Appendix H – 'The Nature and Nurture of Economic Outcomes' by Bruce Sacerdote

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NATIONAL BUREAU OF ECONOMIC RESEARCH

1050 Massachusetts Avenue

Cambridge, MA 02138

October 2000

I thank the Henry A. Murray Research Center of the Radcliffe Institute for Advanced Study, researchers at the Colorado Adoption Project, and Peter Shepherd at the Centre for Longitudinal Studies at the University of London. Thank you to Nithya Rajan for her excellent research assistance. I am grateful to Dartmouth College and the National Science Foundation for supporting this work. The views expressed in this paper are those of the author and not necessarily those of the National Bureau of Economic Research.

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The Nature and Nurture of Economic Outcomes
Bruce Sacerdote
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ABSTRACT

This paper uses data on adopted children to examine the relative importance of biology and environment in determining educational and labor market outcomes. I employ three long-term panel data sets which contain information on adopted children, their adoptive parents, and their biological parents. In at least two of the three data sets, the mechanism for assigning children to adoptive parents is fairly random and does not match children to adoptive parents based on health, race, or ability. I find that adoptive parents' education and income have a modest impact on child test scores but a large impact on college attendance, marital status, and earnings. In contrast with existing work on IQ scores, I do not find that the influence of adoptive parents declines with child age.

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I. Introduction

The relative importance of biology and environment is one of the oldest and most prominent areas of scientific inquiry and has been examined by researchers as diverse as Hume [1748], Darwin [1859], and Freud [1930]. Social scientists are particularly interested in the degree to which family and neighborhood environmental factors influence a child's educational attainment and earnings.

The stakes in this debate are quite high and far-reaching. As Herrnstein and Murray [1994] point out, the effectiveness of anti-poverty and pro-education policies is largely dependent on the degree to which environment matters. Any claim of treatment effects from different family structures, different teachers, different peers or different neighborhoods needs as a pre-condition that some aspects of environment are important to long-term outcomes. Attempts to understand the root causes of income inequality often involve trying to sort out the effects of family background from the effects of genetic endowments (see for example Jencks [1972] or Grilliches and Mason [1972]).

One of the most effective instruments for separating out biology from "everything else" is to study children who were adopted at birth. With adoption, there is the potential for the clear separation of genetic endowments from environmental factors. The vast majority of research on adopted children has been done by psychologists including Scarr and Weinberg [1978, 1981], Loehlin, Horn, and Willerman [1985, 1987, 1994], and Plomin, Defries, and Fulker [1988, 1991, 1997]. This work examines IQ tests, other mental ability tests, and personality tests. Most of the research concludes that birth parents matter a great deal for child outcomes (e.g. IQ tests) and that adoptive parents have either zero influence or a small influence which declines as children grow.[1]

The current paper extends this work to economic outcomes including children's years of education, college attendance, marital status, and labor market earnings. I use samples of adopted children from the Colorado Adoption Project (CAP), the National Child Development Survey

(NCDS), and the National Longitudinal Survey of Youth 1979 (NLSY79). I find that adoptive family income and education have large effects on children's college attendance and marital status and modest sized effects on labor market income. I also find evidence that the impact of adoptive family background on test scores does not diminish as children mature.

A natural concern is that my coefficients are biased upwards by the effect of high education parents selecting high ability babies for adoption. I present evidence showing that within two of my samples this is not the case. I do this by examining the correlation between birth mother's test scores, education, and socio-economic status and the same variables for the adoptive parents. I also have some knowledge of the adoption placement process in each data set and this information indicates that babies and families are not being matched on ability measures or race.

II. A Brief History of Thought in the Adoption Literature

Existing research on adoption has been conducted almost exclusively by psychologists and behavioral geneticists. In a seminal article, Scarr and Weinberg [1978] administered IQ tests and collected educational data for 194 adopted children, their adoptive parents, and their biological mother. The researchers also have a separate control group of (non-adopted) children who were living with both of their biological parents. Scarr and Weinberg find no statistically significant impact of the adoptive parents' income, education or IQ score on the children's IQ score. However, biological mother's education level strongly affects adopted child's score. This study and others like it have pushed psychologists towards the "nativist" view.

Loehlin, Horn, and Willerman [1989] study 258 adopted children in Texas and find that adoptive parents have a small influence on the IQ scores of children who are young (i.e. age 7) but that this influence declines over time. Similar conclusions are found in Capron and Duyme [1989] and Plomin, DeFries and Fulker [1988] in their on-going study of 245 adopted children in Colorado.

[1] The literature on this topic is extensive and I am reporting here only two well known themes.

Cardon, Fulker, DeFries [1992] and Loehlin, Horn and Willerman [1994] show that adopted children inherit not just "general intelligence" from their birth mothers, but also more specific skills including verbal, spatial, and numeric abilities.[2] The study closest in focus to the current paper is Maughan, Collishaw, and Pickles [1998] which finds that higher family socio-economic status raises adoptees' years of education.[3]

A chief obstacle to adoption studies has always been sample size. In 1990 in the U.S., 2.1% of children living with a married couple were living with an adoptive mother and father. The sample of adopted children (defined as living with two adoptive parents by age 1) in the NLSY79 is roughly 198 people from a sample of more than 12,000 children. My only solution to the sample size problem (in the current paper) is to examine three small data sets rather than one small data set. A second major issue with adoption data is that most data sets only follow the children up to age 11 or age 16 making it hard to study years of education or labor market outcomes. I avoid this problem by using the NLSY and NCDS which have already followed subjects through age 30.[4]

A separate methodology for controlling for genetic endowments is to examine pairs of identical twins as in Wilson and Matheny [1986], Ashenfelter and Krueger [1994] and Ashenfelter and Rouse [1998]. Studies of twins are often used to "hold genes and family environment constant" while examining the effects of differential schooling or other treatments. This is distinct from the adoption methodology which is used in this paper to examine the treatment effect of different family environments. Data on twins separated at birth could potentially combine the two strengths of twin and adoption studies, but the incidence of such separation is extremely rare [see Segal 1998].

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[2] All of these authors have also done extensive studies of the heritability of various personality traits. For more detail see the collective volumes: DeFries, Plomin and Fulker [1994] and [1998].

[3] My identification comes from using variation within the set of adoptive parents. Maughan, Collishaw and Pickles are comparing adopted children from low income birth mothers to a control group of non-adopted children from low income birth mothers.

