

Family Influences on Children's Verbal Ability*

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Abstract

Using the 1958 British Birth Cohort dataset and its supplemental survey of biological children, the Children of the National Child Development Study, this paper investigates the influence of family attributes and behaviors on children's verbal ability measured by the Peabody Picture Vocabulary Test (PPVT). The hypothesis is that the child's PPVT score is positively associated with the family's resources – parent's education level, parent's own ability, family income – and is associated as well with other family characteristics including employment, religious participation, and number of siblings, as well as grandparent's socioeconomic status a generation earlier. The paper hypothesizes, additionally, that the family's "culture" that reflects the parent's willingness to invest in their children and their resolve to give nurturance and support to their children differs across families, is correlated across generations within the family, and has influence on the child's PPVT score. The empirical evidence confirms a strong positive association of family resources with the PPVT, and using several proxy variables for family culture, also shows that the behavior of the mother toward her child in utero and in infancy has strong association with the child's later PPVT test score, and also that the childrearing behaviors of the grandparents a generation earlier have influence on the grandchild's test score. The mother's behaviors include her smoking and drinking during the pregnancy and breastfeeding her child, the grandparent's behaviors a generation earlier (with the child's parent) includes breastfeeding, reading to the child, and the grandmother and grandfather's engagement in the schooling of their child, the tested child's parent. The evidence is interpreted as offering support of the notion of family culture and its influence on the child's cognitive development.

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Both biology and culture are transmitted from parents to children, one encoded in DNA and the other in a family's culture. Much less is known about the transmission of cultural attributes than of biological ones.

Becker and Tomes 1986

INTRODUCTION

Much attention is paid to understanding the determinants of children's cognitive capacities and acquired skills. This seems appropriate since the products from these skills will influence the successes of society in the decades ahead. There are many strands of literature that address the topic and contribute to our understanding of how children develop their skills. Employing the perspective of economics and empirically focusing on the child's vocabulary test score, this paper documents the considerable influence of the family's resources on their children's test score. It also introduces an additional factor, conceptualized as the family's willingness or inclination to expend resources on their children, and called family "culture." The nested hypothesis is that this willingness differs across families, persists across generations within a family, and influences children's measured cognitive ability. The data used in the paper, the British dataset known as the Children of the National Child Development Study, has measures of both parental behaviors with the tested child and also grandparental behaviors with the child's parent as a child a generation earlier. As proxy variables for family culture, two discretionary parental behaviors and four discretionary grandparental behaviors are used. The empirical model shows their association with the child's measured vocabulary test score.

BACKGROUND

In modern society, there is no good case to be made that any child might be better off without the skills of reading, of oral communication that requires substantial vocabulary, or the basic mathematical skills of arithmetic. I will assume, therefore, that all parents wish to encourage in their children a good vocabulary and good reading and math skills among other attributes. We know children differ dramatically in their abilities and their achievements. There is a vast literature from many disciplines that investigates the determinants of these skills. Studies in developmental psychology look at processes and the practices in which parents engage that are associated with successful "outcome" measures. Studies in social demography identify associations between family characteristics or structures and children's test scores. Studies in economics emphasize the family resources and relative prices that create incentives for families to make investments in their children's cognitive and social-emotional skills. Some emphasize the critical role of genetic endowments; others focus on the importance of the community and racial/ethnic or religious cultures to which the child is exposed.

This paper contributes to the literature that emphasizes the role of family resources as a central factor influencing the development of children's measured skills. The prior literature identifies three broad domains of resources: the parent's education, the family's income level, and the family structure. Evidence of the relationship between parent's education and their children's measured ability or cognitive achievement is quite strong and is found in many data

sets and reported in practically every analytic perspective. To cite but one example, Smith, Brooks-Gunn & Klebanov (1997) show strong associations between parent's education level and several measures of children's ability using two distinct data sources.

A second family characteristic that influences the child in many ways including test scores is its level of income. Here, however, the evidence of influence is more complex and deserves a longer description. Extreme income deprivation or poverty has been shown to have severe effect on the nutrition and health of the child, and this in turn adversely affects the child's capacity and eagerness to learn. Two excellent collections of studies on this topic are found in Huston, McLoyd & Coll (1994) and Duncan & Brooks-Gunn (1997), the latter concluding: "Children raised in low-income families score lower than children from more affluent families do on assessments of health, cognitive development, school achievement and emotional well-being." (Brooks-Gunn, Duncan & Maritato, 1997, p.1) Income differences well above poverty also impact children's cognitive test scores. Studies use various cognitive tests and report strong relationships with family income, some showing a linear effect across wide ranges of incomes, others finding stronger effects at lower levels of income (see, i.e., Duncan, Brooks-Gunn & Klebanov, 1994; Peters & Mullis, 1997; Smith, Brooks-Gunn & Klebanov, 1997). (Also see Hobcraft (1998) who documents for Britain the persistent effects of a different framing of income and resources, "social exclusion," during childhood on subsequent adult behaviors.)

Mayer (2002) provides a comprehensive review of the impact of income on children's outcomes in the domains of cognition, health, and later labor market behaviors. Regarding cognitive test scores she notes that many studies that show sizable effects of family income when not controlled for other parental characteristics, do not show that effect when the parent's education or own test scores or family structure are controlled. Mirroring that point, McCulloch & Joshi (2002) look at the effects of family income on the child's vocabulary test score, the Peabody Picture Vocabulary Test (PPVT), using the same dataset as is used below. They measure income by quintile dummy variables and show strong income effects on PPVT scores controlling for only the child's age and gender. But they show that these income effects decline in significance as mother's education and aspects of the home environment are included in the statistical models. Clearly family income is important for children's cognitive development. It is also clear, however, that when the things income can provide or the personal parental attributes that typically generate income are statistically controlled, money itself is not found to be the critical ingredient. This distinction is important in social policy, since handing a family the money without those parental attributes will not have the same impact as it has in comparisons across families with both the money and the accompanying characteristics. This distinction is also important for the research strategy adopted in this paper, as will become clear below.

There is far less consistency in the evidence on the influence of family structure on children's test scores. Families with only one adult have less parenting capacity and face greater stress in childrearing, so one might expect to find a negative effect of single-parenthood. Similarly, families that have experienced turmoil through marital disruption may also exhibit the effects of stress on the children's measured skills. Yet empirically, the findings in McLanahan (1997) reflect the literature that shows that family structure does not have a strong, persistent effect on children's test scores, although it does have a stronger association with other aspects of

their wellbeing. Similarly, Joshi et al (1999, p.22) report inconsistent effects of lone parenting on different cognitive tests, and these decline in significance when family attributes like parent's education are included in their analysis. Yet, Pierret (2001, p.36) shows that for adolescents in the National Longitudinal Study of Youth – 1997 (NLSY97), their grades in eighth grade are lower by 7 to 12 percent if they were not raised in an intact family, controlling both the family's income and parent's education. DeLeire & Kalil (2002), using NELS88 data, also report effects of family structure on high school graduation rates with income and parental education controls.

So, we know that family characteristics including parent's education and income as well as other indicators of family resources have an important influence on children's measured cognitive skills. This paper investigates and confirms these well-established influences on children's test scores. It then goes beyond these factors to investigate an additional, important cross-generational family influence.

Studies in many disciplines stress the importance of cross-generational family influences on children's healthy development. Below, scholars from several disciplines are cited briefly to stress the breadth of interest and the range of evidence that children are much influenced by family behaviors across generations. This paper suggests a rather novel way in which one generation affects its grandchildren, but the point of this brief literature review is to acknowledge that the basic idea is deeply embedded in thinking about the role of the family. Behaviors and values carry over from one generation to the next.

One type of evidence suggests how similar parent and child are in terms of behavior patterns or aspects of their temperament. For example, Cohen, et al (1998) use data on two generations (tested as children in each) to document the consistency of measures of what are described as inhibited behavior (i.e., shyness and fearfulness or timidity) and difficult behavior (i.e., intensity of anger, negative mood, excessive attention seeking and low score on a measure of persistence on tasks and "careful with things"). Of course, the issue of heritability is related to this parent-to-child transmission of attributes and behaviors. It has been suggested heritability extends beyond physiological or psychological attributes even to environmental factors like "parenting." (see Rowe 1981) McGuire's (2003) tutorial on "the heritability of parenting" suggests that several studies, but not all, confirm that parental warmth is heritable, while a measure of "parental control" is not. (See the "special section" of *Developmental Psychology* (1998) for studies of intergenerational continuity suggesting that "parenting practices....emerge as a gateway for transfer of a variety of characteristics between generations." (p.1161))

Another type of evidence suggests that experiences as a child carry over into attitudes and behaviors as an adult. For example, Stuart Hauser has followed a small group of adolescents with psychological disorders over the past quarter-century and has recently reported a study of resiliency (Hauser 1999). It is striking, as he describes the open-ended reports by these adolescents, how they associate their behaviors as parents to behaviors they knew as children. Hauser reports for one of his subjects, "her father and husband converge" as she describes her husband in later interviews much as she had described her father in earlier years. It is not surprising that a person carries with them the associations and experiences of childhood as they assume adult roles. Continuity from the experience as a child to that of a parent is one mechanism for the transmission of family culture.

There are many linkages, of course, between early experiences of youths and subsequent physical health status. To cite but two: the intriguing “Barker hypothesis” offers evidence linking fetal and early childhood growth and coronary heart disease in later life. (See Eriksson et al 1999, Forsen et al 1999). A similar phenomenon is reported by De Stavola et al (2000) finding a robust positive relationship between birthweight and the risk of premenopausal breast cancer: “Women who weighted 4kg or more at birth were nearly six times more likely to develop breast cancer prior to menopause than those who weighted less than 3kg.” (p.967). While far afield from the investigation reported here, these biological connections between exposure at one age and consequences at another are suggestive of the linkage I wish to emphasize: experiences as a child frame and influence behavior as an adult and as a parent.

