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The Effect of Maternal Depression and Substance Abuse on Child Human Capital Development

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ABSTRACT

Depression has been shown to affect the functioning, educational attainment and work-related outcomes of adults affected by the disease. Clinical evidence links maternal depression and behavior problems in children. Little research attention has been accorded the inter-generational effects of parental mental and addictive disorders on cognitive, behavioral, and educational outcomes of children. Heckman (2007) has shown that social and emotional aspects of early childhood outcomes have profound effects on the ultimate economic well-being of individuals. We study effects of maternal depression and substance abuse among children born to mothers in the initial cohort of the 1979 National Longitudinal Survey of Youth (NLSY), a national household survey of high school students aged 14-19 in 1979. We follow 1587 children aged 1-5 in 1987, observing them throughout childhood and into high school.

To identify the intergenerational impact of maternal depression and substance abuse on child outcomes in primary and secondary school, we use propensity score methods to control for a rich set of early life factors of the mother. Specifically, we use information on the mental health status and alcoholism of maternal grandparents and the presence of symptoms of mental and addictive disorders early in a mother's life, and early depression and alcohol abuse symptoms in a mother's sibling to predict symptoms of maternal depression in models of child outcomes described above. We also estimate fixed effect models, to examine within mother differences in symptoms of depression and substance abuse on different siblings, with similar results.

After controlling for early life predictors of maternal depression, maternal symptoms of depression have little effect on contemporaneous cognitive scores in children. However, maternal depression symptoms have a moderately large effect on child behavioral problems. The pattern of results is similar for maternal symptoms of alcohol abuse. These findings suggest that the social benefits of effective behavioral health interventions are understated. Based on evidence linking early life outcomes to later well-being, efforts to prevent and/or treat mental and addictive disorders in mothers and other women of childbearing age have the potential to improve outcomes of their children not only early in life, but throughout the life cycle.

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Introduction

New approaches to modeling the formation of human capital represents a synthesis of the human capital approach and a life cycle view of human development that is grounded in neuroscience(Heckman 2007). That literature highlights the importance of the household environment on the development of children and the fact that a child’s relationship with their care giver is important in determining the development of the brain. Thus, the stability of the home and parental mental health can have notable impacts on skill development in children that may have impacts on the stock of human capital in adults (Knudsen, Heckman et al. 2006; Heckman 2007).

There is a well developed literature that links mental illness in adults to lower levels of employment, reduced productivity, lower earnings and early exits from the labor force (Currie and Madrian 1999; Frank and Koss 2005).¹ Empirical analysis of the causal links between mental illness and labor market outcomes reveal evidence of intergenerational effects of mental disorders on labor market outcomes. That is, working age adults with parents that suffered from mental disorders had relative odds of working that 5 to 10 percent lower than the odds for otherwise similar adults that reported no mental illness in their parents (Ettner, Frank et al. 1997). Similarly parental mental illness has the effect of reducing earnings and hours worked in working adults holding constant other factors affecting labor supply. That research and other work (Currie and Stabile 2008) also suggest that the effect is in part due to an increased likelihood of experiencing a mental illness if one’s parents had such illnesses (relative odds of 1.12 to 1.24). Understanding how parental mental disorders can affect skill accumulation and adult

¹ When we refer to mental illnesses we include substance use and abuse disorders.

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human capital is especially important given that there are cost-effective treatments that have been tested in women of child bearing ages at various income levels (U.S. Department of Health and Human Services 1999; Miranda, Chung et al. 2003). Thus, ameliorating parental mental health problems offer the potential to efficiently bolster the development of human capital at an early age.

In this paper we examine the impact of maternal depression and substance abuse on the cognitive and behavioral development of children during their early school years. We make use of data from the National Longitudinal Survey of Youth, 1979 cohort, to estimate the impact of maternal mental health on a set of cognitive and behavioral outcomes in grammar school aged children. Our results show that the main effect of maternal mental health problems is on behavioral rather than cognitive outcomes. As shown in recent work (National Research Council and Institute of Medicine 2000; Heckman 2006; Cunha and Heckman 2007; Heckman 2007), non-cognitive skills and attributes are important determinants of economic success that have been under appreciated in policy circles.

The paper is organized into 7 sections. The first summarizes background research on child development and maternal depression. The second provides a theoretical discussion of how maternal depression and substance use and abuse may influence child human capital development. Section 3 describes our data and measures of interest. Section 4 lays out the empirical strategy in detail. Section 5 provides the main results on how maternal behavioral health influences maternal investments in children and child outcomes. Section 6 provides alternative specifications of these results and robustness checks. Section 7 concludes with a discussion of implications.

Background

Research in neurobiology and child development shows important effects that stress in the home environment can have for the healthy development of children. That research also shows that early influences (positive or negative) on emotional development in children can have lasting effects into adulthood. The quality of maternal care early in life is known to be important in animals and humans (McEwan and Seeman 1999). Stable and supportive care giving environments have been linked to an enhanced ability to cope with stress that reduces the likelihood of mental health problems.

Maternal depression is thought to disrupt the care giving environment (U.S. Department of Health and Human Services 1999; Kim-Cohen, Moffit et al. 2005). The early literature on maternal depression established evidence that there are important and lasting effects of maternal depression on child development (Cogill, Caplan et al. 1986). A study by Cogill and colleagues (1986) shows that maternal depression early in a child's life (1st year) has a negative and significant effect of cognitive skills measured at age 4. A meta-analysis published in 1999 reviewed 33 studies of the relationship between maternal depression and child behavior (Beck 1999). That review showed a consistent relationship between maternal depression and child behavior. The results showed that behavior problems occurred both in the pre-school period and among school aged children.

Two more recent studies have been reported. In one paper, (Petterson and Albers 2001), the authors analyzed the National Maternal and Infant follow back survey data to examine the impacts of maternal depression and poverty on child development. They found that mothers with likely depression as measured by a CESD score of 16 to 30 and

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30 and above had young children that scored lower on cognitive and motor skills development tests. They also found that higher income levels appear to attenuate but do not eliminate the effects of maternal depression. A British study examined the link between maternal depression and antisocial behavior in children (Kim-Cohen, Moffit et al. 2005). Using data on twins, the authors examined the impact of maternal depression that occurred during the first 5 years of life on antisocial behavior measured at age 7. They also examined the incremental effects of maternal depression that occurred when the children were aged 5 to 7 years. The results showed a significant impact on antisocial behavior at age 7 of both early maternal depression and more recent depression.

The presence of mental health problems in school aged children has been linked to long term reduction in the accumulation of human capital (Currie and Stabile 2008). Currie and Stabile (2008) use the National Longitudinal Survey of Youth (NLSY) to examine the impact of mental disorders on children and their subsequent academic achievement. They show that ADHD and conduct disorders both have negative and significant impacts on achievement test scores and levels of educational attainment. Together these results suggest that maternal depression, one of the most treatable of mental disorders, can have lasting effects on the accumulation of human capital early in life.

