - Mother's Education</b>										
Mother's Education * Total/Combined Score	-0.005 [0.31]	0.031 [0.77]	-0.010 [1.16]	-0.005 [0.54]	0.002 [0.15]	-0.053** [2.08]	0.011 [0.41]	0.080 [1.13]	-0.015 [0.51]	-0.003 [0.29]
Total/Combined Score	0.008 [0.86]	0.005 [0.17]	0.016*** [3.24]	0.018*** [2.91]	-0.006 [0.65]	0.016 [0.91]	-0.051*** [3.10]	-0.119** [2.26]	-0.041** [2.24]	0.014** [2.37]
R <sup>2</sup>	0.75	0.93	0.69	0.86	0.80	0.95	0.86	0.94	0.86	0.79
N	3221	2185	3586	5594	2480	2493	2573	2293	2573	2732

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01. The absolute value of each t-statistic (clustered at the household level for OLS) is in brackets.

**Appendix Table**

**OLS: Effects of Total/Combined Behavioral Score on Various Outcomes**

	Young Adult Delinquency		Grade Repetition		In School		Standardized Math Score		Standardized Reading Score	Special Ed. Education
	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	Canada	U.S.	U.S.
Total/Combined Score	0.016*** [4.90]	0.023*** [4.05]	0.008*** [4.45]	0.020*** [8.20]	-0.006** [2.35]	-0.008** [1.96]	-0.030*** [5.02]	-0.022* [1.91]	-0.049*** [7.02]	0.013*** [6.09]
Permanent Income (/\$100,000)	0.015 [0.68]	0.043 [1.43]	-0.019** [2.47]	-0.069*** [6.85]	0.065*** [4.81]	0.088*** [4.54]	0.213*** [4.43]	0.342*** [5.33]	0.214*** [5.07]	-0.022*** [2.96]
Mother Is Immigrant	-0.042 [1.12]	0.061* [1.66]	-0.035** [2.09]	-0.031*** [2.66]	0.059** [2.04]	0.027 [1.12]	-0.070 [0.88]	-0.004 [0.05]	-0.080 [0.91]	-0.039** [2.02]
Male Child	0.153*** [9.04]	0.183*** [8.94]	0.034*** [3.87]	0.038*** [4.99]	-0.025* [1.77]	-0.032** [2.22]	0.121*** [3.67]	0.087** [2.11]	-0.032 [0.85]	0.057*** [5.42]
First Born Child	-0.091*** [4.84]	0.016 [0.71]	-0.025** [2.56]	-0.012 [1.39]	0.063*** [3.81]	0.037** [2.28]	0.157*** [4.25]	0.016 [0.34]	0.281*** [6.93]	-0.024** [2.07]
Ln(Family Size)	-0.091*** [3.27]	0.074 [1.39]	-0.018 [0.96]	-0.009 [0.41]	-0.006 [0.19]	-0.052 [1.31]	-0.093 [1.31]	-0.071 [0.63]	-0.152* [1.90]	0.007 [0.28]
Two Parent Household	-0.031 [1.22]	-0.041 [1.10]	-0.041** [2.37]	-0.043** [2.40]	0.055** [2.28]	0.078*** [2.65]	0.062 [1.15]	0.069 [0.90]	0.092 [1.37]	-0.027 [1.35]
Mother's Age at Child's Birth	-0.010** [2.12]	0.002 [0.95]	-0.002 [1.09]	-0.001 [0.52]	0.009** [2.34]	-0.001 [0.68]	0.023*** [2.69]	0.016*** [3.12]	0.018* [1.84]	0.001 [0.38]
Child Born to Teenage Mother	-0.020 [0.41]	-0.098* [1.91]	0.015 [0.48]	-0.003 [0.12]	0.063 [1.48]	-0.052 [1.22]	0.110 [0.73]	-0.01 [0.10]	0.200 [0.76]	-0.027 [0.46]
Mother > High School Education	-0.012 [0.59]	-0.036 [1.62]	-0.050*** [5.68]	-0.048*** [5.45]	0.038** [2.42]	0.059*** [3.78]	0.280*** [7.12]	0.252*** [5.72]	0.287*** [6.42]	-0.030*** [2.71]
Mother Depressed or Activity Limit	0.033 [1.53]	0.007 [0.24]	-0.002 [0.18]	0.021* [1.67]	-0.063*** [3.16]	-0.041* [1.95]	-0.157*** [3.44]	-0.099* [1.70]	-0.119** [2.14]	0.031* [1.80]
Black (U.S.)	-0.071*** [3.10]		0.037*** [3.03]		0.027 [1.36]		-0.498*** [10.46]		-0.417*** [7.43]	0.006 [0.41]
Hispanic (U.S.)	0.053** [2.06]		0.047*** [3.57]		-0.046** [2.16]		-0.370*** [7.32]		-0.160*** [2.67]	0.000 [0.03]
Adult Respondent is Female (Canada)		0.063 [1.47]		0.015 [1.02]		-0.024 [0.99]		-0.329*** [3.09]		
Imputation Dummy (Canada)		-0.057* [1.80]		0.007 [0.72]		-0.036*** [2.79]		-0.026 [0.55]		
Age 4	-0.294*** [5.98]		0.03 [1.48]	-0.050*** [3.17]			-0.05 [0.63]		-0.03 [0.26]	0.04 [1.56]
Age 5	-0.233*** [5.72]		0.047** [1.98]	-0.012 [0.74]			0.006 [0.08]	0.000 [0.01]	-0.006 [0.06]	0.040 [1.62]
Age 6	-0.178*** [4.65]		0.028 [1.31]	-0.004 [0.21]	0.089*** [3.23]	0.275*** [9.78]	-0.002 [0.02]	-0.144*** [2.60]	0.004 [0.05]	-0.004 [0.20]