Deborah Vandell (2000) has recently provided a fine summary of the thinking of developmental psychologists on the importance of parent’s behavior on the socialization of their children. She stresses the interactions between the child, the family, and the broader social environment. Parenting, she argues, is undertaken in a complex and conditional way that is “embedded in a framework that is both historical and cultural.” What she means by historical, citing Glen Elder’s (1979) work of the effects of the Great Depression on families and subsequent lifetime behavior, is similar to the notion I wish to stress. The experiences and habits formed during childhood and adolescence influence behavior as parents later in life.

In economics as well, the idea that experience early in life has great influence on later perceptions and actions is well developed. One example is Easterlin’s (1973) relative income hypothesis applied to fertility behavior. It suggests that a woman’s perception of previous economic wellbeing as an adolescent, when compared to her economic circumstance as a young adult, influences her assessment of her capacity to afford having children. The concept of human capital—of investments in skills and attributes at one age that pay dividends later in life—is quintessentially a cross-generational idea since so much of the early investment in a child reflects the actions and motivations of the parents. As Heckman (2000, p.8) stresses, “learning begets learning” and so the dynamic of early experiences and efforts to encourage children’s learning influences their subsequent capacity as well as their interest in further learning. Another example is Becker’s (1991) discussion of family dynasty, of differences across families in their orientation toward the advancement and perpetuation of the family name or its reputation.

In other contexts as well, we often see recognition of the importance of experience as a child on adult behavior. Amartya Sen notes, “the culture in which one is born and bred can leave a lasting impact on one’s perceptions and predispositions.” Although Sen adds, “But this does not imply that a person is not able to modify or even reject antecedent associations.” (Sen 2001, p.327) In a context closer to the subject of this study, Irving Harris observes, “People seem to have an extremely strong, probably unconscious motivation to replicate their parent’s patterns of child rearing even when they end up repeating the resulting disasters.” (1996, p.205).

While these citations from several literatures emphasize that experiences as a child have profound effects on the behaviors and perceptions at an older age including as a parent, there are at least two cautionary notes that should be acknowledged. First, a large portion of the variation among children in their test scores on any subject is not associated statistically

with any measure of family background. The child's personality, innate ability, eagerness to learn as well as the quality of instruction at home and at school, the social encouragement and values of peers, as well as characteristics of the child's residential, ethnic and cultural communities, and signals from the labor market all have their influence. The child's motivation to do well on the cognitive tests also has an effect. Many of these varied factors are not measured in any one study and they cannot be measured here. Thus, we know at the outset that family behavior will not capture a large portion of the variation in the children's test scores.

A second qualification is that children skilled in one subject are not necessarily also skilled in another. Huttenlocher, Levine and Vevea (1998) show modest inter-test correlations among pairs of skills of language, spatial operations, concept mastery and associative memory for kindergarten and first graders (i.e., correlations (?) from 0.42 to 0.61). Sternberg, Grigorenko & Bundy (2001) document the relatively high inter-test correlations on different general intelligence tests (i.e., Stanford-Binet, WISC, Raven, etc.), with $r = 0.50$ to 0.88 , but they show the declining correlation for the same test administered at respective ages (i.e., for the Stanford-Binet $r = 0.87$ between ages 5 and 6, but $r = 0.62$ between ages 5 and 12, adopted from Sontag, Baker, & Nelson, 1958). As Kagan (1998) eloquently insists, pointing out that the correlation across children on separate cognitive tests is typically no higher than 0.4, the notion of a general intelligence is fallacious, if nonetheless seductive. (Michael 2002 shows confirming evidence that for the children in the dataset used here, correlations across cognitive tests are on the order of 0.40.) If measures of cognitive ability are not highly intercorrelated, then there is not a single influence of some family background, or any single determinant, on cognitive ability. Here we look only at a measure of vocabulary skills. What we find may not reflect influences on other skills.

THE CONCEPTUAL FRAMEWORK

This paper focuses on the child's verbal ability measured by a test score, T . The inquiry asks how the family influences T . Expressed as a series of questions, the first is: "Are parental resources positively associated with their child's T ?" The literature briefly reviewed above surely suggests that we should expect an affirmative answer. From the perspective of an economic approach to the question, the expected answer is also affirmative. If we consider the matter as reflecting demand for the desired outcome of a healthy and capable child, then as resources such as income increase the demand should rise. If we view the matter as household production, then an increase in family resources implies more inputs and an increase in the output T .

While empirical measures will be discussed in the next section, it is helpful in fixing ideas to note that the paper uses three distinct parental resources: (1) the cognitive ability of one of the parent, assessed when he or she was age 11; (2) that parent's completed education level, and (3) the family's income level. Several additional family controls will be included in this vector of "family resources" including the employment of the parents, the sex of the focus-parent, the mothers' age at first birth, the religion of the family, and the number of siblings of the child. Of these, only the latter is strictly another measure of resources available per child.

A second question is: “Are the grandparent’s resources (measured by their socioeconomic status (SES)) additionally associated with the child’s T?” Their SES is measured when the child’s parent was a young child. The expectation is that this too will be positively associated with T. The reason for expecting a positive association is that our measure of the child’s parents’ resources is probably incomplete, so adding the grandparent’s SES should capture some of that unmeasured parental resource.

The third and fourth questions require more extensive framing because they are more novel. They are the main contribution of the paper. The hypothesis is that there is a quite distinct family attribute that can be described as parental willingness to invest in their children, or as parental inclination to sacrifice in behalf of their children, or as parental resolve to give nurturance and support and advantage to their children. Designate this family attribute as C; it will be referred to as the family’s “culture.” C cannot be measured directly. It captures the fact that families differ in their orientation and their efforts in behalf of their children. The family’s resource level constrains their capacity to give to their children, but separately from the given level of resources, families also decide how much to give, how much to sacrifice their own adult preferences and interests and activities in behalf of their children. (Typically in an economic demand framework, in addition to income one would include prices as the key regulator of demand. In the present context, however, I think the differences on the preference side are important to capture and suggest that they are strongly influenced cross-generationally. They are called family “culture” here.)

If C could be directly measured, the third question would be: “Is the family’s C positively associated with their child’s T?” Since C is a construct for which no direct measure is available, let the vector P be a proxy for C, and again to fix ideas, two measures will be used: (1) a dummy variable indicating that the mother breastfed the child; (2) a continuous variable that measures the child’s birthweight which partially reflects the mother’s efforts to insure a healthy baby (i.e., by not smoking or drinking during pregnancy, by early medical care during pregnancy, etc.). So this third question becomes: “Are breastfeeding and birthweight (interpreted as proxies for family culture) positively associated with their child’s T?” (A defense of these proxy variables is offered below.)

There is a fourth question that is an extension of the third. Recursively, the behavior of the parent in the current generation is surely influenced by the behavior of the grandparent a generation earlier. I can construct another set of proxies for C based on the parenting behavior of the grandparents in raising this child’s parent. Call that vector G, which will contain four elements, each of which is a dummy variable: (1) Did the grandmother breastfeed the parent? (2) Did both the grandmother and grandfather read to the parent as a pre-schooler? (3) Did the parent’s teachers consider the grandmother to be uninterested in her child’s schooling activities at ages 7, 11, and 16? (4) Did those same teachers consider the grandfather to be exceptionally (positively) interested in his child’s schooling activities at those same ages?

With G defined as these four behaviors by the grandparents in raising their child, and serving as a proxy for C, the basic question about the association of the family’s C and their child’s T, becomes: “Are the breastfeeding, and child-rearing practices of the grandparents (interpreted as proxies for family culture) positively associated with their grandchild’s T?”

There is symmetry between questions one and two and between questions three and four that is worth discussing. It is not surprising to think that if we measure a few elements of the current family's resources, there are probably other current resources that are unmeasured that we can capture by including information about the prior generation's resources. That is the rationale for including the grandparent's SES measure in the model of the influence of family resources on T, and we easily accept the notion that there is a cross-generational transmission of financial or material resources.

But parents pass along not only material assets, they also pass along their attitudes including their attitude toward children and the way in which they ought to be nurtured, raised, and provided for. So if there is an association between C and T, and if there is a cross-generational transmission of C, then the measured vector G should be associated with T. That association should be strongest if P and the parental resources are not included in the estimation, since in that model G captures all the direct and indirect investments of grandparents on their children and through them to their grandchildren. The association of G on T should be weaker if the parental resources are included in the estimation, since its influence through the parental resources are controlled. And the association of G on T should be weaker still if both the parental resources and P are controlled, since only the unmeasured aspects of the cross-generational transmission of C is then reflected in the coefficients on the elements of G. These tests are reported below.

The three measures of family resources need little justification. Family income and parental education and the measured ability of the parent (when a child) all constrain the family's efforts to promote child skills. The intellectual capabilities of the two parents may affect the child's test scores in at least two ways. First, since capability is at least partially inherited, the child is directly influenced by each biological parent's own capability. Second, the more capable are the parents in encouraging and teaching their child, the less costly or more productive is that instruction. Thus, more skilled parents probably respond to that lower cost by providing more and better instruction or by encouraging and participating in their child's learning. There is surely an interaction as well, with a more capable child finding it easier to learn and therefore being more eager to focus on learning.

It is useful to reflect on the notion of family "culture," and to consider the proxy variables used to measure it. What are the ways in which family attributes and behaviors can influence their child's cognitive ability, specifically their verbal skills? Part of that influence, surely, is genetic: the parents' choices of one another as a partner are a primary influence on their child. Subsequently, the biological mother carries the fetus and influences the child physiologically and perhaps in other ways that may affect later skills. From birth onward the parental influence is partly a direct engagement with their child and is partly indirect, through the choices the parents make regarding the child's care during infancy and pre-school ages and thereafter through the guidance they provide regarding the child's experiences in neighborhoods, schools and elsewhere and with the child's peers as the parents attempt to influence their selection.

