# EARLY PARENTAL TIME INVESTMENTS IN CHILDREN'S HUMAN CAPITAL DEVELOPMENT: EFFECTS OF TIME IN THE FIRST YEAR ON COGNITIVE AND NON-COGNITIVE OUTCOMES

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**Early Parental Time Investments in Children's Human Capital Development: Effects of Time in the First Year on Cognitive and Non-cognitive Outcomes**

by

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**Abstract**

Based on recent neuropsychological literature, this study measures the effects of early parental time investments on children's cognitive and non-cognitive development. This study offers three innovations. First, time investments are not permitted to be substitutable over time. Second, short and long term cognitive and non-cognitive outcomes are considered. Third, a household fixed effect is constructed to capture the unobserved heterogeneity of caregivers and children. This offers a lower bound of the true effect of time investments. Using the National Longitudinal Survey Child-Mother file, the results are consistent with neuropsychological evidence. They suggest that uninterrupted parental time investments for up to one year offer lasting benefits, particularly for non-cognitive outcomes, but longer spells of uninterrupted investments are of questionable value. (JEL Classifications: J13, J22, D13)

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## 1. Introduction

A growing interest in very young children has been spawned by recent neurological evidence that suggests the social environment significantly affects the physical development of the brain (Lecours (1982)). Therefore, it is not surprising that many early intervention programs for preschool children have been linked with lasting impacts (Currie (2000), Karoly et. al. (1998)). However, the effects of interventions prior to age 3 are largely unknown, and the role for policy intervention is less clear.

Neuropsychological research on attachment theory has proposed that the interaction between the primary caregiver and infant has a significant and lasting impact on the social and emotional development of the child. More specifically, an uninterrupted relationship with a loving caregiver starting almost immediately after birth and continuing through the first year of life will have permanent effects on the social and emotional development of the child (Schore (1996)). This implies that parents[1] can invest in their children by allocating a larger quantity of quality time to them throughout the entire first year.

The goal of this study is to measure the effects of time investments as implied by neuropsychological evidence on children's cognitive and non-cognitive development. This study differs from previous research in three important ways. First, earlier studies have tended to use the average number of hours or weeks worked in a given period, which implies that investments are substitutable over time (Ruhm (2000), Blau and Grossberg (1992), Desai et. al. (1986), Parcel and Menaghan, (1994)). Recent neurological literature instructs that time investments are time specific and not substitutable. I measure investments in a way that does not permit substitutability over time.

A second important contribution of this study is to consider a wide range of both short and long-term cognitive and non-cognitive measures of children's development. Most research has focused on short-term cognitive outcomes (Greenstein (1995), Blau and Grossberg (1992), Ruhm (2000)), but neuropsychology suggests a permanent impact on social and emotional development. Social and emotional skills, or more generally non-cognitive skills, are important components of human capital. They are crucial determinants of an individual's general well-being as well as performance in school or the labor force. For example, the attributes of a child prior to kindergarten that teachers define as the most important for school readiness are health, communication skills, enthusiasm, and the ability to pay attention (Carnegie Foundation (1991)). The economic literature has also stressed the importance of non-cognitive outcomes in determining an individual's labor force productivity (Heckman (1999), Heckman et. al. (2000)).

Third, despite these two differences, the empirical issues, namely the need to control for the quality of the caregiver and the child's initial endowments, are essentially the same. To address these, I propose a household fixed effect. This approach limits the analysis to measuring the effect of differential inputs across children within a single family on the outcomes of the children. While the use of siblings as a control does not remove all potential biases, I argue that the estimates offer a lower bound of the true effect of time with the child and significantly improve upon other estimation strategies.

Using the National Longitudinal Survey of Youth (NLSY) Child-Mother file, the results from this approach are mostly consistent with neuropsychological evidence. Overall, they suggest that uninterrupted parental time investments up to one year would offer lasting benefits, particularly for non-cognitive outcomes, but longer spells of uninterrupted investments are of questionable value.

This paper is laid out as follows. Section 2 provides background neuropsychological and economic information. Section 3 describes the theoretical model and policy implications. The empirical strategy is described in section 4. Section 5 describes the data used in the analysis. Section 6 presents results from estimation. A discussion in Section 7 describes the potential

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[1] The caregiver is not limited to the parent of the child. However, this theory stresses an uninterrupted role for a loving caregiver, and the parent of the child is most likely to fill this description.

biases of the fixed effects estimator. The final section concludes and discusses policy considerations.

## 2. Background

### *A. Neuropsychological Evidence*[2]

Neuropsychology has stressed the importance of the interaction between the primary caregiver and infant in the first year. In a nutshell, the theory states that frequent interactions between the infant and primary caregiver become increasingly internalized by the infant's nervous system. At approximately 6 months the pair forms a unique bond, or attachment, in which their brains become synchronized (Schore (1994)). Through this attachment the attuned caregiver regulates the emotion of the child by minimizing negative affect and maximizing positive affect (Schore (1994)). This significantly affects the connections in the orbitofrontal cortex until it matures at approximately 10-12 months (Schore (1996)). The orbitofrontal cortex is considered the "Senior Executive" of the social-emotional brain (Joseph (1996)) and is strongly linked to the lifelong mental and physical health of the infant (Wittling and Schweiger (1993), Schore (1997)).

By 12 months, the infant is significantly more able to regulate his or her own emotion and is less dependent on the caregiver. As a result, interactions during the second year become increasingly social in nature, suggesting that an acceptable time for separation between the pair is at the end of the first year[3] (Schore (1994)). This implies that an uninterrupted relationship for at least one year between an infant and caregiver which leads to a secure attachment will have a permanent impact on the social and emotional development of the child.[4]

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[2] More interested readers should consult Schore (1994, 1996).
[3] Although neuropsychologists have concluded that separation should not occur before a year, this is some speculation that it should actually occur at 18 months or beyond (Schore (1996)).
[4] Whether attachment affects cognitive development remains a point of debate. No direct links have been established, but indirect improvements in cognitive skills may occur.

***B. Economic Evidence***

Recently the United States has witnessed a dramatic increase in the labor force participation (LFP) of women, particularly married women with young children. The LFP of women with children under age 18 has risen from under 20 percent to over 70 percent in the last 50 years, and it has risen almost 30 percentage points in the last 20 years for women with children under age 2 (Committee on Ways and Means (1998)).

Largely in response to these trends, there has been a wide range of research (mainly using the NLSY) looking at the effect of early parental employment on children's cognitive outcomes, with little conclusive results. Some have found positive effects of maternal employment during the first year (Parcel and Menaghan (1994)), but most have found negative effects (Blau and Grossberg (1992), Ruhm (2000)). Maternal employment during the second and third years has almost always been linked with positive outcomes. Harvey (1999) provides an excellent overview of earlier research. The wide range of results is due to differences in the measurement of time investments, the age of the child when the dependent variables were measured, sample selections, and control variables used (Harvey (1999)).

Despite these differences in approaches, the estimates are difficult to interpret as causal because of the failure to adequately control for the quality of the caregiver and the endowment of the child. Since time inputs by a parent are likely to be correlated with these unobserved factors, estimates of the effect of time in a least squares framework give biased results. For example, parents with strong labor market skills may choose to spend less time with their children. If labor market skills are positively correlated with home production skills, we would expect estimates that do not control for these skills to underestimate the effect of time investments.[5]

Two studies with explicit attempts to correct for this endogeneity are Blau and Grossberg (1992) and Ruhm (2000). Blau and Grossberg address it by instrumenting for time away from home using an assortment of variables that are assumed to affect the labor supply decision but not

[5] Additional potential biases are discussed below.

the child's outcome, but reject their IV estimates in favor of least squares based on Hausman tests. However, they admit that the instruments could in fact be highly correlated with regressors in the main equation and do not rule out heterogeneity entirely.[6] Ruhm addresses endogeneity by performing ordinary least squares regressions with an extensive set of control variables available in the NLSY. While his study appears to have success in dealing with the endogeneity, unobserved characteristics of children and families may remain after conditioning on this rich set of observables. Despite these attempts, both papers only focus on short-term cognitive outcomes and measure time investments using the average number of hours or weeks worked per year.

Thus, there does not appear to be a study that fully considers neuropsychological evidence or controls for the unobserved characteristics of caregivers and children in measuring the effects of early time investments. A solid theoretical grounding based on neurological evidence on the development of children and economic decisions of the household will provide a more consistent empirical framework for understanding the impact of early parental time investments.

## 3. Theory

This section outlines a basic theoretical context for analyzing how human capital develops during early childhood according to neuropsychological evidence and how parents choose to invest in their children. The effect of parental leave on time investments is then discussed.

### *A. Human Capital Development*

A child's human capital in a given period ($H_t$) is determined by the resources devoted to the child, mainly in the form of time ($T_t$) and consumption ($C_t$), the quality of the resources ($Q_t$), and the existing human capital stock of the child ($H_{t-1}$) (Leibowitz (1974)), according to the following equation:

$$H_t = f_t(C_t, T_t; Q_t, H_{t-1}) \quad (1).$$

[6] The authors do not provide a detailed explanation for the validity of their instruments and do not report

The amount of resources is chosen by the parent or society, and the quality and human capital stock determine the efficiency with which the resources affect human capital. Human capital can be viewed as anything that affects future utility and productivity. This can range from health outcomes to academic achievement to self-confidence.

I define two main periods in children's human capital development: from birth until approximately year one (the "infancy" period), and from the first year on (the "socializing" period). These periods represent stages in which the nature and choice of inputs vary considerably.[7]

During the infancy period, as highlighted by the neuropsychological findings, the interaction between the primary caregiver and the infant is crucial. This literature implies time investments will have positive effects *only if the parent remains with the child throughout the entire period.* Therefore, time investments are not substitutable within a given period. The measurement of time in the infancy period is an important distinction in this model.

With regard to consumption, a certain level of income is important to provide sufficient nutritional consumption. However, it is argued that "enrichment" goods that are purchased to specifically promote learning, such as playing classical music to a child, are unnecessary at this stage (Bruer (1999)). This suggests that additional income beyond a certain threshold would not improve the child's human capital *ceteris parabis*.[8] However, the type of nutritional consumption is extremely important. For example, the consumption of human milk via breastfeeding for the first 6 months has been linked to better health and neurological development (American Association of Pediatrics (1997)).

In the socializing period, time investments change as children explore in their environments and begin to enter school. As they spend less time with their parents, the quality of

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first stage estimates in their paper.

[7] I considered more periods in earlier work, but this approach did not yield additional implications.

[8] However, Currie and Bhattacharya (2000) find that nutritional deficiencies of youths in the United States are generally insensitive to income, suggesting that many children in the U.S. receive comparable levels of nutrition.

these environments become increasingly important. Nutritional consumption remains important, but it is unclear as to what age enrichment goods become important and thus when family income will play a stronger role.

***B. Basic Model***

A family raising a child faces a trade-off in deciding how to allocate their scarce resources, namely time and money, to the child in each period. To model this decision, I assume the following: a household contains at least one altruistic parent ("primary parent") and one child. If there is a second parent, he or she participates in the labor force in all periods. The care of other children, if they exist, is also determined outside the model. The supply of children and quality of parental care are determined exogenously.[9] Since the focus here is on time inputs in the first period, I assume the primary parent faces a binary choice over how to allocate his or her time in the first year of a child's life. The primary parent can participate in the labor market and purchase child care services ($T_1$=0) or remain home to spend time with the child and forgo child care services ($T_1$=1).[10] For now, I assume the primary parent then participates in the labor force in the following period ($T_2$=0). Wages in each period ($w_t$) are also determined exogenously.