Age 7	-0.117*** [3.21]	0.036 [0.35]	-0.011 [0.54]	0.004 [0.25]	0.052* [1.85]	0.334*** [7.86]	0.023 [0.30]	0.217*** [3.72]	-0.032 [0.39]	0.025 [1.17]
Age 8	-0.087** [2.48]	0.117*** [3.21]	-0.021 [1.10]	0.029 [1.62]	-0.116*** [3.71]	0.351*** [15.55]	-0.042 [0.58]	0.296 [1.64]	-0.017 [0.21]	0.041* [1.82]
Age 9	-0.076** [2.33]	0.119*** [3.42]	-0.008 [0.41]	0.031* [1.77]	0.025 [0.93]	0.313*** [13.05]	-0.036 [0.50]		-0.023 [0.29]	-0.020 [1.03]
Age 10	-0.075** [2.29]	0.092*** [3.52]	0.000 [0.02]	0.028* [1.70]	-0.134*** [4.53]	0.138*** [5.28]				
Constant	0.820*** [6.89]	-0.062 [0.52]	0.144** [2.15]	0.124*** [2.75]	0.594*** [5.53]	0.646*** [7.40]	-0.324 [1.36]	-0.226 [0.93]	0.111 [0.41]	-0.039 [0.52]
R <sup>2</sup>	0.09	0.08	0.05	0.07	0.11	0.20	0.22	0.09	0.18	0.06
N	3204	2185	3566	5594	2467	2493	2559	2293	2559	2715

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01. The absolute value of each t-statistic (clustered at the household level) is in brackets.

## **Underlying variables in the NLSY:**

### **MAIN EXPLANATORY VARIABLES**

**Behavior Problem Index – Total, Hyperactivity, Antisocial, Depressed:** The Behavior Problems Index is asked to parents of children 4-14. There are 26 questions asked for all children, and 2 questions asked only for children who have been to school. For each question, parents reply that the statement is “often true”, “sometimes true”, or “not true”. To convert into a total score, the NLSY sets “not true” equal to zero and “often true” or “sometimes true” equal to one, then sums the answers to the questions (so the maximum score is either 26 or 28). The NLSY then standardizes the total score by the child’s age. We convert this standardized score to one that has the same range as the score in the Canadian data (0-16). Subscores for hyperactivity, antisocial, and anxious/depressed (which we refer to in the paper as just “depressed”) are calculated in similar fashion, using subsets of the 28 questions. Though not used in this paper, subscores are also calculated for “headstrong”, “dependent”, “peer conflict”, and “withdrawal”.

The hyperactivity subscore has 5 questions:

1. He/she has difficulty concentrating, cannot pay attention for long
2. He/she is easily confused, seems to be in a fog
3. He/she is impulsive, or acts without thinking
4. He/she has a lot of difficulty getting his/her mind off certain thoughts (has obsessions)
5. He/she is restless or overly active, cannot sit still.