Considered across the child's developmental stages—in utero, in infancy, and then in the pre-school and school age years—the parent's direct influence probably declines as the child

encounters more and more non-parental exposures. Yet the correlation of parental attributes with the child's cognitive skills like verbal ability may not decline with the child's age because of the cumulative effect of learning on new learning. As with other types of human capital formation, we can think of the production of additional units of T in year i , call them K_i (i.e., new verbal skills acquired in year i), as produced in part using the accumulated stock T_i . Because parental influence on the production of T at early ages is substantial, it may be that the influence is as clearly identified at later ages as it would be at young ages. Indeed, it would be odd if the parental efforts diminished to obscurity as the child aged. For one thing, if it did, the parents would have far less incentive to make large investments early in the child's life.

It may be tempting to conceptualize and to estimate a production function that relates the "inputs" of the parents, the child, the community and subsequently the schools to the "output" of the child's measured test score. This is not attempted here for three reasons. First, the theory of the development of the child's skills tells us how complex that relationship seems to be. (see, e.g., Vandell 2000) For example, the influence of the parents on the child's skills is not a one-to-one relationship: the same parental action will not have the same outcome for every child. At best, parental actions are influencing not determining. So while conceptually there may be an input-to-output relationship, it is probably not an engineering production function relationship. That framework is too deterministic, too mechanical as a representation of the process of interest.

Second, although "parenting" is a primary focus within developmental psychology, that literature does not provide much guidance in formulating statistically the way parents influence their children's skill acquisition. It does not provide guidance about what particular parental behavior or action might yield a higher score on a particular achievement test. So, even if a data set had extensive information about child-rearing practices—for example, the number of hours she read to the child or the detailed nature of her play with the child—it is not clear how to link those actions to any particular skill development through an empirically estimated production function. Third, the data set used here does not have enough detail about the child-rearing practices or time spent instructing or motivating the child to permit estimation of an input-output relationship.

Yet it is a helpful heuristic to frame the activity of the parents expending effort and resources on their child as production that yields skills embedded in the child. It guides the analysis even though no structural estimation is attempted. The analysis here assumes that parents want to promote their child's verbal ability, measured by T , and assumes that two types of characteristics influence its production. One is their level of resources, and the second is their willingness or resolve to use these resources in behalf of the child.

Families with greater levels of resources are expected to make larger investments in their children's skill development. They can provide greater stimulation and encouragement to their child, they can protect their child from detrimental external insults or help their child overcome adverse events. While they cannot insure successful skill development, they have the capacity to promote it and protect it, relative to less well-endowed families. Just as one's own "learning begets learning," a parent's skill facilitates similar skill acquisition in the child. Thus, the family's income, and the capabilities of the parents measured by the formal schooling and by the ability test scores of the parent (measured as a youth) reflect the family resources.

The second of the two constraints, the parent's willingness, resolve, or commitment to nurture their child, is family culture. One attribute of a current family is that it has a history; the adults who manage it and establish its patterns and activities were themselves children in their own families of origin. The experiences they had as children surely influence their perceptions about attractive and appropriate family life and about the appropriate ways to rear and nurture their children. The child-oriented nature of the family of origin may or may not be motivated primarily by a concern about human capital development in the children. The motivation may have more to do with direct preferences for having, engaging and raising children, or it may be a preference or a habit of family activities such as making big events of birthdays and holidays and this then naturally includes the family's children. In other cases the motivation may be a conviction of an ethnicity, shared by families from that culture. Examples include the conviction that schooling is the key to economic success, or that a strong work ethic is critical for social success, or that service to others is the highest calling. These help define what being a member of this family means, as emphasized by the adults, and absorbed if not always accepted by the children. Be it habit or purposive strategic behavior, there are family cultures or family capital that become part of one's sense of an appropriate family style or way of living and these are carried into the next generation of the family. Some of these practices or values constitute what we mean when we refer to the culture of an ethnicity or a community or a family dynasty.

Of course, this is not a linear, one-to-one translation of doing what one's parents did. One complication is that there are experiences of childhood that, as an adult, one may reject or rebel against and purposively avoid doing in the interest of a successful family experience. Another complication is that there are at least two family cultures that merge in the formation of a new family; one partner may be dominant or his or her family culture may be dominant in some social or economic way. The new family may reside in a neighborhood that reinforces one of the family cultures at the expense of the other. One religious culture may, for example, have an express policy of promoting its beliefs among the next generation while the other does not. How the two family cultures develop into the new family's style of action is not explored here. This family resolve or commitment to devote resources to child rearing is additional to the level of available family resources: both additional resources or a greater commitment to use available resources in the child's behalf should have a positive impact on the child's skill acquisition. Thus, we expect to see a positive effect on the child's test scores of both the family's level of relevant resources and the family's resolve to invest in their children.

This paper uses two direct measures of behavior by the child's parents that are interpreted as good indicators, or proxies, of this family resolve. These are behaviors that are discretionary; they suggest the degree of commitment by the parents in behalf of their child. One is whether the mother breastfed the child. While there may be many reasons why a mother does or does not choose to breastfeed her new infant, the contention here is that partitioning mothers into the two groups of those who do and those who do not breastfeed effectively partitions the mothers into a first group who are more engaged and inclined to invest in their child, and a second group who are on balance less so. In the dataset used below, 63 percent of the mothers breastfed their child. This dummy variable serves as a proxy variable; its coefficient is interpreted as indicating the influence on the child's test score of the parent being more willing, resolved or committed to investing in the child. The second proxy reflects the mother's efforts to protect the healthy

development of her baby while she was pregnant. It is described more extensively below. These two proxy variables, referred to as the vector P above, are included in the empirical model.

Additionally, there are four indicators of the child-oriented culture of the family actions taken by the grandparents when the parent was a child. These are indicators of that family's culture or style of child rearing, of its commitment to using resources in behalf of the child. These four indicators of commitment to the children in the family—actions by a grandparent a generation earlier—are introduced into the model to provide further evidence on this family-specific attribute. The empirical strategy is first to control for family characteristics that have been shown to affect children's cognitive development. Then, with those controls in place, to look at evidence of an incremental influence on the child's test scores of measures of the family's resolve to invest in their child. This resolve is measured first by two indicative discretionary behaviors by the parents and then also by four discretionary behaviors by the grandparents when they raised their child.

THE NCDS DATA

This paper uses survey data from the British birth cohort study of 1958, a longitudinal data set known as the National Child Development Study (NCDS). Begun as a perinatal mortality study of births in the week of March 3 – 9, 1958, nearly all (98%) of the women who gave birth in England, Scotland and Wales that week were interviewed and the child born that week became the subject of the follow-up surveys conducted in 1965, 1969, 1974, 1981, and 1991 when the child was, respectively, age 7, 11, 16, 23 and 33. The size of the sample was 18,558 subjects, with information from at least one of the surveys. The 1991 interview with the cohort members was undertaken for a sampled subset of 15,666, with a survey response rate of 85% of the cohort members.

Early studies using these data focused on perinatal mortality (Butler & Bonham, 1963), "high risk" mothers and problems of low birthweight (Butler 1965a, 1965b) and highly influential evidence of the adverse effects of smoking during pregnancy (Butler, Goldstein & Ross 1971, Goldstein 1972, Butler and Goldstein 1973). As the children aged, studies focused initially on their health then shifted emphasis to their social and developmental conditions (Butler & Alberman 1969, Davie, Butler, & Goldstein 1972, Fogelman 1983) as well as early work on methods of longitudinal data analysis (Goldstein 1968). These data are the basis of Power, Manor and Fox's (1991) investigation of health status in young adults (at age 24) and its close linkage to their family's income and social class, and Ferri's (1993) up-date on their lives at age 33. The 1991 interview with the cohort members was undertaken for a sampled subset of 15,666, with a survey response rate of 85% of the cohort members.

That 1991 interview of the cohort members, followed since their birth in 1958, included a supplemental survey of the biological children of a randomly sub-sampled one-third of the male and female cohort members (the response rate on this child survey was a remarkable 96%). That sample of "Children of the NCDS," sponsored principally by NICHD, is used here, together with information on the cohort-member-parent (cm-parent) and information from an interview of the child's mother (she may or may not have been the cohort member). There are a total of 4,229

children in the data set. The verbal ability test was administered to 2,847 children age 4 and above. It is the dependent variable in most of the analyses reported below.

The Children of the NCDS were administered several cognitive tests; the one is used here is the PPVT-R, the Peabody Picture Vocabulary Test – Revised. It assesses the hearing vocabulary for standard English and is described as “a quick estimate of the verbal ability of scholastic aptitude” (Dunn and Dunn, 1981). The test consists of a set of 175 words spoken to the child who is asked to point to a picture of the word spoken, selecting one of four pictures shown on an easel, word by word. The test is scored according to a strict protocol dictating the starting and ending of the test, initiated according to the age of the test taker. The test has been extensively used in the U.S. and was Anglicized by the test authors for administration in England. The children’s raw scores have been transformed to adjust for the age of the child normalized on this British sample. (See Michael (2002) for a comparison of test scores for these British children and a comparable sample of U.S. children from the “Children of the NLSY”.)

The models estimated below use as control variables only a few attributes of the child—age, gender and race. One does not want to control for malleable attributes of the child through which the family’s influence on cognitive skills may operate. The attributes of the child’s parents used in the analysis are more extensive. These are mostly attributes of the cohort member (cm-parent), about two-thirds of whom are the mother. A few facts pertain to the child’s mother, whether she is the cohort member or the spouse.

Three sets of variables directly measure current family resources. One is the cm-parent’s education level, defined in categories from the lowest if no certifications were earned, through the O-levels, A-levels (about equivalent to U.S. high school graduation), and higher education. The second is the cm-parent’s reading and mathematics test score obtained at age 11, in 1969. The third is family income. It can be measured in five different ways, described here, but the empirical results rely on only one, with a few sensitivity checks described in the text.