The primary parent chooses $T_1$, $C_1$, $C_2$, and the amount of consumption for him or herself ($Z_1$ and $Z_2$) to maximize the following utility function of the family:

$$U(Z_1,Z_2,H_1,H_2).^{11} \tag{2}$$

Equation (2) is maximized subject to the human capital constraint in periods 1 and 2:

$$H_1 = f_1 (C_1, T_1; Q_1, H_0) \tag{1'}$$

$$H_2 = f_2 (C_2, T_2; Q_2, H_1) \tag{1''}$$

where $H_0$ is human capital at birth, and the following budget constraint:

$$p_1\cdot(Z_1+C_1)+m_1\cdot(1-T_1)+p_2\cdot(Z_2+C_2)/(1+r) = w_1\cdot(1-T_1)+A_1+(w_2+A_2)/(1+r) \tag{3}$$

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[9] This assumption will not affect the theoretical results, but is further considered in the empirical results.
[10] This also implies no distinction between pure leisure and time investments as well as no choice over the number of hours to work.

where $p_t$ is the price of consumption in each period and $m_1$ is the price of child care services. $A_t$ is other family income in each period, which could be the second parent's income and/or non-labor income.

Solving for the first order equations above, we can interpret the equilibrium condition in a reservation wage structure:

$$w_1 - m_1 >< \{\delta H_1/\delta T_1 \cdot (\delta U/\delta H_1 + \delta U/\delta H_2 \cdot \delta H_2/\delta H_1)\} \,/\, \delta U/\delta Z_1. \qquad (4)$$

If the wage of the primary parent less the cost of child care services exceeds the reservation wage (also the shadow value of time), the primary parent will work. On the other hand, if it falls below the reservation wage, the parent will remain home.

The following implications come from this model. If labor market and home production skills are positively correlated, that is $\rho(w_1,Q_1) > 0$, then it is not possible to sign how quality in home production will affect the time investment decision because quality affects the wage on the left-hand side of (4) and the efficiency of human capital production on the right-hand side in the same direction. If initial human capital ($H_0$) is positively correlated with $Q_1$ because of better prenatal care or genetics, it is also not possible to sign the relationship between earlier human capital and the amount of time investments. If, however, labor market skills and home production skills are not correlated, higher labor market skills will have the unambiguous affect of decreasing time investments by increasing only the wage.

***C. Policy Implications***

Market forces acting on their own may lead to an inefficient allocation of time for the following reasons. Parents may not fully understand the effects of early investments ($\delta H_1/\delta T_1$, $\delta H_2/\delta H_1$), which is likely because the neuropsychological findings are relatively new.[12] They may act myopically because returns from the investment are reaped over a long period of time.

[11] If parents receive pleasure from being with their child instead of working, it may be reasonable to think that time also enters the utility function. I omit it here for simplicity, and implications do not change with it in the utility function.

Imperfect capital markets may limit the ability to invest optimally. Externalities that arise from children's behavior, such as good citizenship and responsible behavior, may not be fully internalized by parents.

In addition to the potential market failures, an argument for policy intervention also stems from an equity argument. If early investments have long-lasting effects and lower income families invest less because of liquidity constraints, existing inequality may be further exacerbated. Additionally, many current policies aim at increasing the labor force participation of families with young children, having the simultaneous negative effect of decreasing time investments.[13]

To understand how policies can affect the time allocation decision, I relax the assumption that the LFP of the parent in period 2 is given by introducing uncertainty into future employment. We may believe that time spent home in period 1 affects the probability of being employed in period 2, and can rewrite the expected wage in the second period as:

$$E(w_2) = w_2 \cdot [\Pr(T_2 = 0 \mid T_1 = 0) \cdot \Pr(T_1 = 0) + \Pr(T_2 = 0 \mid T_1 = 1) \cdot \Pr(T_1 = 1)] \qquad (5).$$

Resolving for the reservation wage, we are left with:

$$w_1 - m >< [\{\delta H_1/\delta T_1 \cdot (\delta U/\delta H_1 + \delta U/\delta H_2 \cdot \delta H_2/\delta H_1)\} / \delta U/\delta Z_1] + \delta E(w_2)/\delta T_1 \qquad (6).$$

Potential shifts in behavior would occur if we impose exogenous changes to the parameters in (6).

One mechanism that will increase time investments is a paid parental leave policy. This would include an exogenous increase in $A_1$, which increases $Z_1$ and lowers $\delta U/\delta Z_1$ (if utility is concave in Z), thereby increasing the reservation wage and time investments. Second, if the probability of being employed in period 2 is greater if employed in period 1$\{\Pr(T_2 = 0 \mid T_1 = 0) > \Pr(T_2 = 0 \mid T_1 = 1)\}$, then $\delta E(w_2)/\delta T_1 < 0$. Protection of future employment to equate the

[12] In fact, segments of the public have been extremely responsive to these neurological findings, as evident by increased purchases of products designed to provide a wide array of stimulus (Marcus et. al. (1999)) despite the fact that these stimuli may have little or no effect on development (Bruer (1999)).

probabilities will make $\delta E(w_2)/\delta T_1 = 0$, and raise the reservation wage and increase time investments.[14]

Therefore, if parents are under-investing in their children relative to society's preferences or we seek to reduce inequality, offering a parental leave policy that increases other income available to the family and/or protection of future employment for the parent will unambiguously increase parental time investments.[15]

## 4. Empirical Strategy

To determine the effects of time investments on children, we can estimate the second period human capital production function by recursively substituting in the human capital functions of the previous period. After linearizing and adding an idiosyncratic error term, we are left with:

$$H_{ij2} = \beta_0 + \beta_1 * T_{ij1} + \beta_2 * T_{ij2} + \beta_3 * C_{ij1} + \beta_4 * C_{ij2} + H_{ij0} + Q_{j1} + Q_{j2} + e_{ij} \qquad (7)$$

where $T_{ijt}$ are the time investments from household *j* in child *i* in period t, $C_{ijt}$ is the consumption of child *i* in household *j* in period *t*, $H_{ij0}$ is the initial indicator of human capital, $Q_{jt}$ is the quality of household investments in period *t*, $e_{ij}$ is an i.i.d error term, and $\beta_k$ {k=0,1,2,3,4} is a vector of coefficients representing the marginal effect of a given input on $H_{ij2}$.

The main approach taken in the previous literature has been to estimate equation (7) in a least squares (LS) framework. We would obtain unbiased estimates of $\beta_1$ using LS if we could observe and measure all of the variables in (7) that are correlated with $T_{ij1}$. However, quality and initial endowments are difficult to measure and are likely to be correlated with the time

[13] Policies such as the Child Care Tax credit, which do just this in an effort to increase LFP, have the additional effect of reducing time investments. As with most policies designed to increase wages, EITC will have an ambiguous effect.
[14] While policies that increase the cost of child care services ($m_1$) will also lead to increases in time investments, this is likely to be extremely unpopular as it would further exacerbate inequality. A policy that improves the quality of alternative caregivers, however, is another potential avenue to improve the child's outcomes. While this is in disagreement with attachment theory because it will still lead to a disruption in the relationship between the parent and the child, it is not possible to test this prediction using these data.
[15] While this is only a partial equilibrium analysis, these results are likely to hold in a more general framework. For example, parental leave policies have been found to lower wages of women (Gruber (1994)). This would lower wages in *both* period 1 and 2, leading to no overall change in (6).

investment decision. Therefore, to the extent that quality and endowment are unobserved and thus omitted from (7), LS would yield biased results.

One way to understand the direction of the bias in LS is by interpreting the quality and endowment omission as a self-selection bias. Negative selection occurs if those best at producing children are also the most potentially skilled workers. These parents, by having the greatest opportunity cost of staying home, are more likely to work, implying $\rho(Q_{j1}, T_{ij1}) < 0$. If we omit $Q_{j1}$ from (7), this will yield a downward bias of LS estimates. However, the possibility exists that work quality and child production quality are not correlated. For example, "warmth" and "love", two desirable traits in caring for children, may be completely unrelated to an individual's productivity in the labor market. Therefore, those most likely to stay with the child are most able at producing children, implying $\rho(Q_{j1}, T_{ij1}) > 0$. If quality is omitted from (7), then positive selection occurs and we have an upward bias of LS estimates.

The type of self-selection that occurs would determine the direction of the bias from omitting initial endowment. The genetic aspects of ability (as it relates to work quality and/or child production) may be passed onto children genetically, implying $\rho(Q_{j1}, H_{ij0}) > 0$. If negative selection is occurring, then omission of the higher initial endowment of the child will further exacerbate the downward bias. Thus, it is not possible to assign an overall direction of the bias caused by the potentially omitted variables.

To overcome these limitations, we must make an assumption about the structure of unobserved quality and endowment. If we believe that the quality of home production is constant within a family, then using a household fixed effect will control for these time invariant components of quality. This is reasonable if parental skill as valued by the labor market does not vary systematically with time investments, thereby eliminating the negative selection issue. If skills like "warmth" and "love" are largely instinctual and constant over time, this will eliminate the potential positive selection. Other environmental qualities, such as neighborhoods and schools, will be constant if, as expected, families with young children do not relocate often.[16]

Use of a household fixed effect will also control for initial endowment to the extent that siblings share common genetic components. However, we still expect some differences in siblings. Children have a unique resiliency to prenatal inputs, such as alcohol, that can affect early outcomes (Werner (1990)). Furthermore, information and laws with respect to alcohol and smoking and pregnancy have evolved rapidly during the past 20 years. To control for this variation in initial health, I eliminate children with serious health conditions and include the birth weight of the child as a control, which is regarded as the single best indicator of a child's health.

Therefore, I propose to estimate the following equation

$$H_{ij2} = \beta_0 + \beta_1 * T_{ij1} + \beta_2 * T_{ij2} + \beta_3 * C_{ij1} + \beta_4 * C_{ij2} + \beta_5 * H_{ij0} + g_j + e_{ij} \qquad (8)$$

where $H_{ij0}$ is an indicator of the child's birthweight and $g_j$ is the household fixed effect.

The household fixed effect assumes that the time allocation choice within a family, after controlling for other varying family inputs, is not systematically related to the unobserved components that affect human capital. In order for this approach to yield unbiased estimates of $\beta_1$, the main coefficients of interest, we would need $E(e_{ij} \mid T_{ij1}, T_{ij2}, C_{ij1}, C_{ij2}, H_{ij0}, g_j) = 0$. Section 7 describes the potential biases that may arise if this condition is not met and provides evidence on the likely importance of the bias. To obtain precise estimates of $\beta_1$, we would need a large sample of siblings with ample variation in time spent with each child. The following section describes the NLSY in more detail and the amount of variation within families.

**5. Data**

The data used for this study is the 1996 wave of National Longitudinal Survey of Youth (NLSY) Child-Mother file. The NLSY has conducted annual interviews of a nationally representative group of females who were between 14 and 22 years old in 1979. Beginning in 1986, children of these women were also assessed, and have been surveyed biannually since then.

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[16] In the NLSY, approximately 21% of all children used in this analysis moved at least once between the

The NLSY contains a wide range of family background variables and measures of children's development useful for this analysis.

One major weakness of the NLSY is that we only have sufficient data on the time that mothers spent with their children. While there may be reasons to believe mothers and fathers can have different impacts on their children, we are unable to say anything about it in this study.[17] Another limitation of the NLSY is that few measures of child care quality exist and we can not explicitly compare the impact of the quality of alternative caregivers.[18] Despite these weaknesses, the NLSY appears to be the most useful data set for conducting such an analysis given its longitudinal nature, the wealth of information, and the large number of siblings available.

