INCOME AND CHILD DEVELOPMENT

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ABSTRACT

We examine how income influences pre-school children's cognitive and behavioral development, using new data from a birth cohort study of children born at the end of the 20th century. On average, low income children have lower PPVT scores, more mother-reported aggressive, withdrawn, and anxious behavior problems, and also more interviewer-reported problems with behavior, than more affluent children. For most outcomes, differences in the home environments are sufficient to explain the link between low income and poorer child outcomes. Policy simulations indicate that income transfers can potentially play an important role in reducing gaps in development between poorer and richer children.

I. Introduction

Children from less well-off families are at greater risk than wealthier children for poor cognitive, behavioral and health outcomes. If these associations between children's outcomes and the economic status of their families reflect causal relationships—so that the poorer outcomes of less wealthy children can be attributed to their low incomes—they have implications for the intergenerational transmission of poverty. Children who have worse cognitive, behavioral and health outcomes may be more likely to obtain less education and have lower earnings as adults, and to go on to rear their children in poorer environments. This line of reasoning suggests that policies and programs that improve outcomes for low-income children may break—or at least dampen—the links between poverty across generations.

In this paper, we examine the routes through which income may influence children's cognitive and behavioral development, taking advantage of new data from the Fragile Families and Child Wellbeing (FF) study, a birth cohort study of children born at the end of the 20th century in 20 U.S. cities. The FF study over-sampled children who were born to unmarried parents. For this reason, the sample is both racially and ethnically diverse, and includes large numbers of children from low-income families. The FF study collected a wide array of data during the first three years of the children's lives. The study interviewed children's parents at the time of the birth, and then followed up with telephone interviews with both parents when the children were one year and three years old. At three years, families were also asked to participate in an in-home assessment. The in-home module was designed to assess multiple domains of parenting, material aspects of the home environment, mother-child interactions, and the child's language ability and behavior, using both a questionnaire and a set of interviewer observations. Taken together, these data provide unusually detailed information on child developmental outcomes as well as factors that are likely to influence those outcomes.

The focus of this paper is on whether differences across lower and higher income children in the quality of the home environment—defined to include parenting behaviors and characteristics, as well as

material aspects of the home environment—can account for the income gradients observed in measures of child development. We first document associations between family income and detailed measures of the home environments in which young children live. We show that low-income children are disadvantaged across multiple dimensions: they have mothers who are more likely to be depressed, anxious, and stressed; receive parenting that is less warm and responsive; have home environments that provide less cognitive stimulation; and live in homes and neighborhoods with more safety problems. The associations between family income and these measures of the child's home environment are robust to the inclusion of a wide set of controls for household socioeconomic and demographic characteristics.

We then turn to the analysis of a set of child developmental outcomes, including language ability and several measures of behavior problems. Like the measures of the child's home environment, these outcomes are strongly associated with family income. However, the associations between children's outcomes and family income are almost fully accounted for by household socioeconomic characteristics and the measures of the child's home environment. Although it is difficult to establish whether these relationships are causal, the results are consistent with the hypothesis that low incomes influence children's developmental outcomes in large part through their effects on multiple aspects of the child's home environment.

Finally, we provide some illustrative calculations of the effects of different poverty alleviation programs on closing the gaps in developmental outcomes between children from low-income and more affluent families. These calculations rely on the assumption—which may or may not be correct—that the associations we document between income and measures of the child's home environment, and between the child's home environment and child outcomes, are in fact causal. Given this caveat, our results indicate that moderately large transfers could go some way to reducing income-related disparities in children's outcomes. For example, we estimate that a transfer program that provides $2,400 per child per year to families with incomes of less than $60,000 would close the gap in the language ability score

between poor and near-poor children by 9 to 15%, and would have larger effects on the gaps in behavioral outcomes between these groups. A more narrowly targeted program, which raises the family incomes of all children in poverty up to the poverty line, would have even more substantial effects on narrowing the gaps between poor children and their near-poor neighbors.

II. Background

A large number of papers investigate the associations between families' economic resources and children's development. Recent examples include Blau (1999), Shea (2000), Maurin (2002), Auginbaugh and Gittleman (2003), and Taylor, Dearing, and McCartney (2004).[1] A broad conclusion of this work is that there are clear associations between family income and measures of children's intellectual and behavioral development. However, the interpretation of these associations, and their implications for policy, has been debated.

A critical issue in interpreting these associations is whether the estimated effects of income on children's outcomes are biased. There are two types of problems that are likely to lead to biased estimates. One is measurement error in income. If the measurement of income is noisy, then classic attenuation bias will bias the coefficient on income toward zero. A similar result will occur if children's outcomes depend on "permanent" rather than transitory income. A common finding from previous research is that the estimated effects of income on children's outcomes are larger when income is averaged over multiple years (see, for example, Korenman, Miller, and Sjaastad, 1995; Mayer, 1997; Blau, 1999). This is consistent with the idea that there is measurement error in income—which is reduced via averaging—or that permanent rather than transitory income is the key determinant of children's outcomes. In this paper, we address this potential problem by carrying out our estimates using two different measures of income: income at age 3; and income averaged over the three years of

[1] See also books by Mayer (1997) and Duncan and Brooks-Gunn (1997). A related literature examines the effects of maternal employment on young children's development, for example, Waldfogel, Han, and Brooks-Gunn (2002); Brooks-Gunn, Han, and Waldfogel (2002); and Ruhm (2004).

our data. The fact that the children in this sample are only age 3, and that we have up to three data points on income over the three years (at birth, 1 year post-birth, and 3 years post-birth) gives us confidence that we have a fairly accurate measure of family's economic resources during the child's lifetime to date.