Theoretical Considerations

Cunha and colleagues (Cunha, Heckman et al. 2006; Cunha and Heckman 2007) have developed a model that links skill or capability (education, cognitive, emotional and behavioral attributes that underlie economic success) formation in children to parental capabilities and parental investments in child development. The model developed by

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Cunha et al (2006) also recognizes that there are multiple stages in child development. The findings from the neuroscience literature (National Research Council and Institute of Medicine 2000) indicate that parental capabilities and investments have different impacts on child development at different stages of development. Cunha et al (2006) yields several implications. First, cognitive, behavioral, physical and other capabilities are interdependent. That is, cognitive skills obtained today depend on investments in health and emotional development among other factors (possibly made at an earlier point in time). Second, parental capacity to invest in child capabilities are important and have varying impacts at different points in a child’s development. Third, past investments affect the impact of current investments in child development.

The empirical work presented in this paper takes these ideas as a point of departure. Consider the skills formation function of Cunha et al (2006)

$$(1) S_{t+1} = F(PS, S_t, I_t; M_t)$$

Where S is the level of skill formation, PS is parental skill attributes (education, cognitive abilities etc), I is the investment in child capabilities at time t, and M is mother’s mental health status at time t. We focus on mother’s mental health status because of the mother’s central role as a care giver and the existing clinical evidence cited above of a link between mother’s mental health and child skills acquisition. We focus on depression and substance abuse because they are relatively common mental health problems in women of child bearing age and because they can disrupt care giving. We observe the impact of these two sets of mental health problems on measures of cognitive and behavioral skills formation early in a child’s academic career (grades 1-5 and again in grades 6-9). In our conception, maternal depression and substance abuse can affect skill formation in

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children by reducing the effective level of parent skills (PS) and by reducing the productivity of parental investments in child skills development (I). The literature on the impact of mental disorders on human capital formation shows that mental and substance abuse problems affect productivity conditioning on human capital attributes (Frank and Koss, 2005).

The empirical implications of these ideas are that models aimed at estimating the impact of depression and substance abuse on child development should condition on parental skill levels. Thus our empirical analysis tries to account for the mother’s stock of human capital at the time of the child’s early schooling. We then estimate the impact of a proximate mental health shock (maternal depression substance abuse) on the parents’ level and effectiveness of investment in skill acquisition for their children. Our empirical strategy directly examines the effect of depression and substance abuse on indicators of maternal investments in child development. We then use propensity score weighting methods (Rosenbaum and Rubin 1983) and maternal fixed effects to condition out mother’s unmeasured human capital and other capabilities (Currie and Thomas 1999).

Data and Methods

The 1979 National Longitudinal Survey of Youth

We used the 1979 cohort of the National Longitudinal Survey of Youth (NLSY; (Bureau of Labor Statistics 2005) to follow a cohort of women and their children through the child’s primary and secondary school years. The NLSY conducted in-person interviews with individuals aged 14-22 in 1979, re-interviewing them annually through 1994 and every 2 years since then. Blacks, Hispanics, and economically disadvantaged non-black/non-Hispanic youths were over-sampled. Until 1989, interviews were

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conducted using pencil and paper before converting to Computer Assisted Personal Interviews in 1990. About 4,000 women were interviewed over the period from 1979 through 2004. Initial response rates were high, 87 percent, and retention rates were about 90 percent through 1994. In the years since, retention rates have ranged from 77 to 85 percent. The data set provides information on demographics, household structure (both in the household of origin, and in new living arrangements as respondents mature), education, income, cognitive ability, symptoms of depression, substance use and symptoms of substance abuse and dependence.

Beginning in 1986, the NLSY collected information on all children of interviewed females, through maternal reports, but also from direct assessments of children. Children age 10 and older were interviewed biennially regarding family, school, and delinquent behavior, and children 15 and older reported information themselves. We selected all female respondents with a preschool aged child (ages 0-4) in 1986. From this sample of 2,421 unique female NLSY respondents and their 3,333 children, we dropped 1327 children missing one or more cognitive assessments. From the remaining 2006 children, we dropped 116 children due to missing information on key variables such as maternal depression and substance use, abuse, and dependence symptoms. We also dropped 303 children due to missing information on other covariates such as education and income. This left us with a sample of 1587 children of female NLSY respondents. Each mother was interviewed, 18 times, on average (from 1979 through 2004).

Maternal mental health and substance abuse

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In the analysis reported below, we attempt to isolate the affect of episodic symptoms of depression on investments in children and on cognitive and behavioral outcomes of children. We chose this focus because there are many successful behavioral and pharmacological treatments available for individuals with mild and moderate depression. Similarly there are many effective treatments available for individuals with substance abuse or dependence. For these reasons, the variables of interest include maternal symptoms of depression, symptoms of alcohol abuse or dependence, and heavy use of marijuana (which we use as a proxy for substance abuse or dependence). Each of these items is reported directly by the respondent.² The NLSY provides several direct and indirect measures of maternal mental health. In 1992, respondents completed the 20 item CES-D, or Center for Epidemiological Studies – Depression Scale (Radloff 1977). Respondents answer questions regarding their mood, energy level, feelings of worth, and related questions. Generally, a score of 16 or higher on a scale from 0 to 60 indicates a cluster of symptoms consistent with a high likelihood of a diagnosis of depression. Respondents also responded to an abbreviated seven item CES-D in 1994³, and again in the first interview after age 40. Respondents answered a nine item CES-D scale when taking the age 40 assessment in 2000 and later. We coded women as having symptoms of depression if they scored 16 or higher (1992 CES-D) and if they scored more than one standard deviation above the mean on later CES-D scales.⁴ For the bulk of our analyses, we categorize women as depressed if they had a CES-D score at or above the cutoff in

² In the case of depression and substance abuse or dependence, diagnosis of these disorders relied heavily on self-reported symptoms of the patient.

³ The seven item CES-D is highly correlated with the 20 item scale ($r=.90$ according to David Dooley and JoAnn Prause Social costs of underemployment)

⁴ The cutoff for depression was 8 on a scale from 0 to 21 on seven item scales, and 9 on a scale from 0 to 27 on 9 item scales.

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both 1992 and 1994. We do this to minimize the measurement error natural in population based measures of depressive symptoms. In models that examine within-mother outcomes of multiple children, we use a single measure of depression (1992, 1994, or age 40) closest to the child's 7-10 year old assessment.

As part of our attempt to focus on proximate symptoms of depression that occurred during a child's primary school years, we also wanted to control for early depression in mothers before the child was born. We did this to control for the most recalcitrant cases of depression that might be less amenable to treatment. Because the CES-D questions were not used before 1992 in the NLSY, we used another assessment administered in 1980 and 1987, the ten item Rosenberg scale of self-esteem (Rosenberg 1965), that measures some symptoms of depression in mothers. Although this scale was designed to measure self-esteem, it correlates strongly with many aspects of the CES-D.⁵ We created our proxy indicator of depression in 1980 and 1987 using the standard cutoffs for low self esteem, a score below 10 on the 30 point Rosenberg scale.

The NLSY asked respondents extensive questions regarding use of alcohol and illicit drugs, and in selected years, respondents were asked to report a wide array of symptoms associated with alcohol abuse or dependence. To target alcohol use associated with functional impairment, we used questions from the 1985, 1989, and 1994 surveys to code individuals with 2 or more symptoms of alcohol abuse or dependence. See the appendix for a list of the questions used to identify symptoms. Very few mothers reported use of illicit drugs other than marijuana, so we focused on measures of heavy marijuana

⁵ We verified the correlation among female respondents in the National Longitudinal Survey of Generations (Bengston 1997), a survey of California health maintenance organization enrollees age-matched to the same cohort as the NLSY. In this survey, measures of the CES-D and the Rottenberg scale were significantly ($p < .0001$) positively correlated with ρ ranging from .56 to .64 during years in which both measures were available (1988, 1991, 1994, and 1997).