III. Empirical Framework

My principal goal is to estimate the causal effects of family environment inputs on children's outcomes. For example, I am interested in the effect of adoptive mother's years of education (abbreviated amed) on child's years of education. As a result, I run the following regression:

(1) Child's years of education= $\alpha + \beta 1 * \text{amed} + \varepsilon_i$

Adoption and random assignment play a critical role in allowing me to interpret $\beta 1$ as a treatment effect from family environment.[5] There is substantial variation in adoptive mother's education that is uncorrelated or at most only weakly correlated with any unobserved, innate ability of the children. If I were using non-adopted children in the regression, $\beta 1$ would be determined by some unknown blend of genes and family environment.

Of course, having data on adopted children does not guarantee that we can separate out biology and environment. A natural concern is that high ability adoptive parents might be able to select children from high ability adoptive mothers. This could bias the coefficient $\beta 1$ upward and lead me to conclude that adoptive parents have a large treatment effect when in fact the coefficient is being driven by selection on unobservables.

However, in at least two of my three data sets, adopted children are assigned to adoptive parents in a random manner. Specifically, children are not assigned to adoptive parents on the basis of the birth mother's observed ability, health, education, race, or socio-economic status. As a result, the birth mother's observable and unobservable characteristics are uncorrelated with the adoptive parent's characteristics. This means that in equation (1), $E(\varepsilon_i , \text{amed}) = 0$ and the estimate $\beta 1$ is not biased upwards by selection.

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[4] Both the Colorado Adoption Project and the Texas Adoption Projects are currently in the process of conducting follow-up waves which will collect adult outcomes for the adoptees in those samples.

[5] I use the phrase "family environment" very broadly to refer to any treatment effect that stems from the adoptive family. The effect could work indirectly through choice of peers, schools, or neighborhood to name a few possibilities.

In cases where I know the years of education for the birth mother (abbreviated bmed), I can also identify the treatment effect of biological mother's education on the child's outcomes. In these cases, I run the following regression:

(2) Child's years of education= $\alpha + \beta 0 * bmed + \beta 1 * amed + \varepsilon_i$

Under the assumption of random assignment (of children to adoptive parents), the inclusion of birth mother's education should not alter E(β1), but should increase the precision of the estimate of β1. (I could also try to estimate the interaction effect, if any, between birth and adopted mother's education.)

I calculate the ratio $\beta 1/(\beta 0 + \beta 1)$ which as a measure of the environment effect as a percent of the "total effect" of genes plus environment. Interpreting the ratio in this way requires very strong assumptions about functional form; I am assuming that genes and environment enter linearly and separately.

I have data on adopted children in three separate data sets and I also have a group of "control" children in each data set. These are non-adopted children who were raised by both of their biological parents. I calculate the coefficient on mother's education for the control children and test whether this coefficient is statistically different for adopted and non-adopted children. To do this, I pool the adopted and control samples and run the following regression:

(3) Child's years of education = $\alpha + \beta 3 *$ mother's education + $\beta 4 *$ dummy for adoption + $\beta 5 *$ (dummy for adoption * mother's education) + ε_i

I use a t-test on β5 to check whether or not the coefficients for adopted and non-adopted children are statistically different. I take the ratio $(\beta 3 + \beta 5)/\beta 3$ to create a measure of the importance of family environment relative to genetic influences. Again, under very strong functional form assumptions, I can interpret this ratio as the percent of the total effect that is due to family environment.

IV. Data Description

I use three separate samples of adopted children. The samples are drawn from the British National Child Development Survey (NCDS), the Colorado Adoption Project (CAP), and the National Longitudinal Survey of Youth (NLSY79). The three samples are small which reflects the relative rarity of children adopted at birth. The NCDS and the NLSY data follow the children well into adulthood, whereas the CAP data currently only follows the subjects up to age 7.

The NCDS study is a longitudinal panel which began as a perinatal mortality study in 1958. The initial sample included all children born during a single week in Britain in March 1958. There have been four subsequent waves of data collection with substantial attrition at each wave. The most recent wave that I use was collected in 1981 when the subjects were age 23. The data include a broad range of health measures, academic test scores, teacher assessments, and employment information.

Table I shows summary statistics for my NCDS sample. I have a base sample of 128 adopted children. Most of these are illegitimate children who were placed with an adoptive mother and father at birth or within 3 months of birth. The average age of the birth mother is 24.3 years and 20 percent of the birth mothers smoked during pregnancy. Sixty percent of the children are boys and 98 percent are white.

My first outcome variable is the Southgate reading test of word recognition and reading comprehension. This exam was administered to all of the children at age 8. The adopted children have a mean score of 24.9 and the control children have a mean score of 24.0. I also have reading and math test scores at age 11. For outcomes at age 23, the sample shrinks to 112 children. Within that sample, 40 percent obtained some form of post-secondary education. This includes university, nursing school, teaching school, or technical college. At age 23, 41 percent of the sample was married and the average family income (of the subject and spouse if any) was £110.8 per week.

For the adoptive parents, I have father's years of education and an index of socioeconomic status that is based on the father's occupation. This latter index ranges from 1 to 11 and has a mean of 6.8. A score of 11 is given to white collar managers in large firms; a 6 is for junior non-manual workers and a 1 is for unskilled manual workers.[6]

I have a large "control" sample of 7981 children in the NCDS who were raised by their birth parents. I limit the sample to children who were living with both parents from birth through age 11 or longer. The control children are quite similar to the adopted children on several dimensions. The mean reading scores at age 7 are similar and both samples are mostly white. The birth mothers are older in the control sample than in the adopted sample.[7]

My analysis consists of regressing the outcomes for the adopted children on characteristics of the adoptive parents. The key identifying assumption is that the adopted children are assigned randomly or quasi-randomly to adoptive parents. The data support this assumption. Appendix I shows three regressions of birth mother characteristics on adoptive family socioeconomic status (SES). In column (2), I regress birth mother's smoking status (0-1) on adoptive family SES, dummies for the child's region of birth, and dummies for child male and child white. The coefficient on adoptive mother's SES is small (-.007) and insignificant. This result is robust to the exclusion of the other right hand side variables. Columns (3) and (4) show that birth mother's age and socioeconomic status are also unrelated to the adoptive family's socioeconomic status. Column (1) shows the analogous result for child's birth weight. I obtain similar results when I substitute adoptive father's education for adoptive family's SES (not reported).

The adoption process in Great Britain at this time greatly limited the ability of adoptive parents to select a child based on birth mother or child characteristics. (See Pringle [1966].) In the

[6] NCDS actually coded this variable with 1 being the highest income category, but for consistency with US data, I reversed the coding so that 11 is the highest category and 1 is the lowest.