After eliminating children with serious permanent health conditions,[19] children who did not reside with their mothers during their 1st 3 years, and families with only one child, we are left with a sample of 4829 children born to 1543 mothers. Table 1 displays basic descriptive statistics of children and mothers in the NLSY[20]. The average mother is 35 years old, has 3 children, and has almost 12 years of education. Approximately 50 percent of the children are either black or hispanic, half are boys, and their ages range from 4 to 19 years old.

Table 1 indicates that the environment at birth for these children is often not ideal. 30 percent of children did not have a father present, just over 9 percent of the mothers were 18 years or younger old when they gave birth, and almost 8 percent of the children were born at 5.5 pounds or less. In terms of family inputs, 57 percent of the mothers stayed home with their child for at least 6 months, and 24 percent stayed for at least 2 years. Roughly 44 percent of the children were breastfed, with 14 percent breastfed for over half a year.

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ages of 6 and 12.

[17] However, it is difficult in general to get information on father's time with children. For example, in Sweden, despite a liberal parental leave policy, mothers accounted for 93% of total family leave weeks (Peters (1997)).

[18] In 1986 and 1988, detailed questions were asked regarding child care for the last four weeks only.

[19] This includes children who are blind, deaf, mentally retarded, or have a brain dysfunction.

[20] The unweighted data is presented in this table and used throughout the analysis. Although the NLSY provides sample weights, MaCurdy et. al. (1998) do not advocate using the given weights. While their conclusion is based on the men and women of the NLSY (not children), it should have similar applicability

*A. Time Investments*

As mentioned in the previous section, the measurement of time is crucial. To capture an uninterrupted time investment from birth until a given period, I construct dummy variables as such:

$T_a = 1$ if mother did not work *at all* for 6 months or more[21]; $= 0$ otherwise (9)

$T_b = 1$ if mother did not work *at all* for 12 months or more; $= 0$ otherwise

$T_c = 1$ if mother did not work *at all* for 18 months or more; $= 0$ otherwise

$T_d = 1$ if mother did not work *at all* for 24 months or more; $= 0$ otherwise.

For example, a mother who did not return to work for 15 months after the birth of a child would be coded as $T_a$=1, $T_b$=1, $T_c$=0, $T_d$=0. To construct these dummies, I use "number of weeks remained home after birth" for each child, which is a variable constructed from the work history file (not a retrospective question).

The rationale for creating the above breakpoints is as follows. First, since attachment occurs at approximately 6 months, this represents the first stage at which we might expect benefits to occur. Second, the first significant developmental milestone for a child occurs around 10-12 months, at which point the role of the caregiver changes. Furthermore, other studies have commonly found negative effects from investments beyond 1 year[22]. I include a cutoff beyond year 1 to allow sufficient time to cover this major development but to prevent later negative effects from confounding the effects of earlier investments.[23] Two additional cutoffs are sequentially spaced another 6 months apart to further disentangle potential negative effects. Thus, the coefficients assigned to the above dummy variables $\{\beta_a, \beta_b, \beta_c, \beta_d\}$ represent the marginal effect of an additional uninterrupted (full-time) investment of 6 months. The main hypothesis of this study is that $\beta_a > 0$.

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to the children of the women. Therefore, the findings from this study are not necessarily representative of all children in the U.S. (which also occurs when doing a sibling comparison).

[21] Note that this does not include mothers who worked part-time during a time interval.

[22] Most studies have found positive effects beyond the second year from employment, which would be equivalent to negative effects from time investments.

Previous research has tended to use the average number of weeks or hours worked in a given period, usually separately for during the first year and beyond the first year. This measurement does not specifically capture an uninterrupted investment, as part-time employed mothers are included, and implies time investments are substitutable within a given period. For example, a mother who stayed at home for the first 6 months and worked full-time (40 hours/week) for the next 6 months would be assigned the same average number of hours worked as a mother who worked the first 6 months full-time and stayed home the next 6 months. The measurement of time as described above does not permit substitutability over time.

As mentioned earlier, in order to get precise estimates of the effect of time we need significant variation in time spent with children within a family. Table 2 provides a glimpse of this. It displays the number of mothers who spent time home in each of the above categories (slightly redefined)[24] from one child to the next. For example, 74 mothers spent less than 6 months home with their first child and 6-12 months home with their second child. In the first panel, there appears to be clumping in the 0-6 month/0-6 month and 24+/24+ cells. However, there appears to be a sufficient number of observations in the off-diagonal (approximately 50%). Additionally, there does not appear to be a clear pattern from one sibling to the next, with 28% of the observations below the diagonal and 23% above it. Similar patterns also emerge in the 2nd and 3rd panels, though there are far fewer observations, as expected.

Other time investment variables of interest include the age of the child (to capture the amount of schooling received) and a dummy variable equal to one if the child was ever enrolled in head start or another preschool. The number of other children in the household under age 3 at birth reflects that time (and consumption) must be divided between siblings.

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[23] I performed robustness checks on these cutoffs points. The main findings did not vary significantly.
[24] These categories are slightly redefined to make the table easier to understand. For example, instead of the first time category being assigned as 6 or more months home, it is assigned 6-12 months home.

***B. Consumption, Quality, and Endowment Variables***

Income is an important determinant of consumption for children as it relates to food sufficiency. I construct average household (real) income levels for each child at ages 0-3 and 3-6 from all sources other than the mother, omitting maternal income since it is likely to be endogenous to her participation decision. Averaging over the years smoothes over missing observations for income, a common problem in the NLSY.[25] Since breast feeding is an extremely important component of consumption, I include dummy variables to signify if and how long a mother breast fed her child.

Commonly used measures of household quality that also might reflect the child's endowment are the education of each parent in the household. The Armed Forces Qualifying Test (AFQT) is a widely used measure of labor market skill, which could also reflect home quality and the child's endowment. Additional measures of household quality include the absence of a father or presence of grandparent at birth, who can assist in caring for the child and offer emotional support for the mother. Since parental skill may vary with age, I create dummy variables to represent if the mother was age 18 or younger at the birth of her child or 25 or older at birth. Birth order effects are a common issue that arises in sibling studies. I create a dummy variable to represent if the child was a first born.[26] For initial endowment, a dummy variable is created equal to one if the child's birth weight was less than or equal to 5.5 pounds, a widely accepted measure of low birth weight.

Table 3 displays means of the above variables by (the redefined) time categories. The most striking finding is mothers with the highest AFQT and education are the least likely to spend time at home. If these skills are correlated with home production, this would possibly support that negative selection is occurring. Not surprising, the largest households are the mostly likely to have a mother spending time home, reflecting increased child care costs. Staying home longer is

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[25] I also use the technique described by Currie and Cole (1994) for cleaning income in the NLSY.
[26] Approximately 89 percent of the final sample used consists of household with 3 children or less. Additional birth order control were added, but did not affect the results.

also positively associated with the absence of a father. This could be due to easier qualification for government support. Average income during the 1st 3 years does not appear to vary with months spent home. This is surprising given the relationship between AFQT and education and time, although many of the mothers spending this time home could be young and still living with *their* parents. The more expected pattern for income returns in years 3-6.

***C. Human Capital Measures***

There is a wide range of child assessments available in the NLSY that can represent human capital development of the child. These measures provide a wide range of potential effects of early time investments, but their precise relationship to eventual adult outcomes is not entirely clear. Currie and Thomas (1999) have found a strong link between early test scores and future labor market outcomes and educational attainment, but such measures are currently unavailable in the NLSY.

One of the most widely used measure of a child's cognitive ability is the Peabody Picture Vocabulary Test (PPVT). This test is age-normed and is intended to measure the verbal intelligence of a child. It was administered to all children over age 3, with a repeat measure taken in 1992. The Peabody Individual Achievement Test Math and Reading Recognition (PIAT-M and PIAT-R, respectively) are also widely used measures of cognitive development. Both are available as age-normed scores and were administered to all children 5 years and older and each subsequent wave if eligible.

The Behavioral Problems Index (BPI), based on maternal responses to a series of questions, is designed to reflect early behavioral issues. It is measured for all children age 4 and over and each subsequent wave if eligible, and offers scores that are normed by age and sex. The Self-Perception Profile for Children (SPPC) is a widely regarded measure of a child's self-esteem both in terms of scholastic competence (SPS) and global self-worth (SPW). It has been found to be highly correlated with teachers' ratings of the child's scholastic competence and self-esteem and is a potentially valuable indicator of psychological well-being (NLYS Handbook (1990)). It is a self-reported exam administered to all children over age 8 and each subsequent year the child was eligible. The SPPC only provides a raw score and no national norms.

Information regarding the child's performance in school, such as whether a child has repeated a grade or has been suspended from school, reflects both cognitive and non-cognitive abilities of children, such as the child's scholastic competence as well as self-esteem and behavior. This information is available for children over age 10. I create separate dummy variables if the child never repeated a grade or was never suspended from school, equal to one if true and zero otherwise.

Since multiple observations are available for the same children for some of the outcomes, I construct dependent variables by averaging over an individual's score to account for possible measurement error.[27] Figure 1 displays histograms of these outcomes, both as individual and within family scores[28], with a corresponding normal curve overlaid. The tests available with normed scores (PPVT, both PIAT, and BPI) follow closely to a normal distribution for both the individual and within family scores, with less outliers for the within family scores. The individual scores for non-normed test (SPS and SPW) appear skewed and truncated. However, the within family scores follow much more closely to a normal distribution.

One of the limitations of a sibling comparison is that outcomes available for the oldest siblings are not necessarily available for younger siblings, so we cannot compare the impact of time investments on these outcomes. Such potential measures available in the NLSY include

[27] The NLSY Handbook (1990) discourages averaging across SPPC scores, but does not provide a specific explanation. In light of this and other concerns, I also construct measures over specific age ranges, discussed in more detail in section 6.B. For PPVT scores, the standardization of raw scores changed from the 1988 to 1990 wave. Raw scores below the standardized maximum or minimum were assigned a standardized score of 0 in 1986 and 1988. After 1988, such scores were instead assigned the maximum or minimum standardized score available, respectively. I adjusted the 1986 and 1988 standardized scores based on the reported raw scores to match the post-1988 strategy.

[28] The within family score was created by subtracting the average score of all children within one family from each child's score in that same family, i.e. $Y_{ij} - \overline{Y}_j$.

receipt of public assistance, high school graduation, criminal behavior, and sexual activity, which may be better representative of children's outcomes and have stronger policy implications.[29]

## 6. Estimation

### *A. Main Results*

For each of the dependent variables the following equations are estimated. The first is a basic least squares estimate of equation (7) with controls commonly used in other studies except for maternal AFQT and education of the mother and father. The next estimate is a full LS model with AFQT and parental education. The final estimation is the fixed effect model of equation (8), where AFQT, parental education, and other time-invariant characteristics of the family are constant. The rationale for this strategy is if AFQT and parental education are good measures of quality and endowment and are correlated with time investments, then we would expect simple estimates without them to change when they are added. Then, if the FE estimates change in the same direction as from the basic to the full LS model, this would indicate that the fixed effect does a better job of controlling for quality and endowment than the full LS model. Tables 4 and 5 show the results for the estimated models for cognitive and non-cognitive outcomes, respectively.

