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, and especially ADHD, 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 suffer 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).[1] 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

[1] 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 "screener" 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).[2] 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

[2] 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 little evidence that these effects are modified by family income or maternal education.

Our results are robust to controlling for other diagnosed learning disabilities or birth weight or excluding children with other diagnosed learning disabilities, and to different ways of handling treated children. We also find that the effects of mental health conditions on test scores are large relative to those of other chronic conditions of childhood (though both mental health conditions and chronic physical conditions increase the probability of grade repetition). Finally, when we control both for past and current mental health problems, we find that past

mental health problems have significant negative effects on test scores, suggesting that the effects of persistent mental health problems in children are cumulative.

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.[3] 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

[3] 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.

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 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 <u>any</u> 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.[4]

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

[4] 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).

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.[5] Hence, it is of interest to see whether these conditions have similar effects on the

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[5] 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

prospects of children in the two countries. Moreover, the conditions we focus on are measured 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. [6] 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

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treatment compared to 3.3 percent of the American children. The NLSCY asks specifically about Ritalin, tranquillizers 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.

[6] 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.

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.[7] This procedure yields a maximum sample of 3,758 children. We restrict the age range of the NLSY children to be greater than 4 and less than 12 years of age in 1994. This makes the Canadian and U.S. samples comparable, and it has the additional benefit of making the NLSY sample more representative. The mothers of the NLSY children represented a nationally representative cohort of 14 to 21 year old women in 1978. But 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, and this problem is more pronounced when the oldest children (who were born to the youngest mothers on average) are included.

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

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

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 also estimate models that include both behaviour problems and other learning disabilities in order to assess the comparative magnitude of the effects. Using the Canadian data on chronic conditions, we also compare the effects of behaviour problems to those of chronic physical conditions.

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.

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 estimated 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. Results for younger children were similar.

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.[8]

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 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

[8] 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.

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 distribution, 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. It is interesting that correlations between the various types of behaviour problems and other learning disabilities are rather low. The strongest correlation is between other learning disabilities and ADHD, at .18.

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 7th birthday and exhibit considerable stability over time.[9] 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.

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,

[9] 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

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, where they are statistically significant, 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 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 90th percentile BPI score to all of the

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large sample of 41/2 to 5 year olds and find that those who had 3 or more symptoms at age 5 (about 6.6 percent of

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:

$$(3)\quad outcome_i = \alpha + \beta(income)_i + \phi income_i * MENTAL94_i + \chi MENTAL94_i + \lambda X94_i + \varepsilon_i$$

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 suggest that the negative effects of mental health problems were mitigated in high income children. In addition to including interactions with linear income, we also use interactions between the mental health scores and having a mother who is a high school dropout, and between the mental health scores and being in poverty[10].

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.

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

[10] We define poverty as having family income below the federal poverty line in the U.S. data and below the Statistics Canada Low Income Cutoff in the Canadian data.

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.[11] 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 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.

[11] 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.

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.

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.

An important question about the interpretation of the results in Table 3 concerns whether we think that early mental health conditions matter because they predict later mental health conditions, or whether they have effects independent of a child's future mental health status. Table 3a shows models that include both the overall score for 90 to 94, and the score for 98 to 2004. These models are estimated only for the U.S., because the Canadian sample had two few children with scores available for both periods. The estimates suggest that for schooling attainment, early mental health problems matter mostly because they predict later mental health problems. However, for cognitive test scores, early mental health problems have large significant effects even controlling for later problems. Hence, these estimates indicate that early mental health problems have significant and lasting effects on children's cognitive achievements, even if they do not lead to grade repetition and special education.

Table 3b shows that the results are unchanged if we also control for the presence of other learning disabilities (even though these disabilities have large independent effects, especially on test scores). We have estimated similar models (not shown) that include for birth weight, and this also has little effect on the estimated effect of mental health problems. Table 3c compares the effects of mental health conditions to those of chronic physical health problems. This analysis is conducted only with the Canadian data, since the U.S. data does not ask every child about the presence of chronic conditions. The estimated effects of mental health conditions are almost exactly the same as those in Table 3. Chronic physical conditions have a large effect on grade repetition, but no effect on test scores.

Table 4 shows several specification checks. First, we try excluding children with other diagnosed learning disabilities. Second, we exclude treated children. Third, we impute a high (90^{th} percentile) BPI score to treated 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 includes 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 between mental health scores and whether the mother is a high school dropout are also insignificant in the fixed effects models. Curiously, the last panel shows that if we use poverty rather than a continuous income measure, the interaction terms for U.S. math and reading scores are positive. That is, higher mental health problem scores appear to have little effect on poor U.S. children—the positive interaction offsets the negative "main" effect of a high screener score. It is possible that this result reflects the fact that poor children have the lowest scores on these tests to begin with. In any case, there is little evidence that maternal education or family income mitigate the negative effects of childhood mental health conditions, in sharp contrast to the large literature suggesting that higher income does mitigate the negative effects of physical health conditions.

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. Our estimates also indicate that mental health conditions in early childhood have persistent negative effects on children's test scores regardless of their future mental health, and that the effects of mental health conditions on test scores are large, relative to those of chronic physical conditions.