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use based on the 1984, 1992, and 1998 surveys. We coded marijuana use as heavy for individuals who had used marijuana more than 5 times in the last 30 days (1984) or 1-2 times per week or more often in the last 30 days (1992 and 1998). Unlike the NLSY questions on alcohol use, the survey provides no information regarding symptoms related to marijuana use, and heavy use of marijuana in itself does not necessarily imply that mothers were impaired by marijuana use.

Maternal investments in children – the HOME scales

To understand how maternal depression and problem substance use might influence children, we first examine investments in children made in the home. The NLSY asked extensive questions regarding parental involvement with children using the Home Observation for Measurement of the Environment-Short Form, adapted from the HOME inventory (Caldwell and Bradley 1984). The public use data provide two separate summary scales based on these questions: a cognitive stimulation scale and an emotional stimulation scale. Examples of cognitive stimulation scale questions include, “How many children’s books does your child have?” and emotional questions like, “If your child got so angry that he/she hit you, what would you do?” Questions differ based on relevance for the child’s age. We use continuous measures of these scales provided by the NLSY as outcomes reflecting maternal inputs.

Child outcomes

We focused on both cognitive and behavioral outcomes of children. The cognitive outcomes were scores on the Peabody Individual Achievement Test (PIAT) in Math and Reading Comprehension. We include two PIAT assessments for each child, the first took place when the child was between the ages of 7 and 10, and the second occurred

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when the child was between ages 11 and 14. In a separate assessment of child behavior, mothers were asked multiple items regarding child behavior, the Behavior Problem Index (BPI), which was adapted from Achenbach’s Child Behavior Check List (Achenbach and Edlebroch 1978; Achenbach and Edlebroch 1979). As with the cognitive measures, we include two BPI measures, an assessment between ages 7 and 10, and an assessment between ages 11 and 14. In addition, children aged 10 and older answered 9 items related to delinquency which were combined by NLSY staff to form a delinquency scale (see the Appendix for details). For all children, we examine whether the child has ever been suspended or expelled from school at any point during the schooling years.

Overview of Empirical Approach

Our analysis of the influence of depression and substance use or abuse on child outcomes faces several common methodological challenges due to potential reverse causation and omitted variables that may be correlated with both measures of interest (maternal depression and substance use and abuse) and the child outcomes. Reverse causation could occur if children who have poor behavior or low cognitive skills cause stress for mothers that might trigger symptoms of depression, alcohol abuse, or lead to heavier use of marijuana. The second potential threat to our analysis is that unobserved variables could influence both maternal behavioral health and child outcomes. For example, if mothers with lower cognitive skills also are at higher risk of poor mental health, and if maternal cognitive skills affect the way in which mothers invest in children, we might erroneously attribute child outcomes to maternal depression when in fact the mother’s low cognitive endowment causes both poor mental health and poor child

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outcomes. We undertake multiple steps to address these threats to inference in our analyses.

First, the longitudinal nature of the NLSY helps to insure that we identify symptoms of depression and/or substance abuse that precede child assessments of behavior and cognitive outcomes. We experimented with alternative specifications regarding the measurement of a mother’s mental health and the measurement of child outcomes, but our qualitative and quantitative findings hold regardless of whether maternal behavioral health measures precede child outcome measures, or whether they are simultaneously measured. Second, the rich data available through the NLSY minimize the potential threat of unobserved variables because we can control for an expansive set of covariates. For example, we have a measure of maternal IQ based on her 1980 percentile on the Armed Forces Qualification Test. We also know details regarding the mother’s household of origin during her high school years, so we can control for household structure, a measure of permanent income (income measured over the period from 1979-84) and educational attainment of the mother’s parents. A unique feature in the NLSY is that respondents report depression and/or anxiety of their parents, as well as whether a mother or father had problematic drinking behavior. Throughout the paper, we refer to the mother’s parents as grandparents, since we are focused on child outcomes. Also, due to the structure of the NLSY sample frame, many mothers have siblings in the NLSY; we have measures of depression and substance use/abuse. We use these family measures of parent and sibling behavioral health to control for family-level factors such as genetic predisposition to have behavioral health problems. Third, we combine the detailed information about the mother’s family of origin with early measures

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of the mother’s behavioral health and substance use to match mothers based on their likelihood of depression using propensity score methods. This ensures that we are comparing mothers who are similar with respect to observed characteristics that are associated with a high likelihood of depression. Finally, we test the robustness of our main findings among a sample of mothers with more than one child, using fixed effect specifications to measure within-mother differences in child outcomes related to contemporaneous symptoms of depression and/or alcohol abuse. This last approach is similar in spirit to models estimated by Chatterji and Markowitz (2001) in the NLSY, although we employ multiple measures of maternal depression symptoms, and we examine alcohol abuse whereas the prior paper estimates the effect of substance use (Chatterji and Markowitz 2001). Our narrower definition captures women who are impaired by drinking behavior, and we incorporate the effect of maternal depression on primary school outcomes for children.

Propensity Score Models

To ensure that we are comparing similar women, we use propensity score methods to balance our data so that the women in our sample share common attributes during their youth that are associated with depression (whether or not they actually display symptoms). Using an adaptation of weighting methods initially proposed by Hirano and Imbens (2001), but modified as described in Li, Zaslavsky and Landrum (2007), we use the extensive information available in the NLSY on the mother’s youth to predict her likelihood of depression measured using the CESD in 1992 and 1994 (Hirano and Imbens 2001; Li, Zaslavsky et al. 2007). The propensity score model takes the following form:

$$(1) \quad \log[P(\text{DEPRESSED})/(1-P(\text{DEPRESSED}))] = \beta_0 + \beta_1 X_{ij\text{YOUTH}} + \beta_2 Z_{ij\text{YOUTH}}$$

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where X is a vector of early life characteristics of the mother and Z captures characteristics of the mother's family and household of origin. The X vector of mother's characteristics when she was a youth includes: a measure of depression using the 1980 Rosenberg scale, whether the mother had 2 or more symptoms of alcohol abuse or dependence in 1985, whether the mother used marijuana 6 times or more in the 30 days prior to the 1984 survey, whether the mother was an oldest child, the mother's race and ethnicity, and her 1980-81 AFQT percentile. The Z vector includes: whether the mother reports that either of her parents (the maternal grandparents) had alcohol problems, whether either maternal grandparent had anxiety or depression, whether the maternal grandparents were married in 1979, the mother's mean real family income 1979-1984, the mother's number of siblings in 1979, two indicators for whether the maternal grandmother completed high school or some college, indicators for whether the mother had a sibling NLSY participant who was depressed in 1980, had symptoms of alcohol abuse in 1985, or used marijuana heavily in 1984. We then used the estimated parameters from (1) to construct a propensity score, $\hat{p}_i = \hat{\beta}_1 X_{iYOUTH} + \hat{\beta}_2 Z_{iYOUTH}$. The propensity score formed the basis of person-level weights that balanced the observed characteristics (from equation 1) of depressed and non-depressed mothers, giving more weight to the overlapping portion of the distribution of propensity scores. Specifically $\omega_i = \hat{p}_i$, if the mother was not depressed in 1992 and 1994, and $\omega_i = 1 - \hat{p}_i$, if the mother was depressed in 1992 and 1994. This propensity score weighting approach, described briefly in Li, Zaslavsky, and Landrum (2007), like more commonly discussed inverse probability weighting techniques (Hirano & Imbens, 2001), balances observed characteristics across treatment and control groups. However, in this case, characteristics are balanced to resemble those among overlapping portions of the treatment and control distributions of observed characteristics. This adapted technique obtains average treatment effects, over the distribution of covariates in the population where the treatment and control groups overlap, as opposed to the entire

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population. This approach also minimizes the variance of our estimates, which can be excessively large in inverse probability weighting techniques when individuals have a very low propensity score. By construction, this propensity score weighting technique forces the distribution of observed characteristics in the propensity model to be identical across the two groups.⁶ All estimates presented later weight each observation with the propensity-score-based weight multiplied by the sample weight provided in the NLSY surveys.