A second important source of bias is endogeneity. In particular, if relevant child or family characteristics that are positively correlated with both income and child outcomes are not observed, the effects of income will be biased upwards in models that omit those characteristics. If the bias is sufficiently severe, income may not be causally related to children's outcomes at all, but may instead merely be a marker for the other child or family characteristics, and policies that change incomes will not affect children's outcomes. The endogeneity problem is widely recognized (see, for instance, Mayer, 1997) and the existing literature contains several different strategies for handling it, including the use of instrumental variables techniques, fixed effects models, and controlling for family characteristics that are correlated with income and could influence children's outcomes. Each of these strategies has disadvantages. Instrumental variables techniques, for example, rely on the identification of variables that affect income but are uncorrelated with the error term in equations for children's outcomes. Finding good candidates for instruments is difficult, especially if what matters for children's outcomes is permanent rather than transitory income. For example, Shea (2000) uses information on parents' union status, industry, and job losses as instruments; if these identify short-term variations in income but not differences in permanent income across children, estimates of effects of income may well be too small. Similarly, fixed effects models, such as those estimated by Blau (1999), are well-suited to identifying the effects of short-run changes in family income on children's outcomes but less well-suited to capturing long-run changes.[2]

[2] In addition, a small number of studies have used data on adopted children in an attempt to separate the effects of income from the effects of heredity. A study of a small sample adopted twins by Scarr and Weinberg (1978) found no correlation between the income of the adopting family and children's educational outcomes; however, a more recent study by Duyme et

In this paper, we follow the approach of controlling for an extensive set of background characteristics, including maternal cognitive ability, to reduce problems associated with unobserved heterogeneity. This approach is sensible, given that the FF data contain a rich set of family background characteristics measured over the children's lives, and also given that its sample is relatively homogeneous. Children are drawn from only 20 cities, and within each of the cities, children were born in the same set of hospitals. Thus, we are comparing children to their "neighbors", even when we are comparing low-income children to more affluent children. And, low-income children make up a large share of our sample: 45% are below the poverty line, and another 25% have incomes between 100 and 200% of poverty (the remaining 30% have incomes above 200% of poverty). These income groupings contrast sharply with the samples used in prior research.[3] However, like the fixed effects and instrumental variables approaches discussed above, this strategy also has limitations: in spite of the rich data and the relatively homogeneous sample, there may be remaining family characteristics that really drive the associations between income and children's outcomes. The conclusions we draw must therefore be treated with appropriate caution.

In terms of drawing policy implications, one key issue is whether the size of the associations between income and child outcomes is "large" or "small". That is, assuming that we have estimates that are unbiased, how much does income matter? Results from a variety of data sources, including the National Longitudinal Survey of Youth (NLSY) (for the United States) and 1958 National Child Development Study (NCDS) (for Britain) have tended to indicate that the estimated effects of income are "small" relative to those of family characteristics other than income. For example, Aughinbaugh and

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al. (1999) found a strong correlation between the adoptive family's income and child IQ post-adoption. There are also a small number of studies that have used data from experiments (Morris and Gennetian 2003; Morris, et al., 2004) or natural experiments (Costello et al., 2003) and find positive associations between exogenous increases in income and improvements in child outcomes.

[3] In the NICHD-SECC, for instance, only 17% of children had incomes below the poverty line at age 3 (Dearing, McCartney, and Taylor, 2001). In the NLSY, about a third of children have incomes below poverty (see, for instance, Guo and Harris, 2000).

Gittleman (2003) find that a $10,000 increase in income is associated with a much smaller gain in test scores than would be produced by having a maternal grandfather who worked in the highest occupational class rather than the lowest. [4]

This sort of comparison, although interesting, has several shortcomings. First, money and grandfathers' occupations are not measured in common units, and converting to money units could yield different conclusions: the cost of providing the education required to move someone from the lowest to the highest occupational class could far exceed $10,000. Second, and more generally, broad measures of "social class" are often not amenable to change via policies. This is clearly the case for grandfathers' occupations and factors such as race and ethnicity. Family background characteristics such as maternal education may be amenable to change, but here again the policy-relevant calculation is to compare the costs of improving children's outcomes via policies that increase maternal education with those that do so via policies that provide money. This point is made by Taylor, Dearing and McCartney (2004), who compare the effects of income transfers relative to those of equally expensive Head Start programs, and find that cash transfers compare favorably to Head Start.[5]

A related issue in terms of drawing policy conclusions is whether the associations between income and child development are constant across groups. Two sources of variation have received particular attention. The first has to do with the age of the child. Virtually all studies that have examined children separately by age group have found that the effects of income are strongest in early childhood (see e.g. Duncan and Brooks-Gunn, 1997; and Morris et al, 2004). Second, it appears that the effects of income are larger for children in low-income or less-educated families than for children in

[4] Other authors have found larger effects. See, most recently, Dahl and Lochner (2005) whose estimates using a fixed effects instrumental variables strategy suggest that increasing income by $1,000 raises math test scores by 2% and reading test scores by 3.6% of a standard deviation. See also Maurin (2002) who, in French data, finds that the effects of parental poverty on a child being held back in elementary schools are larger than the effects of other characteristics such as the child's age or gender.

[5] Dearing, McCartney, and Taylor (2001), in a similar vein, compare the effect of income to maternal education and find that the effect of income is about two-thirds as large. Both studies use the NICHD Study of Early Child Care (NICHD-SECC).

more advantaged families. Shea (2000), for example, found no effects of exogenous income changes on child development in his overall sample, but did find positive effects in families where the fathers had low levels of education, while others (e.g. Smith, Brooks-Gunn, and Klebanov, 1997; Dearing, McCartney, and Taylor, 2001; and Maurin, 2002) have found that income matters more to children in poverty than to children in higher-income families. These findings suggest that we might expect to find larger effects of income on child development in our sample, than have been found in some prior samples, because our sample consists of young children and children who are primarily low-income. If income does matter for child development, ours is a sample where we would expect to see that.