The antisocial subscore has 6 questions:

1. He/she cheats or tells lies
2. He/she bullies or is cruel or mean to others
3. He/she does not seem to feel sorry after he/she misbehaves
4. He/she breaks things on purpose or deliberately destroys his/her own or another’s things
5. He/she is disobedient at school
6. He/she has trouble getting along with teachers

The depression subscore has 5 questions:

1. He/she has sudden changes in mood or feeling
2. He/she feels or complains that no one loves him/her
3. He/she is too fearful or anxious
4. He/she feels worthless or inferior
5. He/she is unhappy, sad or depressed

We averaged children’s scores for each of these indices over 1990, 1992 and 1994.

[Underlying variables: BPIZ1990-1994, HYPRZ1990-1994, ANTIZ1990-1994, ANXZ1990-1994]

## **Child Treatment**

In 1990, 1992 and 1994, respondents were asked: “During the past 12 months has (child) seen a psychiatrist, psychologist or counselor about any behavioral, emotional, or mental problem?” In 1990, 1992 and 1994, respondents were also asked: “Does (child) regularly take any medicines or prescription drugs to help control his/her activity level or behavior?”

A child with at least one valid answer in any of these three years had the treatment variable set equal to one if his/her mother had answered yes at least once and set equal to zero otherwise.

[Underlying variables: CS902111, CS922211, CS94H-16, CS902139, CS922239, CS94H-18]

## **Maternal Activity Limitations**

From 1990 to 1994, the NLSY created a variable set equal to one if the mother had any health problem limiting her ability to work and set equal to zero otherwise. A mother with at least one valid answer in any of these five years had the health limitation variable set equal to one if she had answered yes at least once and set equal to zero otherwise.

[Underlying variables: Q5867 (1990), Q1925 (1991), Q5923 (1992), Q10-5A (1993), Q11-5A (1994)]

## **Maternal Depression:**

In 1992 and 1994, the mother was asked the following questions:

During the past week...  
I had trouble keeping my mind on what I was doing.  
I felt depressed.  
I felt that everything I did was an effort.  
My sleep was restless.  
I felt sad.  
I could not get going.

Possible responses were: Rarely/None of the time/1 Day; Some/A little of the time/1-2 Days/Occasionally/Moderate Amount of the Time/3-4 Days/Most/All of the Time/5-7 Days. These responses were given values 0, 1, 2, or 3. To create a depression score, we summed the responses for each question, averaged over the two years, and chose a cutoff so that 10% of the mothers were depressed.

[Underlying variables: Q6245/Q6247/Q6249/Q6257/Q6271/Q6275 (1992), Q11-90G/Q11-90H/Q11-90I/Q11-90M/Q11-90T/Q11-90V (1994)]

## **Permanent Income**

For 1990-2004, each family's "Total Net Family Income in Past Calendar Year" was converted to 2004 dollars using the BLS's Consumer Price Index. The results were then averaged to obtain a measure of permanent income.

[Underlying variables: \*Created (1990-1992), TNFI (1993-2002), TNFI\_TRUNC (2004)]

## **Mother Has More than High School Education**

From 1990-1994, the NLSY asked mothers: "What is the highest grade or year of regular school that you have completed and gotten credit for?" We took the mother's highest answer to this question over this time period, then created a variable set equal to one if her answer was greater than 12, and 0 otherwise.

[Underlying variables: Q0421 (1990-92), Q3-4 (1993-94)]

## **DEPENDENT VARIABLES**

### **Delinquency**

Questions about violence, theft and drug use were asked as part of the young adult self-report for children 15 and older (as of December 31 of the calendar year).

Such questions include:

In the last year, about how many times have you:

Hurt someone badly enough to need bandages or a doctor?

Taken something from a store without paying for it?

Damaged school property on purpose?

We recode the answers as zero if the answer is never, and 1 otherwise.

Questions about drug use ask whether the respondent has ever used marijuana, cocaine, LSDs, uppers, downers or amphetamines, or sniffed or huffed substances to get high. We code a one if the respondent answers yes to any of these questions.

We set young adult delinquency equal to 1 if the respondent has answered yes to any of the above questions on the young adult self-administered questionnaire at any time from 2000-2004, and 0 otherwise.

[Underlying variables:

Child drugs: CSAS061 / CSAS066 / CSAS071 / CSAS076 / CSAS081 (2000-04)

Child misbehavior: CSAS040B / CSAS040D / CSAS040E (2000-2004)

YA drugs: YASR-24A / YASR-27A / YASR-27E / YASR-38A (2000-04)

YA misbehavior: YASR-60C / YASR-60E / YASR-60F (2002-2004)]

## Grade Repetition

A variety of questions concerning grade repetition are asked both of children and young adults. We combined these answers to determine whether the child or young adult had ever repeated a grade after 1994 (i.e. between 1995 and 2004).