Outcome models

To examine how maternal depression and substance use/abuse affect children, we estimate models of both maternal inputs (the HOMES scales) and continuous child outcomes. We estimate models of the following form:

$$(2) \quad Y_i = \alpha + \beta_1 * DEPRESSED + \beta_2 * ALCOHOL + \beta_3 * MARIJUANA + \delta_k + \Gamma X_i$$

Where the measures of depression, symptoms of alcohol abuse or dependence, and heavy marijuana use are the main variables of interest, and are coded as described above. The model includes a set of age dummies to reflect the age of the child at the time the outcome Y was measured in relation to a reference age, the modal age at which an assessment occurred. Child cognitive and behavior scores vary widely with the age of the child. The vector X includes individual characteristics of the child, the child's mother, and the household at the time the outcome was measured. These variables (defined in table 2) include: child sex, whether child is the oldest, number of child's siblings, whether child was born to a teenage mother, mother's marital status, mother's years of education, and a measure of permanent income, average annual household

⁶ For an application in health services research see (McWilliams et al. 2003).

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income 1986-2004. In addition to the OLS models described earlier, we have one binary outcome for children, suspension/expulsion from school at any point during the schooling years. We estimate logit models of the same variables in (2), but the dependent variable is the log-odds of the probability of being expelled or suspended.

Because we balance depressed and non-depressed mothers based on a extensive set of early life characteristics, including behavioral health of mother and her family members, we interpret the β coefficients as the effect of proximate symptoms of depression, alcohol abuse, and heavy marijuana use on maternal inputs and child outcomes. By specifying the model in this way, we hope to isolate symptoms of depression, for example, that are most amenable to treatment. We also hope to learn something about the mechanism linking depression and substance abuse to child human capital by studying how these factors relate to maternal emotional and cognitive inputs.

Factor models

As described earlier we examine several indicators of cognitive development (PIAT reading and math scores) and several behavioral measures (BPI, reports of suspension/expulsion, delinquency). Because these measures seek in part to measure fundamental phenomena related to cognitive development, learning, and social and emotional development, we develop a summary measure of cognitive development and behavior. We do this by estimating a factor model. We expect that the use of factors will increase our statistical power to estimate the effect of depressive symptoms and substance abuse on child cognitive and behavioral outcomes. Our approach follows previous work (Fryer, Heaton et al. 2006). We estimate these models in two steps. First, we conduct the factor analysis from which we construct our cognitive and behavior outcome measures.

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We follow Fryer et al (2006) and focus on a single factor with the greatest explanatory power if it explains more than 50% of the variance in the proxy measures. In these data, the cognitive factor accounts for over 67% of the variation in the proxies, while the cognitive factor explains 53% of the variation in those proxies (see Table 6).

Results

Table 1 summarizes the outcomes of interest for the 1587 children in our sample. The total HOMES scale measure averages 985 with a standard deviation of about 150. The cognitive stimulation score has a similar mean and variance. The emotional stimulation score averages about 48, but with a standard deviation close to 30. The cognitive measures are all standardized to have an average near 100 with standard deviations in the range of 12 to 15. The behavior problems indices are similarly standardized, although the variance is modestly higher for these (with standard deviations ranging from 15-17). The delinquency scale is standardized to have a mean of zero with higher numbers indicating increasing delinquent behavior. In this group of children born to relatively young mothers, the average score on the scale is slightly positive, .055. Finally, a sizeable minority of children in our sample, 22.4 percent, have experienced suspension or expulsion from school.

Table 2 summarizes the maternal characteristics of interest, the rate of mothers likely to have depression, alcohol abuse/dependence symptoms, and heavy marijuana use; it also summarizes the set of covariates employed in each analysis. As teenagers and young adults, based on Rosenberg scores, the mothers had rates of depression of 18.6 percent. This rate is in line with epidemiological evidence from the National Comorbidity Study Replication (Kessler, Berglund et al. 2005). The NCS collected

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information on US adults aged 18 and older, where about 18 percent of the population experiences an anxiety disorder, 9.5 percent experience a mood disorder, and about 26 percent are estimated to have a diagnosis of any mental disorder in the course of the year (Kessler, Berglund et al. 2005). Just over 3 percent had symptoms of alcohol abuse and/or dependence, similar to national numbers on the 12 month prevalence of alcohol abuse. One surprising statistic from Table 2 is the high rate of problem drinking women report among their parents, 20 percent. This measure is admittedly crude and we would expect it to be considerably higher than the mother's own alcohol abuse or dependence both because of the measure (which likely includes drinking that does not cause functional impairment) and because this variable reflects the perceived drinking behavior of both parents, rather than a single individual. In contrast, mothers report very low rates of anxiety and/or depression among their parents, less than 4 percent. To address the potential for under-reporting of depression and anxiety and possible over-reporting of problem drinking, where available, we used sibling reports to increase the specificity of problem drinking questions and to increase the sensitivity of questions regarding anxiety and depression among maternal grandparents.

Maternal Inputs:

Table 3 displays results for our first set of outcome models, those estimating how maternal emotional and cognitive stimulation varies with maternal depression and maternal substance use or abuse. Two patterns emerge from this table. First, maternal depression is estimated to have a significant influence on the supply of maternal emotional stimulation measures to school aged children in both primary and middle

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school years. The emotional stimulation sub-component of the HOMES falls by about 6 points (or one fifth of a standard deviation) if a mother has symptoms of depression. Second, the magnitude of this adverse effect of depression is large, especially if one compares it to the magnitude of other indicators that we think are likely to be important, like household income. For example, the 6 point drop in the emotional sub-scale is larger than the drop that occurs with an increase of one in the log of household income. Third, the effect of maternal depression on the emotional stimulation scale does not hold for the cognitive stimulation scale. Recall that the cognitive scale averages over 990, with a standard deviation of nearly 150. Thus, the insignificant 7 point drop in the cognitive stimulation scale for mothers who are likely to be depressed versus those that aren't depressed is small. Finally, the table reveals a similar lack of influence of symptoms of alcohol abuse or dependence among mothers on the cognitive stimulation provided by mothers. In contrast, symptoms of alcohol abuse and/or dependence have moderately large, and statistically significant, effects on the emotional stimulation subscale measured when children were age 11 to 14. Together, our results imply that behavioral health symptoms among mothers may have moderate effects on inputs that influence a child's emotional development and behavior, but have few measureable effects on our measure of mother's cognitive input.