A final question that has to do both with the interpretation of income effects, and their implications for policy, is the route by which income affects child outcomes. Much of the literature on pre-school children stresses the role of the home environment, broadly defined to include what parents provide for their children as well as how parents interact with their children (Bornstein, 2002; Magnuson and Duncan, 2002; Brooks-Gunn and Markman, 2005). The recent literature on income and child development hypothesizes that low incomes affect child development through two major routes. First, children who are low-income may live in physical environments that offer less stimulation and fewer resources for learning. Their parents may be less able to purchase games and toys that promote learning, to live in places that are safe for outdoor play, or to provide their children with high-quality childcare. Second, poverty may affect the quality of parenting children receive. Developmental psychologists define quality of parenting in terms of its sensitivity and responsiveness to the child (Shonkoff and Phillips, 2000). Low-income parents may be more depressed or stressed; as a consequence, they may be harsher with their children and less responsive to their needs.

Although, in theory, a broad set of aspects of the home environment may affect child development, few data sets contain detailed measures of parenting quality and materials aspects of the home environment. The strategy taken by most studies has been to construct a handful of indexes that

measure different domains of the home environment—for example, cognitive stimulation and emotional support—and examine whether the inclusion of these indexes in models reduces or eliminates the association between income and child outcomes. These studies also often examine whether some indexes of the home environment matter more for children's outcomes than others.[6] In general, researchers have concluded that measures of the home environment account for a large portion of the association between children's outcomes and income, and that cognitive stimulation has a larger impact on children's scores on language and achievement tests than does emotional support (Guo and Harris, 2000; Yeung, Linver and Brooks-Gunn, 2002; Aughinbach and Gittleman, 2003).

A possible problem with this approach is that the quality of the home environment may be measured with noise. For example, measures of parenting based on the HOME score (the most commonly used measure) are based on interviewers' observations of parent-child interactions during a short period of time on a single day. Similarly, the assessment of the cleanliness and degree of organization in a child's home at one point in time is likely to be an imperfect measure of the physical environment over an extended period of time. Although all of these measures may be useful proxies for the true underlying quality of a child's home environment, the fact that they are likely to be measured with error may produce attenuation bias in estimates of their effects.

An alternative strategy, which we follow in this paper, is to use a much larger set of measures of the home environment than has been used in previous work and to view each of these measures as a proxy for "quality of the home environment", which is not directly observed but is assumed to influence children's outcomes. Estimating models with a large set of proxies for quality—many of which are

[6] For example, Aughinbach and Gittleman (2003) use two measures from the HOME scale—one for cognitive stimulation and another for emotional support. Taylor, Dearing and McCartney (2004) use the overall HOME score and measures of maternal verbal intelligence and maternal depression. Guo and Harris (2000), using the NLSY, conduct analyses that break the HOME items into three groups—the child's physical environment; "parenting style", which is similar to Aughinbach and Gittleman's measure of emotional support; and cognitive stimulation, and conduct analyses using structural equation modeling. Gershoff et al. (2005) also use structural equation modeling in their study of income and material hardship and child outcomes.

correlated with each other, and which measure similar constructs in different ways—makes it difficult to interpret the coefficients on the individual proxy measures. However, Lubotsky and Wittenberg (2004) provide a method for aggregating coefficients to obtain an estimate of the effect of quality of the home environment that minimizes attenuation bias. This method is described in more detail below.

III. Data and Methods

Data

Our data are drawn from an in-home module of the *Fragile Families and Child Wellbeing Study* (FF). FF is a longitudinal birth cohort study that began in 1998 with a baseline sample of 4,898 births in 20 U.S. cities (a complete description of the sample and design is in Reichman, et al., 2001). The survey contains an over-sample of non-marital births. As a consequence, children in the sample are more likely to be poor, to have absent fathers, and to have mothers with lower levels of education than children in a nationally representative sample. The sample is also racially diverse: 47% of the mothers originally sampled identified themselves as non-Hispanic African American and 27% as Hispanic.

Families were surveyed at the time of the child's birth and by telephone when the children were one year and three years old. After the age three interview, families were asked to participate in an in-home assessment in which children and their mothers were administered the Peabody Picture Vocabulary Test-Revised (PPVT-R) (a test of receptive vocabulary), mothers were asked about their parenting behaviors, and interviewers assessed the behaviors of mothers and children, as well as their interactions with each other. The main sample used for this study consists of data on 1,699 children whose families participated in the in-home study and for whom we had complete information on all variables used the analyses.[7]

[7] 4,231 families completed the core telephone interview at age 3. Of these 3,355 completed some portion of the "in-home" assessment and 2,179 completed the portions of the in-home assessment that included child observations. An additional 480 observations were excluded due to missing values for at least one of the control variables used in the analyses. There are several reasons why child observations are not available for some families. In the majority of cases, families completed the survey portion of the "in-home" assessment over the telephone because home visits could not be completed—either because the family refused or had moved to a location where they could not be interviewed in person. In a smaller number of cases, an in-home survey was conducted but the child was not available to be assessed. Appendix Table 1 shows means for basic socioeconomic variables measured at baseline and at the age 3 core interview for increasingly restricted samples. These results indicate that, overall, the observable characteristics of the final sample used are quite similar to those of the baseline

The analyses described below use information on family income, a set of family background characteristics, a set of measures of the home environment, and a set of child outcomes. We use two measures of family income. Our first measure is family income received in the year before the 36-month telephone survey. The second is a "long-term" income measure, which averages income at the baseline survey (i.e. just following the child's birth), the 12-month survey, and the 36-month survey.[8] All income values are deflated to 1999 dollars before averaging.[9] The regression models shown below use the logarithm of income, either from the 36-month survey or the average over all survey waves. We prefer to use the logarithm of average income rather the average logarithm of income, because we avoid losing families who report no income in one or two of the three years.