[7] I should emphasize here that my primary objective in this paper is to use variation in family income and education within the adopted sample to identify the effect of environment on outcomes for the adopted children. I am not comparing adopted children to the control children to estimate treatment effects.

1950s in Great Britain, almost all children given up for adoption were born to young unwed mothers. Private agencies did much of the placement and often matched infants with qualified adoptive parents on a first-come, first-serve basis. The adoptive parents typically had no information on the birth mothers, which meant that selection based upon birth mother's education or socioeconomic status was not possible. Selection on the basis of child race was not an important factor because 98 percent of the children in the sample are white.

The Colorado Adoption Project

My second data set is a sample of 183 adopted children who were born in Colorado during the period 1977-1984. These children were placed for adoption at birth by the two largest adoption agencies in the state.[8] Almost all of these children are white and were born to young, unwed mothers. As with the NCDS, there is also a sample of "control" children who were raised by both of their biological parents. Observations in the control sample are not matched pair-wise to the adopted sample. Instead, a general control pool was recruited such that the average education and income of the control parents is similar to the average education and income of the adoptive parents.

Table II contains descriptive statistics for the adopted and control samples. Columns (1)-(3) contain data for the birth parents of the adopted sample. Columns (4)-(6) are for the adoptive parents and the adopted children. Columns (7)-(9) are for the control parents and control children.

The birth mothers (of the adopted children) have an average of 12.1 years of education. The adoptive mothers have 14.8 years and the control mothers have 14.9. Birth, adoptive and control parents were all given a series of standardized tests during their first interview. Mean scores for the vocabulary tests are shown in Table II. The birth mothers had an average of 31.0 correct answers out of 50 questions. This compares to 40.8 correct for the adoptive mothers and 40.9 for the control

[8] These data were collected by the Colorado Adoption Project. See Plomin, DeFries, and Fulker [1994] for more information. The book provides detail on how the adoptive and control families were recruited into the study.

mothers. On both measures (years of education and the vocabulary score), the control mothers are not statistically different than the adoptive mothers.

I also have an index of socioeconomic status for the birth mothers, adoptive parents, and control parents. This is a ranking based on income and occupation and ranges from 1 to 93. The index was developed by the National Opinion Research Center (NORC).

The outcome measures in the CAP data include a wide variety of test scores, personality scores, teacher ratings, and parent-reported likes and dislikes. I focus on outcomes that measure school achievement. These outcomes include the Wisconsin IQ test score, PIAT reading score, reading capability as assessed by the parents, and ability to do subtraction at age six. The mean test scores for the adopted children look remarkably similar to the mean scores for the control children. For example, the mean total score on the Wisconsin IQ test was 114.4 for the adopted children and 114.6 for the control children.

My outcome measures in the CAP data are all taken when the children are age 6 or age 7. Naturally it would be desirable to have some outcomes for these children when they were college age or older. Unfortunately at the time of this writing, those data were still being collected by researchers at the CAP.

There is fairly strong evidence that the adopted children in the CAP are not matched to the adoptive parents on the basis of child or birth mother characteristics. The most important fact is that throughout this period (1977-1984) in the U.S., there was excess demand for white infants available for adoption. As a result, the two adoption agencies maintained a queue of adoptive parents. When prospective parents reached the front of the queue, they were given whichever baby became available at that moment. In fact, as a matter of policy, the adoption agencies expressly

avoided any attempt to match children and parents using observables.[9] (See Plomin, DeFries, and Fulker [1994].)

This quasi-random assignment is evident in Appendix II which shows three regressions of birth mother characteristics on adoptive parent characteristics. In column (1), birth mother's education is regressed on adoptive mother's education. The coefficient on adoptive mother's education is small and statistically insignificant. Similar results are shown in columns (2) and (3) for scores on the vocabulary test and for socioeconomic status.

The National Longitudinal Survey of Youth

My third sample is drawn from the NLSY79. I create a sample of 170 children who are living with an adoptive mother and adoptive father at age three or earlier. Two thirds of these children are adopted at birth. Unlike the situation with the CAP and NCDS data, I do not have any evidence that adopted children in the NLSY are assigned to adoptive parents in a random fashion. It is quite possible that some of the adoptions involve parents selecting children on the basis of race, child health, or geography.

Despite this potential for selection bias, the NLSY data are still useful. Because the children are adopted, there is still a separation (albeit imperfect) between the biological parents and the parents that raised the child. This allows me to calculate an estimate of the impact of environment (i.e. $\beta 1$ in equation (2)).

For comparison purposes, I also create a "control" sample of 5,614 non-adopted children. These are children who lived with both of their biological parents until at least age 17. Table III shows descriptive statistics for both the adopted and control samples. Mean years of education by age 30 is 13.4 years for the adopted children and 13.3 for the control children. The adopted children have a mean AFQT score of 49.3 versus 44.4 for the control children. The adopted sample is about

[9] The reason for this policy is still unclear to me. There may have been a belief that somehow matching children to

52 percent male and 18 percent black. The adoptive mothers and fathers are much more likely to have attended college than the control mothers and fathers.

IV. Empirical Results

Results for the NCDS

Table IV contains the results for the NCDS data. The structure of the table is as follows: Each of the seven columns contains a separate outcome (dependent) variable. The first two rows show the mean and standard deviation of the dependent variable for the adopted and control samples. The next four rows show OLS coefficients and standard errors from four separate regressions of the dependent variable on adopted family's socioeconomic status (SES), adopted father's years of education, control family's SES , and control father's years of education respectively. The regressions also include controls for child's sex, child's race, and dummies for child's region of birth.

Column (1) examines the child's score on the Southgate reading test, which was administered at age 8. The mean score for the adopted children is 24.9 with a standard deviation of 5.9 points. The coefficient on adoptive family's SES is .31 and is significant at the 10 percent level. A one standard deviation increase in SES is associated with a .16 standard deviation increase in the reading score. For the control children, the coefficient on family SES is moderately larger at .42. In row (7), we see that the difference between the adopted and control coefficients is not statistically significant.[10]

The effect of adoptive family's SES on the child's reading score is not large. However, the comparable effect for the control children is not particularly large either. In row (9) I show that the coefficient for the adopted children is 75 percent as large as the coefficient for the control children.

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parents on observables somehow created unrealistic expectations or increased the likelihood of a bad outcome.