We also find that little evidence that higher income protects against the negative effects of mental health conditions. 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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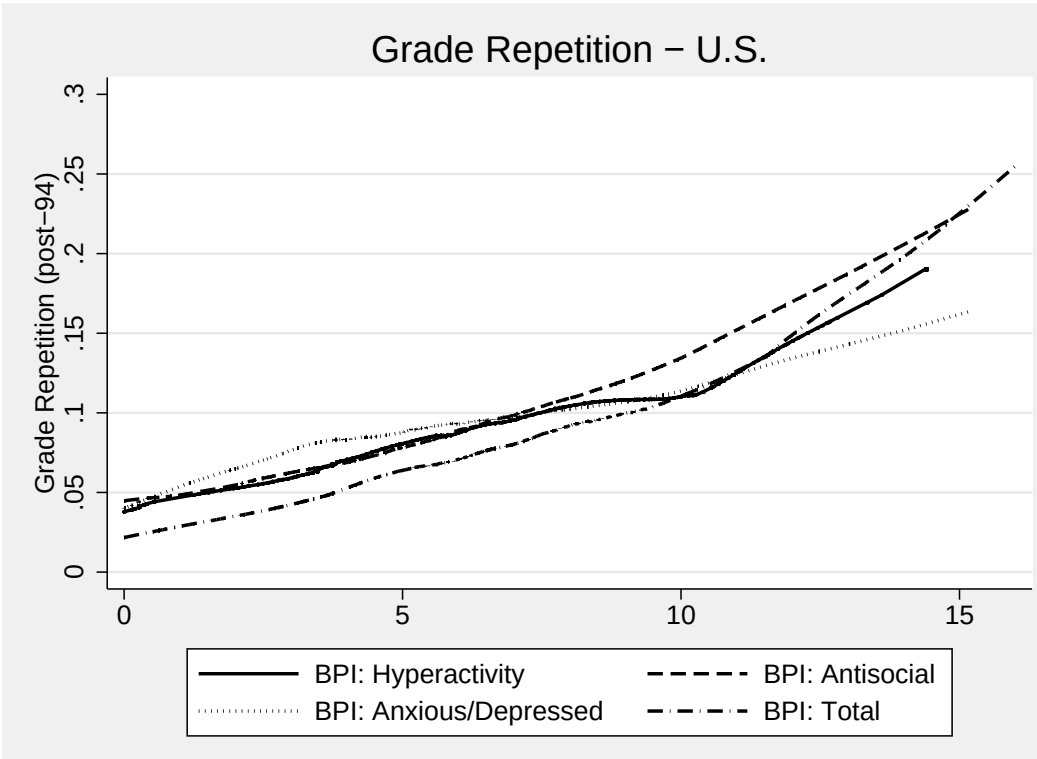