One measure is the family’s gross income, expressed in natural logs. While it is the most conventional measure, it is missing for about 16 percent of the cases. A second measure is the log of the value of the family’s home, which is an indicator of longer run income, but it is missing for more than half the cases. The third measure is featured here since it is defined for all cases and reflects longer run income. The 1991 survey has information about whether the family did or did not meet each of seven conditions that typically vary with family income. In descending order of commonality (showing the percentage of families that have each condition), they indicate if the family: has a bathroom in their home (98% do), has a phone (90%), was currently not on welfare in 1991 (89%), owned or was buying their home (73%), has some savings account (68%), has never been on welfare (68%), and has some financial investments (23%). In the empirical model reported below, income is measured as the simple sum of these seven dummies, called “income index.” It ranges in values from zero to seven. A fourth income measure uses all seven of these dummies separately as a step function in income. A fifth income indicator is the total number of rooms in the family home.

Several additional family attributes are controlled in the statistical models and several of these can be interpreted as further measures of resources available for the nurturance of the child.

One is the age at which the mother had her first child. Women who are very young at their first birth may lack the maturity and psychological resources suited to child rearing. The second attribute is the total number of children in the family. As it increases, holding constant the family's income and other resources, there is a simple negative relationship to the resources available per child. Another control is an indication of the employment status of each parent. Another control, the religion practiced in the family, is included as is a dummy variable indicating the family "often" attends religious services. The cm-parent's marital history was also used, but showed no influence in the regressions, and so it was dropped.

As discussed above, there is information about the socioeconomic status (SES) of the cm-parent's parents; it is measured in four categories (1=lowest; 4=highest) in 1958 and the early 1960s and averaged over the two time point. (I thank Kath Kiernan for sharing this variable.)

These measures of the child, parents and grandparents are the basic family characteristics and resources used in the regression model reported below. The child's test score is expected to be positively associated with the family resources—the parent's education, cognitive skills, income, and maturity (age at first birth)—and with grandparent's SES. It is expected to be negatively associated with number of siblings since this lowers the parental resources available per child.

There are two proxy variables that reflect the parent's resolve or commitment to make investments in their child. One is a dummy variable indicating whether or not the mother breastfed her child. The rationale was discussed above; the dummy variable is interpreted as partitioning the observations into two groups with the breastfeeding mothers relatively more committed to investing in their child. The other is the child's birthweight; the rationale for it is offered here since it is dealt with by a more complex empirical strategy. Birthweight is frequently used as an indicator of the initial wellbeing or health of the child at birth. While the variable involves much stochastic variation, it also has both an inherited component and it may reflect certain maternal behaviors such as whether she smoked and drank alcohol during the pregnancy. It is these maternal behaviors, her attentiveness to her pregnancy, that are of interest here. They are interpreted as an in-utero investment by the mother in behalf of the child and an indication of parental commitment to the child's nurturance.

To strengthen this interpretation of the variable, it is used in several separate statistical strategies. One simply includes the child's birthweight as a regressor, along with the mother's breastfeeding practice as a proxy for the unmeasured commitment, C . The second strategy purges the variable of its stochastic component and includes only that portion of the child's birthweight that is associated with the parent's own attributes and behaviors during the pregnancy. This purging is accomplished in two separate manners. One uses a two stage least squares regression with birthweight as an endogenous variable identified by certain maternal behaviors during pregnancy. These behaviors include the amount she smoked and drank during that pregnancy, the month in which the pregnancy was confirmed and the month of her first prenatal medical visit, whether the pregnancy was planned, and as controls the cm-parent's own birthweight and the race and gender of the baby. The other strategy involves a side regression that estimates the child's birthweight as a function of these several parental attributes and behaviors during pregnancy (this is essentially the first stage regression in the 2SLS but without

the other exogenous variables from the second stage). That side-regression's predicted value is used as a proxy variable measuring the commitment to the child. But, since the mother's actions explain only a small percentage of the variation in the child's birthweight, and since the additional variation in birthweight may also contribute to the child's cognitive development, a second variable, the side-regression's *residual*, is also included. This residual, orthogonal to the predicted birthweight by construction, is interpreted as a child-specific stochastic influence on the child's development. The model with the side regression and the use of both the predicted and the residual birthweight variables is considered superior to the more standard, two stage least squares model. So, it is featured in the discussion below. These two sets of variables, breastfeeding and the two birthweight measures, are the proxy variables in the vector P.

The other set of four proxy variables for the unmeasured family culture, C, those referred to in the vector G, are measures of the grandparent's behaviors toward the cm-parent as a child. The argument is not that these four grandparent behaviors directly influence the child's cognitive skills but instead that they reflect the culture or style of that family and thereby act as proxy variables for unmeasured family investments that do influence the child's cognitive skills. These four variables indicate the grandparent's willingness, resolve or commitment to their child back in the late-1950s and early-1960s. That behavior by the grandparents helped develop the cm-parent's own expectation about appropriate child caring behavior. Thus, the argument is, that child-turned-parent a generation later was probably influenced in his or her willingness to invest in children, or had greater resolve to use available resources in behalf of their child in the 1980's and early-1990s if their parent had done so earlier. This is, admittedly, a subtle and indirect test of the importance of family culture. Among other limitations, even at best the information captures only one of the two sets of grandparent's behaviors.

The four grandparent variables are these. One is a dummy variable indicating whether the grandmother breastfed her child, the cm-parent, in 1958. A second is a dummy variable indicating that both grandparents reported that they spent time reading to their child when the child was age 7 (in 1965). The third and fourth measure the grandparent's engagement in their child's schooling at ages 7, 11, and 16 (in the 1960s and early 1970s). Although the grandparents reading to the child is a self-reported fact, these measures of engagement in the schooling of their child is an assessment reported by the child's teachers in the three classes, asked in the three separate years and then averaged. One is a dummy variable indicating that the teachers considered the grandmother to be among the least interested of mothers, and the other is a dummy variable indicating that those teachers reported that the grandfather was among the most interested fathers. (These two variables are constructed from composites of the three teacher reports. They were created by John Hobcraft; see Hobcraft 1998.)

The empirical strategy is to regress the child's verbal test score on the set of family resources to see if they have the positive association found in other studies and to affirm the notion that resources contribute to the healthy cognitive development of the child. Then the vector P is introduced and its influence is reported with the several strategies for using the child's birthweight. Then the vector G is added as well, initially along with P and subsequently without P and without the parental resources in order to assess its association with the child's test score.

REGRESSION MODELS

Table 1 shows the summary statistics for the variables used in this analysis. The children range in age from 4 to 18 (eleven are a month or so under age 4 and were eligible for the PPVT), about half are girls and nearly all of these British children whose parent is in the NCDS are white. The PPVT score, normed on these British children, has a mean of 100 and a standard deviation of 15. Regarding the cm-parent, about two-thirds are the mother of the child; the many descriptive statistics are self-explanatory. For the grandparent (the parent of the cm-parent), the socio-economic status is shown, missing for about one-in-five. The variables listed as child experiences include the child's birthweight (in pounds), dummies for those born at "low" and "very low" birthweight, a dummy indicating if the child was breast-fed (nearly two-thirds were), and the number of siblings. For the parent's behavior, all variables refer to aspects of this child's prenatal life. About three-quarters of these pregnancies were reported to be "planned" by the couple, on average the pregnancy was confirmed in the 8th week, the first antenatal doctor's visit occurred on average in the 10th week of the pregnancy, and during the pregnancy on average the mother drank about four drinks per month and smoked about 0.6 cigarette per day. (During the pregnancy, about 34% of the mothers drank no alcohol and 90% did not smoke.)

Regarding the grandparent's behaviors, 58 percent breastfed their child. (This information is from the survey in 1964.) About one-quarter of the grandparents both read to their young child in the late-50s, or early-60s. Regarding the teachers' report about the grandparent's interest in the cm-parent's schooling at ages 7, 11 and 16, 10 percent of the grandmothers were identified as having low interest and 16 percent of the grandfathers were identified as having high interest; the table also shows the whole distribution of these assessments, those with low, some, much and great interest in their children's schooling.

The regression analysis is shown in Table 2. Model #1 reports the relationship of the child's test score to the child's, parent's and grandparent's attributes and resources. This regression confirms results from many other studies. While the child's age is not statistically related to the PPVT score when it is regressed alone or with only gender and race, it is positively related to the test score in this model. The white children do substantially better on this vocabulary test than do the nonwhite children. This is an interesting finding since in the U.S. the PPVT has been somewhat controversial as using words that are more likely known by white children. But nonwhites in Britain similarly score lower although a much smaller fraction is black and at least one of the child's parents was born in Britain in 1958.

Many of the cm-parent's or mother's attributes are strongly associated with the child's test scores. The cm-parent's own reading test score (measured at age 11) is significantly related to the child's PPVT score, but the age-11 score in mathematics is not so. The cm-parent's education level is quite strongly related to the child's test score. The family's income level is strongly associated with the test scores, and is so as well when other of the income variables is substituted into the model. For example, when the income index is replaced by the log of income (and missing variable dummy), the coefficient on the log of income is 0.87 ($t=2.41$) and the missing variable coefficients is not near statistical significance ($t=0.26$). When ROOM is used as the income variable it also is significant: the coefficient is 0.52 ($t=2.33$). (ROOM is a

reasonable indicator of longer-run income; about 10% of the cases have 0-3 rooms, about 80% have 4-6 rooms and the remaining 10% have 8-12 with a very few having 14-19 rooms.)

The current employment status of the cm-father is positively associated with the child's test score while that of the cm-mother is consistently negative. Religious affiliation is not significant but "often" attending religious services is. (Tepper's (2001) suggestive essay that parent's have influence on their children by the structure they introduce into the family life may help explain the finding here that children have higher test scores in families that attend religious services frequently.) The older the mother was at the birth of her first child, the higher is this child's test score. The more siblings the child has, the lower is the test score. Additionally, the socio-economic status of the grandparents when the cm-parent was a child is positively associated with the child's PPVT score.

Over all, the results in model #1 are quite impressive in several respects: first, nearly all of these estimated relationships conform with expectations; second, these results are quite similar to those reported for U.S. children in other studies, and third, the strengths of the relationships with the PPVT test score are substantial. Interpreting family resources as a constraint on the parent's capacity to influence their child's cognitive test scores offers a compelling interpretation of these findings: as these constraints are relaxed, the test scores increase. The similarity of the British and U.S. results suggests that the same factors are at work in both societies.