If we believed that genetic and environmental influences were linear and additive, our point estimate would be that environmental influence is 75 percent of the total influence. Unfortunately there would be a large standard error on this point estimate; notice that the ratios differ greatly across different outcomes.

In row (4), I show the OLS coefficient of the child's reading test score regressed on adoptive father's years of education. The coefficient (.16) is small and insignificant. The comparable coefficient for the control group (.58) is larger and is significant.

The general pattern of coefficients observed in column (1) repeats in columns (2)-(4) which examine scores on standardized tests administered at ages 11 and 16. In column (4), for the math test at age 16, the coefficient on adopted family SES is .60 and is significant at the 5 percent level. The coefficient for the control children is similar at .61. A one standard deviation increase in adoptive family SES is associated with a .29 standard deviation increase in the math score -- i.e. about a 13 percent increase at the means of the data. Adoptive family SES appears to have a larger impact on math score at age 16 than it does on the reading score at age 8. As in column (1), father's years of education does not affect the score significantly in the adopted sample, but again has a large effect in the control sample.

The effects of adoptive family SES on test scores are moderate in size. And family SES appears to be nearly as important for the adopted children as for the control children. These results are somewhat at odds with those parts of the psychology literature that downplay the importance of environmental factors and stress the importance of genetic factors.

Columns (5)-(7) examine the importance of family environment to college attendance, income, and marital status. College attendance here is defined very broadly to include university, technical schools, and nursing and teaching schools.

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[10] I calculate the differences in coefficients and the standard error of the difference in the following way: I stacked the adopted and the control data and included interactions of a dummy for adoption status with all of the right hand side variables.

Column (5) is a probit and partial derivatives are shown. For the adopted children, the coefficient on family SES is .032. This means that a one standard deviation increase in family SES is associated with a 9.3 percent increase in the probability of attending college. This is a 23 percent increase in probability if measured at the means. The corresponding coefficient for the control group is similar in magnitude and not statistically different from the coefficient for the adopted sample. Again, the coefficient on adopted father's years of education is not significant.

In column (6), I show that adoptive family SES has no measurable effect on family income at age 23. This is the weekly income (in British pounds) of the subject and his or her spouse if any. It is difficult to reconcile the results that family environment affects college attendance but not income. Perhaps lifetime incomes are affected, but a snapshot at age 23 does not pick this up.

In column (7) we see that there is a large effect of adoptive family SES on marital status. Higher family SES makes a child less likely to be married at a young age. I find that the effect is similar for adopted men and women (results not shown here.). A one standard deviation increase in SES is associated with a 17 percent decrease in the probability of being married at age 23.

Appendix IV shows regressions of adopted child outcomes on both adoptive family SES and birth mother SES.[11] In this table we see the dual importance of both environment and biology. For three of the seven outcome variables, the coefficients on birth mother's SES and adoptive family SES are both statistically significant. For the reading test at age 16, birth mother's SES has a coefficient of .28 and adoptive family's SES has a coefficient of .41. If I exclude birth mother's SES, (as in Table IV), the coefficient on adoptive family's SES drops to .33. For the other outcomes, the coefficients on adoptive mother's SES are fairly similar whether I include or exclude birth mother's SES. The largest difference is for the reading score at age 8 where inclusion of birth mother's SES reduces the coefficient on adoptive family's SES by 37 percent.

Results for the NLSY

Table V presents results for the NLSY using the same format as Table IV. In Table V, I have three measures of inputs from the adoptive family including mother's years of education, father's years of education, and the log of family income in 1979. As in the previous table, each coefficient is from a separate regression. Controls for child age, sex, and race are included in each regression.

In column (1) we see that each additional year of adoptive mother's education is associated with a gain of .22 years for the child. The coefficient for the control children is .35 and the differences between control and adopted are statistically significant. A one standard deviation increase in adoptive mother's years of education corresponds to an increase of .49 years of education for the child.

When I regress child's years of education on adoptive father's education, the coefficient is smaller (at .16) but is also significant at the 5 percent level. The regression of years of education on log of adoptive family's income has a coefficient .56. This implies that a doubling of family income is associated with a .56 increase in child's years of education. The coefficient on control family's income is .46 and is not statistically different from the comparable coefficient for the adopted sample.

Column (2) shows results for six probits and switches the dependent variable to whether or not the child completed four years of college. The right hand side variables are a dummy for mother completed four years of college, a dummy for father completed four years of college, and log of family income.[12] Partial derivatives are shown. The coefficients on adoptive mother's or father's completion of college are quite large at .40 and .38 respectively. Both of these coefficients are statistically significant. This means that children adopted by a mother with a college degree

[11] Inclusion of birth mother's SES further limits the sample. This is the reason that I currently show these results in an appendix rather than in Table IV.

have a 40 percent higher chance of graduating from college themselves when compared to children adopted by a mother without a college degree. The coefficients for the control children are not statistically different from those for the adopted children.

The implications from this result are enormous; family environment has a massive influence on whether or not a child graduates from college. Admittedly, these coefficients may in part be driven by selection bias. However, it is hard to believe that the coefficient is entirely driven by selection bias. Recall that the comparable coefficients in Table IV from the British NCDS are also large.[13]

Column (3) shows that the AFQT score is also influenced by family environment. An extra year of adoptive mother's education raises AFQT by 1.9 points, or about .07 standard deviations. The effect for control mother's education is larger and the difference is statistically significant. In column (4), I show similar results for the ASVAB general science test administered in 1991. A one year increase in adoptive mother's education leads to an increase in general science score of roughly .07 standard deviations.

The dependent variable in the final column is the log of family income in 1994. (By that year, very few people in the adopted sample are living with their adoptive parents, and hence I use income in 1994 as an outcome variable rather than another measure of parental inputs.) A one year increase in adoptive mother's education is associated with a 7 percent increase in family income. The coefficient for the control sample is 6 percent and the difference is not statistically significant.

The results in Table V lead to several tentative conclusions. First, it is evident that child's years of education and probability of college graduation are highly influenced by family environment. Second, the effect of parental education on child's college graduation is remarkably larger than the effect of parental education on test scores. Perhaps family environment is able to

[12] For column (2) only, I switch the right hand side variables from "years of education" to a dummy for four years of college.

influence educational attainment more than test scores. This theory makes sense if one believes that test taking ability relies more heavily on genetic endowments whereas college attendance relies more heavily on parental expectations and income. The theory would also explain why many psychologists have concluded that family environment matters little; these researchers are focusing on IQ scores rather than attainment.