[Underlying variables:

Child grade repetition: CS901557 / CS921651 / CS94-8,  
BKGN-37 / BKGN-29D / BKGN-37A.01 (2000-2004)  
MS961531-55 / MS985005A-J, N

YA grade repetition: Q4-14 (1996-2004), Q4-15\_000001-12 (1996-2004)]

## In School

In 2000, 2002 and 2004, young adults were asked “Are you currently attending or enrolled in regular school, that is in an elementary school, a middle school, a high school, a college, or graduate school?” We set the variable *inschool* equal to one if the respondent had answered yes for the most recent year that he/she was between the ages of 16 and 19, and zero otherwise.

[Underlying variables: Q4-1 (2000-2004)]

## Special Education

In 1998, each respondent was asked: “Has your child participated in any of the following programs in the past year? (Circle all that apply) d. Special education/handicapped.”

In 2000, 2002 and 2004, each respondent was asked of her child: “During the past school year, did he/she participate in special education or a program for handicapped children?”

A child with at least one valid answer to any of these four questions had the special education variable set equal to one if his/her mother had answered yes at least once and set equal to zero otherwise.

[Underlying variables: MS985004D (1998), BKGN-29D (2000-2004)]

## Standardized Test Scores

Peabody Individual Achievement Tests (PIATs) were administered to children with PPVT ages of 5 to 14. We use the mathematics test and the reading recognition test. The NLSY reports age-normed percentile scores which are then converted into standard scores (mean 100 and standard deviation 15). We further transformed these scores to have mean 0 and standard deviation 1. We then assigned each child a score equal to the average of their non-missing scores from 1998 to 2004.

[Underlying variables: MATHZ1998-2004, RECOGZ1998-2004]

Underlying Variables in the NLSCY:

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Sample: Children who were between the ages of 4 to 11 in Cycle 1 (1994). These children were between the ages of 12 to 19 in Cycle 5 (2002).

MAIN EXPLANATORY VARIABLES

**Mental Health Variables**

1. **Hyperactivity Score** in Cycle 1 (1994). From abecs06. Questions:

a) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Can't sit still, is restless or hyperactive?

b) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is distractible, has trouble sticking to any activity?

c) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Fidgets?

d) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Can't concentrate, can't pay attention for long?

e) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is impulsive, acts without thinking?

f) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Has difficulty awaiting turn in games or groups?

g) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Cannot settle to anything for more than a few moments?

h) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is inattentive?

2. **Emotional Disorder Score** in Cycle 1 (1994). From abecs08. Questions:

a) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Seems to be unhappy, sad or depressed?

- b)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is not as happy as other children?
- c)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is worried?
- d)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Cries a lot?
- e)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Appears miserable, unhappy, tearful, or distressed?
- f)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is nervous, highstrung or tense?
- g)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Has trouble enjoying %him/her%self?
- h) HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is too fearful or anxious?

3. **Aggression Score** in Cycle 1 (1994). From abecs09. Questions:

- a)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Gets into many fights?
- b)HOW OFTEN WOULD YOU SAY THAT %FNAME%: When another child accidentally hurts %him/her% (such as by bumping into %him/her%), assumes that the other child meant to do it, and then reacts with anger and fighting?
- c)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Physically attacks people?
- d)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Threatens people?
- e)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Is cruel, bullies or is mean to others?
- f)HOW OFTEN WOULD YOU SAY THAT %FNAME%: Kicks, bites, hits other children?

4. **Combined Behavior Problem Index:**

Consists of the sum of the three scores above plus the prosocial behavior score (NLSCY question ABECs07) the indirect aggression score (NLSCY question ABECs10) and the

property offense score (NLSCY question ABECS11). The score is scaled by 4.75 to take on a range of 0 through 16.

### **Other Key Variables:**

1. **Average Income:** Average real family income (in 2002 dollars). This variable is the average over all five cycles if family income is available for all five cycles. This variable is the average over Cycles 1 to 4 if family income is missing in Cycle 5 (2002).
2. **Mom's education 1994:** This is an indicator for the mother having more than high school education in Cycle 1 (1994). momhs1994=1 if momedu1994>2. This variable is derived from aedpq02, aedpq04, aedsq02, aedsq04 and admcd06.