Model #2 introduces the two proxy variables for the family's resolve or commitment to investments in their child. This model includes all the variables in model #1 plus the two additional ones: the child's birthweight (in pounds) and the breastfeeding dummy variable. Both variables show relatively strong positive relationships with the child's cognitive test scores measured several years hence, even though all the other descriptive characteristics of the cm-parent are being held constant in this regression. (When the model was re-run replacing the continuous birthweight variable with two dummies, one indicating that the child was born at "very low birthweight" (under 1.5 kilograms or 3.31 pounds) or at "low birthweight" (under 2.5 kilograms or 5.51 pounds), only the very low birthweight coefficient was significant: its coefficient was -8.09 ($t=-2.87$).) Model #2 is consistent with the interpretation suggested earlier: holding the level of resources fixed, there is another dimension of parental investment in their children and that has to do with the commitment or willingness to make those investments. The regression can be interpreted in other ways as well, of course, but it does offer support to this interpretation.

Model #3 adds the four measures of the grandparents' behaviors when the cm-parent was a child; they are the elements in the vector G. These too are indicators of family resolve or commitment to invest in the family's children. The four are actions taken, and measured, a generation earlier in this longitudinal data set. As described above, each is dummy variable. While all four show the expected direction of effect, only one – the dummy that the grandfather was exceptionally interested in his child's schooling – shows statistical significance in this highly controlled regression. The model holds fixed many parental attributes and behaviors that influence the child's skills. Consequently, much of the influence of grandparents on their child's behaviors and skills as parents are already controlled here, and yet these grandparent behaviors do still show some influence. Investigating their association with the child's test score in a less

highly controlled regression is discussed below, but first, we focus on the alternative strategies for handling the measure of the child's birthweight.

Model #4 decomposes the child's birthweight into two components; the regression is otherwise the same as model #3. As described above, since the child's birthweight partly reflects the behavior of the mother during the child's prenatal growth but is partly independent of the mother's behavior, this regression partitions the influence of these two elements. The birthweight variable is decomposed by a first-stage regression of the child's birthweight on gender, race, cm-parent's own birthweight, the planning status of the conception, the duration of the pregnancy (in weeks) when confirmed, the week of the first prenatal medical visit, and the amount of drinking and smoking during the pregnancy. That side regression is shown in Table 3. For each child a predicted birthweight is calculated from this regression; it is interpreted as reflecting the parent's investment in the child's wellbeing during the pregnancy. It, far better than the birthweight measure used in models #2-3, captures the parental investment or efforts in behalf of their child. But since birthweight from whatever source including luck may have influence on the child's cognitive development, model #4 also includes the residual from that side-regression as it measures the birthweight that is not related to the parent's behavior. The second variable has a zero mean but a much larger variance than the predicted component of the child's birthweight (see Table 3).

Model #4 of Table 2 shows that both birthweight variables are indeed relevant. As expected, the predicted birthweight has a strong and quite large coefficient—more than five times as large as the coefficient on the residual. Expressed in terms of the effect of one additional pound of weight at birth, the parent-related pound is associated with a 3.2 point increase in the PPVT test score while an additional pound of weight at birth unrelated to the parent is associated with about a half point in the test score. (If we consider instead the standardized coefficient reflecting the larger standard deviation in the residual birthweight variable, the parent-related pound of birthweight is associated with a little under one point on the test score ($0.92 = 3.18 * 0.29$) while the residual effect is about two-thirds of a point ($0.64 = 0.55 * 1.17$.) The suggested interpretation of the difference in these two measures of a pound of birthweight on the cognitive skills of the child is that the first proxies the many parental efforts that typically go unmeasured in regressions of this nature and have impact on the child's skill development, while the second shows the influence of a stochastic pound of birthweight.

Model #4 contains the central finding in this paper but before discussing the implied magnitudes or interpreting its results, several sensitivity checks and extensions deserve mention. A two-stage least-squares model was estimated, with the identical structures for the endogenous child's birthweight and the child's test score as in model #4. There were few notable differences in the coefficients or their significance, compared with model #4. The coefficient on breastfeeding was 2.02 (3.40), and the birthweight coefficient is 3.17 (2.54). Of course, the residual from the birthweight regression is not included in the 2SLS model. (see Appendix Table A2.)

The sampling strategy for the children in this dataset included all biological children of the cm-parent, so there are many siblings in the sample. Consequently, the observations are not all independently sampled observations. In fact, the distribution of the 2,755 children by the

number from each family, is: 31% one child; 38% two children; 23% three children; 7% four children; 1.4% five children; and 0.4% six children from the same family. Model #2 in Table 2 was re-estimated, adjusting the standard errors for the family clustering. The coefficients are unaffected and the t -statistic based on the adjusted standard errors are shown in Table 2 model #2 as the second number in parentheses. The adjustments are not major.

When we consider that the data structure includes more than one child per family, we can also investigate the within-family influence of different breast-feeding practices and different pregnancy behaviors as reflected in the children's birthweights. The dataset has information about breastfeeding and about the smoking, drinking and prenatal behavior by the mother for each child separately. Consider breastfeeding practice. By the logic of the interpretation of the breastfeeding practice suggested in this paper, one would not expect a within-family effect on the children's test scores. The interpretation in this paper is that breastfeeding is a proxy for a family specific effect – the family's commitment to child caring and nurturing – not a child-by-child effect of breastfeeding per se. In fact, in this interpretation, one would have trouble explaining differential breastfeeding practices within the family. The within and between family differences, however, offer a test of the suggested interpretation.

First, the regression model can be run looking for the effect of a within-family breastfeeding difference on the children's test scores. We should expect to find no effect if the breastfeeding is a family-fixed effect. That is just what is found: using the families with exactly two children ($n=1045$), the within-family breastfeeding coefficient is -0.20 (-0.11) a wholly insignificant effect. When all pairs, threes, fours, fives, and six sibling groups from a given family are included in a family-fixed effect model ($n=1921$), again the coefficient on breastfeeding is wholly insignificant: -0.18 ($t = -0.14$). By contrast, as we would expect from the interpretation offered here, when the model is estimated with only the one-child per family children ($n=854$), the coefficient on breastfeeding shows the effect across families, not within families and here, the effect is very strong and large: 3.30 ($t = 3.30$). These results reinforce the interpretation here. The fact of breastfeeding per se is not what is being captured in the basic model; instead, the breastfeeding practice is a proxy that partitions the families. The suggested interpretation is that it partitions families into those with a tradition and commitment for nurturing their children (those who do breastfeed), and the families without that tradition (those who do not breastfeed). (See Appendix Table A2 for the full regressions.)

As another check on the robustness of model #4, the model was re-estimated on four subsets of the children, those whose mother, or separately the father, was the cohort member, and again separately for those children below or above age 8. These comparative models show a few interesting facts and are not included here. For many of the covariates, the estimated coefficients are similar, with somewhat larger standard errors because of the smaller number of cases. For example, the child's age, the parent's own test score and family income have about the same coefficient for all four subsets of children. Race, however, has a very large and significant coefficient in the cm-dad regression and for children age 8 and under but is not significant for the cm-moms or the children over age 8. The cm-parent's education level shows somewhat different patterns across the four subsets but is uniformly positive. Father's employment is consistently positive while mother's employment is always negative but strongly significant only for the younger children. The degree of structure in the family life, as indicated by "often" attending

religious services, is stronger for the cm-mothers and the younger children, and the number of siblings isn't a factor for the children of cm-dads or the older children.

It is the older children who are, by the construction of the dataset, much more likely to be born to a teenage mother and so it is quite reasonable that for that subset the age at first birth of the mother is a key factor reflecting the resource of her own maturity. The two proxy variables measuring family commitment and involvement, breastfeeding and predicted birthweight, are stronger for the younger children and stronger also for the cm-dads but are not statistically significant for the cm-moms. Perhaps this latter fact indicates that the several variables about the cm-parent better capture the investment in children when it measures the mother's attributes, so there is less remaining variation to capture by the mother's breastfeeding and prenatal behavior. The grandparent's interest in their child's schooling a generation earlier shows its largest influence on the older, not the younger, children, which is reasonable if these variables are indicators of family differences in habits of investing in their children, which then show up better over the longer life of the older children since the regression has no directly measured parental actions beyond the first year of life. In all, the pattern of the estimated coefficients on these subsets appears to reinforce the interpretations suggested above. (See Appendix Table A1)

Returning to the issue of the elements in the vector G, Table 4 shows their influence on the child's test score under five different sets of controls. Column 1 simply repeats the results from model #3 of Table 2 for convenience. Column 2 deletes the elements in the P vector, the dummy variable for the mother's breastfeeding and the child's birthweight. There, the four dummy variables in G are only very slightly affected. Column 3 further deletes all the parental characteristics and the grandparent SES variables and in that case, all four elements of G are strongly significant and quite large in magnitude. When the elements of the P vector are reintroduced in Column 4, the Grandparent variables are weakened, as expected, but they remain substantial in magnitude and statistical significance. For completeness, Column 5 shows the results of a regression that deletes the parental characteristics and all the grandparent variables and there, both the mother's breastfeeding and the child's birthweight have strongly associated with the child's test score.

Featuring the estimated model #4 of Table 2, the implied magnitude of the relationships between the parent's behaviors and the child's test scores are illustrated in Table 5 for three key variables. Panel A shows the actual differences in PPVT scores by parent's education levels and the effect implied by the regression model #4, holding all the other variables at their mean. There are quite large difference in the actual test score by parent's education level—nearly a full standard deviation (i.e., $105.67-92.88 = 12.79$, and $s = 14.99$)—and the muted yet strong effect of education with all other variables held constant—about one-third of a standard deviation ($101.92-97.73 = 4.19$). The interpretation of the partial effects would be that either those with more education are more effective in influencing their child's ability in vocabulary skills within the behaviors controlled in the regression, or they also act differently with their children in ways not measured by the regression covariates.