Results for the CAP

Table VI presents results for the Colorado Adoption Project. One advantage of the CAP data (relative to the NLSY data) is that I am able to include both birth and adoptive parent characteristics in the same regression. A major disadvantage of the CAP data is that I only have outcome variables through age 7.

Rows (3) and (4) show the coefficients from a regression of the six outcome variables on birth mother smoking status and adoptive father smoking status. In column (1), adoptive father smoking status enters negatively and significantly in the equation for the child's IQ score at age 7. Children with an adoptive father who smokes score 5.5 points (about 1/2 a standard deviation) lower on the IQ test. I do not of course interpret this negative coefficient to be caused directly by smoking.[14] Rather, adoptive father's smoking status appears to be a marker for some negative characteristics about the child's environment.

Columns (2)-(5) show that an adopted child's verbal score, reading ability, and ability to do subtraction are all lower when the adoptive father smokes. This is not completely surprising given that all of these outcomes are correlated with the IQ score in column (1).

[13] The NCDS coefficients are smaller. However, the NCDS data are from the UK where higher education is more heavily subsidized than in the US.

[14] In fact the corresponding coefficient for the control is negative but much smaller in magnitude. If the smoking-low child IQ score connection were directly causal, the control coefficient would probably be large too.

The coefficients on birth mother smoking (for adopted children) are all insignificant in columns (1)-(5). In column (6), birth mother's smoking is marginally significant and lowers the index for "child's interest in books" by about 1/3 of a standard deviation.

The regressions using birth, adoptive, and control family's socioeconomic index as the measure of parental inputs show a different pattern. Here all of the coefficients on adoptive family's SES are small and insignificant. The effect of birth mother's SES on verbal IQ score is significant at the 10% level. The size of the effect is modest; a one standard increase in birth mother's SES raises verbal IQ by .16 standard deviations. This coefficient is similar in magnitude to the corresponding coefficient for the control group of .12. All of the other coefficients for birth mother's SES are small and insignificant. In the control child sample, family SES has a significant effect on all of the outcome variables. But the magnitude of the effect is modest.

I find a different pattern for birth, adoptive, and control mother's years of education. In these results, adoptive mother's education never matters but birth mother's education matters strongly for the first three of the six outcomes (IQ, verbal IQ, and PIAT reading score). Control mother's education always matters significantly and with a large magnitude.

In isolation, the results for mother's education would suggest that adoptive family environment does not matter and that the biological component of IQ and test scores matters a great deal. Results similar to these have lead many researchers to conclude that biology is the major determinant of outcomes and test scores in particular. However, this is not the whole story. In the CAP data, adoptive father's smoking status appears to be negatively correlated with child test scores. And in the NCDS and NLSY data, adoptive family inputs affect college going, marriage and income significantly.

V. Conclusion

Studies of adopted children provide one of the most effective ways to separate biological from environmental influences. In this paper I have used variation in education and socio-economic status across adoptive parents to identify the treatment effects of family environment. Two of my three data sets are particularly useful due to the quasi-random assignment of children to parents. In contrast to some of the existing literature, I find large treatment effects from family environment. Outcomes such as college attendance and marriage are particularly affected by characteristics of the parents. Test scores are somewhat responsive to adoptive family inputs depending on the outcome measure considered and the data set employed. The biggest obstacle to this work is sample size. Much more precise statements could be made if we had larger samples of adopted children. Continued data collection in this area will almost surely lead to a deeper understanding of human behavior.

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Table I
Summary Statistics
National Child Development Survey

	Adopted			*Control*		
	Obs	***Mean***	***sd***	***Obs***	***Mean***	***sd***
Parent's socioeconomic index	128	6.78	2.91	7981	5.47	2.98
Father's years of education	81	15.21	1.79	6482	14.97	1.73
Child is male (0-1)	128	0.60	0.49	7981	0.51	0.50
Child is white (0-1)	128	0.98	0.13	7981	0.98	0.13
Birth mother's age	124	24.27	6.52	7763	27.62	5.53
Birth weight in ounces	117	109.86	16.77	7522	118.19	18.28
Birth mother smoked during pregnancy	123	0.20	0.40	7695	0.13	0.34
Southgate reading score at age 7	128	24.85	5.87	7981	24.04	6.64
General ability score at age 11	128	46.09	15.55	7981	44.57	15.60
NFER reading score at age16	107	27.26	5.23	7981	25.88	6.70
NFER math score at age 16	107	13.04	5.99	7981	13.19	7.00
Child attended college by age 23 (see notes)	112	0.40	0.49	6249	0.38	0.49
Family income per week at age 23 (£)	112	110.75	55.68	6249	117.39	60.52
Child married at age 23	112	0.41	0.49	6249	0.46	0.50

Notes:
Adopted children are adopted at birth or by age 3 months.
Control children are those who are raised by both of their biological parents.
Parent's socioeconomic index is from NCDS and is based on father's occupation. Occupations are ranked 1-11 with 11 being the highest income. See text for more detail.
College attendance is defined broadly as any attendance of university, technical school, nursing, or teaching school. Family income includes income of subject plus spouse. NFER is the National Foundation for Educational Research.

Table II
Summary Statistics
Colorado Adoption Project

	Birth			Adoptive			Control		
Input Variables	**Obs**	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**
mother's years of education	174	12.09	1.77	180	14.79	1.79	202	14.90	2.02
father's years of education	30	12.40	1.45	180	15.73	2.38	202	15.65	2.27
mother's college attendance (=1 if attended college)	174	0.23	0.42	180	0.46	0.50	202	0.50	0.50
mother's smoking status (=1 if smoker)	183	0.38	0.48	179	0.15	0.35	201	0.23	0.42
father's smoking status (=1 if smoker)	50	.46	.50	183	0.34	0.48	202	0.34	0.47
mother's Hollingshead Job Rating	134	4.48	1.97	183	2.63	3.28	203	3.29	3.35
father's Hollingshead Job Rating	41	6.56	1.84	183	6.71	1.77	203	6.57	1.73
family socioeconomic Index	117	34.82	19.38	183	45.50	15.58	203	45.94	16.80
child's total birthweight in pounds				139	6.44	1.32	139	6.76	1.14
mother's score on vocabulary test (number correct out of 50)	183	31.02	10.21	183	40.81	7.86	203	40.92	8.14
child's score on Wisconsin IQ test in year 7				183	111.57	10.82	203	114.41	11.23
child's verbal score on Wisconsin IQ test in year 7				183	108.38	11.45	203	112.10	12.34
child's Piat Reading Recognition Score in year 7				183	23.66	7.23	203	24.13	7.42
child's reading capabilities in year 6 (as reported by parents)				183	3.57	1.06	203	3.53	1.15
child capable of subtraction in year 6				183	0.66	0.48	203	0.69	0.46
child's level of interest in books in year 6				159	4.62	0.64	165	4.61	0.65
child's year 6 weight in pounds				141	45.32	6.60	146	45.23	6.23

Notes:
The socioeconomic index (SES) is based on occupation and was designed by the National Opinion Research Council (NORC). Family SES is the average for the two parents. Parents' smoking status is measured at time of interview. Interest in books is reported by parents.
Data collected by Plomin, Defries, and Fulker and the Colorado Adoption Project. Data provided by the Henry A. Murray Research Center of the Radcliffe Institute for Advanced Study.