Table 4 shows models of child math and reading comprehension scores on the PIAT. The main message from these models is that maternal depression (after controlling for early life circumstances of the mother) has little or no effect on cognitive outcomes among children. For young adolescents, age 11 to 14, having a mother with symptoms of alcohol abuse is estimated to lower math test scores. Finally, there is no

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discernable effect of contemporaneous maternal marijuana use on cognitive outcomes among children.

Table 5 reports the results for similar models of child behavior outcomes. Strikingly, scores on the BPI are 7 points higher (indicating more behavior problems) among children with mothers who are depressed. These results are consistent with the decrement to emotional stimulation among these depressed mothers based on the HOMES scale. As in the earlier results on emotional stimulation, these effects are sizeable, especially in comparison to other measures such as household income. However, it is difficult to link maternal depression to either delinquency of 10-14 year olds, or suspension/expulsion, since these parameter estimates are small and not precise. The estimated effects of maternal alcohol abuse on behavior are mixed. For younger children, alcohol abuse is associated with worse BPI measures. For older children, this is not the case. And, surprisingly, children with mothers who have symptoms of alcohol abuse are significantly less likely to be suspended or expelled. The mechanism for this is unclear, although one potential hypothesis is that schools that are aware of substance abuse problems among parents may be reluctant to suspend or expel children because school offers a safe environment with less exposure to substance abuse. We do not have information on the location of suspensions (in or out of school) to test this hypothesis, however. A similarly surprising effect is that children of mothers who are heavy marijuana users tend to engage in less delinquent behavior than other children. In the case of marijuana, this may reflect the lack of information about potential marijuana abuse or dependence as opposed to use that does not coincide with functional impairment.

Factor Analyses

Because few studies have assessed more moderate effects of depression and substance use on cognitive and behavioral outcomes during the school years, there is little guidance to indicate which behavioral measure or which cognitive measure might be most important among children who have mothers with behavioral health problems. We used factor analysis to create an outcome measure that would be guided by the data. This approach has the added advantage of allowing us to combine very concrete measures from the mother’s standpoint, such as suspension/expulsion and the delinquency scale, with more impressionistic indicators such as the BPI that might be influenced by symptoms of depression in mothers. Table 6 displays results of the factor analysis. It shows that, as we suspected, the cognitive measures capture related constructs and they contribute relatively equal weights to the first factor. Similarly, the behavioral measures contribute comparable weight to the underlying behavior factor. As noted earlier, the first factor captures more than half the variation in both sets of proxy variables.

Table 7 displays the results of analyses using our constructed behavior and cognitive factor indices as the outcomes of interest. This table confirms the results of the paper thus far. Maternal depression has relatively little effect on cognitive outcomes among children in primary and middle school years. In contrast, it has a moderately large negative effect on child behavior (about one third of a standard deviation). Heavy marijuana use by mothers is estimated to have a negative effect on the cognitive score that is significantly different from zero at conventional levels. Surprisingly maternal

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alcohol abuse and dependence is estimated to have a positive and significant effect on the cognitive factor for the 7-11 year olds. This result is stable to changes in specification.

Robustness check – Fixed Effect Models

Our preferred models are those presented in tables 3 through 6 because they allow us to capture the influence of contemporaneous maternal behavioral health at different points in time for children in primary and middle school years. We deliberately chose not to look “within child” at the effect of maternal depression because depression might matter differently for children at different ages and we did not want to assume that the effect of behavioral health problems should be the same at different ages. However, most women in our sample have more than one child, allowing us to examine the impact of maternal behavioral health for different children, measured at similar ages. Thus, for an expanded sample of NLSY women with multiple children (not just the mothers of our 1587), we estimated age 7-10 outcomes as a function of maternal depression symptoms, controlling for mother-specific fixed effects. With the fixed effects, it was no longer necessary to use the propensity score weighting. However, we did control for the time varying covariates used in the rest of our child outcome models. The results of these within mother models for 2653 women with 2 or more children are shown in Table 8.

As in our previous results, maternal depression seems to be exerting the most important effect on child behavior measures but not for child cognitive measures. The BPI is 3.3 points higher for children who are assessed during a period shortly before, during, or after an interview in which the mother had symptoms of depression according to her responses on the CESD. Given that the measures of depression do not necessarily match up to child assessments as well as in the earlier models, and considering the

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variation absorbed by the maternal fixed effects, we view this result as strong confirmation of our main finding, that maternal depression interferes with child behavior.⁷ both internalizing and externalizing. Our results from the HOMES scales suggest that this negative influence of maternal depression operates mainly through decrements in emotional stimulation at home, rather than through lowered opportunities for cognitive stimulation.

Conclusions and implications

The analysis reported here shows that symptoms consistent with a high likelihood of depression in mothers of young school age children interfere with measures of social and emotional development. This result is robust to a variety of empirical specifications. We uncover evidence suggesting that the mechanism through which depression affects the social and emotional development of grammar school aged children is through the disruption of parenting activity that manages anger, misbehavior and other emotions of young children. At the same time we do not find any evidence that maternal depression has a meaningful effect on measures of cognitive development (reading and math).

To put the magnitude of the effects in context we use the parameter estimates from our models of the BPI for young children (7-11) to consider the increase in household income that would compensate for the impact of maternal depression. We estimate that an increase in household income of about \$63,000, assessed at the sample

⁷ We also estimated models of behavior using sub-scale for internalizing mental health problems (anxiety and depression) and externalizing behavior (conduct disorder). The results indicate that a high likelihood maternal depression affects both types of behavior problems. Detailed results are available from the authors upon request.

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mean, would produce an increase in BPI sufficient to offset the impact of mother's depression.

The results for indicators of maternal alcohol abuse and dependence are somewhat mixed. There we find some evidence that alcohol abuse/dependence affects both cognitive and social and emotional development. The estimates are less consistent across models than were those for depression. We did find evidence suggesting that alcohol abuse/dependence indicators interfere with mother's activities aimed at emotional support. We are therefore more tentative in our view about the impacts of mother's substance abuse on human capital formation in young children. More investigation of the mechanism and the impact on outcome of substance abuse problems in mothers is warranted.

Heckman and coauthors have produced evidence showing the importance of investment in the social and emotional development of children to economic successes later in life (Heckman, Stixrud et al. 2006). Our results highlight the role of maternal behavioral health as an input into the social and emotional development of young children. Specifically, we find that maternal depression can be especially disruptive of child social and emotional development

There are a number of effective strategies for the treatment of depression. They can include psychotherapies, antidepressant medications and combinations of these inputs. A number of these approaches have been tested on low income mothers of young children and have been found to be highly effective (Miranda, Chung et al. 2003). This means that recognizing and treating depression in mother's of young children may constitute an effective investment in human capital formation. Given the modest costs of

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treating most cases of depression (\$1200-\$2000), and the potential significant and lasting effects that interruptions in social and emotional development can have of human capital formation, greater attention to screening and treatment of at risk women (e.g. Head Start mothers) with young children may be warranted.