Panel B of Table 5 shows the relationship of PPVT score and family income. Here the sample is divided into three groups by the log of measured income: those below, at, or above a standard deviation from the mean of log-income. The actual PPVT scores differ by about 7

points or half a standard deviation, while the regression-predicted values differs by nearly 4 points. Holding all other variables in the model fixed, the estimated coefficient on income implies only a 1-point difference among these three groups. This is an example of a variable that has its effects through the several other covariates in the model. Were we to interpret the equation as structural, this would suggest, as often discovered, that handing the family more income and none of the other attributes that typically accompany income in the real world, there would be only a very slight impact on the child's PPVT score, at least in the range of the average level of income in these families.

Most importantly for the theme of this paper, consider Table 5, Panel C with its four sub-panels each showing the joint and separate influence of both breast feeding the child and the mother's efforts regarding the birthweight. The top part (Panel C.i.) shows the average actual PPVT scores for the children, simply sorted by whether their mother breastfed them and by their predicted birthweight. There we observe that the children with the least involved parents (those that did not breastfeed and with the lowest predicted birthweight) have a PPVT of 92.93 while those with the most involved parents have a predicted PPVT of 105.27, an unadjusted difference of 12.3 points, nearly a whole standard deviation.

When the average predicted PPVT scores are compared (Panel C.ii.), again the difference between those same two groups is quite large: 11.5 points. But these two comparisons don't hold constant any of the attributes or variables that co-vary with the breastfeeding and prenatal behavior. Panel C.iii. partially does that by showing the average of the predicted PPVT score for each cell for only those children whose mother had completed their O-level qualifications in school. There the influence of both breast feeding and prenatal behavior are muted, yet there remains about an 8-point difference between the two extreme groups of mothers with low or high involvement measured by both behaviors. Finally, Panel C.iv. shows the implied effects from the regression while controlling all the covariates at their means. In this circumstance, the least involved group has an estimated PPVT of 97.00 and the most involved has an estimate of 102.33, still a difference of over 5 points or about a third of a standard deviation in the test score.

This, then, is the order of magnitude of the estimated influence of the parent's efforts or commitment to child rearing, over and above the influence of their economic and social attributes or characteristics. A third-of-a-standard deviation in measured ability is not a breath-taking magnitude but it is about the same size as the standardized influence estimated for higher education compared to no formal education (seen in Panel A), and it is in addition to that influence. Moreover, the effect here is based on only two behavioral proxies that reflect the mother's behavior prenatally and in the first few months of the child's life. The interpretation offered is that these behaviors of sacrificing in behalf of the child by foregoing alcohol or cigarettes during pregnancy, by early medical attention to the pregnancy, and by engaging in breast-feeding and enduring its limitations on the mother's mobility reflect a commitment that probably continues as the child grows, although this regression uses no further information about that subsequent behavior.

CONCLUSION

Family behavior is certainly not the only factor influencing the cognitive development of

children; the low explained-variance in the regression models reported here reminds us of that fact. Yet, the model also supports the hypothesis that the family's available resources of money, skills, and time have influence in promoting their child's measured vocabulary skills. This evidence confirms much evidence in the literature. In addition to the influence of parental characteristics and behaviors, the grandparent's attributes also have influence. So the answers to the first two questions posed earlier are both "yes:" parental resources and grandparent resources are both positively associated with the child's T, measured by the PPVT score.

The answer to the third question is also "yes:" Breastfeeding the child and the child's birthweight are positively associated with the test score, controlling for parental attributes and resources and the grandparent's SES. The interpretation of this evidence, however, is more debatable. By the logic of the argument presented in this paper, these two behaviors proxy the family's C, its culture in terms of the parent's willingness to invest in children and their resolve to give the child nurturance, support and advantage. If one sees these two discretionary practices as indicative of or as proxies for this willingness, then the interpretation is that, yes, this aspect of family culture is positively associated with the child's test score. Even if the interpretation is not accepted, the empirical result remains: breastfeeding and the child's birthweight are strongly positively associated with the PPVT score.

A more qualified "yes" is found for the fourth question. The breastfeeding and child-rearing practices of the grandparents are weakly positively associated with their grandchild's test score when added to the previous model. But as Table 4 shows, the influence of these four proxies is stronger when the parental proxies, P, are not included, and are quite strong when the parental attributes are also removed (column 4 of Table 4). The pattern shown in Table 4 is in fact what was expected; it supports the notion that these grandparental behaviors both have indirect influence through the child's parent as well as a discernible direct influence even when the measured parental attributes and behaviors are controlled. This is evidence, in this interpretation, of the influence of family culture across generations.

That interpretation here is that we cannot fully measure the family's commitment to investing in their children, so these proxy variables reflect that commitment and capture some of its influence. What more importantly might define the nature of a family than its commitment to its children? Family dynasties are built only in part on the transferable accumulation of economic wealth, and relatively few families have the economic capacity to pass along to their children much accumulated financial wealth. A far larger proportion of families invest in the human capital, the skills, of their children through formal schooling. (See Becker's well-known 1967 Woytinsky Lecture (1991) for a theoretical explanation of this fact also elaborated in Becker and Tomes 1986.) But even more families, indeed nearly all, have the capacity to invest in their young children by sacrificing time, enduring much tedium and repetition, engaging with their young children. Those efforts and investments by parents both influence their child's cognitive development and influence how those children act, as parents, a generation later.

Table 1: Descriptive Statistics for Child of NCDS Variables

<u>Variable Description</u>	<u>Variable Name</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Min-Max Values</u>
Child Test Score				
PPVT	PPVTB	100.05	14.99	1-187
Child Attributes				
Age (years)	AGE	8.16	3.08	3-18
Gender	GIRL=1	0.51	0.50	0-1
Race	WHITE=1	0.98	0.13	0-1
CM-Parent Attributes				
Gender	CMMOM=1	0.63	0.48	0-1
Age at first Birth	AGEPAR	22.97	3.24	15-33
Education- no educ	NOEDUC	0.16	0.37	0-1
Low (cse 4/5)	NOQUAL	0.15	0.36	0-1
O-levels	OQUAL	0.37	0.48	0-1
A-levels	AQUAL	0.11	0.32	0-1
Higher educ	HIGHQUAL	0.18	0.38	0-1
Missing*	MISCMED	0.02	0.13	0-1
Income, gross	INCOMEG	111.3	56.4	4-386
Ln(Incomegr)	LNINCG	4.52	0.76	1.39-5.96
Missing*	MISINCG	0.16	0.37	0-1
Ln(homeprice)	LNHOMEPR	9.60	0.30	6.26-11.51
Missing*	MISLNHPR	0.64	0.48	0-1
Has Bath	BATH	0.98	0.14	0-1
Has Phone	PHONE	0.90	0.30	0-1
Not now on Welfare	NWELFARE	0.89	0.31	0-1
Owens home	OWNHOME	0.73	0.44	0-1
Has Savings	SAVINGS	0.68	0.47	0-1
Never on Welf	NEVERWLF	0.68	0.47	0-1
Has Investments	INVESTM	0.23	0.42	0-1
Income Index	INCINDEX	5.09	1.49	0-7
No. Rooms	ROOM	4.80	1.39	0-19
Religion-Church of Engl.	RELENGL	0.32	0.46	0-1
Catholic	RELCATH	0.10	0.30	0-1
None	RELNONE	0.47	0.50	0-1
Attend Rel Service often	RELOFTEN	0.16	0.37	0-1
Marital history- Alone	ALONE	0.01	0.08	0-1
Split (from coh or mar)	SPLIT	0.24	0.43	0-1
Stable (coh-mar-cont)	STABLE	0.19	0.39	0-1
Married, continuously	MARRIED	0.57	0.50	0-1
CM Full time Employed	CMFTEEMPL	0.45	0.50	0-1
CMFTEmploy*Cmmom	EMPLOYDM	0.13	0.33	0-1
CM's General ability	CMGNABLE	42.77	14.44	0-79
CM's Reading compre.	CMREADTS	15.55	5.41	0-32

(continued)

Table 1: Continued

CM's Math score	CMMATHTS	6.06	9.26	0-39
Missing	MISCMABL	0.13	0.33	0-1
CM's birthweight	CMBRTWT	7.30	1.15	2.25 – 12.75
CMbwt*Cmmom	MOMBWT	4.54 ¹	3.57	0 – 12.75
Missing*	MISCMWT	0.05	0.22	0-1
Grandparent Attributes				
SES lowest	GRPSES1	0.53	0.50	0-1
SES second	GRPSES2	0.18	0.38	0-1
SES third	GRPSES3	0.08	0.26	0-1
SES highest	GRPSES4	0.04	0.21	
Missing*	MISGRSES	0.18	0.38	0-1
Child Experiences				
Number of Siblings	TOTCHLD	2.41	0.89	0-7
Birthweight	BRTWT	7.27	1.20	1.75-11.56
Very low B wt (<1.5kg)	VLOWBWT	0.01	0.10	0-1
Low B wt (1.5-2.5kg)	LOWBWT	0.06	0.24	0-1
Missing*	MISBRTWT	0.02	0.15	0-1
Was Child breast-fed?	BREAST=1	0.63	0.48	0-1
Missing*	MISBREAS	0.02	0.15	0-1
Parents' Behavior				
The child's pregnancy:				
Was it planned?	PGPLAN	0.72	0.45	0-1
When confirmed preg	CMPGCONF	8.00	3.65	1-39
First antenatal visit	CMPG1V	10.19	3.98	1-36
Missing*	MISPG1V	0.06	0.24	0-1
No. drinks/mo dur. preg	CMPGALCN	3.92	6.15	0-31
Missing*	MISPGALN	0.02	0.15	0-1
No. cigs/day during preg	PGSMOCN	0.61	2.65	0-60
Grandparent Behavior (with CM)				
Gr'dmom breast-fed CM	GRPBREAS	0.58	0.49	0-1
Gr'dmom read to CM	MOMREAD	0.41	0.49	0-1
Gr'ddad read to CM	DADREAD	0.30	0.46	0-1
Both grandpar read to CM	BOTHREAD	0.24	0.43	0-1
Mom's School interest: Low	MOMINTL	0.10	0.30	0-1
Some	MOMINTS	0.20	0.40	0-1
More	MOMINTM	0.42	0.49	0-1
Great	MOMINTG	0.24	0.43	0-1
Dad's school interest: Low	DADINTL	0.11	0.31	0-1
Some	DADINTS	0.24	0.43	0-1
More	DADINTM	0.38	0.49	0-1
Great	DADINTG	0.16	0.37	0-1

*If the variable's value was missing, its mean value was substituted for the missing value. A missing-variable dummy variable was created; it mean indicates the percent of cases missing information.