Table III
Summary Statistics
NLSY 79

	Adopted			*Control*		
	Obs	***Mean***	***sd***	***Obs***	***Mean***	***sd***
years of child's education	170	13.412	2.228	5614	13.312	2.486
whether child attended college	170	0.200	0.401	5614	0.247	0.432
score on armed forces qualifying test (afqt)	170	49.324	27.048	5614	44.400	29.434
score on ASVAB general science test	170	16.424	4.530	5614	14.873	5.230
score on ASVAB math test	170	13.618	5.590	5614	12.932	6.445
log of family income in 1994	114	10.497	0.805	3671	10.485	0.831
adopted mother's years of education	170	11.806	3.091	5614	10.993	3.265
adopted mother attended college (0-1)	170	0.153	0.361	5614	0.088	0.283
adopted father's years of education	151	11.868	4.280	5321	11.054	4.071
adopted father attended college (0-1)	151	0.245	0.432	5321	0.164	0.370
log of family income in 1979	138	9.427	0.891	4531	9.522	0.880
child's age in 1979	170	17.465	2.192	5641	17.741	2.259
child is male (0-1)	170	0.524	0.501	5614	0.491	0.500
child is black (0-1)	170	0.176	0.382	5614	0.199	0.399
child is hispanic (0-1)	170	0.035	0.185	5614	0.143	0.350

Notes:
Educational attainment is measured in 1993 (or 1990 when 1993 was missing). The adopted and control distributions for years of education are shaped very differently. This explains how the mean of "years" can be similar but the mean of "college" different.

Means are unweighted and include the poverty oversample. ASVAB vocational test was administered in 1991. Armed forces qualification test (AFQT) was administered in 1980.

Table IV
National Child Development Survey
Adopted and Non-adopted Children
Regression of Child Outcomes on Parent Characteristics:

	Southgate reading score age 8	General ability score age 11	NFER reading test age 16	NFER math test age 16	College (0-1) age 23	family income age 23	married (0-1) age 23
Mean depend. var. (std. dev)	24.852	46.086	27.262	13.047	0.402	110.753	0.411
adopted	(5.867)	(15.551)	(5.235)	(5.986)	(0.492)	(55.683)	(0.494)
Mean depend. variable (std. dev)	24.040	44.573	25.882	13.187	0.381	117.388	0.462
control	(6.640)	(15.604)	(6.704)	(6.997)	(0.486)	(60.524)	(0.499)
Regressions (1)-(4). Each coefficient is from a separate regression.							
adopted family's socio-economic	0.314*	1.163**	0.334**	0.600**	0.032**	-0.982	-0.058**
status (SES)	(0.194)	(0.333)	(0.081)	(0.132)	(0.015)	(1.003)	(0.012)
adopted father's years of education	0.159	1.473	0.110	0.084	0.048	0.393	-0.041
	(0.300)	(1.486)	(0.338)	(0.499)	(0.037)	(4.863)	(0.038)
control family's socio-economic	0.421**	1.217**	0.548**	0.607**	0.037**	1.695**	-0.018**
status (SES)	(0.055)	(0.176)	(0.087)	(0.088)	(0.007)	(0.377)	(0.002)
control father's years of education	0.583**	2.044**	0.833**	1.151**	0.070**	1.652**	-0.035**
	(0.049)	(0.160)	(0.057)	(0.093)	(0.010)	(0.330)	0.004
Test for Control Coefficient=Adoptive Coefficient							
Difference in coefficients on SES:	0.107	0.054	0.214	0.007	0.005	2.677	0.040**
Control-adoptive	(0.190)	(0.423)	(0.143)	(0.106)	(0.012)	(1.015)	(0.016)
Difference in coefficients on fathers'	0.424	0.571	0.723	1.067	0.022	1.259	0.006
education: Control-adoptive	(0.452)	(1.474)	(0.431)	(0.361)	(0.033)	(3.425)	(0.035)
Ratios of Coefficients. These are intended as a measure of (nurture effect)/(nature effect+nurture effect)							
Adoptive coefficient/(Control coefficient)	0.746	0.956	0.609	0.988	0.865	-0.579	3.222
Socio-economic status							
Adoptive coefficient/(Control coefficient)	0.273	0.721	0.132	0.073	0.686	0.234	1.171
father's education							

Column 1: Reading test developed by Southgate in 1962. Column 2: General ability test developed by Douglas in 1964. Columns 3 and 4: reading comprehension and mathematics exams constructed by the National Foundation for Educational Research for use in the NCDS. Column 5: An indicator variable for "college" which codes as "1" any graduate of university, technical college, teaching college, or nursing college.

In the upper portion of the table, each coefficient β is from a separate regression. : Child's outcome = α + β(parent characteristic) + γ*(dummy for male) + δ*(dummy for white) + $\boldsymbol{\pi}$*(ten dummies for region)

The lower portion of the table shows the differences between coefficients for control and adopted children. The differences and t-stats are from the interaction coefficients (β5) in the following regressions: Child's outcome = α + β1*(education of mother who raised child) + β5*(education of mother who raised child*dummy for child is control) + β6*dummy for child is control + γ*(dummy for male) + δ*(dummy for white) + $\boldsymbol{\pi}$*(nine dummies for region) .