In the basic LS model in column 1 of each panel, estimates for all time categories are often close to zero and rarely precise. It is also not uncommon to see negative results in any of the time categories. In the full LS model with better quality and endowment measures, there is a shift towards more positive estimates for nearly every time category and child outcome, though they are still imprecisely measured. This shift indicates the potential importance of quality and/or endowment, and the positive increases indicate the previously omitted variables (AFQT and education) are negatively correlated with time investments.

[29] As the sample ages, these variables will become more readily available (children are followed until age 22). However, another methodology that does not rely on siblings could offer this comparison and also add an element of robustness. I attempted two instrumental variable strategies (instrumenting for time investments): using changes in EITC legislation and child care credits designed to affect labor supply decisions and using county level measures of employment and income to reflect changes in demand for labor. First stage results from these approaches were unimpressive.

Controlling for unobserved family differences via a household fixed effect changes the estimates considerably. These results are displayed in the 3rd column of each panel. For the PIAT and PPVT scores, in Table 4, we see the positive trend from (1) to (2) continue in column (3) for time investments greater than 6 months. This suggests that negative selection is dominant and the FE approach is capturing more of the unobserved heterogeneity. The coefficient for PPVT is just insignificant, and coefficients for both PIAT scores are insignificant. For later time periods, the trend from (1) to (2) disappears as we shift to the FE strategy. Nearly every later time period is measured imprecisely.

The coefficients for grade repetition and school suspension, in the 4th panels of Tables 4 and 5, respectively, are measured imprecisely. This could be due to little variation in measures within a family. Of the 1700 or so observations used for these 2 measures, less than 33% have variation in outcomes within a family. The results for BPI, in panel 3 of Table 5, are also not precisely estimated.

The estimates for both self-perception scores, displayed in panels 1 and 2 of Table 5, are perhaps the strongest results. Strong positive effects exist from investments over 6 months, and continue in the same direction from column (1) to (2). This also supports that the fixed effect is picking up some of the unobserved heterogeneity and negative selection is prevalent. However, strong negative effects from time investments that exceed 1 year counterbalance these earlier positive effects. Time investments beyond 18 months are insignificant.

For income variables, non-maternal income during the first 3 years is significant only for PPVT and SPW in the LS specifications, but in the FE specification it falls in magnitude for every dependent variable and is never significant. This supports Bruer's contention that "enrichment" goods do not directly affect development at this age, and Currie and Bhattacharya's findings that that nutritional deficiencies of youths in the United States are generally insensitive to income in the U.S. Non-maternal income during the second 3 years is more precisely estimated, suggesting that "enrichment" goods may play an important role at this stage.

In sum, the FE approach appears to represent an improvement over LS approaches. We often see significant changes[30] from the full LS model to the FE model. For investments in the first year, we sometimes see changes in the direction of the effect from negative to positive. The changes in the FE model also tend to move in the same direction as from the basic to the full LS model. These findings indicate a negative selection is occurring: those with the better job opportunities are more likely to work despite the fact that they are the most able caregivers.

We often see positive effects from uninterrupted investments over 6 months, with larger effects for non-cognitive outcomes. For SPS and SPW, the point estimates are 0.16 and 0.34 of a standard deviation, respectively, while coefficients for PPVT and PIAT scores are less than 1/10 of a standard deviation. These findings are consistent with neuropsychological evidence which stresses an effect for non-cognitive outcomes, with cognitive outcomes potentially affected indirectly. Additional unobserved heterogeneity could also explain the lack of magnitude (and precision) in cognitive scores.[31]

As hypothesized, most time investments beyond 24 months have little affect, if any. However, a surprising result is the negative effect for time investments over 1 year for SPS and SPW. This could reflect further unobserved heterogeneity. Another possible explanation is that, as the attachment literature emphasized, the role of the caregiver changes dramatically to a more "socializing" role after the first major critical period occurs around age 1. It could be possible that a non-parental environment with other children to socialize with is more ideal than remaining in a isolated environment with a parent.

In comparing these results to previous studies, it is important to remember that time investments are measured differently and magnitudes are not possible to compare. Furthermore, most studies have only focused on short-term cognitive outcomes such as PPVT and PIAT. Most have found that time is positively related to test scores during the first year, while some have

[30] As measured by Hausman tests under the null hypothesis that the $\beta_{ls} = \beta_{fe}$, we reject the null at 5% for SPW and never repeated grade and 10% for PPVT and PIAT-Math.

[31] Potential sources of remaining unobserved heterogeneity are explained in more detail below.

found negative effects. I find small or negative effects for these scores in the LS models, but under the FE specification the negative findings disappear and the results in general become larger in magnitude. Most studies have found negative effects from investments in the second and third year, but Ruhm (2000) finds no negative effects from second and third year investments. The results found here for cognitive outcomes are consistent with Ruhm's findings.

***B. Extensions***

Time investments may impact children differentially across families. High quality families may invest time more efficiently or may place their children in better sources of alternative care. To this extent, I run FE models for families where the mother's AFQT score is less than the median score and where her score is at or above median. These results are displayed in columns 1 and 2 of each panel in Table 6.[32] While there is a tendency for families with AFQT above the median to produce larger effects for cognitive outcomes and lower effects for non-cognitive outcomes, the differences between the two groups are insignificant.

Differential impacts may also occur by gender. Biological differences in development between boys and girls may exist, parents may treat siblings of opposite sex differently based on social norms and expectations, or the test measures may include a gender bias. To get a sense of these effects, I run separate regressions by gender, shown in columns 3 and 4 of Table 6. The results indicate that cognitive skills are more likely to be affected for boys while non-cognitive skills are more likely to be affected for girls, but only significant differences exist for SPW.

An additional concern arises with respect to the creation of dependent variables when multiple scores are available. The age at which an outcome is measured is important in early childhood studies because 'sleeper effects' or 'fade-out' are often possible. Since multiple measurements are available for some of the outcomes, I construct separate measures for each

[32] Since little variation was present in the school outcomes in the full sample and this will become more of an issue in a stratified sample, I do not perform regressions for these dependent variables.

child when they are less than or equal to 10 and greater than 10.[33] The results from this approach are shown in columns 5 and 6 of Table 6. There are almost no differences in effects across the age categories. For SPS, there is a tendency for larger effects for the older category, but the difference is insignificant. This suggests that the effects from early time investments persist for children with no signs of fade-out.

The final extension considered is to include part-time investors in the measurement of time. It is possible that after a certain amount of time some employment-related separation between the infant and caregiver is acceptable. To reflect this, I adjust the time dummy variables to include mothers who averaged no more than 20 hours of work per week by using information from the NLSY work history files. The last column of each panel in Table 7 shows the results for the FE estimates. These results are not significantly different from those in Tables 4 and 5, although there is a tendency for estimates to attenuate towards zero. This tendency supports a full-time investment during the first year and that a socializing atmosphere may be more ideal for the child beyond the first year.

**7. Discussion**

The fixed effects methodology employed clearly shows the importance of controlling for unobserved heterogeneity. In order for the FE estimates to be unbiased, however, we need the error term in (8) to be uncorrelated with time investments. It is possible that there are time-varying unobserved factors specific to each child within a family that are correlated with the time investment decision of a parent.

One potential source of bias would occur if, despite controlling for the birth weight of the child and eliminating those with serious health conditions, early human capital of the siblings differ and parents make their investment decision based on this. There are two investment strategies that could lead to biases. A parent may choose to spend more time with a child with early developmental or health problems in the hopes of equalizing outcomes across siblings, that

[33] Since information for grade repetition and suspension is only available for children over age 10, I do not

is $\rho(T_{ij1}, e_{ij}) < 0$. Since these problems are likely to affect the eventual human capital of the child,[34] this will lead to a downward bias of FE estimates. On the other hand, parents may choose to invest more in the child that displays the greatest potential return $\{\rho(T_{ij1}, e_{ij}) > 0\}$ to maximize the sum of their children's human capital. This would induce an upward bias of FE estimates.[35] Previous studies have indicated that parents tend to exhibit compensatory behavior towards their children when the children are older (Behrman et. al. (1982)). If this is true for early time investments also, then a downward bias is more likely.

To get a clearer sense of the presence of this potential bias, I regress the number of months after birth the mother remained away from work on the regressors in equation (8) that are predetermined at birth. In addition, I include potential indicators of early development that come from maternal responses to a series of questions on "How my infant usually acts." Since these responses are only available for children less than 1 at the time of interview, I estimate an LS model for the entire sample where these responses are available. Table 7 includes descriptive statistics for these responses and regression results.

The results show that mothers spend more time with low birth weight children and with infants who display "fearfulness." The effects of low birthweight have been found to persist into adulthood (Currie and Hyson (1999)). There are no direct links between early displays of "fearfulness" and human capital development, but it clearly does not support an investment strategy. These two findings support that mothers are more likely to take a compensatory strategy, if any. Therefore, a sibling comparison leads to a downward bias, and the fixed effect estimates can be interpreted as lower bounds of the true effect of time investments on human capital.

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create age specific scores

[34] Currie and Hyson (1999) find that differences from initial health shocks, such as low birth weight, persist into adulthood and socio-economic status does little to alleviate this.

[35] A third option would be if parents invest equal amounts in their children. This, however, would not lead to a bias in estimation.

## 8. Conclusion

This paper set out with 3 main objectives: to improve methodological approaches to measure the effects of time investments; to consider implications from neuropsychological theory when measuring time investments; and to measure short and long-term impacts on cognitive and non-cognitive outcomes.

The estimates presented here show that it is important to take unobserved characteristics associated with maternal employment into account when assessing impacts on child outcomes. Mothers who work have children with better outcomes, but this is due to maternal unobservables rather than maternal employment per se. This group could be more informed about how to care for their child, both during and after pregnancy, or they could have a higher genetic endowment to pass onto their children. Least squares estimates which ignore these unobservables mask the negative effect of mothers spending less time with children in the first year of life.

The results are consistent with neuropsychological evidence on the development of the brain and the role of attachment. Positive effects are found for mothers investing up to one year of uninterrupted time, which corresponds with a major developmental milestone for an infant: the maturation of the orbitofrontal cortex. Stronger effects exist for non-cognitive outcomes, also a prediction from attachment theory, and there is no evidence of 'fade-out'. Negative effects are found at some point from time investments in the second year, which may be due to remaining unobserved heterogeneity. Alternatively, socializing environments, such as day care, may be better for children at this age.

The results presented here have implications for the debate over parental leave. Benefits exist from uninterrupted investments of up to one year, which is well beyond the currently allowed leave of 12 weeks under the Family and Medical Leave Act (FMLA) of 1993.

In comparison to other policies targeted at young children, the benefits from additional time investments are significant. Krueger (1999) estimates that a change in classroom size from 22 to 15 leads to a 0.22 standard deviation increase in test scores. Currie and Thomas (1995,

1999) find that Head Start, a public preschool program designed to improve the school readiness of disadvantaged children, raises the PPVT percentile scores of Hispanic and White children by 0.42 and 0.22 standard deviations, respectively, but no long-term gains exist for African-American children. I find an increase from an additional 6 month time investment in the first year of 0.16 and 0.34 standard deviations for two separate self-confidence measures.

Do non-cognitive improvements eventually turn into similar gains as cognitive improvements? While I did not find any direct links between the self-confidence measures available in the NLSY and labor market outcomes, Heckman et. al. (2000) find that non-cognitive skills may explain as much as 9 percent of the wage gap between GED recipients and high school dropouts after controlling for observable differences. Furthermore, Heckman et. al. also find there is a weak correlation between cognitive and non-cognitive skills, so we might expect an independent effect from cognitive gains on labor market outcomes as well.