¹The mean (std. dev.) birthweight of dads and moms are, respectively: 7.53 (1.10) & 7.16 (1.15) in pounds.

Table 2: Regression Models: Child's PPVT Test Score

MODEL	#1	#2	#3	#4
Child's attributes				
Age	1.09 (8.62)	1.11 (8.71) (924)*	1.10 (8.67)	1.10 (8.67)
Gender (girl=1)	-0.68 (-1.31)	-0.51 (-0.98) (-0.96)	-0.48 (-0.91)	0.08 (0.13)
Race (white=1)	8.01 (2.47)	7.78 (2.41) (2.21)	7.80 (2.43)	5.66 (1.72)
CM-parent attributes				
CM is female	5.09 (3.23)	5.13 (3.27) (3.12)	5.15 (3.30)	5.07 (3.24)
CM's reading test	0.43 (5.95)	0.41 (5.55) (5.11)	0.39 (5.28)	0.39 (5.31)
CM's math test	0.08 (1.80)	0.08 (1.97) (1.78)	0.07 (1.73)	0.07 (1.57)
Missing cmtests	-1.03 (-1.17)	-0.98 (-1.12) (-1.05)	-0.88 (-1.01)	-0.87 (-0.99)
Education: no quals	1.82 (1.96)	1.68 (1.79) (1.57)	1.45 (1.53)	1.36 (1.44)
O-levels	3.61 (4.12)	3.36 (3.84) (3.51)	3.09 (3.48)	3.05 (3.44)
A-levels	5.04 (4.28)	4.51 (3.83) (3.51)	4.09 (3.42)	3.99 (3.35)
Higher educ	5.34 (4.92)	4.71 (4.33) (3.94)	4.29 (3.89)	4.19 (3.80)
Missing*	6.84 (2.60)	6.58 (2.47) (2.55)	6.40 (2.41)	6.39 (2.41)
Income Index	0.96 (4.28)	0.84 (3.75) (3.45)	0.79 (3.51)	0.76 (3.42)
CM Fulltime emply	3.83 (2.35)	4.04 (2.50) (2.39)	4.10 (2.55)	4.03 (2.50)
Cmftempl*cmmom	-4.89 (-2.76)	-5.07 (-2.90) (-2.72)	-5.12 (-2.93)	-5.03 (-2.87)
Religion: often	1.94 (2.41)	1.69 (2.10) (1.89)	1.56 (1.94)	1.52 (1.89)
Church of Engl	-0.45 (-0.75)	-0.36 (-0.61) (-0.56)	-0.51 (-0.85)	-0.56 (-0.94)
Catholic	-1.73 (-1.69)	-1.49 (-1.47) (-1.32)	-1.51 (-1.48)	-1.52 (-1.49)
Age at First birth	0.60 (4.45)	0.58 (4.32) (4.24)	0.56 (4.14)	0.55 (4.03)
No. Sibs	-0.69 (-2.01)	-0.71 (-2.11) (-1.85)	-0.73 (-2.16)	-0.76 (-2.28)
Grandparent attributes				
Grpar's SES2	0.91 (1.24)	0.79 (1.08) (0.99)	0.63 (0.86)	0.63 (0.86)
Grpar's SES3	2.85 (2.60)	2.79 (2.57) (2.44)	2.23 (2.02)	2.27 (2.04)
Grpar's SES4	3.39 (2.19)	3.22 (2.09) (1.91)	2.32 (1.46)	2.27 (1.43)
Missing*	-0.11 (-0.15)	-0.08 (-0.11) (-0.10)	0.52 (0.68)	0.48 (0.62)
Mother's Investment (Vector P)				
Breastfed=1		2.33 (4.03) (3.79)	2.24 (3.89)	2.29 (3.97)
Missing*		4.47 (2.03) (2.02)	4.55 (2.02)	4.36 (1.99)
Birthweight		0.64 (2.64) (2.57)	0.64 (2.66)	
Predicted				3.18 (2.92)
Residual				0.55 (2.21)
Missing*		-4.37 (-2.10) (-1.77)	-4.39 (-2.12)	-4.34 (-2.10)
Grandparents' Investments (Vector G)				
Gr-mom breastfed			0.76 (1.37)	0.68 (1.23)
Both Grs read			0.92 (1.45)	0.88 (1.39)
Gr-mom low interest			-1.22 (-1.44)	-1.19 (-1.41)
Gr-dad great interest			1.59 (2.10)	1.69 (2.22)
Intercept	50.60 (9.06)	46.12 (7.83) (7.71)	46.90 (7.90)	30.89 (3.40)
Adj-R ²	.171	.180	.184	.185
N	2775	2775	2775	2775

[* See text for explanation: the second set of *t*-statistics adjust for within family clustering.]

Table 3: Regression on Child's Birthweight

	All Children-NCDS*		PPVT-Children	
	<u>Coef (std. err.)</u>		<u>Coef (std. err.)</u>	
Girl(=1)	-0.20	(-5.44)	-0.19	(-4.23)
White (=1)	0.84	(6.05)	0.76	(3.64)
Pregnancy planned?	0.11	(2.49)	0.11	(2.09)
Week preg confirmed	-0.01	(-1.06)	-0.02	(-2.31)
Week first prenatal visit	-0.002	(-0.32)	0.010	(1.35)
Number alcohol drinks during preg.	-0.002	(-0.58)	-0.004	(-1.08)
Number cigarettes during preg.	-0.020	(-2.95)	-0.012	(-1.50)
CM-parent's birthweight	0.19	(11.45)	0.18	(8.96)
Mom's birthweight	0.012	(2.27)	0.008	(1.33)
Intercept	5.13	(28.16)	5.24	(19.94)
Prob>F	.000		.000	
Adj-R ²	.06		.05	
N	4228		2775	

* All analyses use this regression with 4228 observations. The second regression includes only the 2775 children with a PPVT score. For that subset, the mean predicted birthweight is 7.27.

	Mean	Std. Dev.	Min-Max
Actual birthweight	7.27	1.20	1.75 – 11.56
Predicted birthweight	7.31	0.29	5.96 – 8.64
Residual	-0.03	1.17	-5.50 – 4.46

Table 4: Regressions Featuring the Vectors G and P

	One	Two	Three	Four	Five
Child's attributes					
Age	1.10 (8.67)	1.08 (8.56)	0.27 (2.99)	0.38 (4.14)	0.21 (2.28)
Gender (girl=1)	-0.48 (-0.91)	-0.65 (-1.24)	-0.71 (-1.31)	-0.54 (-1.00)	-0.71 (-1.28)
Race (white=1)	7.80 (2.43)	8.05 (2.50)	8.68 (2.91)	8.72 (2.96)	9.59 (3.22)
CM-parent attributes					
CM is female	5.15 (3.30)	5.11 (3.26)			
CM's reading test	0.39 (5.28)	0.41 (5.64)			
CM's math test	0.07 (1.73)	0.07 (1.56)			
Missing cmtests	-0.88 (-1.01)	-0.92 (-1.05)			
Education: no quals	1.45 (1.53)	1.56 (1.64)			
O-levels	3.09 (3.48)	3.30 (3.71)			
A-levels	4.09 (3.42)	4.58 (3.83)			
Higher educ	4.29 (3.89)	4.89 (4.44)			
Missing*	6.40 (2.41)	6.23 (2.53)			
Income Index	0.79 (3.51)	0.90 (4.03)			
CM Fulltime emply	4.10 (2.55)	3.88 (2.39)			
Cmftempl*cmmom	-5.12 (-2.93)	-4.95 (-2.80)			
Religion: often	1.56 (1.94)	1.81 (2.24)			
Church of Engl	-0.51 (-0.85)	-0.60 (-1.00)			
Catholic	-1.51 (-1.48)	-1.75 (-1.71)			
Age at First birth	0.56 (4.14)	0.58 (4.25)			
No. Sibs	-0.73 (-2.16)	-0.70 (-2.06)			
Grandparent attributes					
Grpar's SES2	0.63 (0.86)	0.75 (1.02)			
Grpar's SES3	2.23 (2.02)	2.27 (2.03)			
Grpar's SES4	2.32 (1.46)	2.49 (1.55)			
Missing*	0.52 (0.68)	0.56 (0.72)			
Mother's Investment					
Breastfed=1	2.24 (3.89)			4.66 (8.10)	5.82 (9.99)
Missing*	4.55 (2.02)			2.04 (0.87)	1.51 (0.62)
Birthweight	0.64 (2.66)			0.85 (3.44)	0.96 (3.77)
Missing*	-4.39 (-2.12)			-3.88 (-1.63)	-2.93 (-1.19)
Grandparents' Investments					
Gr-mom breastfed	0.76 (1.37)	0.90 (1.61)	1.48 (2.64)	1.07 (1.95)	
Both Grs read	0.92 (1.45)	0.93 (1.47)	1.84 (2.80)	1.66 (2.57)	
Gr-mom low interest	-1.22 (-1.44)	-1.34 (-1.58)	-5.77 (-6.73)	-4.90 (-5.79)	
Gr-dad great interest	1.59 (2.10)	1.54 (2.01)	6.74 (9.28)	6.18 (8.60)	
Intercept	46.90 (7.90)	51.48 (9.15)	87.85 (28.48)	77.99 (21.78)	78.65 (21.81)
Adj-R ²	.184	.174	.065	.092	.049
N	2775	2775	2847	2847	2847