Control children are defined as children who lived with both biological parents until at least age 18.
Sample sizes for control children: 7981 "control" children for SES regressions and 6482 for father's education regressions. Sample sizes for adopted children: 128, 128, 107, 107, 112,112,112 respectively for SES regressions. 81 for father's education regressions.
Standard errors shown in parentheses. ** indicates significance at the 5% level. * indicates significance at the 10% level

Table V
NLSY79: Regression of Child Outcomes on Parent Characteristics:

	years of education	completed 16+ years of education (0-1)*	AFQT score	ASVAB general science score	ASVAB math score	log family income 1994
Mean depend. var. (std. dev) *adopted*	13.41	0.2	49.32	16.42	13.62	10.50
	2.23	.40	27.05	4.53	5.59	0.81
Mean depend. variable (std. dev)	13.31	0.25	44.40	14.87	12.93	10.48
control	2.49	0.43	29.43	5.23	6.45	0.83
Regressions (1)-(6). Each coefficient is from a separate regression.						
adopted mother's years of education	0.223**	0.400**	1.893**	0.335**	0.310**	0.066**
	(0.055)	(0.104)	(0.590)	(0.098)	(0.140)	(0.028)
adopted father's years of education	0.161**	0.377**	1.264**	0.221**	0.316**	0.027
	(0.042)	(0.092)	(0.455)	(0.074)	(0.108)	(0.023)
control mother's years of education	0.347**	0.443**	3.565**	0.608**	0.760**	0.058**
	(0.010)	(0.023)	(0.109)	(0.020)	(0.026)	(0.005)
control father's years of education	0.284**	0.442**	2.822**	0.461**	0.604**	0.047**
	(0.008)	(0.018)	(0.085)	(0.015)	(0.020)	(0.004)
log(family income 1979) adoptive	0.561**	0.078*	7.475**	0.963**	1.778**	0.158
families	(0.217)	(0.040)	(2.117)	(0.379)	(0.507)	(0.108)
log (family income 1979) control	0.458**	0.049**	5.710**	0.953	1.206**	0.229**
families	(0.042)	(0.007)	(0.436)	(0.078)	(0.103)	(0.018)
Test for Control Coefficient=Adoptive Coefficient						
Difference in coefficients on mothers'	0.124**	0.043	1.672**	0.273**	0.450**	-0.008
education: Control-adoptive	(0.055)	(0.083)	(0.575)	(0.104)	(0.138)	(0.025)
Difference in coefficients on fathers'	0.123**	0.065	1.558**	0.240**	0.288**	0.020
education: Control-adoptive	(0.044)	(0.087)	(0.467)	(0.084)	(0.112)	(0.020)
Difference in coefficients on family	-0.103	-0.029	-1.765	-0.010	-0.572	0.071
income: Control-adoptive	(0.136)	(0.026)	(1.421)	(0.255)	(0.337)	(0.055)
Ratios of Coefficients. These are intended as a measure of (nurture effect)/(nature effect+nurture effect)						
Envir coefficient/(Biology + environment coefficients)	64.2%	90.3%	53.1%	55.1%	40.8%	113.8%
mother's education						
Biology coefficient/(Biology + environment coefficients)	56.7%	85.3%	44.8%	47.9%	52.3%	57.4%
father's education						

Notes: Control children are defined as children who lived with both biological parents until at least age 18. T-statistics shown in parentheses.

In the upper panel, each coefficient is from a separate regression. : Child's outcome = $\alpha + \beta 1$(parent characteristic) + γ*(dummy for male) + δ*(dummy for white)

The lower panel shows the differences between coefficients for control and adopted children. The differences and t-stats are from the interaction coefficients ($\beta 5$) in the following regressions: Child's outcome = $\alpha + \beta 1$*(education of mother who raised child) + $\beta 5$*(education of mother who raised child*dummy for child is control) + $\beta 3$*dummy for child is control. + dummies and interactions for male and white.

* Column (2) is a probit of Child attend college on parent characteristics. Mother or father "attend college" is substituted for mother and father's years of education.

The differences in coefficients (control - adoptive) are the implied coefficients on biological influence under the restrictive assumption that Child's outcome = $\alpha + \beta 1$*(biology)+ $\beta 2$*(environment) . Rows (10) and (11) show the size of the implied biology effect as a percent of the total effect.

For column's (1)-(5): Sample sizes for adopted mother's education (170) , adopted father's education (151), control mother's education (5614), control father's education (5321), log family income adopted (138), log family income control (5614)

For column (6), all rows: 114 adopted children. 3671 control children.

Table VI
Colorado Adoption Project
OLS of Child Outcomes on Parent Characterestics

	child's score-Wisconsin IQ test in year 7	child's verbal score-Wisconsin IQ test in year 7	child's Piat Reading Recognition Score in year 7	child's reading capabilities in year 6 (as reported by parents)	child capable of subtraction in year 6	child's level of interest in books in year 6
Mean depend. var. (std. dev) *adopted*	111.856	108.741	23.661	3.586	0.672	4.621
	(10.626)	(11.555)	(7.267)	(1.032)	(0.471)	(0.639)
Mean depend. variable (std. dev) *control*	114.417	112.034	24.152	3.534	0.686	4.608
	(11.237)	(12.273)	(7.419)	(1.151)	(0.465)	(0.649)
Coefficients from Regression (1)						
birth mother smokes (0-1)	-1.079	-0.901	0.323	0.124	-0.053	-0.194*
	(1.589)	(1.722)	(1.102)	(0.160)	(0.071)	(0.107)
adoptive father smokes (0-1)	-5.500**	-4.797**	-3.096**	-0.412**	-0.216**	-0.018
	(1.625)	(1.761)	(1.127)	(0.163)	(0.073)	(0.110)
Coefficients from Regression (2)						
control father smokes (0-1)	-0.708	-0.343	-0.548	0.349**	-0.061	0.001
	(1.671)	(1.841)	(1.104)	(0.168)	0.069	(0.108)
Coefficients from Regression (3)						
birth family's socioeconomic index	0.065	0.100*	0.033	0.003	-8.22E-5	0.003
	(0.047)	(0.053)	(0.036)	(0.005)	(0.002)	(0.004)
adoptive family's socioeconomic Index	-0.007	0.030	0.008	-0.001	-0.002	-0.002
	(0.060)	(0.068)	(0.046)	(0.006)	(0.003)	(0.004)
Coefficients from Regression (4)						
control family's socioeconomic index	0.139**	0.120**	0.063**	0.017**	0.005**	0.007**
	(0.047)	(0.052)	(0.031)	(0.005)	(0.002)	(0.003)
Coefficients from Regression (5)						
birth mother's years of education	0.985**	0.847**	0.534**	0.004	0.020	0.013
	(0.352)	(0.393)	(0.251)	(0.036)	(0.016)	(0.023)
adopted mother's years of education	-0.359	-0.127	-0.108	0.032	0.013	0.024
	(0.395)	(0.441)	(0.281)	(0.040)	(0.018)	(0.027)
Coefficients from Regression (6)						
control mother's years of education	1.350**	1.436**	0.737**	0.083**	0.048**	0.044*
	(0.381)	(0.417)	(0.254)	(0.039)	0.016	(0.025)
Tests for equality of Coefficients						
F test: coeff adoptive=coeff control	F=3.02	F=2.60	F=10.50	F=0.83	F=2.40	F=0.02
parent's smoking	p=0.083	p=0.108	p=0.001	p=0.363	p=0.122	p=0.902
F test: coeff birth =coeff adoptive	F=1.92	F=3.88	F=4.33	F=0.24	F=2.20	F=1.08
parent's smoking	p=0.167	p=0.050	p=0.038	p=0.627	p=0.139	p=0.300
F test: coeff birth=coeff control	F=0.05	F=0.31	F=0.94	F=2.18	F=0.01	F=1.65
parent's smoking	p=0.826	p=0.578	p=0.334	p=0.140	p=0.934	p=0.200