### **3. Child Treatment**

Children are classified as taking drug treatment for mental health treatment if the PMK answers yes to one of the following questions:

a) DOES HE/SHE TAKE THE FOLLOWING PRESCRIBED MEDICATION ON A REGULAR BASIS: Ritalin?

b) DOES HE/SHE TAKE THE FOLLOWING PRESCRIBED MEDICATION ON A REGULAR BASIS: Tranquilizers or nerve pills?

Children are classified as visiting a doctor for mental health treatment based on the following question:

IN THE PAST YEAR, HOW MANY TIMES HAVE YOU SEEN OR TALKED ON THE TELEPHONE ABOUT CHILD'S PHYSICAL OR MENTAL HEALTH WITH: A psychiatrist or psychologist?

### **5. PMK Activity Limitations**

The PMK is asked if they have are restricted in their daily activities.

The PMK Depression Score variable is derived using the responses to the following questions.



- a) How often have you felt this way during the past week: I did not feel like eating, my appetite was poor?
- b) How often have you felt this way during the past week: I felt like I could not shake off the blues even with help from family or friends?
- c) How often have you felt this way during the past week: I had trouble keeping my mind on what I was doing?
- d) How often have you felt this way during the past week: I felt depressed.
- e) How often have you felt this way during the past week: I felt that everything I did was an effort?
- f) How often have you felt this way during the past week: I felt hopeful about the future.
- g) How often have you felt this way during the past week: My sleep was restless.
- h) How often have you felt this way during the past week: I was happy.
- i) How often have you felt this way during the past week: I felt lonely.
- j) How often have you felt this way during the past week: I enjoyed life.
- k) How often have you felt this way during the past week: I had crying spells.
- l) How often have you felt this way during the past week: I felt that people disliked me.

The possible responses to these questions were Rarely or none of the time (less than 1 day), Some or a little of the time (1-2 days), Occasionally or a moderate amount of the time (3-4 days) or Most or all of the time (5-7 days). The total score varies between 0 – 36, where a high score represents the presence of symptoms of depression.

We used the chose a cutoff such that 10 percent of the mothers in the survey were classified as depressed.

#### **DEPENDENT VARIABLES:**

1. **Delinquent Behavior <16:** This is an indicator variable for delinquent behaviour in Cycle 5 (2002) for children who were under the age of 16 (i.e. between the ages of 12 to 15) in Cycle 5. This variable is derived from the following variables:

- a) During the past 12 months, about how many times were you questioned by the police about anything that they thought you did?

b) I steal outside my home.

c) I vandalize.

d) During the past 12 months, about how many times were you questioned by the police about anything that they thought you did?

e) During the past 12 months, about how many times have you run away from home?

2. **Delinquent Behavior 16-19:** This is an indicator variable for delinquent behaviour in Cycle 5 (2002) for children who were between the ages of 16 to 19 in Cycle 5. This variable is derived from the following:

a) During the past 12 months, about how many times have you stolen something?

b) During the past 12 months, about how many times have you damaged or destroyed anything that didn't belong to you (for example, damaged a bicycle, car, school furniture, broken windows or written graffiti)?

c) During the past 12 months, about how many times have you attacked someone with the idea of seriously hurting him/her?

d) During the past 12 months, about how many times have you carried a weapon for the purpose of defending yourself or using it in a fight?

e) During the past 12 months, about how many times have you sold any drugs?

3. **Standardized Math Score:** Standardized version of the raw math test scores in Cycle 5 (2002). Math test scores are available only for children in the sample who were between the ages of 12 to 15 in Cycle 5. Name of original variable in NLSCY: emacs01

4. **In School:** This is an indicator variable for the child being still in school in Cycle 5 (2002). This variable is available for children who were between the ages of 16 to 19 in Cycle 5 (2002).  $Inschool\_dum1=1$  if  $eedyeq1a=2$  or  $eedyeq1a=4$ .

5. **Repeated Grade:** This is an indicator variable for the child having at least one grade-repetition episode taking place in the time period between Cycle 1 and Cycle 5 (i.e. between 1994 and 2002). This variable is available for children of all ages in the sample. This variable is created from  $eedydq50$ ,  $eedcd03$ ,  $dedcd03$ ,  $cedcd03$ ,  $bedcd03$ ,  $eedyed12$  and  $aedcd01$  for children who were between the ages of 16 to 19 in Cycle 5 (2002). This variable is created from  $eedcd01$ ,  $eedcd03$ ,  $dedcd03$ ,  $cedcd03$  and  $bedcd03$  for children who were under the age of 16 in Cycle 5 (2002).