The family background variables (which we refer to below as "extended SES controls") include measures of the total number of family members, and the number of members who are ages 0 to 5, 6 to 11, and 12 to 17; indicators for the mother's race and ethnicity (coded as non-Hispanic white, non-Hispanic African-American, Hispanic, and "other"); indicators for the mother's level of education (coded as less than a high school degree, a high school degree, or post-high school education); indicators for family structure at age three (coded as mother living with and married to the child's biological father, cohabiting with the child's biological father, married to or living with a new partner, or neither cohabiting nor married); and the mother's score on the PPVT. We also included an indicator for whether or not the mother took the Spanish version of the PPVT (the TVIP), which serves as measure of whether the mother's primary language is Spanish rather than English.[10]

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and core age 3 samples. The families that participate in the in-home survey have slightly lower incomes on average at age 3 than those who completed the age 3 core interview. Those that have child observations are more likely to be black, and to have lower incomes, and are less likely to be married to the child's father at age 3 than those who participated in the in-home survey but do not have child observations. Note that our sample sizes vary slightly for different analyses due to missing values for the various child outcomes. In addition, the sample sizes are slightly larger when we use the "long run" measure of income, since this measure is available for more observations.

[8] For the cases in which income is missing for one or two waves of the survey, we compute "long-run" income as the average over the available measures. This will introduce some measurement error into long-run income. However, only 155 observations had missing income information in one wave, and only 6 had missing income information in two waves.

[9] The interview schedule is staggered across cities, so that children turned three in some cities more than a year before they turned three in other cities.

[10] The Fragile Families sample included only births to mothers whose primary language was English or Spanish.

We use a set of 17 "proxy" measures of the quality of the home environment, which cover maternal characteristics, measures of parenting behavior including parent-child interactions, and measures of the child's material environment (details are in the Appendix). The five measures of maternal characteristics include maternal depressive symptoms (using an 8-point scale drawn from the Composite International Diagnostic Interview-Short Form (CIDI-SF) (Nelson, et al., 1998)), maternal anxiety (using a 13–point scale from the CIDI-SF), maternal stress (using 11 items adapted from a measure used in the Early Head Start Study), the interviewer's assessment of whether the mother lacked verbal and social skills, and the interviewer's assessment of whether the mother was "difficult to interview" (this included items such as whether the mother was articulate, cooperative, and attentive during the interview, and whether she appeared to understand the questions being asked). We use four measures of parenting behavior and parent-child interactions. Two of these—whether the mother is harsh or unresponsive—are interviewer-assessed measures drawn from subscales of the Home Observation for Measurement of the Environment (HOME) (see Bradley, 1993; Caldwell and Bradley, 1984).[11] The other two parenting behavior measures are binary measures based on maternal reports. The first is an indicator for whether the mother said she would physically punish the child if the child had a tantrum in a public place, and the second is based on the "child neglect" subscale from the Conflict Tactics Scales, which asks mothers if they engaged in specific neglectful activities such as leaving the child unattended, or if drug or alcohol problems interfered with the care of the child. Because few mothers admitted to these behaviors, this variable was coded as a binary indicator of whether any of the neglectful behaviors occurred in the past year.

The six measure of the child's physical environment include a measure from the HOME scale of lack of materials for cognitive stimulation; measures of whether the interviewer noted problems with the child's block, home exterior, and home interior; a measure of whether the interviewer noted specific safety problems in the child's home; and a measure of "home disorganization" which is based on the

[11] The development and psychometric properties of these particular subscales are described in Fuligni, Han, and Brooks-Gunn (2004) and Leventhal, Martin, and Brooks-Gunn (2004). These subscales are also sometimes referred to as measuring "punitiveness" and "lack of responsivity."

interviewer's observations of whether the home was cluttered, dirty, or dark. Finally, we use two measures that could be classified as either aspects of the child's physical environment or aspects of parenting. These include a measure of food insecurity (from the USDA scale), and a measure of the number of hours of TV the child watches in a typical week. Food insecurity could be a consequence of low income, but could also reflect the parent's degree of organization and the priority she places on food relative to other types of expenditures. High levels of TV viewing could indicate that the parent is less engaged with her child or concerned with her child's development, but could also be the consequence of unsafe neighborhoods that limit a child's outdoor activities.

We do not include in our measure of the home environment information about out-of-home child care, as our focus is on parenting and other aspects of the home. However, we have information on whether a child was attending child care at the time of the age 3 assessment, as well as whether that child care arrangement was home-based or center-based. While we do not include these controls in our main models, we do include them in supplemental models as robustness checks.

We examine how income and the home environment measures are associated with five measures of children's outcomes. Language ability is measured by the child's age-standardized score on the PPVT.[12] The PPVT is a widely-used measure of receptive vocabulary that measures the size and range of words that the respondent understands. PPVT scores in early childhood have been shown to be correlated with literacy outcomes in young adulthood (Baydar, Brooks-Gunn and Furstenberg, 1993). Furthermore, earlier work has found that other measures of cognitive ability, such as the Stanford-Binet and the Wecshler PreSchool and Primary Scale of Intelligence, have associations with income that are similar to that of the PPVT (Smith et al, 1997).