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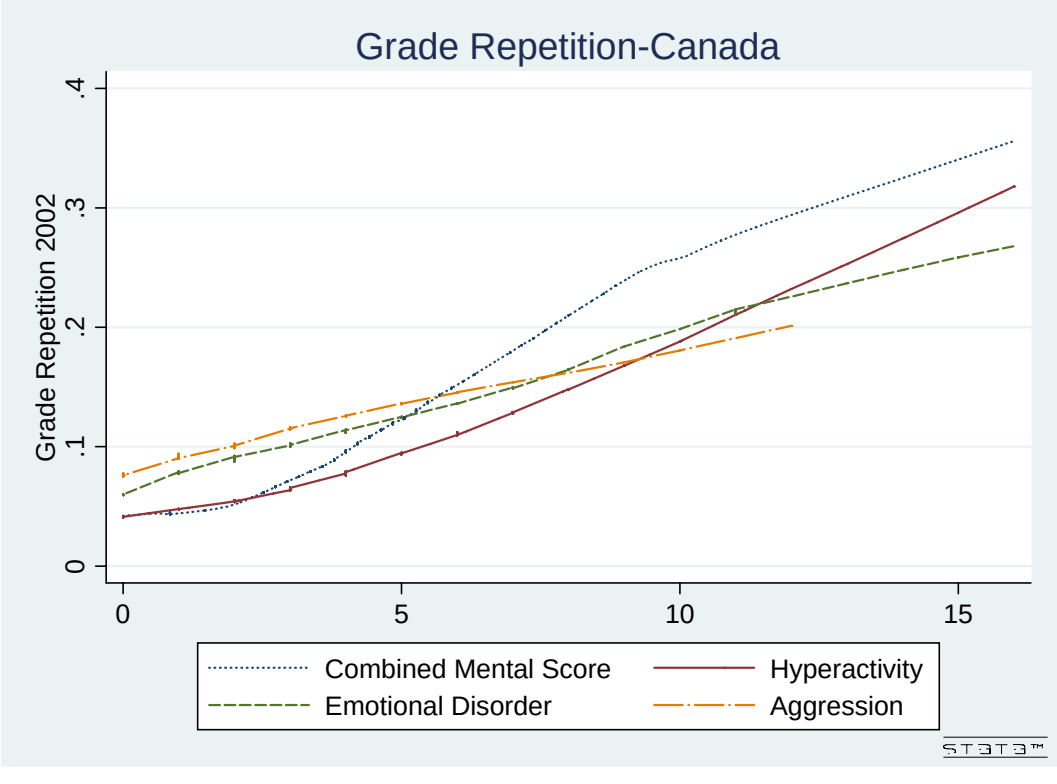
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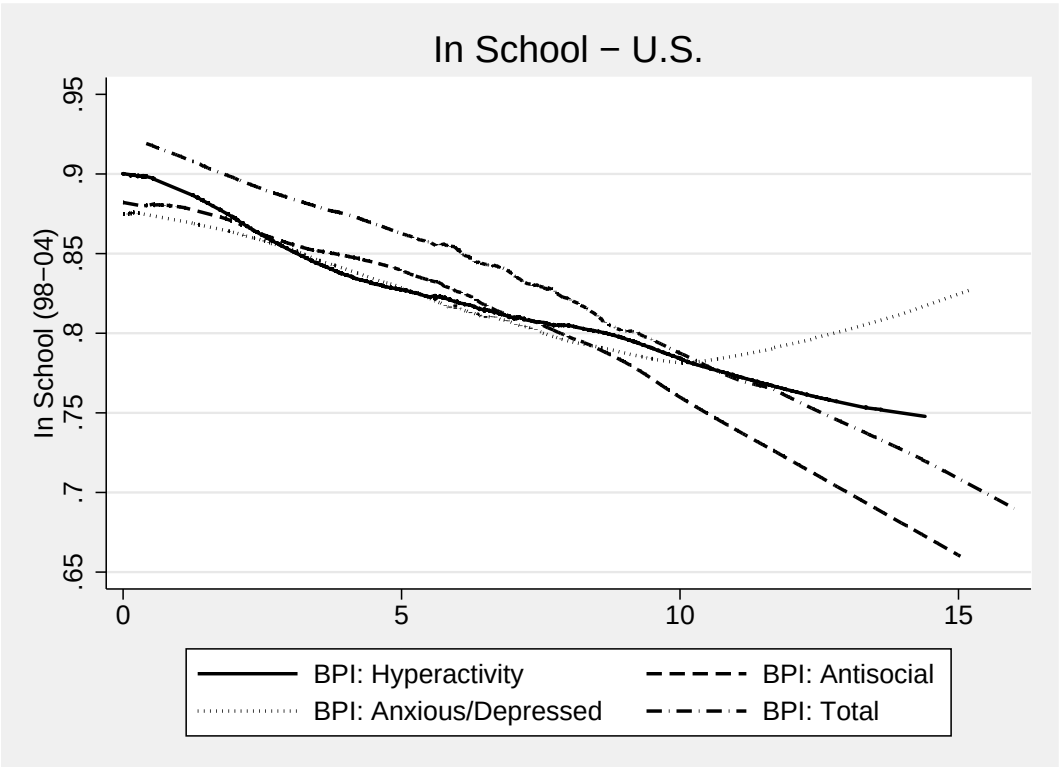
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