The immediate costs of extending parental leave, however, are potentially larger than other policies aimed at children. Krueger estimates that the reduction in class size he considers costs $2,151 in 1996 per student per year, and it may take 4 years of class size reduction to achieve this effect. Head Start costs approximately $4,571 per child per year in 1996 (Head Start Bureau (2000)), and is available for a maximum of 2 years. To get a rough sense of the costs of staying home through the first year, I assume that all mothers are home for the first 3 months after the birth of their child as permitted under the FMLA. The average earnings for working women age 18 and over in 1996 is $20,570 (U.S. Census Bureau (1996)). An additional 9 month investment would cost an average of $15,428 in wages. Child care costs for 9 months are roughly $5,671[36] in 1996 for infants (Blank et. al. 1999). If we assume that 55.6% of employed mothers pay for child care (Currie (2000)), then the savings in child care costs would lie between $3,153

[36] This number is calculated as follows. Blank et. al. (1999) report that child care costs for 1-year olds range from $3,633 to $12,324 in specific cities across the U.S. in 1998. I use the average of $3,633 and $12,324 to come up with a rough estimate of the average costs across the U.S., deflate by the Consumer Price Index to $1996 to be consistent with the earnings measure, and multiple by ¾ to reflect an additional 9 month investment. Note that costs may be more expensive for children than less 1 year old.

and $5,671, leaving a net cost between $9,757 and $12,275.

Parental leave may have additional consequences. For example, maternity leave has been associated with lower relative wages of women (Gruber (1994), Ruhm (1998)), increases in employment for women (Ruhm (1998)), slight macroeconomic benefits (Ruhm and Teague (1997)), and decreases in child fatalities (Ruhm (2000)). Additionally, the benefits of emotional well-being extend far beyond the labor market – from marital formation to intergenerational transmission of human capital to general mental and physical health – and must not be overlooked in a more complete policy analysis.

Finally, there is still much to be learnt about early investments. We must have a better understanding of the role that educational or informational programs on caring for children can play, the effects of paternal time investments, and the effectiveness of alternative policies designed to improve the quality of non-maternal caregivers.

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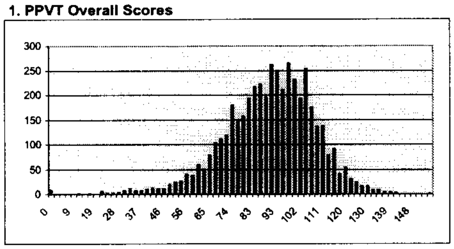
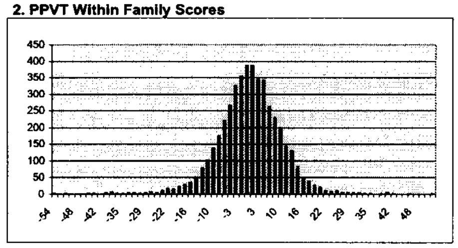
## Figure 1. Histograms of Child Outcomes

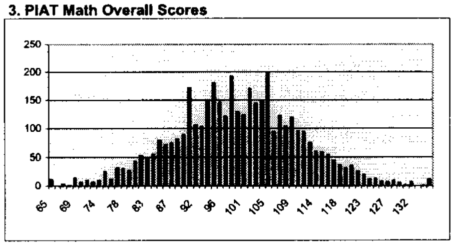
1. PPVT Overall Scores



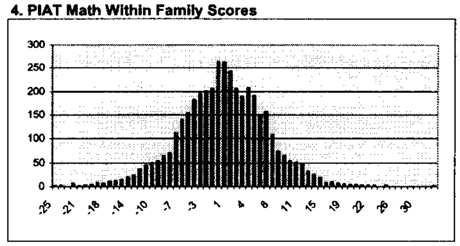

2. PPVT Within Family Scores



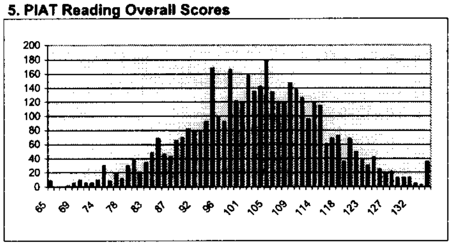

3. PIAT Math Overall Scores



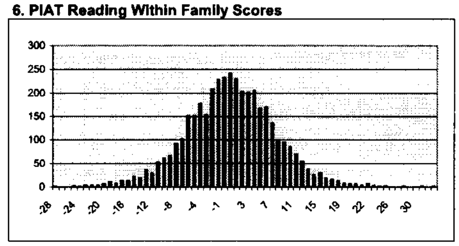

4. PIAT Math Within Family Scores



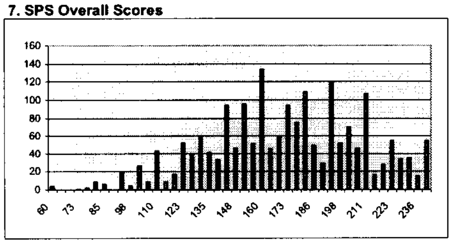

5. PIAT Reading Overall Scores



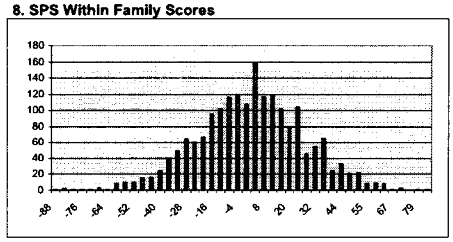

6. PIAT Reading Within Family Scores



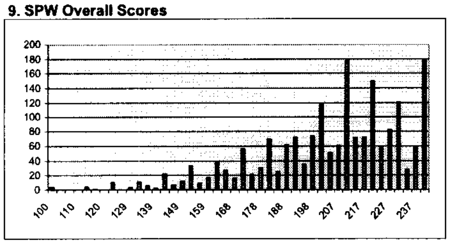

7. SPS Overall Scores



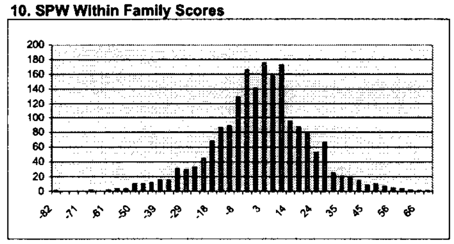

8. SPS Within Family Scores



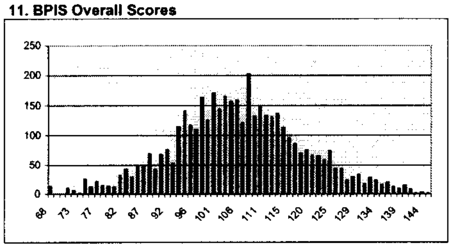

9. SPW Overall Scores



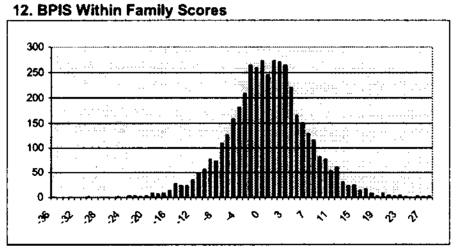

10. SPW Within Family Scores




11. BPIS Overall Scores




12. BPIS Within Family Scores



## Table 1. Summary Statistics

| Variable | Obs | Mean | Std. Dev. |
|---|---|---|---|
| ***Background Variables*** | | | |
| black | 4829 | 0.293 | 0.455 |
| hispanic | 4829 | 0.218 | 0.413 |
| male | 4829 | 0.514 | 0.500 |
| age of mother | 4829 | 35.131 | 2.213 |
| age of child | 4829 | 11.419 | 3.814 |
| number of children in household | 4829 | 3.128 | 1.188 |
| ***Time Variables*** | | | |
| weeks after birth mother remained home | 4829 | 91.374 | 128.341 |
| percent of weeks worked during year 1 | 4829 | 0.601 | 0.387 |
| percent of weeks worked during years 2 & 3 | 4829 | 0.938 | 0.176 |
| average hours worked per week year 1 | 2598 | 24.523 | 13.469 |
| average hours worked per week beyond years 2 & 3 | 3354 | 26.847 | 13.148 |
| mother stayed home at least 6 months | 4829 | 0.569 | 0.495 |
| mother stayed home at least 12 months | 4829 | 0.456 | 0.498 |
| mother stayed home at least 18 months | 4829 | 0.359 | 0.480 |
| mother stayed home at least 24 months | 4829 | 0.291 | 0.454 |
| child ever attended head start or preschool | 4829 | 0.563 | 0.496 |
| number of sibling under age 3 when born | 4829 | 0.403 | 0.553 |
| ***Consumption Variables*** | | | |
| average family income other than mother age 0-3* | 4829 | 1.915 | 6.377 |
| average family income other than mother age 3-6* | 4829 | 1.769 | 10.049 |
| child not breastfed | 4829 | 0.561 | 0.496 |
| child breastfed 0-24 weeks | 4829 | 0.301 | 0.459 |
| child breastfed 24 or more weeks | 4829 | 0.138 | 0.345 |
| ***Quality and Endowment Variables*** | | | |
| education of mother at birth | 4829 | 11.718 | 2.551 |
| education of father at birth | 4203 | 9.643 | 5.611 |
| education of father missing at birth | 4829 | 0.130 | 0.336 |
| AFQT | 4619 | 601.521 | 218.075 |
| AFQT missing | 4829 | 0.043 | 0.204 |
| father absent from household at birth | 4829 | 0.306 | 0.461 |
| grandparent present in household at birth | 4829 | 0.170 | 0.376 |
| first born | 4829 | 0.353 | 0.478 |
| birth order | 4829 | 2.027 | 1.038 |
| age of mother at birth | 4829 | 23.712 | 3.961 |
| mother <= 18 at birth | 4829 | 0.091 | 0.288 |
| mother >= 25 at birth | 4829 | 0.417 | 0.493 |
| birthweight <= 5.5 lbs. | 4829 | 0.077 | 0.267 |
| ***Dependent Variables*** | | | |
| PPVT | 4581 | 88.154 | 18.599 |
| PIAT - Mathematics | 4007 | 98.890 | 11.528 |
| PIAT - Reading Recognition | 4000 | 102.773 | 12.524 |
| Behavioral Problems Index - Same Sex (BPIS) | 4226 | 105.469 | 13.114 |
| Self-Perception - Scholastic Competence (SPS) | 1888 | 169.781 | 36.371 |
| Self-Perception - Global Worth (SPW) | 1888 | 203.344 | 27.630 |
| Never Suspended from School (SUSP) | 1781 | 0.812 | 0.390 |
| Never Repeated a Grade (RPT) | 1662 | 0.726 | 0.446 |

*Measured in 1986 $10,000.