We use four measures of the child's behavior problems. Three are subscales from the Achenbach Child Behavior Checklist. These include measures of whether the child is withdrawn, aggressive, and anxious. One potential shortcoming of these measures is that they are based on maternal report. It is possible that maternal characteristics that influence parenting—such as depression or stress—could

[12] Seventy-eight children whose spoke primarily Spanish took the TVIP, and age-standardized scores for these children were used.

color how mothers answer questions about child behaviors. For this reason, we also use a measure of how the interviewer rated the child's behavior during the interview, with an emphasis on how persistent and cooperative the child was when completing the PPVT and other assessments conducted in the home. This measure is crude, but displays significant associations with the Achenbach subscales for withdrawn and aggressive behaviors.[13]

The seventeen proxy variables for the quality of home environment and the six child outcome variables are measured in very different ways: some are binary variables, some are scales with a limited number of discrete outcomes, and others can take a wide range of values. In our regression analyses, we standardize all proxies by subtracting the sample mean and dividing by the standard deviation. This standardization assists in the interpretation of results.

Methods

We start by examining the relationship between family income and the proxy measures of the quality of the child's home environment described above. Let Z^j denote the j^{th} measure (out of a total of J) of the child's home environment, $\ln(y)$ denote the logarithm of family income, and X denote the set of "extended SES controls" described above. We first estimate a set of equations:

$$(1) \qquad Z^j = \beta^j + \beta_y^j \ln(y) + \varepsilon^j,$$

which include, in addition to the logarithm of income, a set of indicators for the child's sex, the child's age (in months), and a set of indicators for the city of birth. These basic controls for sex, age and city are included in all models that follow. The city of birth indicators may capture differences in home environments common to children within cities, and will also capture price differences across cities.

Although estimates of (1) provide information on the associations between income and measures of children's environments, it is possible that the coefficients on income instead reflect other

[13] A regression of the interviewer-rated behavior problems on the three Achenbach subscales indicates that a 1-standard deviation increase in the Achenbach measure of withdrawn behavior is associated with a significant increase in the interviewer-rated scale of 0.16 standard deviation; a 1-standard deviation increase in the measure for aggressiveness is associated with an increase in the interviewer-rated scale of 0.07 standard deviations.

socioeconomic factors such as maternal education, family size and structure, and maternal language ability, all of which may be associated with measures of the environment and influence family income. We therefore check whether associations between income and the home environment are robust to the inclusion of the "extended SES controls":

(2) $$Z^j = \beta^j + \beta_y^j \ln(y) + X\beta_X^j + \varepsilon^j .$$

As discussed above, estimates of the associations between income and the measures of the home environment must be interpreted with caution. If income is measured with error, estimates of β_y^j may be biased toward zero. On the other hand, the presence of other unmeasured variables not included in X that affect both income and the child's environment could potentially bias the estimates of β_y^j away from zero.

We then turn to models of child outcomes, including the child's PPVT score and the set of four measures of behavior problems. Let Y denote a child outcome measure, and Z denote the matrix of the J measures of the child's environment. Paralleling equations (1) and (2), we estimate:

(3) $$Y = \alpha + \alpha_y \ln(y) + \nu ,$$

which provides information on the sex-, age- and city-adjusted association between family income and the child outcome, and:

(4) $$Y = \alpha + \alpha_y \ln(y) + X\alpha_X + \sum_{j=1}^{J} \alpha_Z^j Z^j + \nu ,$$

which provides information on the association between income and the outcome, controlling for both extended background characteristics plus the set of proxies for the child's home environment.

In (4), we are particularly interested in whether the proxies for the child's home environment collectively have large effects on children's outcomes. However, the interpretation of the individual

coefficients α_Z^j is complicated by the fact that many of the measures of the environment measure similar things. For example, maternal depression, anxiety, and stress may provide similar information on maternal mental health; maternal harshness observed by the interviewer and the mother's report of whether she would physically punish the child in response to a tantrum are also similar. Because these variables are correlated and overlap conceptually, the coefficients on individual items are likely to be imprecisely estimated and difficult to interpret.

One useful way to interpret results of regressions such as (4), which include multiple proxy variables, has been proposed by Lubotsky and Wittenberg (2004), referred to as LW in what follows. The starting point for their method is to assume that the proxy variables are all noisy measures of an underlying latent variable which, in our case, is the "quality of the home environment", denoted H. The true model is expressed as:

(5) $$Y = \alpha + \alpha_y \ln(y) + X\alpha_X + \alpha_H H + \nu \ ,$$

where the latent variable H is related to each of the $j = 1...J$ proxy variables according to:

(6) $$Z^j = \rho^j H + u^j \ ,$$

where it is assumed that the error terms in (6) can be correlated with each other but are not correlated with the error term in (5). The coefficient of interest is the parameter α_H, which cannot be estimated directly since the variable H is not observed. LW show that, after suitable normalization of one of the values of ρ (in practice, setting $\rho^1 = 1$), the estimate of α_H that has the smallest possible amount of attenuation bias is simply a weighted sum of the regression coefficients α_Z^j from equation (4). The optimal weights are provided by the formula[14]:

[14] Note that when other covariates X are included, the covariances in (7) are calculated from residuals of regressions of Y and Z^j on X.

$$(7) \qquad \hat{\alpha}_H = \sum_{j=1}^{J} \hat{\omega}^j \hat{\alpha}_Z^j = \sum_{j=1}^{J} \frac{\text{cov}(Y, Z^j)}{\text{cov}(Y, Z^1)} \hat{\alpha}_Z^j .$$

The intuition underlying this weighting method is that the ratio of the covariances in (7) provides information on the size of the association between each of the proxies and the latent variable (relative to the proxy selected to be the numeraire.) As LW stress, an advantage of this procedure is its transparency. The estimate of α_H is simply a weighted sum of the regression coefficients from (4); the weights can be easily checked to make sure they are reasonable.