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Table 1. Child Outcomes for 1587 Children of NLSY79 women		
	Age 7-10	Age 11-14
	Mean	Mean
	(SD)	(SD)
COGNITIVE		
Piat Math Standardized Score	99.74 (12.79)	99.15 (13.85)
Piat Reading Standardized Score	102.1 (13.89)	96.35 (13.45)
Cognitive factor score		0.037 (1.012)
BEHAVIOR		
Behavior Problems Index Total	106.8 (14.93)	107.64 (15.22)
Internalizing behavior subscale	--	103.63 (17.50)
Externalizing behavior subscale	--	105.88 (16.39)
Anxiety/Depression subscale	104.1 (13.12)	105.4 (12.95)
Child Delinquency Scale Standardized	--	0.055 (0.643)
Behavior factor score	--	-0.023 (1.006)
Ever Suspended or Expelled (all ages)	22.37%	
INTERMEDIATE OUTCOMES – Measures of Maternal Involvement		
Cognitive stimulation score	991.5 (148.3)	990.7 (149.1)
Emotional stimulation score	48.91 (29.43)	48.38 (30.02)
Total stimulation score	985.3 (147.3)	984.3 (151.7)
Mother reads to child 3+ times per week (age 7-10)	49.45%	

Table 2. Characteristics of 1587 NLSY79 Women & Their Families	
	% or Mean (SD)
Characteristics of mother & her family at baseline	
Grandparent Alcoholic	21.36
Grandparent Anxiety/Depression	4.158
Mother Depressed 1980 (Rosenberg scale)	18.65
Mother's Sibling Depressed 1980 (Rosenberg scale)	14.85
Mother Symptoms of Alcohol Abuse/Dependence 1985	3.019
Mother's Sibling Symptoms of Alcohol Abuse/Dependence 1985	7.763
Mother Heavy Marijuana User 1984	4.806
Mother's Sibling Heavy Marijuana User 1984	9.452
Mother Oldest Child	20.16
Maternal Grandmother Education	
Did not graduate from high school	54.95
High school graduate	35.17
At least some college	9.890
Mother's Parents Married 1979	64.27
Mother's Mean Real Family Income 1979-1984 (in 2006 \$)	34,521 (22,884)
Mother Mean Number of Siblings 1979	4.395 (2.804)
Race-Ethnicity	
Black	32.88
Hispanic	22.18
White	45.05
AFQT Percentile 1980-1981	34.71 (26.97)
Covariates in models of child outcomes	
	%
Gender of child	
Male	47.57
Female	52.36

Table 2, ctd.

Oldest Child	44.23
# of Siblings	1.824
Teen Mother	9.098
Mother Marital Status when child took ages 7-10 tests	
Never married	13.86
Married	61.06
Divorced, Separated or Widowed	24.95
Mother Marital Status when child took age 11-14 tests	
Never married	11.97
Married	59.86
Divorced, Separated or Widowed	28.05
Mother Immigrant	6.106
Mother Poor Mental health 1992 and 1994 (CES-D score of 16+)	11.34
Mother Heavy Marijuana Smoker	
1992	4.096
1998	2.458
Mother Symptoms of Alcohol Abuse/Dependence	
1989	9.635
1994	11.03
Mother Years of Education at Child’s Age 7-10 Test	12.35 (1.662)
Mother Years of Education at Child’s Age 11-14 Test	12.55 (2.015)
Average Annual Household Income 1986-2004 (\$2006)	48,833 (43,145)

Table 3: Regressions of the Impact of Maternal Mental Health on home cognitive and emotional stimulation – weighted on 1992/94 depression

	Home Stimulation Emotional Sub-Scale Score		Home Stimulation Cognitive Sub-Scale Score		Mom Reads to Child 3x/week
	Age 7-10	Age 11-14	Age 7-10	Age 11-14	Age 7-10
Mother's Depression & SA					
Mother Depressed 1992 & 1994	-6.136** (2.432)	-5.472** (2.558)	-2.888 (13.15)	-7.274 (12.99)	-0.082 (0.236)
Alcohol Abuse/Dependence ¹	1.572 (3.929)	-7.012** (3.568)	-7.583 (20.26)	-11.66 (18.16)	0.126 (0.361)
Heavy Marijuana Smoker ²	-3.015 (6.310)	-1.390 (4.871)	-42.584 (37.736)	14.236 (47.051)	-0.613 (0.614)
Age at test (reference = 8/14)					
7/11	24.60** (10.80)	13.57** (6.846)	17.61 (113.4)	6.969 (37.86)	2.172 (1.497)
9/12	13.89 (8.960)	0.122 (5.419)	-7.500 (92.13)	-61.820** (31.02)	0.129 (1.067)
10/13	19.00** (9.036)	3.739 (5.477)	-29.34 (91.98)	-13.02 (30.50)	-0.301 (1.071)
Region (reference=North East)					
North Central	5.789 (3.931)	1.851 (4.797)	6.604 (22.10)	3.012 (25.75)	-0.008 (0.370)
South	1.502 (3.666)	-4.246 (4.303)	-8.222 (20.48)	-33.81 (24.87)	0.323 (0.336)
West	3.886 (3.842)	3.774 (4.545)	-40.53* (23.19)	-39.59 (26.55)	-0.015 (0.380)
# of Adults in Household (reference=1)					
2	15.284*** (3.278)	2.692 (2.615)	24.79 (19.71)	-6.107 (17.80)	-0.175 (0.318)
3 or more	1.850 (3.946)	1.762 (4.161)	3.902 (30.39)	6.658 (22.45)	-1.142*** (0.429)
Child is female					
	4.604** -2.214	-0.926 -2.32	34.08*** -12.75	45.91*** -12.777	-0.056 -0.213
Oldest child					
	1.578 -2.402	3.322 -2.368	47.56*** -13.56	32.75** -14.69	0.926*** (0.224)
# of siblings					
	-2.255***	-1.776**	-5.785	-9.024*	0.145*

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	-0.781	-0.791	-4.761	-5.591	-0.088
Ln (Annual Household Income)	3.981**	4.889**	61.94***	58.25***	0.167
	(1.921)	(2.257)	(10.67)	(11.864)	(0.192)
Mother's education (yrs) at time of assessment	-1.043	-1.645**	8.779**	13.70***	0.082
	(0.740)	(0.828)	(3.61)	(4.125)	(0.075)
Mother was a teenage mother	-0.590	-1.152	5.793	11.69	-0.159
	(3.571)	(4.594)	(23.35)	(21.80)	(0.340)
Mother's Marital Status at test (reference=never married)					
Married	11.013**	20.067***	26.57	2.347	0.116
	(4.335)	(4.156)	(24.93)	(23.18)	(0.385)
Divorced , Separated, Widowed, Other	-6.162	-1.494	13.62	-19.76	0.021
	(4.167)	(3.457)	(25.16)	(21.678)	(0.371)
Constant	-19.12	4.621	146.2	178.6	-4.104
	(20.12)	(21.61)	(141.2)	(128.8)	(2.162)
R²	0.325	0.284	0.248	0.266	

note: *** p < 0.01, ** p < 0.05, * p < 0.10; Regressions 1-4 are estimated using OLS regression 5 is estimated with logistic regression;

¹ 1989 for age 7-10 outcomes and 1994 for age 11-14 outcomes; ² 1992 for age 7-10 outcomes and 1998 for age 11-14 outcomes. All observations weighted based on propensity scores from models of maternal depression in 1992 and 1994.