**Table 2. Number of Mothers in Each Time Category by Sibling**

**Panel 1**

| | | 2nd sibling | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | *time spent home* | *0-6 mos* | *6-12 mos* | *12-18 mos* | *18-24 mos* | *24+ mos* | *Total* |
| s | 0-6 mos | 509 | 74 | 44 | 23 | 80 | 730 |
| t | 6-12 mos | 95 | 33 | 23 | 9 | 36 | 196 |
| | 12-18 mos | 60 | 19 | 13 | 14 | 31 | 137 |
| s | 18-24 mos | 40 | 15 | 15 | 4 | 18 | 92 |
| i | 24+ mos | 46 | 45 | 44 | 45 | 198 | 378 |
| b | Total | 750 | 186 | 139 | 95 | 363 | 1533 |

**Panel 2**

| | | 3rd sibling | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | *time spent home* | *0-6 mos* | *6-12 mos* | *12-18 mos* | *18-24 mos* | *24+ mos* | *Total* |
| n | 0-6 mos | 174 | 23 | 29 | 20 | 35 | 281 |
| d | 6-12 mos | 38 | 14 | 4 | 5 | 21 | 82 |
| | 12-18 mos | 18 | 11 | 7 | 3 | 7 | 46 |
| s | 18-24 mos | 19 | 6 | 10 | 2 | 8 | 45 |
| i | 24+ mos | 31 | 22 | 26 | 37 | 102 | 218 |
| b | Total | 280 | 76 | 76 | 67 | 173 | 672 |

**Panel 3**

| | | 4th sibling | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | *time spent home* | *0-6 mos* | *6-12 mos* | *12-18 mos* | *18-24 mos* | *24+ mos* | *Total* |
| r | 0-6 mos | 43 | 13 | 4 | 3 | 10 | 73 |
| d | 6-12 mos | 9 | 3 | 1 | 2 | 1 | 16 |
| | 12-18 mos | 4 | 3 | 1 | 2 | 4 | 14 |
| s | 18-24 mos | 8 | 2 | 7 | 3 | 0 | 20 |
| i | 24+ mos | 12 | 8 | 15 | 10 | 52 | 97 |
| b | Total | 76 | 29 | 28 | 20 | 67 | 220 |

**Table 3. Summary Statistics by Time Category**

| Variable | 0-6 mos | 6-12 mos | 12-18 mos | 18-24 mos | 24+ mos |
|---|---|---|---|---|---|
| black | 0.26 | 0.32 | 0.30 | 0.33 | 0.33 |
| | (0.44) | (0.47) | (0.46) | (0.47) | (0.47) |
| hispanic | 0.21 | 0.19 | 0.21 | 0.24 | 0.24 |
| | (0.41) | (0.39) | (0.41) | (0.43) | (0.43) |
| male | 0.51 | 0.51 | 0.53 | 0.54 | 0.52 |
| | (0.50) | (0.50) | (0.50) | (0.50) | (0.50) |
| age of child | 10.86 | 11.81 | 10.57 | 11.06 | 12.46 |
| | (3.80) | (3.90) | (4.35) | (3.76) | (3.36) |
| number of children in household | 2.91 | 3.00 | 3.25 | 3.36 | 3.41 |
| | (1.00) | (1.04) | (1.29) | (1.38) | (1.34) |
| child ever attended head start or preschool | 0.59 | 0.55 | 0.53 | 0.56 | 0.54 |
| | (0.49) | (0.50) | (0.50) | (0.50) | (0.50) |
| number of sibling under age 3 when born | 0.34 | 0.39 | 0.40 | 0.52 | 0.48 |
| | (0.51) | (0.54) | (0.57) | (0.59) | (0.59) |
| average family income other than mother age 0-3 | 1.91 | 1.66 | 2.46 | 1.88 | 1.84 |
| | (1.53) | (1.21) | (14.10) | (2.18) | (8.30) |
| average family income other than mother age 3-6 | 2.11 | 1.99 | 1.29 | 1.44 | 1.42 |
| | (13.71) | (12.94) | (1.63) | (1.43) | (1.40) |
| child not breastfed | 0.53 | 0.55 | 0.53 | 0.60 | 0.62 |
| | (0.50) | (0.50) | (0.50) | (0.49) | (0.49) |
| child breastfed 0-24 weeks | 0.34 | 0.29 | 0.28 | 0.24 | 0.27 |
| | (0.47) | (0.46) | (0.45) | (0.43) | (0.44) |
| child breastfed 24 or more weeks | 0.13 | 0.16 | 0.19 | 0.16 | 0.12 |
| | (0.34) | (0.36) | (0.39) | (0.37) | (0.32) |
| education of mother at birth | 12.43 | 11.76 | 11.54 | 11.25 | 10.81 |
| | (2.31) | (2.10) | (2.62) | (2.73) | (2.66) |
| education of father at birth | 10.42 | 9.80 | 9.36 | 9.13 | 8.46 |
| | (5.36) | (5.29) | (5.77) | (5.89) | (5.82) |
| AFQT | 665.97 | 599.23 | 588.68 | 569.81 | 516.86 |
| | (202.93) | (195.14) | (207.01) | (221.16) | (220.52) |
| father absent from household at birth | 0.23 | 0.29 | 0.33 | 0.36 | 0.41 |
| | (0.42) | (0.46) | (0.47) | (0.48) | (0.49) |
| grandparent present in household at birth | 0.15 | 0.18 | 0.16 | 0.15 | 0.21 |
| | (0.36) | (0.38) | (0.37) | (0.36) | (0.40) |
| first born | 0.38 | 0.38 | 0.33 | 0.29 | 0.33 |
| | (0.49) | (0.49) | (0.47) | (0.45) | (0.47) |
| birth order | 1.90 | 1.93 | 2.22 | 2.26 | 2.15 |
| | (0.90) | (0.97) | (1.22) | (1.14) | (1.13) |
| age of mother at birth | 24.42 | 23.03 | 24.30 | 23.89 | 22.68 |
| | (3.88) | (3.82) | (4.53) | (3.91) | (3.68) |
| mother <= 18 at birth | 0.06 | 0.11 | 0.10 | 0.09 | 0.13 |
| | (0.23) | (0.32) | (0.30) | (0.28) | (0.34) |
| mother >= 25 at birth | 0.50 | 0.33 | 0.49 | 0.44 | 0.30 |
| | (0.50) | (0.47) | (0.50) | (0.50) | (0.46) |
| birthweight <= 5.5 lbs. | 0.06 | 0.07 | 0.08 | 0.09 | 0.10 |
| | (0.24) | (0.26) | (0.28) | (0.28) | (0.30) |
| Number of Observations | 2081 | 547 | 465 | 332 | 1404 |

Note: Standard deviations in parenthesis

## Table 4. Regression Results for Cognitive Outcomes

| | Panel 1: PPVT | | | Panel 2: PIAT - Math | | | Panel 3: PIAT - Reading | | | Panel 4: Never repeated grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LS | LS | FE | LS | LS | FE | LS | LS | FE | LS | LS | FE |
| 6+ mos. home | -0.592 | 0.768 | 1.233 | -0.970 | -0.139 | 0.549 | -0.770 | 0.188 | 0.523 | -0.033 | -0.016 | 0.045 |
| | (0.753) | (0.703) | (0.766) | (0.568)* | (0.535) | (0.643) | (0.590) | (0.561) | (0.657) | (0.034) | (0.033) | (0.044) |
| 12+ mos. home | -0.966 | -0.325 | -0.793 | -0.053 | 0.351 | 0.063 | 0.503 | 0.903 | 0.916 | 0.034 | 0.034 | -0.022 |
| | (1.021) | (0.961) | (1.009) | (0.774) | (0.727) | (0.843) | (0.805) | (0.769) | (0.855) | (0.046) | (0.045) | (0.055) |
| 18+ mos. home | 0.669 | 0.902 | 0.866 | -0.599 | -0.421 | -0.234 | -1.419 | -1.182 | -1.571 | -0.130 | -0.116 | -0.136 |
| | (1.200) | (1.138) | (1.176) | (0.910) | (0.853) | (0.956) | (0.971) | (0.907) | (0.934)* | (0.056)** | (0.055)** | (0.068)** |
| 24+ mos. home | -2.398 | -1.347 | -1.066 | -0.439 | 0.185 | 0.489 | -0.850 | -0.146 | 0.438 | 0.016 | 0.031 | 0.026 |
| | (1.021)** | (0.963) | (1.057) | (0.760) | (0.714) | (0.837) | (0.825) | (0.763) | (0.851) | (0.048) | (0.047) | (0.058) |
| average non-maternal | 0.110 | 0.063 | 0.015 | 0.044 | 0.016 | 0.012 | 0.046 | 0.016 | 0.001 | 0.031 | 0.013 | 0.002 |
| income 0-3 | (0.052)** | (0.023)*** | (0.014) | (0.033) | (0.014) | (0.014) | (0.033) | (0.020) | (0.019) | (0.008)*** | (0.009) | (0.018) |
| average non-maternal | 0.045 | 0.038 | -0.006 | 0.046 | 0.038 | 0.041 | 0.047 | 0.038 | 0.010 | 0.001 | 0.001 | -0.000 |
| income 3-6 | (0.022)** | (0.017)** | (0.019) | (0.021)** | (0.010)*** | (0.022)* | (0.031) | (0.020)* | (0.021) | (0.000)*** | (0.000)** | (0.000) |
| male | 0.144 | 0.039 | -0.165 | 0.284 | 0.183 | 0.331 | -2.861 | -2.972 | -2.652 | -0.110 | -0.114 | -0.086 |
| | (0.459) | (0.433) | (0.435) | (0.336) | (0.317) | (0.358) | (0.372)*** | (0.350)*** | (0.378)*** | (0.021)*** | (0.020)*** | (0.022)*** |
| age of child | 0.695 | 0.626 | 0.674 | 0.197 | 0.108 | 0.094 | -0.103 | -0.202 | -0.237 | -0.034 | -0.033 | -0.035 |
| | (0.093)*** | (0.090)*** | (0.127)*** | (0.080)** | (0.077) | (0.111) | (0.090) | (0.086)** | (0.125)* | (0.006)*** | (0.006)*** | (0.009)*** |
| birthweight <= 5.5 lbs. | -1.108 | -0.794 | 0.528 | -1.585 | -1.477 | -0.585 | -2.280 | -2.154 | -0.763 | -0.072 | -0.072 | -0.044 |
| | (0.925) | (0.873) | (1.002) | (0.628)** | (0.599)** | (0.829) | (0.721)*** | (0.681)*** | (0.869) | (0.041)* | (0.040)* | (0.051) |
| child breastfed 0-24 | 3.246 | 1.081 | -1.051 | 1.435 | 0.089 | -0.743 | 1.311 | -0.185 | -1.000 | -0.011 | -0.033 | -0.027 |
| weeks | (0.547)*** | (0.526)** | (0.806) | (0.403)*** | (0.377) | (0.626) | (0.440)*** | (0.417) | (0.714) | (0.025) | (0.024) | (0.043) |
| child breastfed >= 24 | 6.536 | 2.686 | -1.655 | 3.182 | 0.658 | -1.181 | 3.415 | 0.648 | -0.650 | 0.059 | 0.021 | 0.063 |
| weeks | (0.733)*** | (0.691)*** | (1.066) | (0.557)*** | (0.527) | (0.849) | (0.598)*** | (0.563) | (1.005) | (0.030)* | (0.030) | (0.066) |
| attend head start or | 1.157 | 0.348 | 0.872 | 0.836 | 0.185 | 0.190 | 0.966 | 0.244 | 0.249 | -0.015 | -0.033 | 0.015 |
| preschool | (0.490)** | (0.462) | (0.576) | (0.351)** | (0.334) | (0.501) | (0.390)** | (0.368) | (0.526) | (0.021) | (0.021) | (0.034) |
| number of sibling <=3 | -1.086 | -1.398 | -0.429 | 0.301 | 0.096 | 0.115 | 0.111 | -0.080 | 0.164 | -0.040 | -0.038 | -0.038 |
| when born | (0.546)** | (0.508)*** | (0.570) | (0.386) | (0.360) | (0.452) | (0.433) | (0.408) | (0.490) | (0.024)* | (0.023) | (0.031) |
| first born | 4.814 | 3.180 | 2.199 | 2.332 | 1.436 | 0.285 | 4.480 | 3.514 | 2.327 | 0.042 | 0.022 | -0.017 |
| | (0.644)*** | (0.620)*** | (0.668)*** | (0.471)*** | (0.453)*** | (0.540) | (0.531)*** | (0.513)*** | (0.610)*** | (0.033) | (0.032) | (0.043) |
| mother <= 18 at | -1.505 | 0.760 | - | -2.231 | -0.975 | - | -2.154 | -0.793 | - | -0.111 | -0.076 | - |
| birth | (0.875)* | (0.833) | - | (0.572)*** | (0.568)* | - | (0.668)*** | (0.660) | - | (0.035)*** | (0.035)** | - |
| mother >= 25 at | 2.749 | 0.134 | - | 2.301 | 0.639 | - | 2.511 | 0.743 | - | -0.003 | -0.024 | - |
| birth | (0.586)*** | (0.564) | - | (0.443)*** | (0.431) | - | (0.481)*** | (0.467) | - | (0.028) | (0.029) | - |
| father absent at | -3.731 | 2.908 | - | -1.485 | 3.658 | - | -1.970 | 3.148 | - | -0.089 | -0.078 | - |
| birth | (0.621)*** | (1.139)** | - | (0.448)*** | (0.816)*** | - | (0.496)*** | (0.905)*** | - | (0.030)*** | (0.059) | - |
| grandparent present | -1.899 | -1.706 | - | -1.230 | -1.061 | - | -1.688 | -1.477 | - | 0.012 | 0.015 | - |
| at birth | (0.710)*** | (0.669)** | - | (0.475)*** | (0.451)** | - | (0.551)*** | (0.518)*** | - | (0.032) | (0.031) | - |
| black | -14.130 | -9.747 | - | -5.722 | -2.417 | - | -2.338 | 1.416 | - | -0.052 | -0.007 | - |
| | (0.618)*** | (0.658)*** | - | (0.473)*** | (0.501)*** | - | (0.521)*** | (0.536)*** | - | (0.029)* | (0.030) | - |
| hispanic | -14.542 | -8.993 | - | -5.756 | -1.870 | - | -3.722 | 0.593 | - | -0.076 | 0.001 | - |
| | (0.692)*** | (0.689)*** | - | (0.439)*** | (0.454)*** | - | (0.489)*** | (0.489) | - | (0.028)*** | (0.029) | - |
| AFQT | - | 0.026 | - | - | 0.019 | - | - | 0.021 | - | - | 0.000 | - |
| | - | (0.002)*** | - | - | (0.001)*** | - | - | (0.001)*** | - | - | (0.000)*** | - |
| education of mother | - | 0.516 | - | - | 0.121 | - | - | 0.133 | - | - | 0.011 | - |
| at birth | - | (0.137)*** | - | - | (0.093) | - | - | (0.102) | - | - | (0.006)* | - |
| education of father | - | 0.374 | - | - | 0.349 | - | - | 0.320 | - | - | -0.001 | - |
| at birth | - | (0.088)*** | - | - | (0.065)*** | - | - | (0.071)*** | - | - | (0.005) | - |
| Sample size | 4581 | | | 4007 | | | 4000 | | | 1662 | | |
| Number of groups | - | - | 1905 | - | - | 1681 | - | - | 1677 | - | - | 745 |
| R-squared | 0.30 | 0.39 | 0.78 | 0.17 | 0.26 | 0.67 | 0.14 | 0.24 | 0.68 | 0.14 | 0.17 | 0.64 |
| Adj R-squared | 0.30 | 0.38 | 0.62 | 0.16 | 0.26 | 0.43 | 0.13 | 0.23 | 0.45 | 0.13 | 0.15 | 0.35 |