In what follows, we show estimates of (4), along with the aggregation proposed by LW. We also present results that use the first principal component of the proxies as a summary measure of the home environment. LW show that their measure will be less subject to attenuation bias than the first principal component.

IV. Results

Nonparametric results

We begin by showing simple descriptive evidence on how measures of the home environment and children's outcomes differ across income groups. We classify children into three groups: those with family incomes at age 3 that are less than the poverty line (45% of the sample), between 1 and 2 times the poverty line (25% of the sample), and more than twice the poverty line (30% of the sample). For each group of children, we computed the empirical cumulative distribution functions for each of the proxies of the home environment (except for the two measures that take binary values) and the child outcomes. The results shown in Figure 1 and 2 are based on unstandardized measures of these variables, so the x-axis measures the raw score or value of the measure, and the y-axis measures the fraction of children with values at or below each value. For all measures except the child's PPVT score, higher values represent more problematic outcomes; more highly-placed cumulative distributions indicate that

larger fractions of children have low ("better") scores. For the PPVT, where higher scores are better, this pattern is reversed.

The graphs shown in Figure 1 indicate that, for all proxy measures of the home environment, lower-income children are more likely to have higher ("worse") scores than wealthier children. For example, for the measure of lack of maternal responsivity, about 70% of mothers with income more than twice the poverty line received a "perfect" score of 0, in contrast to 60% of mothers with incomes between 1 and 2 times the poverty line, and 50% of mothers with incomes below the poverty line. The pattern of increasingly worse distributions of outcomes for poorer groups of children appears for measures of the home environment that are closely tied to material circumstances, such as lack of materials for cognitive stimulation and problems with the block, the home exterior, and the home interior. They also appear for all measures of parenting behaviors and maternal mental health.

The two binary measures of parenting we use show a consistent pattern (not shown in Figure 1). Of mothers living below the poverty line, 13.9 percent of mothers reported neglectful behavior and 26.2 percent reported they would use physical punishment in response to a public temper tantrum; the corresponding numbers for mothers living above twice the poverty line are 7.6 percent and 16.7 percent, respectively.

Similar patterns are presented for child outcomes in Figure 2. The PPVT provides a useful example. The PPVT is normed so that, in a nationally representative population, the mean score should equal 100. The average score in our sample of predominantly low-income children is 86.8. Over 88 percent of children living below the poverty line received a score less than 100, in contrast to 65 percent of children with family incomes more than twice the poverty line. The four measures of child behavior problems exhibit similar patterns, although for the interviewer-rated behavior scale there is little difference between the two lowest income groups.

Measuring associations between income and children's environments

To quantify the relationship between family income and each of the proxies for the child's home environment, we estimated equation (1), which adjusts only for the child's sex, age and city of residence, and equation (2), which adds controls for the extended SES measures. The coefficients on the logarithm of income at 36 months of age (β_y^j) are graphed in Figure 3, along with 10% confidence intervals. The proxies for the home environment are ordered by the size of the coefficient on the logarithm of income from estimates of (1). All measures of the child's environment were standardized prior to estimation, so effects can be interpreted in terms of standard deviation units. The logarithm of family income is not standardized, and has a mean of 9.81 and a standard deviation of 1.12.

The results generally indicate that income has larger associations with material aspects of the home environment than with measures of the mother's behavior and mental health. The two measures with the largest associations with income are problems with the block (coefficient -0.27), and lack of materials for cognitive stimulation (coefficient -0.26); these coefficients indicate that a doubling of income is associated with a decline of more than 25 percent of a standard deviation in the indices for problems with the block and for lack of materials. Food insecurity also has a strong association with income. There are some exceptions to this general ordering. For example, the associations between income and measures of maternal stress, home disorganization, and whether mother was "difficult to interview" are larger than the associations between income and problems with home interior and exterior. And income has the smallest coefficient, about -0.05, in the regression for the measure of safety problems in the home; this coefficient indicates that a doubling of income is associated with a decline of only 5 percent of a standard deviation in the index of safety problems.

As expected, adjustment for the set of extended SES controls reduces the coefficients on family income. However, even with these controls added, the coefficients are significantly different from zero

for all but two measures of the home environment (safety problems in the home and the mother's lack of verbal skills). The point estimates generally lie between –0.05 to –0.15, indicating that with other controls included, the association between income and any one measure of the home environment is fairly modest. However, there is reason to believe that these estimates are biased toward zero due to measurement error in income. When these models are estimated using the logarithm of income averaged over three survey waves, the coefficients on income become somewhat larger: the average value of the coefficient for all 17 measures of the home environment rises in absolute value from –0.09, when current income is used, to –0.11, when the longer-run measure of income is used, a 22 percent change.

Measuring associations between income and children's outcomes

The results discussed above indicate that, across many dimensions, lower-income children live in lower-quality home environments than higher-income children. A key question is whether associations between family income and children's outcomes are accounted for by the aspects of the home environment we measure. To answer this question, we present estimates of equations (3) and (4) for each of our five child outcome measures.

Table 1 presents detailed results for the child's PPVT score. The first column shows estimates of (3), in which the child's PPVT score is regressed on a set of indicators for the child's sex, age and city, and the logarithm of family income at age 3. The estimated income effect is 0.212. This result is comparable to what has been found in the literature; for instance, Aughinbaugh and Gittleman (2003) report a coefficient of 0.23 in a model estimating the effect of current income on the PPVT without extended SES controls.