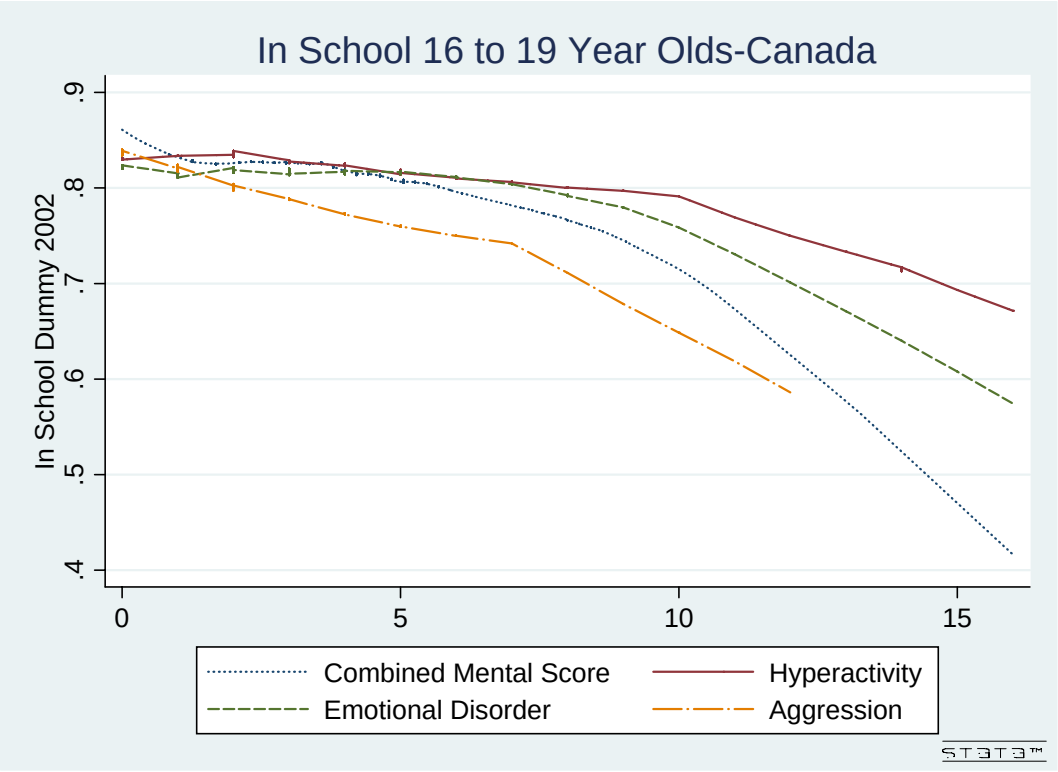
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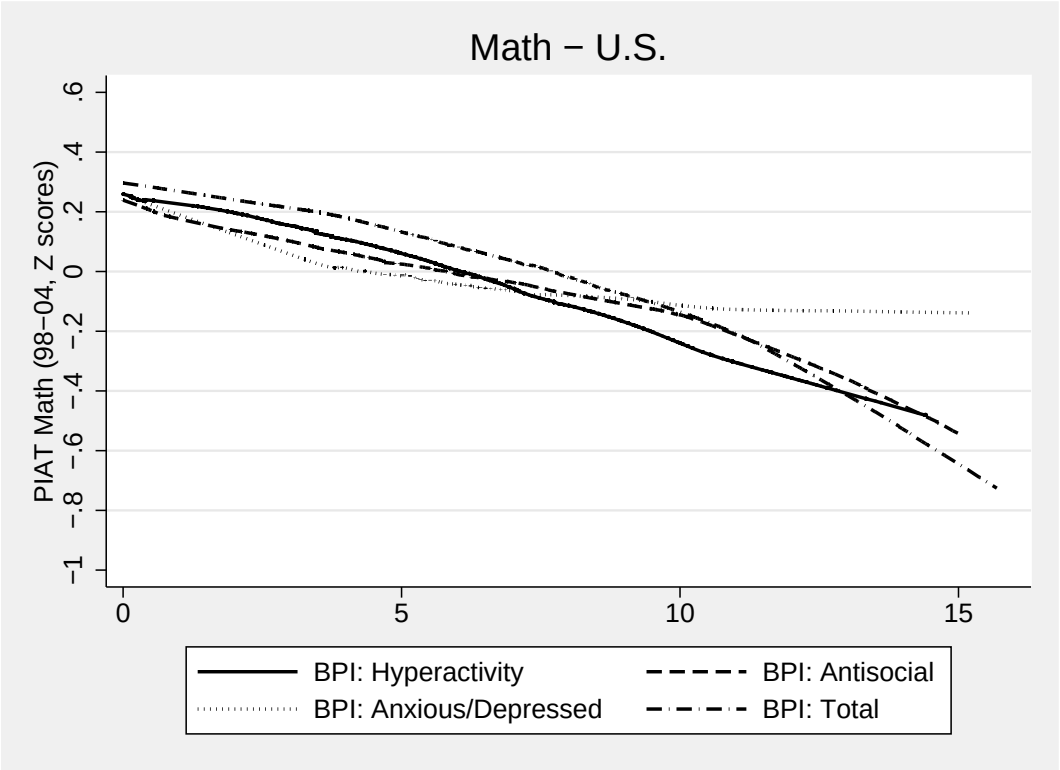
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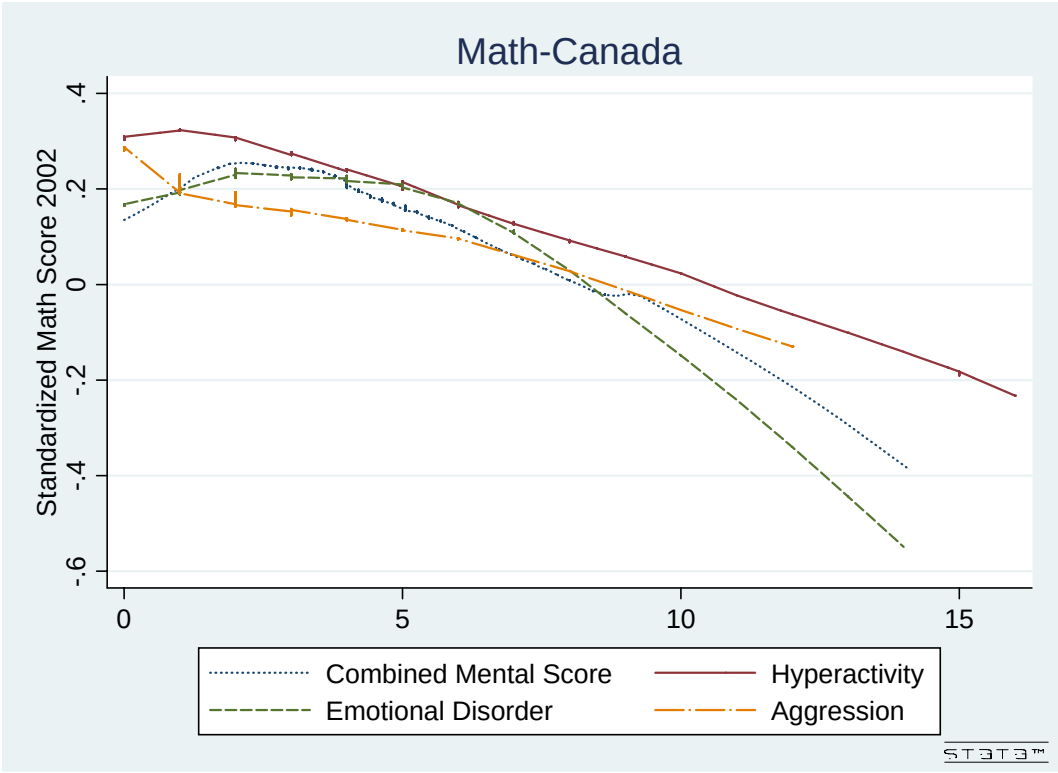