Note: Robust standard errors in parentheses. OLS regressions include controls for missing values of family characterisitcs. All regressions include constant
*significant at 10%; ** significant at 5% level; *** significant at 1% level

## Table 5. Regressions Results for Noncognitive Outcomes

| | Panel 1: SPS | | | Panel 2: SPW | | | Panel 3: BPIS | | | Panel 4: Never suspended | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LS | LS | FE | LS | LS | FE | LS | LS | FE | LS | LS | FE |
| 6+ mos. home | 2.581 | 3.632 | 5.861 | 4.038 | 4.443 | 9.463 | 0.749 | 0.443 | 0.573 | -0.020 | -0.021 | -0.027 |
| | (2.661) | (2.609) | (3.601) | (2.014)** | (2.010)** | (2.797)*** | (0.647) | (0.645) | (0.614) | (0.030) | (0.030) | (0.037) |
| 12+ mos. home | -4.452 | -4.468 | -8.373 | -2.119 | -2.002 | -8.009 | -1.089 | -1.434 | -0.951 | 0.026 | 0.026 | 0.062 |
| | (3.967) | (3.904) | (4.835)* | (2.903) | (2.883) | (3.627)** | (0.906) | (0.899) | (0.813) | (0.043) | (0.043) | (0.051) |
| 18+ mos. home | 2.949 | 3.781 | 4.508 | -0.892 | -0.678 | 1.569 | 0.373 | 0.334 | 0.345 | 0.038 | 0.038 | 0.035 |
| | (4.882) | (4.813) | (5.461) | (3.435) | (3.431) | (4.275) | (1.033) | (1.027) | (0.867) | (0.049) | (0.049) | (0.065) |
| 24+ mos. home | -1.343 | -0.137 | -0.198 | -1.287 | -1.047 | -2.635 | -0.078 | -0.255 | 0.334 | -0.020 | -0.018 | -0.030 |
| | (3.925) | (3.887) | (4.718) | (2.708) | (2.720) | (3.812) | (0.843) | (0.841) | (0.724) | (0.038) | (0.038) | (0.055) |
| average non-maternal | 0.907 | -0.470 | -0.795 | 1.110 | 0.572 | -0.985 | -0.025 | -0.010 | 0.013 | 0.008 | 0.008 | -0.006 |
| income 0-3 | (0.765) | (0.789) | (1.660) | (0.624)* | (0.638) | (1.315) | (0.034) | (0.027) | (0.016) | (0.007) | (0.008) | (0.017) |
| average non-maternal | 0.068 | 0.050 | 0.139 | 0.080 | 0.072 | 0.078 | -0.014 | -0.012 | 0.012 | 0.001 | 0.001 | 0.000 |
| income 3-6 | (0.068) | (0.070) | (0.046)*** | (0.019)*** | (0.021)*** | (0.016)*** | (0.014) | (0.012) | (0.009) | (0.000)*** | (0.000)*** | (0.000) |
| male | -1.649 | -1.910 | -2.944 | 2.477 | 2.470 | 3.162 | -0.526 | -0.497 | 0.349 | -0.124 | -0.124 | -0.104 |
| | (1.659) | (1.640) | (2.017) | (1.265)* | (1.258)** | (1.621)* | (0.403) | (0.400) | (0.349) | (0.017)*** | (0.017)*** | (0.021)*** |
| age of child | -0.708 | -0.832 | -1.287 | 0.208 | 0.154 | 0.169 | 0.317 | 0.316 | 0.857 | -0.048 | -0.048 | -0.063 |
| | (0.508) | (0.511) | (0.692)* | (0.392) | (0.391) | (0.513) | (0.088)*** | (0.088)*** | (0.093)*** | (0.008)*** | (0.008)*** | (0.010)*** |
| birthweight <= 5.5 lbs. | -2.782 | -3.287 | 1.395 | 0.111 | -0.219 | -2.994 | 0.774 | 0.719 | -0.396 | -0.011 | -0.010 | -0.034 |
| | (3.063) | (3.025) | (4.293) | (2.228) | (2.230) | (3.410) | (0.732) | (0.728) | (0.825) | (0.035) | (0.035) | (0.045) |
| child breastfed 0-24 | 2.971 | 1.269 | 1.795 | 1.239 | 0.487 | 1.601 | -0.215 | 0.369 | -0.638 | -0.013 | -0.013 | 0.048 |
| weeks | (2.036) | (2.022) | (3.682) | (1.554) | (1.560) | (2.730) | (0.468) | (0.469) | (0.550) | (0.020) | (0.020) | (0.040) |
| child breastfed >= 24 | 5.867 | 3.037 | -2.256 | 0.978 | -0.429 | -1.203 | -1.681 | -0.545 | -0.473 | 0.006 | 0.007 | 0.034 |
| weeks | (2.725)** | (2.728) | (5.383) | (2.090) | (2.115) | (4.259) | (0.634)*** | (0.644) | (0.817) | (0.027) | (0.028) | (0.051) |
| attend head start or | 0.127 | -1.133 | 0.387 | 1.911 | 1.293 | 1.314 | 0.403 | 0.694 | 0.858 | -0.016 | -0.015 | -0.053 |
| preschool | (1.669) | (1.664) | (2.901) | (1.339) | (1.339) | (2.224) | (0.406) | (0.405)* | (0.430)** | (0.018) | (0.018) | (0.030)* |
| number of sibling <=3 | -2.184 | -1.804 | -5.182 | -3.126 | -2.966 | -5.224 | 0.034 | 0.204 | 0.530 | -0.045 | -0.046 | -0.017 |
| when born | (1.974) | (1.987) | (2.524)** | (1.491)** | (1.484)** | (1.872)*** | (0.444) | (0.440) | (0.423) | (0.021)** | (0.021)** | (0.026) |
| first born | 7.224 | 6.435 | 2.081 | 0.852 | 0.615 | -3.486 | -0.998 | -0.446 | -0.264 | 0.009 | 0.008 | 0.016 |
| | (2.502)*** | (2.512)** | (2.947) | (1.918) | (1.911) | (2.175) | (0.558)* | (0.559) | (0.518) | (0.026) | (0.027) | (0.028) |
| mother <= 18 at | -3.332 | -1.215 | - | -6.679 | -5.671 | - | 0.671 | -0.177 | - | -0.066 | -0.068 | - |
| birth | (2.465) | (2.550) | - | (1.867)*** | (1.915)*** | - | (0.678) | (0.696) | - | (0.031)** | (0.032)** | - |
| mother >= 25 at | 7.063 | 5.445 | - | 2.252 | 1.713 | - | -3.452 | -2.548 | - | -0.025 | -0.024 | - |
| birth | (2.666)*** | (2.680)** | - | (2.087) | (2.089) | - | (0.547)*** | (0.553)*** | - | (0.024) | (0.024) | - |
| father absent at | -0.349 | 6.318 | - | -0.293 | 4.922 | - | 2.924 | -0.600 | - | -0.143 | -0.113 | - |
| birth | (2.274) | (4.264) | - | (1.826) | (3.364) | - | (0.513)*** | (0.934) | - | (0.026)*** | (0.049)** | - |
| grandparent present | -0.214 | 0.118 | - | 2.262 | 2.464 | - | -0.715 | -0.703 | - | 0.042 | 0.042 | - |
| at birth | (2.314) | (2.277) | - | (1.809) | (1.806) | - | (0.570) | (0.568) | - | (0.028) | (0.028) | - |
| black | 2.520 | 6.094 | - | -1.712 | -0.703 | - | 0.247 | -0.531 | - | -0.140 | -0.139 | - |
| | (2.331) | (2.431)** | - | (1.866) | (1.956) | - | (0.542) | (0.588) | - | (0.026)*** | (0.027)*** | - |
| hispanic | -10.635 | -4.507 | - | -4.675 | -2.101 | - | -0.255 | -1.785 | - | -0.009 | -0.013 | - |
| | (2.212)*** | (2.386)* | - | (1.733)*** | (1.858) | - | (0.516) | (0.554)*** | - | (0.021) | (0.023) | - |
| AFQT | - | 0.033 | - | - | 0.010 | - | - | -0.005 | - | - | -0.000 | - |
| | - | (0.005)*** | - | - | (0.004)** | - | - | (0.001)*** | - | - | (0.000) | - |
| education of mother | - | 0.096 | - | - | 0.031 | - | - | -0.243 | - | - | -0.001 | - |
| at birth | - | (0.470) | - | - | (0.337) | - | - | (0.106)** | - | - | (0.005) | - |
| education of father | - | 0.585 | - | - | 0.563 | - | - | -0.312 | - | - | 0.002 | - |
| at birth | - | (0.346)* | - | - | (0.268)** | - | - | (0.073)*** | - | - | (0.004) | - |
| Sample size | 1888 | | | 1888 | | | 4226 | | | 1781 | | |
| Number of groups | - | - | 837 | - | - | 837 | - | - | 1765 | - | - | 790 |
| R-squared | 0.05 | 0.07 | 0.55 | 0.03 | 0.04 | 0.53 | 0.06 | 0.07 | 0.76 | 0.14 | 0.14 | 0.61 |
| Adj R-squared | 0.04 | 0.06 | 0.18 | 0.02 | 0.03 | 0.15 | 0.05 | 0.07 | 0.58 | 0.13 | 0.12 | 0.29 |