The next panel shows estimates of models that include the seventeen proxy measures of the home environment. The first column, marked α, shows parameter estimates and standard errors, and the second column, marked ω, shows the weights for the LW scale construction. When the proxies for the home environment are included, the coefficient on income declines to a much smaller value of 0.089,

although it is still significantly different than zero. The measures of the home environment are jointly significant, and often individually significant. However, the coefficients on individual items do not provide clear information on which specific aspects of the home environment are most important for children's PPVT scores. For example, the largest coefficients are seen for maternal responsivity (a measure of parenting quality), the measure of whether the mother was difficult to interview (a measure of maternal characteristics), problems with the block on which the child lives (a measure of the child's physical environment), and lack of materials for cognitive stimulation (another measure of the physical environment). Our results are not consistent with earlier research that concludes that cognitive stimulation is more important than emotional support for children's intellectual development.[15]

The weights shown in the second column of the panel are normalized so that the measure of how unresponsive the mother is has a weight of 1. These weights can be interpreted as a regression coefficient of the proxy variable on the latent variable H, scaled so that a one-unit increase in H leads to a 1-standard-deviation increase in the measure of "unresponsive". The estimates of the weights indicate that changes in the latent "home environment" variable produce large changes (of 0.70 or higher) in maternal responsivity, verbal and social skills, the extent to which the mother is "difficult to interview", lack of materials for cognitive stimulation, problems with the block, and home disorganization. Proxies that receive little relative weight (0.20 or less) include maternal depression, maternal anxiety, the measure of child neglect, and whether the mother would use physical punishment in response to a tantrum. The weighted sum of the coefficients is shown in the last row: a one-unit increase in H (scaled so that it produces a 1-standard-deviation increase in lack of maternal

[15] This is not due to the addition of the large number of proxies. We estimated models in which the only proxies included were lack of maternal responsivity and lack of materials for cognitive stimulation, both based on the HOME score and similar to the measures used in Aughinbaugh and Gittleman (2003). These results show a coefficient on income of 0.153, a coefficient on lack of responsivity of -0.19, and a coefficient on lack of materials for cognitive stimulation of -0.11. The hypothesis that these latter two coefficients were equal was rejected at the 5% level.

responsivity) is associated with a decline in the PPVT score of –0.46, nearly ½ of a standard deviation.[16] To put this estimated effect size in context, note that, in our sample, the raw "gap" in the average PPVT score between children below the poverty line and those with incomes more than twice the poverty line is equal to 57 percent of a standard deviation.

The last panel in Table 1 adds the set of extended SES controls to the model. Doing so has two effects. First, the coefficient on the logarithm of income declines further, to a value of 0.005, and is no longer statistically different from zero. Second, the estimate of the effect of the home environment on the PPVT score declines a moderate amount, to –0.285. Our overall conclusion is that the large association between family income and the child's PPVT score is fully accounted for by the extended SES controls and the quality of the home environment.

Table 2 provides results for all of the child outcomes; results for the PPVT, discussed above, are included for the purpose of comparison. To save space, we report only coefficients on the logarithm of income and the indexes of the home environment. We begin with models using income measured at age 3. The first row shows associations between income and each of the child outcomes, adjusting only for sex, age and city. Consistent with the graphs shown in Figure 2, income has large and significant associations with all the outcome measures. The largest effects are for the PPVT, withdrawn behavior, and anxious behavior; for each of these, a doubling of income would improve outcomes by about 20 percent of a standard deviation. The next two panels show estimates from models that include the seventeen proxy measures for the home environment, with and without extended SES controls. These results indicate that virtually all of the associations between income and the child outcomes are fully accounted for by the measures of the home environment and the extended SES controls. For several outcomes, including behavior problems and aggressive behavior, the inclusion of the home environment proxies (without the extended SES controls) is sufficient to reduce the coefficient on income to zero. In

[16] The standard error of 0.039 is obtained by bootstrapping the estimate, using 100 replications.

all cases with the exception of withdrawn behavior and anxious behavior, the estimated effect of income on the child outcomes is not statistically different from zero once the extended controls are included. The fact that we explain virtually all of the association between income and the child outcomes with our controls, while prior studies have often found an effect of income remaining even after controls, likely reflects the richer controls for home environment included in our analysis, as well as the young age of our sample.

The estimated effect of the "LW index" of the home environment is larger for the behavioral outcomes than it is for the PPVT score. Aggressive behavior, in particular, is strongly associated with the LW index: deteriorations in the home environment that produce a 1-standard-deviation increase in the measure of lack of maternal responsivity are associated with an increase in aggressive behavior equal to 1.46 standard deviations (in a model that includes extended SES controls). The home environment also appears to be of particular importance for anxious behavior: deteriorations in the home environment that produce a 1-standard deviation increase in the measure of lack of maternal responsivity are associated with a 1.40 standard deviation increase in anxious behavior (model that includes extended SES controls). We show in Appendix Table 2 the coefficients on the seventeen proxy variables and the weights attached to them in the LW index for each of the four behavioral outcomes. The proxy variables that have the highest weight (a weight of 2 or greater in at least one of the behavioral outcome models) are all measures of maternal mental health or behaviors: harshness, depression, stress, and neglect.

The bottom portion of Table 2 shows results from models using income averaged over three years. As expected, the coefficients on the longer-term income measure are generally larger in absolute value than for income at age 3. This is particularly true for estimates of models that do not include measures of the home environment or extended SES controls (shown in the first row). However, the differences between the results using the two different income measures become smaller when additional controls are added, and the coefficients on income (measured either way) shrink. In the results

with extended controls, shown in the bottom portion of Table 2, income is significant only for "withdrawn behavior". The estimated effect of the LW index is similar to that obtained with the shorter-term income measure, although somewhat larger in the models for aggressive behavior, withdrawn behavior, and anxious behavior.