Grade Repetition − U.S.
Grade Repetition (post−94)
0
.05
.1
.15
.2
.25
.3
0
5
10
15
BPI: Hyperactivity
BPI: Antisocial
BPI: Anxious/Depressed
BPI: Total

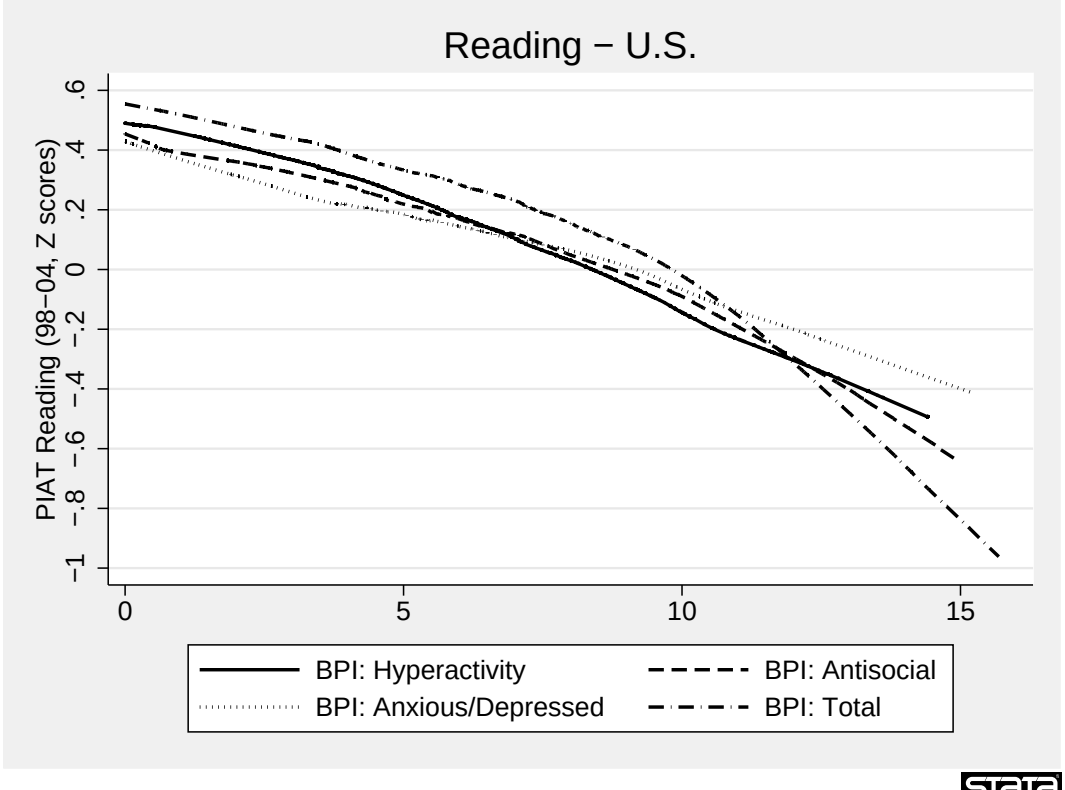

Grade Repetition-Canada
Grade Repetition 2002
0
.1
.2
.3
.4
0
5
10
15
Combined Mental Score
Hyperactivity
Emotional Disorder
Aggression