**Table 5: PPVT Actual and Estimated from Model #4, Table 2,
by Selected Variables**

Panel A: CM-Parent's Education Level

	Actual PPVT	Estimated with all other variables at their means	(N)
CM-Parent's Education			
No education	92.88	97.73	(453)
No Qualifications	97.00	99.09	(427)
O-Levels	100.66	100.78	(1033)
A-Levels	103.55	101.72	(317)
Higher education	105.67	101.92	(496)

Panel B: Family Income {measured by ln(income)}

Family Income ¹	Actual PPVT	Regression Predicted Value	Estimated at mean Incindex with other vars. at their means	(N)
Lower than $\mu - s$	97.31	98.77	99.64	(281)
Between $\mu - s$ & $\mu + s$	100.03	100.01	100.10	(2265)
Above $\mu + s$	104.17	102.61	100.63	(229)

**Panel C: Joint & Separate Influence on PPVT of Breast-feeding & Mother's efforts
re Birthweight (total and for those with O-Level education)**

Breast Feeding	Predicted Birthweight ²			Total
	Low ($\mu - s$)	Mid ($\mu +/- s$)	High ($\mu + s$)	
i. All Children: Average Actual PPVT				
No	92.93 (123)	96.63 (736)	97.71 (138)	96.32 (997)
Yes	99.95 (203)	102.11 (1281)	105.27 (239)	102.29 (1723)
Total	97.28 (327)	100.09 (2063)	102.53 (385)	100.10 (2775)
ii. All Children: Average Predicted PPVT				
No	92.73 (123)	96.50 (736)	98.58 (138)	96.32 (997)
Yes	99.02 (203)	102.45 (1281)	104.23 (239)	102.29 (1723)
Total	96.60 (727)	100.27 (2063)	102.18 (385)	100.10 (2775)
iii. CM-parent has O-level education qualifications: Average Predicted PPVT				
No	95.96 (34)	98.04 (269)	99.57 (51)	98.06 (354)
Yes	100.03 (89)	102.05 (480)	103.89 (93)	101.85 (662)
Total	98.91 (123)	100.60 (763)	102.41 (147)	100.66 (1033)
iv. Regression-estimated PPVT with all other variables at their means:				
No	97.00	98.65	100.04	98.65
Yes	99.28	100.94	102.33	100.94
Total	98.44	100.10	101.49	100.10

¹ The μ & s of ln(income) are 4.518 & 0.757, so the values used are <3.76; 3.76-5.27; >5.27.

² The μ & s of predicted birthweight are 7.307 & 0.289, so the values used are <7.0; 7.0-7.6;>7.6.

Table A1: Additional Regression Models: PPVT Test Scores

	Two-Stage Least Squares	<u>Adjusting for Multiple Children from a Family</u>		
		One Child	Two Children	All
Child's attributes				
Age	1.22 (8.64)	0.33 (0.95)	1.29 (4.42)	1.14 (7.23)
Gender (girl=1)	0.03 (0.05)	-0.73 (-0.78)	-1.66 (-1.39)	-0.71 (-0.85)
Race (white=1)	5.81 (1.76)	9.01 (1.97)		
CM-parent attributes				
CM is female	5.28 (3.37)	1.97 (0.70)		
CM's reading test	0.35 (4.56)	0.50 (3.89)		
CM's math test	0.09 (1.99)	0.06 (0.84)		
Missing cmtests	-0.97 (-1.09)	-0.02 (-0.01)		
Education: no quals	1.20 (1.24)	0.89 (0.54)		
O-levels	2.83 (3.13)	3.50 (2.25)		
A-levels	3.44 (2.80)	3.89 (1.79)		
Higher educ	3.66 (3.15)	4.70 (2.51)		
Missing*	6.17 (2.19)	6.19 (1.81)		
Income Index	0.64 (2.77)	1.48 (3.93)		
CM Fulltime emply	4.21 (2.61)	1.15 (0.41)		
Cmftempl*cmmom	-5.34 (-3.02)	-0.94 (-0.30)		
Religion: often	1.30 (1.57)	0.63 (0.43)		
Church of Engl	-0.45 (-0.74)	0.12 (0.12)		
Catholic	-1.14 (-1.08)	-0.22 (-0.12)		
Age at First birth	0.68 (4.59)	-0.47 (-1.36)		
No. Sibs	-0.81 (-2.35)	0.07 (0.11)		
Grandparent attributes				
Grpar's SES2	0.40 (0.53)	0.99 (0.79)		
Grpar's SES3	1.94 (1.71)	1.19 (0.61)		
Grpar's SES4	2.26 (1.40)	5.79 (1.78)		
Missing*	0.51 (0.66)	-0.00 (-0.00)		
Mother's Investment				
Breastfed=1	2.02 (3.40)	3.30 (3.30)	-0.20 (-0.11)	-0.18 (-0.14)
Missing*	5.27 (2.26)	2.88 (0.79)	7.65 (1.01)	5.99 (1.08)
Birthweight	3.17 (2.54)	-0.25 (-0.6)	0.87 (1.10)	0.87 (1.81)
Missing*	-4.72 (-2.26)	0.36 (0.13)	-23.64 (-1.40)	-6.97 (-1.33)
Grandparents' Investments				
Gr-mom Breastfed	0.77 (1.37)			
Both Grs Read	0.96 (1.48)			
G-mom low interest	-1.09 (-1.25)			
GR-dad great interest	1.80 (2.15)			
Intercept	28.12 (2.55))	79.87 (6.32)	85.57 (12.58)	84.79 (21.20)
Adj-R ²	.144	.174	.754	.788
N	2775	854	1045	1921

Table A2: Regression Models on Subsets of Children: PPVT Test Scores
(Subsets of cases, estimating model #4, Table 2)

	CM-Mom	CM-Dad	Child = 8	Child > 8
Child's attributes				
Age	1.06 (6.83)	1.11 (4.82)	0.98 (3.76)	1.86 (5.72)
Gender (girl=1)	-0.05 (-0.07)	0.08 (0.08)	0.01 (0.02)	0.01 (0.01)
Race (white=1)	-2.45 (-0.75)	12.05 (2.29)	8.74 (2.26)	2.26 (0.42)
Cm-parent attributes				
CM is female	--	--	5.06 (2.62)	5.50 (2.12)
CM's reading test	0.38 (3.90)	0.41 (3.47)	0.40 (4.24)	0.37 (3.17)
CM's math test	0.06 (1.16)	0.09 (1.30)	0.04 (0.66)	0.11 (1.67)
Missing cmtests	-1.21 (-1.28)	-0.19 (-0.11)	-0.96 (-0.85)	-1.35 (-0.95)
Education: no quals	2.05 (1.90)	-0.24 (-0.13)	0.87 (0.54)	1.44 (1.23)
O-levels	3.31 (3.09)	2.47 (1.50)	3.43 (2.33)	2.41 (2.10)
A-levels	4.01 (3.07)	2.45 (1.29)	3.71 (2.10)	3.85 (2.25)
Higher educ	5.69 (4.12)	1.73 (0.91)	4.47 (2.64)	3.83 (2.48)
Missing*	5.74 (1.66)	9.02 (2.49)	0.87 (0.17)	9.82 (3.35)
Income Index	0.83 (3.14)	0.77 (1.84)	0.74 (2.28)	0.79 (2.52)
CM Fulltime emply	--	3.91 (2.13)	4.43 (2.25)	3.40 (1.25)
Cmftempl*cmmom	-1.52 (-1.77)	--	-7.04 (-3.00)	-3.35 (-1.20)
Religion: often	2.10 (2.29)	0.31 (0.19)	2.29 (2.18)	0.13 (0.10)
Church of Engl	-0.09 (-0.12)	-1.43 (-1.31)	-0.56 (-0.70)	-0.52 (-0.59)
Catholic	-0.67 (-0.59)	-2.83 (-1.44)	-1.51 (-1.17)	-1.54 (-0.92)
Age at First birth	0.39 (2.22)	0.66 (2.99)	0.33 (2.08)	1.40 (4.63)
No. Sibs	-1.23 (-3.04)	-0.13 (0.21)	-1.02 (-2.18)	-0.41 (-0.84)
Grandparent attributes				
Grpar's SES2	0.29 (0.31)	1.29 (1.09)	2.52 (2.76)	-2.11 (-1.72)
Grpar's SES3	2.77 (2.06)	1.26 (0.65)	2.61 (1.89)	1.95 (1.03)
Grpar's SES4	1.78 (1.01)	2.32 (0.76)	2.10 (1.30)	4.78 (1.12)
Missing*	-0.03 (-0.03)	1.01 (0.75)	1.21 (1.16)	-0.49 (-0.43)
Parent's Investment				
Breastfed=1	1.00 (1.36)	4.19 (4.46)	2.94 (3.75)	1.69 (1.97)
Missing*	7.23 (2.11)	2.67 (0.84)	4.06 (1.28)	4.58 (1.62)
Birthweight				
Predicted	2.57 (1.94)	4.41 (2.20)	3.19 (2.26)	3.17 (1.88)
Residual	0.15 (0.46)	1.06 (2.70)	0.43 (1.37)	0.64 (1.64)
Missing*	-4.50 (-1.62)	-4.46 (-1.39)	-4.58 (1.74)	-4.34 (-1.47)
Grandparent's Investments				
Gr-mom breastfed	0.79 (1.19)	0.46 (0.47)	0.29 (0.39)	0.96 (1.15)
Both Grs read	0.05 (0.06)	2.80 (2.70)	1.29 (1.61)	-0.00 (-0.00)
Gr-mom low interest	-1.11 (-1.12)	-0.95 (-0.59)	1.29 (0.94)	-2.95 (-2.81)
Gr-dad great interest	2.15 (2.22)	1.06 (0.86)	0.84 (0.91)	3.90 (2.81)
Intercept	53.65 (5.32)	10.90 (0.65)	34.27 (3.19)	7.82 (0.46)
Adj-R ²	.176	.232	.190	.214
N	1762	1013	1595	1180

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