Table 4: Regressions of the Impact of Maternal Mental Health and Substance Use/Abuse on Individual Cognitive Outcomes – weighted on depression

	PIAT Math Scores		PIAT Reading Scores	
	Age 7-10	Age 11-14	Age 7-10	Age 11-14
Mother's Depression & SA				
Mother Depressed 1992 & 1994	-0.186 (0.960)	0.715 (1.028)	-0.074 (1.053)	0.870 (0.979)
Alcohol Abuse/Dependence ¹	-0.580 (1.606)	-4.359*** (1.407)	0.090 (1.827)	-0.417 (1.376)
Heavy Marijuana Smoker ²	2.939 (1.931)	1.668 (2.616)	1.386 (2.105)	-0.475 (2.781)
Age at test (reference = 8/14)				
7/11	6.510** (3.150)	-0.725 (2.674)	0.512 (2.259)	-1.449 (2.060)
9/12	-1.064 (0.953)	2.948* (1.778)	-3.603*** (1.080)	1.676 (2.064)
10/13	4.582 (3.087)	0.155 (1.007)	-6.002** (2.678)	0.269 (0.993)
Region (reference=North East)				
North Central	0.293 (1.732)	3.139* (1.929)	0.798 (1.956)	-0.131 (1.949)
South	-3.212** (1.528)	-1.369 (1.657)	-4.607*** (1.710)	-4.068** (1.673)
West	-3.789** (1.685)	-0.993 (1.809)	-4.238** (1.987)	-2.727 (1.732)
# of Adults in Household (reference=1)				
2	1.062 (1.514)	-1.689 (1.108)	0.646 (1.475)	-0.216 (1.048)
3 or more	-2.686 (1.903)	-0.742 (1.370)	-2.108 (2.179)	0.114 (1.483)
# of siblings	-0.747** (0.367)	-1.051** (0.408)	-1.097*** (0.409)	-0.837** (0.388)
Child is female	-0.334 (0.945)	-2.470** (0.972)	1.400 (1.046)	-0.489 (0.929)
Oldest child	-0.076 (1.157)	0.134 (1.201)	1.453 (1.202)	1.822 (1.152)
Ln (Mean Household Income)	4.079*** (0.987)	4.166*** (1.097)	5.608*** (1.086)	4.558*** (0.963)
Mother's education (yrs) at time of test	1.203***	0.632**	0.817***	0.805***

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	(0.251)	(0.314)	(0.296)	(0.244)
Mother was a teenage mother	0.729	2.291	0.921	2.345
	(1.353)	(1.646)	(1.611)	(1.527)
Mother’s Marital Status at time of test (reference=never married)				
Married	0.371	4.428***	0.943	5.057***
	(1.732)	(1.679)	(1.832)	(1.665)
Divorced , Separated, Widowed, Other	3.433**	2.285	3.394**	4.175***
	(1.476)	(1.453)	(1.484)	(1.385)
Constant	37.68 ***	49.23	-0.074	36.43
	(9.334)	(10.20)	(1.053)	(9.426)
R ²	0.178	.186	0.225	0.219

note: *** p < 0.01, ** p < 0.05, * p < 0.10; Regressions are estimated using OLS; All observations weighted based on propensity scores from models of maternal depression in 1992 and 1994.

¹ 1989 for age 8 outcomes and 1994 for age 14 outcomes; ² 1992 for age 8 outcomes and 1998 for age 14 outcomes

Table 5: Regressions of the Impact of Maternal Mental Health and Substance Use/Abuse on Individual Behavioral Outcomes – weighted on 1992/94 depression

	Behavior Problems Index Total Score		Delinq. Scale	Ever suspended or expelled
	Age 7-10	Age 11-14	Age 11-14	Any age
Mother's Depression & SA				
Mother Depressed 1992 & 1994	6.816*** (1.150)	7.106*** (1.190)	0.008 (0.053)	0.029 (0.199)
Alcohol Abuse/Dependence ¹	4.259** (1.968)	-0.229 (2.085)	0.092 (0.083)	-0.843** (0.327)
Heavy Marijuana Smoker ²	1.634 (2.669)	1.319 (3.332)	-0.176* (0.096)	0.700 (0.605)
Age at test (reference = 8/14)				
7/11	-0.342 (4.231)	0.034 (2.164)	-0.029 (0.163)	-0.177 (0.550)
9/12	-0.001 (1.170)	-1.924 (2.321)	-0.150* (0.078)	-0.536 (0.402)
10/13	-7.75*** (2.609)	-0.320 (1.353)	-0.097* (0.059)	-0.338 (0.220)
Region (reference=North East)				
North Central	2.752 (2.017)	-0.569 (1.895)	-0.003 (0.109)	0.209 (0.397)
South	0.502 (1.728)	-2.776 (1.750)	-0.082 (0.103)	0.231 (0.372)
West	0.851 (1.850)	-1.730 (1.976)	-0.082 (0.099)	0.182 (0.416)
# of Adults in Household (reference=1)				
2	-0.499 (1.523)	-0.025 (1.514)	0.109* (0.062)	0.325 (0.238)
3 or more	0.986 (2.355)	4.010* (2.144)	-0.019 (0.085)	0.885*** (0.333)
# of siblings				
	-0.751 (0.514)	-0.953* (0.527)	0.016 (0.024)	0.070 (0.070)
Child is female				
	-3.363*** (1.113)	-2.150* (1.198)	-0.120** (0.054)	-0.577*** (0.205)
Oldest child				
	1.871	0.533	-0.164***	0.159

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	(1.349)	(1.335)	(0.060)	(0.229)
Ln (Annual Household Income)	-4.887*** (1.067)	-5.983*** (1.025)	-0.021 (0.052)	-0.976*** (0.178)
Mother's education (yrs) at time of assessment	-0.597 (0.315)	0.249 (0.330)	-0.022 (0.016)	0.104** (0.051)
Mother was a teenage mother	-2.386 (1.992)	0.730 (2.153)	0.062 (0.105)	0.401 (0.286)
Mother's Marital Status at test (reference=never married)				
Married	4.966** (1.947)	1.995 (2.326)	-0.240** (0.096)	-0.905*** (0.296)
Divorced , Separated, Widowed, Other	5.063*** (1.797)	2.381 (2.201)	0.006 (0.087)	-0.464* (0.270)
Constant	159.9*** (10.50)	171.4*** (10.3)	0.941 (.556)	8.668*** (1.793)
R ²	0.155	0.138	0.081	

Note: *** p < 0.01, ** p < 0.05, * p < 0.10; Regressions 1-3 are estimated using OLS; Regression 4 is estimated using a logit. All observations weighted based on propensity scores from models of maternal depression in 1992 and 1994.