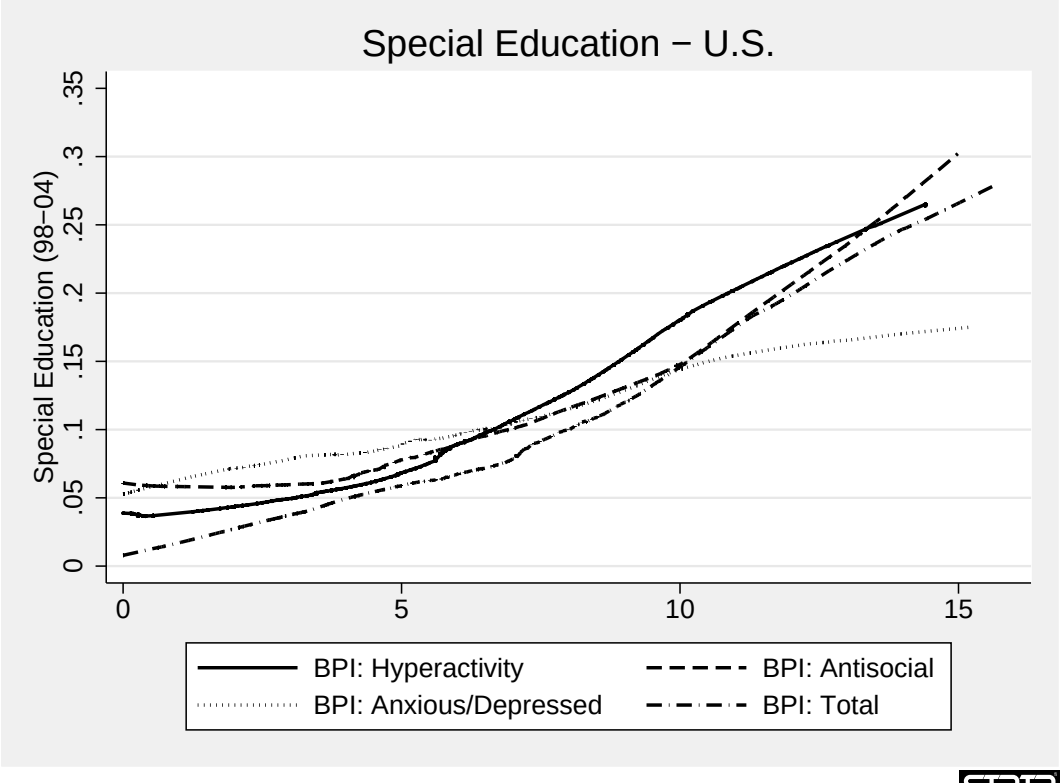

In School − U.S.
In School (98−04)
.65
.7
.75
.8
.85
.9
.95
0
5
10
15
BPI: Hyperactivity
BPI: Antisocial
BPI: Anxious/Depressed
BPI: Total

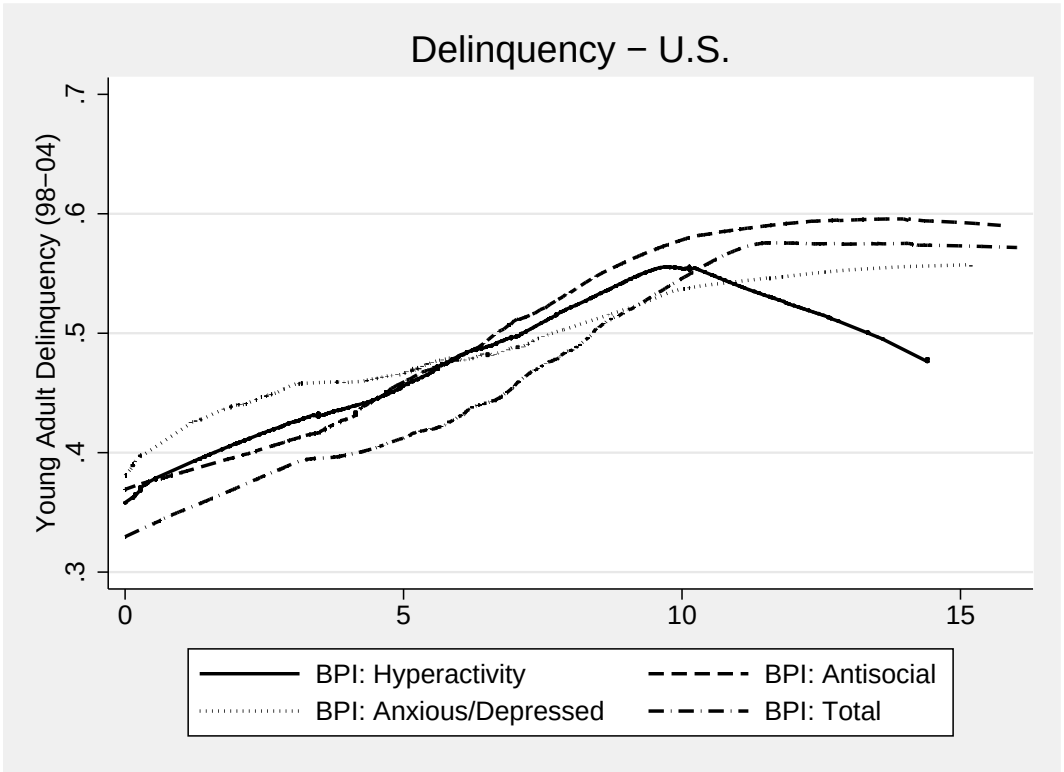

In School 16 to 19 Year Olds-Canada
In School Dummy 2002
.4
.5
.6
.7
.8
.9
0
5
10
15
Combined Mental Score
Hyperactivity
Emotional Disorder
Aggression