Note: Robust standard errors in parentheses. OLS regressions include controls for missing values of family characterisitcs. All regressions include constant
*significant at 10%; ** significant at 5% level; *** significant at 1% level

## Table 6. Extended Regressions Results

**Panel 1: PPVT**

| | AFQT < median | AFQT >= median | males | females | age<=10 | age>10 | Including part-time |
|---|---|---|---|---|---|---|---|
| 6+ mos. home | 0.271 | 2.214 | 2.858 | 0.605 | 1.499 | 1.465 | 0.674 |
| | (1.164) | (1.008)** | (1.330)** | (1.527) | (0.857)* | (1.197) | (0.736) |
| 12+ mos. home | -0.746 | -1.017 | -2.744 | -0.210 | -0.926 | -1.517 | -0.126 |
| | (1.519) | (1.301) | (1.890) | (1.893) | (1.118) | (1.648) | (0.966) |
| 18+ mos. home | 0.972 | 0.693 | 2.926 | 0.830 | 1.132 | 1.842 | -0.187 |
| | (1.664) | (1.664) | (2.316) | (2.064) | (1.298) | (2.006) | (1.011) |
| 24+ mos. home | -0.732 | -1.346 | -0.754 | -1.608 | -1.742 | -1.335 | -0.227 |
| | (1.396) | (1.616) | (2.186) | (1.860) | (1.196) | (1.794) | (0.881) |
| Sample size | 2263 | 2318 | 1325 | 1455 | 4523 | 1652 | 4581 |
| Number of groups | 912 | 993 | 599 | 663 | 1889 | 731 | 1905 |

**Panel 2: PIAT - Math**

| | AFQT < median | AFQT >= median | males | females | age<=10 | age>10 | Including part-time |
|---|---|---|---|---|---|---|---|
| 6+ mos. home | 0.467 | 0.658 | 1.647 | 0.720 | 0.501 | 0.217 | 0.056 |
| | (0.969) | (0.860) | (1.143) | (1.190) | (0.678) | (1.041) | (0.659) |
| 12+ mos. home | -1.650 | 1.170 | -0.225 | -0.476 | 0.314 | -0.421 | 1.078 |
| | (1.212) | (1.187) | (1.594) | (1.614) | (0.879) | (1.384) | (0.795) |
| 18+ mos. home | 1.248 | -1.792 | -1.881 | -0.478 | -0.198 | 1.170 | -1.589 |
| | (1.255) | (1.500) | (2.010) | (1.692) | (0.989) | (1.619) | (0.807)** |
| 24+ mos. home | -0.119 | 1.968 | 2.041 | -0.268 | 0.303 | -0.955 | 1.244 |
| | (1.034) | (1.405) | (1.720) | (1.452) | (0.884) | (1.398) | (0.711)* |
| Sample size | 1979 | 2028 | 1167 | 1263 | 3946 | 1690 | 4007 |
| Number of groups | 808 | 873 | 529 | 581 | 1660 | 748 | 1681 |

**Panel 3: PIAT - Reading**

| | AFQT < median | AFQT >= median | males | females | age<=10 | age>10 | Including part-time |
|---|---|---|---|---|---|---|---|
| 6+ mos. home | -0.117 | 1.096 | 1.341 | 0.880 | 0.314 | 0.073 | 0.818 |
| | (1.042) | (0.835) | (1.175) | (1.298) | (0.665) | (1.152) | (0.673) |
| 12+ mos. home | 0.281 | 1.160 | -1.109 | 0.549 | 0.892 | -0.187 | 0.148 |
| | (1.314) | (1.110) | (1.491) | (1.765) | (0.870) | (1.547) | (0.824) |
| 18+ mos. home | -0.965 | -2.067 | -1.780 | -0.068 | -1.159 | 1.062 | -1.096 |
| | (1.333) | (1.319) | (1.956) | (1.706) | (0.950) | (1.732) | (0.814) |
| 24+ mos. home | 0.198 | 1.096 | 2.254 | -2.338 | 0.403 | -1.065 | 0.280 |
| | (1.139) | (1.278) | (1.865) | (1.486) | (0.877) | (1.386) | (0.733) |
| Sample size | 1976 | 2024 | 1167 | 1261 | 3933 | 1684 | 4000 |
| Number of groups | 806 | 871 | 529 | 580 | 1653 | 745 | 1677 |

**Panel 4: SPS**

| | AFQT < median | AFQT >= median | males | females | age<=10 | age>10 | Including part-time |
|---|---|---|---|---|---|---|---|
| 6+ mos. home | 7.721 | 4.808 | -1.976 | 12.297 | 2.288 | 9.693 | 2.435 |
| | (5.640) | (4.722) | (6.716) | (7.337)* | (4.447) | (4.686)** | (3.619) |
| 12+ mos. home | 1.475 | -15.431 | -22.081 | -7.708 | -5.367 | -19.358 | -4.215 |
| | (7.892) | (6.093)** | (8.785)** | (9.266) | (5.895) | (6.268)*** | (4.594) |
| 18+ mos. home | -6.350 | 11.790 | 33.672 | 2.856 | 4.921 | 12.908 | 0.344 |
| | (8.325) | (7.286) | (11.216)*** | (9.379) | (7.090) | (7.079)* | (4.716) |
| 24+ mos. home | -1.520 | 0.702 | -14.471 | -4.022 | 3.241 | -0.963 | 1.062 |
| | (6.741) | (6.671) | (10.218) | (8.014) | (6.042) | (6.033) | (3.886) |
| Sample size | 941 | 947 | 546 | 547 | 1641 | 1102 | 1888 |
| Number of groups | 405 | 432 | 253 | 261 | 732 | 499 | 837 |

**Panel 5: SPW**

| | AFQT < median | AFQT >= median | males | females | age<=10 | age>10 | Including part-time |
|---|---|---|---|---|---|---|---|
| 6+ mos. home | 12.270 | 8.159 | 1.820 | 20.112 | 4.888 | 4.692 | 4.112 |
| | (4.370)*** | (3.657)** | (5.112) | (5.169)*** | (3.652) | (3.420) | (2.921) |
| 12+ mos. home | -8.900 | -7.623 | -13.471 | -21.822 | -6.129 | -9.823 | -4.526 |
| | (6.503) | (4.282)* | (7.007)* | (5.880)*** | (4.736) | (4.323)** | (3.587) |
| 18+ mos. home | 3.027 | -1.423 | 8.474 | 7.435 | 8.853 | -0.344 | 1.086 |
| | (6.506) | (5.922) | (7.632) | (6.174) | (5.346)* | (5.207) | (3.756) |
| 24+ mos. home | -9.885 | 7.038 | -3.855 | -0.928 | -7.347 | 5.061 | -2.223 |
| | (5.072)* | (5.767) | (6.703) | (6.110) | (4.820) | (5.163) | (3.295) |
| Sample size | 941 | 947 | 546 | 547 | 1641 | 1102 | 1888 |
| Number of groups | 405 | 432 | 253 | 261 | 732 | 499 | 837 |

**Panel 6: BPIS**

| | AFQT < median | AFQT >= median | males | females | age<=10 | age>10 | Including part-time |
|---|---|---|---|---|---|---|---|
| 6+ mos. home | 0.029 | 1.102 | -0.384 | 0.857 | 1.043 | -0.294 | 0.295 |
| | (0.866) | (0.873) | (0.958) | (1.329) | (0.662) | (1.262) | (0.594) |
| 12+ mos. home | -1.411 | -0.642 | 0.836 | 0.383 | -1.341 | 0.055 | -0.902 |
| | (1.183) | (1.122) | (1.486) | (1.594) | (0.899) | (1.579) | (0.764) |
| 18+ mos. home | 0.342 | 0.475 | -1.948 | -0.908 | 0.702 | -1.185 | 0.583 |
| | (1.206) | (1.246) | (1.568) | (1.678) | (0.972) | (1.966) | (0.768) |
| 24+ mos. home | 0.972 | -0.386 | 0.827 | 2.130 | 0.255 | 1.268 | 0.465 |
| | (0.945) | (1.137) | (1.217) | (1.380) | (0.797) | (1.709) | (0.630) |
| Sample size | 2096 | 2130 | 1329 | 1232 | 4185 | 1410 | 4226 |
| Number of groups | 852 | 913 | 599 | 568 | 1751 | 636 | 1765 |

Note: Robust standard errors in parentheses. All specifications are FE as in columns (3) in tables 4 and 5
*significant at 10%; ** significant at 5% level; *** significant at 1% level

**Table 7. Responses to "How my infant ususally acts" and Time Regression Results**

| Variable | Obs | Mean | Std. Dev. |
|---|---|---|---|
| activity | 2199 | 8.671 | 3.261 |
| predictibility | 2195 | 12.633 | 2.410 |
| fearfuness | 2360 | 7.880 | 3.513 |
| positive affect | 2403 | 12.288 | 2.990 |
| friendliness | 2422 | 15.663 | 2.616 |

| | Months home after birth of child |
|---|---|
| male | 0.252 |
| | (0.31) |
| birthweight <= 5.5 lbs. | 2.870 |
| | (1.63) |
| first born | -2.836 |
| | (2.95)*** |
| mother >= 25 at birth | 0.270 |
| | (0.16) |
| father absent at birth | 6.505 |
| | (3.02)*** |
| grandparent present at birth | -1.739 |
| | (1.01) |
| age of mother at birth | -1.079 |
| | (8.85)*** |
| number of sibling <=3 at birth | 3.299 |
| | (3.06)*** |
| activity | -0.133 |
| | (1.02) |
| predictability | 0.044 |
| | (0.23) |
| fearfulness | 0.260 |
| | (1.95)* |
| positive affect | -0.118 |
| | (0.76) |
| friendliness | -0.116 |
| | (0.60) |
| black | -2.248 |
| | (1.96)* |
| hispanic | -0.133 |
| | (0.11) |
| AFQT | -0.010 |
| | (3.29)*** |
| education of mother at birth | -0.695 |
| | (3.09)*** |
| education of father at birth | 0.361 |
| | (2.41)** |
| Observations | 1884 |
| R-squared | 0.14 |

Note: Absolute value of t-statistics in parentheses
Regressions include a constant
*significant at 10%; ** significant at 5% level; *** significant at 1% level