¹ 1989 for age 7-10 outcomes and 1994 for age 11-14 outcomes; ² 1992 for age 7-10 outcomes and 1998 for age 11-14 outcomes

Table 6: Factor Loadings for Cognitive and Behavior Measures

	<u>Factor Loading</u>
<u>Cognitive Ability Measures</u>	
Piat Math Score Age 7-10	0.823
Piat Reading Score Age 7-10	0.816
Piat Math Score Age 11-14	0.832
Piat Reading Score Age 11-14	0.833
Share of variation explained by factor	0.675
<u>Behavior Measures</u>	
Child Delinquency Scale	0.712
Behavior Problems Index	0.726
Ever Suspended or Expelled	0.751
Share of variation explained by factor	0.531

Table 7: Regressions of the Impact of Maternal Mental Health and Substance Use/Abuse on Cognitive and Behavioral Factor Indices

	Cognitive Index Score Age 7-14	Behavioral Index Scores Age 11-14
Mother's Depression & SA		
Mother Depressed 1992 and 1994	0.016 (0.071)	0.229*** (0.081)
Alcohol Abuse/Dependence 1994	0.090 (0.117)	-0.055 (0.111)
Heavy Marijuana Smoker 1998	-0.290** (0.113)	0.012 (0.206)
Alcohol Abuse/Dependence 1998	0.294** (0.136)	---
Heavy Marijuana Smoker 1992	-0.088 (0.162)	---

note: *** p < 0.01, ** p < 0.05, * p < 0.10; Regressions are estimated using OLS. Regressions are estimated using OLS; All observations weighted based on propensity scores from models of maternal depression in 1992 and 1994. Cognitive index model includes covariates from both age 7-10 models and age 11-14 models, as in Table 3. Behavior index model includes covariates from age 11-14 models shown in Table 3.

Table 8: Regressions of the Impact of Maternal Mental Health and Substance Use/Abuse on Child Depression/Anxiety – weighted on depression 1992/94

	BPI Depression/Anxiety Subscale Age 7-10	BPI Depression/Anxiety Subscale Age 11-14
Mother’s Mental Health & SA		
Mother Depressed 1992 & 1994	6.645*** (1.009)	6.411*** (1.005)
Alcohol Abuse/Dependence ¹	0.121 (1.703)	-0.207 (1.470)
Heavy marijuana smoker ²	0.930 (2.374)	1.992 (2.907)

note: *** p < 0.01, ** p < 0.05, * p < 0.10; Regressions are estimated using OLS. Regressions are estimated using OLS; All observations weighted based on propensity scores from models of maternal depression in 1992 and 1994. Models also include covariates in table 3

¹ 1989 for age 7-10, and 1994 for age 11-14 outcomes; ² 1992 for age 7-10 and 1998 for age 11-14 outcomes.

Table 9: Models of Child Outcomes as a Function of Maternal Grandparent Depression/Anxiety and Problem Drinking

	Behavior Problems Index		Delinquency	Ever suspended or expelled	Behavior Factor Index
	Age 7-10	Age 11-14	Age 11-14		
Maternal grandparent mental health & SA					
Anxiety or Depression	0.250 (2.318)	4.610* (2.573)	-0.001 (0.092)	0.856** (0.410)	0.272 (0.177)
Problem Drinking	1.709 (1.134)	2.015* (1.125)	-0.028 (0.046)	0.176 (0.214)	0.071 (0.070)
	PIAT Math Scores		PIAT Reading Scores		Cognitive Index
	Age 7-10	Age 11-14	Age 7-10	Age 11-14	Age 7-14
Anxiety or Depression	-5.009*** (1.874)	-3.224 (2.090)	-3.845** (1.954)	-1.130 (1.956)	-0.308** (0.128)
Problem Drinking	0.758 (0.866)	0.706 (0.965)	1.369 (0.927)	0.423 (0.874)	0.095 (0.067)

note: *** p < 0.01, ** p < 0.05, * p < 0.10, models also include covariates in table 3, except for maternal depression and substance use variables.

Table 10: Fixed Effect Model Predicting Cognitive and Behavioral Outcomes

	Piat Math	Piat Reading	Behavior Problem Index	Ever Repeat Grade
Mother depressed	-0.439 (1.213)	-0.312 (1.268)	3.297*** (1.289)	-0.065 (0.037)
Symptoms of alcohol Abuse or dependence	1.754 (1.783)	1.057 (1.863)	0.019 (1.894)	-0.023 (0.054)
Heavy Marijuana use	3.796 (2.734)	1.545 (2.857)	-1.716 (2.905)	0.139 (0.083)
Includes covariates?	Yes	Yes	Yes	Yes
Number of observations	2,653	2,653	2,653	2,653
R2	0.020	0.054	0.063	0.031

note: *** p < 0.01, ** p < 0.05, * p < 0.10

APPENDIX

Appendix table A1: Common Questions in both the 1989 and 1994 NLSY surveys – used to construct measure of symptoms of alcohol abuse or dependence
CONTINUED TO DRINK ALCOHOL ALTHOUGH THREAT TO HEALTH
CUT DOWN ON ACTIVITIES WITH FRIENDS IN ORDER TO DRINK
DRINKING COULD HAVE CAUSED R/SOMEONE ELSE TO BE INJURED
DRINKING HAS HURT CHANCES FOR JOB PROMOTION
DROVE A CAR AFTER HAVING TOO MUCH TO DRINK
ENDED UP DRINKING MUCH MORE THAN INTENDED TO
FOUND IT DIFFICULT TO STOP DRINKING ONCE STARTED
FREQUENCY GOT INTO PHYSICAL FIGHTS DURING/AFTER DRINKING
HANGOVER INTERFERED WITH THINGS SUPPOSED TO BE DOING
HEARD/SEEN THINGS NOT REALLY THERE AFTER DRINKING
KEPT DRINKING ALTHOUGH CAUSED EMOTIONAL PROBLEMS
KEPT DRINKING ALTHOUGH CAUSED PROBLEMS AT HOME/WORK
LOST TIES TO FAMILY MEMBER/FRIEND BECAUSE OF DRINKING
NEED TO DRINK MORE TO GET SAME EFFECT
DRANK FOR LONGER PERIOD OF TIME THAN INTENDED TO
HEAVY SWEATING/SHAKING AFTER DRINKING/MORNING AFTER
SAME AMOUNT OF ALCOHOL HAVING LESS EFFECT THAN BEFORE
TAKING A DRINK TO STOP SHAKING AFTER DRINKING
SICK OR VOMITED AFTER DRINKING OR THE MORNING AFTER
SPENT A LOT OF TIME DRINKING OR GETTING OVER EFFECTS
SPOUSE/SOMEONE ELSE THREATENED TO LEAVE DUE TO DRINKING
STAYED AWAY FROM WORK/GONE TO WORK LATE BECAUSE DRINKING
TRIED TO STOP DRINKING BUT COULD NOT DO IT

In 1985, there were fewer questions regarding symptoms of alcohol abuse. We used the following six questions:

ONCE YOU STARTED DRINKING, WAS IT DIFFICULT FOR YOU TO STOP BEFORE YOU BECAME COMPLETELY INTOXICATED?

DURING THE PAST YEAR HAVE YOU OFTEN TAKEN A DRINK THE FIRST THING

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WHEN YOU GOT UP IN THE MORNING?
HAVE YOU STAYED AWAY FROM WORK BECAUSE OF A HANGOVER?
HAS DRINKING HURT YOUR CHANCES FOR PROMOTION OR RAISES OR A BETTER
JOB?
DURING THE PAST YEAR HAVE YOU GOTTEN INTO A FIGHT WHILE DRINKING?
ONCE YOU STARTED DRINKING, WAS IT DIFFICULT FOR YOU TO STOP BEFORE YOU
BECAME COMPLETELY INTOXICATED?

Delinquency scale (used for children aged 10 to 14)

Children aged 10 and older were asked, Have you ever:
stayed out later than your parents said;
hurt someone bad enough to need a doctor;
lied to parents about something important;
taken something without paying for it;
damaged school property on purpose;
gotten drunk;
did wrong at school so that parent had to come pick them up;
skipped a day of school without permission;
stayed out one night without permission;