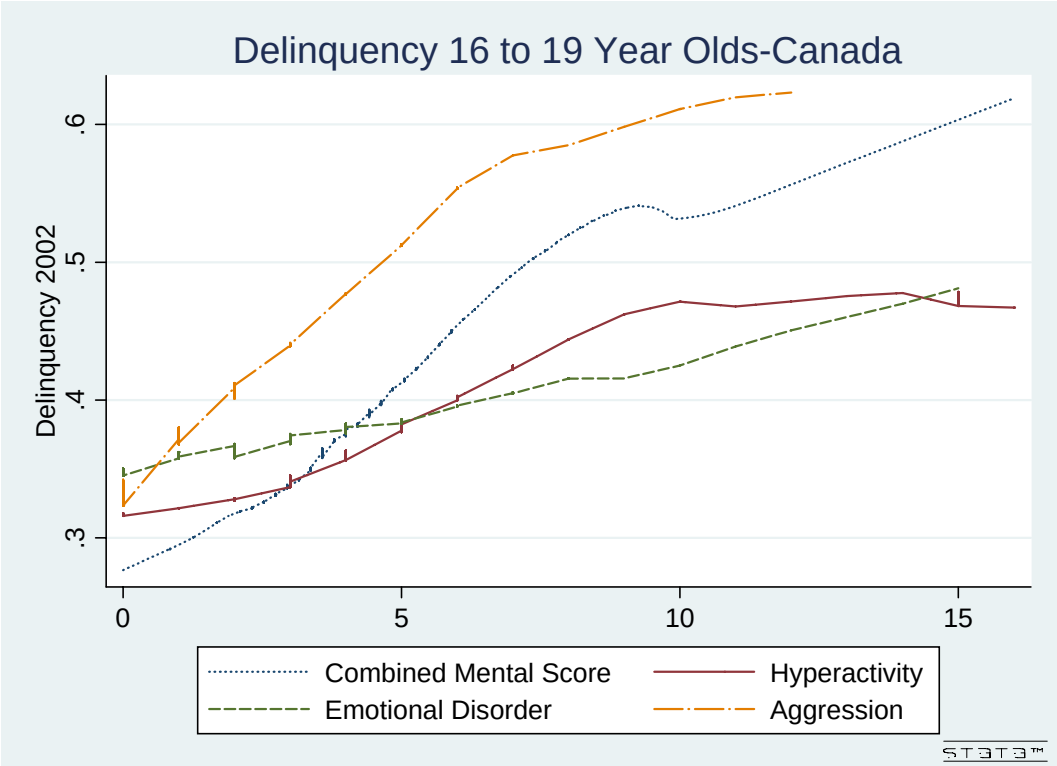

Math − U.S.
PIAT Math (98−04, Z scores)
−1
−.8
−.6
−.4
−.2
0
.2
.4
.6
0
5
10
15
BPI: Hyperactivity
BPI: Antisocial
BPI: Anxious/Depressed
BPI: Total


Math-Canada
Standardized Math Score 2002
.4
.2
0
-.2
-.4
-.6
0
5
10
15
Combined Mental Score
Hyperactivity
Emotional Disorder
Aggression


Reading − U.S.
PIAT Reading (98−04, Z scores)
−1
−.8
−.6
−.4
−.2
0
.2
.4
.6
0
5
10
15
BPI: Hyperactivity
BPI: Antisocial
BPI: Anxious/Depressed
BPI: Total


Special Education − U.S.
Special Education (98−04)
0
.05
.1
.15
.2
.25
.3
.35
0
5
10
15
BPI: Hyperactivity
BPI: Antisocial
BPI: Anxious/Depressed
BPI: Total


Delinquency − U.S.
Young Adult Delinquency (98−04)
.3
.4
.5
.6
.7
0
5
10
15
BPI: Hyperactivity
BPI: Antisocial
BPI: Anxious/Depressed
BPI: Total


Delinquency 16 to 19 Year Olds-Canada
Delinquency 2002
.3
.4
.5
.6
0
5
10
15
Combined Mental Score
Hyperactivity
Emotional Disorder
Aggression