Rows (1) and (2) are OLS coefficients from the following equation:
Child's outcome = $\alpha + \beta 1$*(birth mother smokes) + $\beta 2$*(adoptive father smokes) + $\delta 1$*male
Row (3) is the OLS coefficient from Control child's outcome= $\alpha + \beta 3$*(control father smokes) + $\delta 1$*male
Rows (4)-(6) are similar regressions but subsitute socioeconomic index for smoking status.
Smoking status is measured at time of first interview rather than during pregnancy or at time of birth. Results for adoptive father smoking status are shown because they have larger and more significant effects that adoptive mother smoking status.

Standard errors shown in parentheses. F tests are calculated by stacking the data to include adopted and control samples and then using interaction terms to estimate the same $\beta 1$, $\beta 2$, $\beta 3$ as in rows (1)-(3).
Data collected by Plomin, Defries, and Fulker and the Colorado Adoption Project. Data provided by the Henry A. Murray Research Center of the Radcliffe Institute for Advanced Study.
Sample sizes for parent's smoking: 183 adopted children and 203 control children except column (6) which is 159 adopted and 165 control. Sample sizes for socio-economic index: 117 adopted children and 203 control children except column (6) which is 117 adopted and 165 control.

Appendix I
National Child Development Survey
Evidence of Independence between Birth and Adoptive Families

	Reg One Child's birth weight in ounces	Reg Two Birth mom's smoking status	Reg Three Birth Mom's age in 1958	Reg Four Birth Mom's Job and Socioeconomic Status
Adoptive Mother's social	-0.482	-0.007	-0.403	0.159
class rating	(0.356)	(0.012)	(0.402)	(0.222)
Adopted child is male (0-1)	4.084*	-0.119	0.505	-1.003
	(2.317)	(0.077)	(1.703)	(0.668)
Dummy for child is white	-1.269	-0.113*	-0.432	0.617
	(1.841)	(0.070)	(1.319)	(0.490)
Region where birth child	-11.826*	0.036	2.914	1.285
born: North Western	(6.752)	(0.210)	(2.251)	(2.446)
Region where child born:	3.497	0.392*	0.960	-1.608
Northern	(6.469)	(0.203)	(3.840)	(2.664)
Region where child born:	-12.028*	-0.196*	-1.831	-0.938
East and West Ridings	(6.914)	(0.114)	(1.700)	(3.998)
Region where mother born:	-7.813	0.040	-2.187	0.777
North Midlands	(6.901)	(0.181)	(2.630)	(0.975)
Region where child born:	4.792	-0.104	0.575	-1.734
Eastern	(9.163)	(0.176)	(2.270)	(1.953)
Region where child born:	-1.221	0.042	-0.278	0.922
London and South East	(5.954)	(0.145)	(1.369)	(1.540)
Region where child born:	-3.828	0.040	-1.767	1.861
Southern	(9.941)	(0.206)	(3.109)	(1.719)
Region where child born:	-3.630	-0.220**	-4.533*	2.036
South Western	(11.895)	(0.105)	(2.621)	(2.281)
Region where child born:	-6.370	-0.142	1.134	-1.631
Wales	(5.601)	(0.122)	(2.176)	(2.562)
Region where child born:	-8.166	-0.206**	-1.727	2.877
Midlands	(13.732)	(0.101)	(3.452)	(3.928)
Region where child born:	-10.341	-0.310**	-2.979	1.445
Scotland	(7.087)	(0.113)	(1.903)	(1.327)
N	116	116	116	114
R-Squared	0.1241	0.1844	0.1173	0.1086

Appendix II

Colorado Adoption Project

Evidence of Independence between Birth and Adoptive Motbers

	Adopted Mother's Education	Adopted Mother's Number Correct on Vocabulary Test	Adopted Mother's Smoking Status	Adopted Mother's Socioeconomic Status
Birth Mother's Education	-0.016			
	(0.068)			
Birth Mother's # Correct on Vocabulary Test		-0.031		
		(0.580)		
Birth Mother's Smoking Status			0.109**	
			(0.054)	
Birth Mother's Socioeconomic Status				0.044
				(0.073)
N	174	174	170	114
R-Squared	0.0003	0.0016	0.0237	0.0032

Appendix III
NLSY 79
Frequency Table of Adoptive Mother and Adopted Child College Graduation

	Adopted Child is College Graduate		
	No	Yes	Total
Adoptive Mother is college graduate			
No	124	12	136
Yes	20	14	34
Total	144	26	170

Appendix IV
National Child Development Survey
Regressions with both Adoptive and Birth Parent Characteristics:

	Southgate reading score age 8	General ability score age 11	NFER reading test age 16	NFER math test age 16	College (0-1) age 23	family income age 23	married (0-1) age 23
Adoptive family's socio-economic status	0.198	1.359**	0.409**	0.396**	0.046**	-1.178	-0.058**
	(0.217)	(0.320)	(0.120)	(0.182)	(0.020)	(2.030)	(0.016)
Birth mother's socio-economic status	0.156**	0.078	0.280**	0.448**	0.026**	1.929**	-0.005
	(0.068)	(0.241)	(0.110)	(0.150)	(0.010)	(0.882)	(0.014)
controls for region and child male?	yes	yes	yes	yes	yes	yes	yes
R-squared	0.18	0.24	0.29	0.31	0.20	0.18	0.24
N	97	98	83	83	90	90	87

Standard errors shown in parentheses. F tests are calculated by stacking the data to include adopted and control samples and then using interaction terms to estimate the same $\beta 1$, $\beta 2$, $\beta 3$ as in rows (1)-(3).