Appendix Table 1
OLS: Effects of Total/Combined Behavorial 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***	0.023***	0.007***	0.019***	-0.005**	-0.007*	-0.028***	-0.019*	-0.045***	0.013***
	[4.88]	[4.13]	[3.97]	[7.86]	[1.97]	[1.78]	[4.69]	[1.66]	[6.68]	[5.95]
Permanent Income (/$100,000)	0.013	0.030	-0.019**	-0.066***	0.061***	0.085***	0.230***	0.364***	0.222***	-0.023***
	[0.61]	[1.02]	[2.56]	[6.89]	[4.74]	[4.44]	[4.80]	[5.56]	[5.35]	[3.27]
Mother Is Immigrant	-0.042	0.061	-0.045***	-0.034***	0.073**	0.030	-0.031	0.018	-0.025	-0.043**
	[1.12]	[1.65]	[2.66]	[2.84]	[2.54]	[1.25]	[0.40]	[0.20]	[0.28]	[2.19]
Male Child	-0.073***	0.182***	0.031**	0.037***	0.033*	-0.030**	-0.463***	0.084**	-0.378***	0.003
	[3.18]	[8.88]	[2.53]	[4.89]	[1.68]	[2.10]	[9.68]	[2.03]	[6.75]	[0.18]
First Born Child	0.052**	0.014	0.037***	-0.013	-0.035	0.038**	-0.330***	0.026	-0.104*	-0.004
	[2.01]	[0.58]	[2.83]	[1.49]	[1.64]	[2.33]	[6.52]	[0.56]	[1.74]	[0.25]
Ln(Family Size)	0.153***	0.072	0.034***	-0.012	-0.026*	-0.049	0.115***	-0.069	-0.040	0.058***
	[9.05]	[1.37]	[3.96]	[0.55]	[1.81]	[1.23]	[3.49]	[0.61]	[1.05]	[5.45]
Two Parent Household	-0.092***	-0.036	-0.021**	-0.038**	0.054***	0.072**	0.159***	0.068	0.270***	-0.025**
	[4.85]	[0.98]	[2.17]	[2.12]	[3.29]	[2.47]	[4.34]	[0.89]	[6.65]	[2.05]
Mother's Age at Child's Birth	-0.091***	0.002	-0.023	-0.001	-0.002	-0.001	-0.066	0.018***	-0.116	0.004
	[3.28]	[0.73]	[1.25]	[0.89]	[0.06]	[0.39]	[0.97]	[3.45]	[1.50]	[0.16]
Child Born to Teenage Mother	-0.031	-0.095*	-0.039**	-0.016	0.054**	-0.040	0.060	0.040	0.082	-0.026
	[1.22]	[1.86]	[2.25]	[0.66]	[2.27]	[0.93]	[1.11]	[0.39]	[1.26]	[1.33]
Mother Has Less than l High School	-0.010**	0.004	-0.003	0.082***	0.009**	-0.089***	0.028***	-0.294***	0.022**	0.000
	[2.20]	[0.17]	[1.36]	[6.52]	[2.42]	[4.40]	[3.41]	[5.62]	[2.31]	[0.16]
Mother Depressed or Has Activity Limitation	-0.019	0.007	0.008	0.016	0.067	-0.035*	0.078	-0.077	0.164	-0.026
	[0.40]	[0.26]	[0.26]	[1.28]	[1.59]	[1.69]	[0.52]	[1.31]	[0.62]	[0.43]
Black (U.S.)	0.007		0.083***		-0.088***		-0.338***		-0.451***	0.037**
	[0.31]		[5.59]		[4.11]		[7.16]		[7.76]	[2.02]
Hispanic (U.S.)	0.033		-0.003		-0.060***		-0.158***		-0.112**	0.031*
	[1.55]		[0.28]		[3.05]		[3.47]		[2.02]	[1.81]
Adult Respondent is Female (Canada)		0.066		0.016		-0.026		-0.313***		
		[1.54]		[1.07]		[1.05]		[2.99]		
Imputation Dummy (Canada)		-0.055*		0.005		-0.033***		-0.020		
		[1.76]		[0.50]		[2.60]		[0.43]		
Age 4	-0.293***		0.036	-0.048***			-0.066		-0.036	0.043
	[5.93]		[1.59]	[3.10]			[0.77]		[0.39]	[1.62]
Age 5	-0.232***		0.050**	-0.012			-0.011	0.001	-0.022	0.042*
	[5.70]		[2.14]	[0.71]			[0.13]	[0.01]	[0.24]	[1.72]
Age 6	-0.177***		0.033	-0.002	0.083***	0.288***	-0.030	-0.144***	-0.026	-0.001
	[4.61]		[1.59]	[0.14]	[3.05]	[10.41]	[0.39]	[2.60]	[0.31]	[0.06]

Age 7	-0.117***	0.036	-0.009	0.004	0.050*	0.335***	0.019	0.221***	-0.038	0.026
	[3.20]	[0.35]	[0.46]	[0.26]	[1.78]	[8.12]	[0.25]	[3.79]	[0.46]	[1.20]
Age 8	-0.086**	0.117***	-0.016	0.029	-0.121***	0.352***	-0.057	0.324*	-0.037	0.043*
	[2.45]	[3.19]	[0.83]	[1.59]	[3.94]	[15.66]	[0.79]	[1.81]	[0.45]	[1.91]
Age 9	-0.076**	0.121***	-0.005	0.030*	0.023	0.315***	-0.040		-0.029	-0.020
	[2.32]	[3.46]	[0.29]	[1.71]	[0.84]	[13.23]	[0.55]		[0.37]	[1.01]
Age 10	-0.075**	0.093***	0.002	0.030*	-0.137***	0.135***				
	[2.28]	[3.53]	[0.10]	[1.83]	[4.67]	[5.21]				
Constant	0.823***	-0.065	0.132**	0.092**	0.617***	0.680***	-0.353	-0.122	0.128	-0.036
	[6.89]	[0.53]	[2.00]	[2.05]	[5.79]	[7.70]	[1.49]	[0.50]	[0.47]	[0.48]
R^2	0.09	0.08	0.06	0.07	0.12	0.20	0.22	0.09	0.19	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.