Extensions

In the analyses thus far, we have used the full set of seventeen proxy variables when adding controls for home environment, or constructing the LW index. To see how sensitive the results are to the inclusion or exclusion of particular variables in that group, we estimated several alternative specifications. The results are shown in Table 3. First, to address the concern that some of the proxy variables are indicators of material hardship and thus may simply be alternative measures of (noisily measured) income, we re-estimated the models dropping the proxies that measure material aspects of parenting (i.e., the measures for lack of materials for stimulation; problems with the block, home exterior, and home interior; and food insecurity). The results for the coefficient on current income and for the LW index (shown in panel 1 of Table 3) are basically unchanged from those using the full set of proxies (shown in Table 2). Thus, we obtain the same results using only proxies that are not mechanically related to money.

A second potential concern is interviewer bias—i.e., some interviewers may tend to rate mothers, children, and the home environment negatively, and others not, producing biased estimates of the relationships between measures of parenting and interviewer-assessed child outcomes. Accordingly, we re-estimated our models including interviewer-city fixed effects.[17] As shown in panel 2 of Table 3, this also did not change the overall pattern of results.

A third, and related challenge, is reporting bias on the part of mothers. It is possible that mothers who tend to rate themselves as depressed, anxious, or stressed also tend to rate their children as

[17] Although most interviewers worked in only one city, some interviewers conducted interviews in more than one city.

aggressive, withdrawn, and anxious. (A related issue is that mothers of aggressive, withdrawn, and anxious children may become more depressed, stressed, or anxious themselves). To assess the sensitivity of our results to this potential reporting bias, we re-estimated our models using only interviewer-assessed proxies and dropping all of the proxies reported by the mother (i.e. depression, stress, anxiety, neglect, physical response to tantrum, hours of TV per week, and food insecurity).[18] As shown in panel 3 of Table 2, dropping the mother-reported proxies does not change the results in models for the PPVT or interviewer-assessed behavior problems, but does lead to somewhat larger coefficients on income, and smaller LW indexes, in the three mother-reported behavior problem models. Nevertheless, the overall pattern of results holds up: controlling for home environment as well as extended SES controls explains most of the effects of income, and the home environment, as measured by the LW index, has very substantial effects on the child outcomes.

The last panel of Table 3 shows comparable results when the LW index is replaced with the first principal component of the 17 proxies. As described in LW, we normalized the principal component so that it is expressed in units comparable to the LW index, so the two can be compared. The results indicate that, for all of the outcomes, the coefficient on the first principal component is markedly smaller in absolute value than that for the LW index. This finding is consistent with the idea that the LW index uses a set of weights that minimize attenuation bias, and suggests that results that rely on the first principal component as a summary measure of the home environment suffer from pronounced attenuation bias. However, even though the estimates are attenuated, the addition of the first principal component to the models (and the extended SES controls) produces large reductions in the coefficients on income. For all outcomes except withdrawn and anxious behavior, the hypothesis that the coefficient on income is zero cannot be rejected. The general finding, that the effects of income either vanish or

[18] The measure of "Lack of materials for stimulation" is based both maternal reports and interviewer observations of items such as books and toys that children have available to them. We did not exclude this measure here.

become much smaller when the home environment is controlled for, is not particularly sensitive to the way that the home environment in measured.

We conducted several robustness checks to examine whether the inclusion of other sociodemographic factors altered our results. First, we included indicators for whether the child was born at low birth weight (between 1500 and 2500 grams) or very low birth weight (under 1500 grams), as well as indicators for the education level of the child's maternal grandmother and grandfather. Low birth weight could have direct effects on children's outcomes, and is also associated with income. Grandparent's education could measure maternal background characteristics not measured by her own educational attainment. The inclusion of these controls has little effect on our results. Low birth weight is associated with a significant decline in the PPVT score of –0.225 (with a standard error of 0.08) but is not significantly associated with any other outcome. The inclusion of indicators for low birth weight has little effect on other coefficients. The indicators for grandparents' education levels are jointly significant (at only the 7% level) only for the measure of withdrawn behavior: in this case, children with college-educated grandfathers are less likely to be withdrawn. Again, however, the inclusion of these variables did not have large effects on the coefficients for income or the home environment. Second, we re-estimated our models adding controls for whether the child attended out-of-home child care, and whether that care was center-based. Including these controls did not change the effects of income or the home environment.

Finally, we examined whether our results are sensitive to loosening the restriction that the associations between the logarithm of income and the child outcomes are linear. We estimated models similar to those in the third panel of Table 2 (that used age 3 income and extended contols), but included interactions between the logarithm of income and indicators that the family's income was below the poverty line, and between one and two times the poverty line. These estimates indicate that models that are linear in the logarithm of income fit the data nearly as well as those that are less restrictive. For all of

the outcomes, the hypothesis that the interactions of the logarithm of income and the poverty indicators are jointly insignificant could not be rejected. Furthermore, including these interactions had little effects on the other coefficients.

Policy simulations

Our results indicate that (1) family income is strongly associated with measures of the home environment, and (2) measures of the home environment explain a large share of the association between income and child outcomes. To provide information about the potential practical importance of our results, we conducted some simulations of the effects that various income transfer programs would have on PPVT scores and other outcomes for children. We are interested in the change in mean outcomes for children, and also in the change in gaps between children in our three income groups: family income below poverty, income between 100 and 200% of poverty, and income over 200% of poverty. These simulations are based on the assumption that the estimates of equations (1) and (2), which relate measures of the home environment to income, and equations (3) and (4), which relate child outcome measures to income and measures of the home environment, identify causal effects. Although the issue of causality is not resolved, our calculations provide some indication of how changes in income might influence the levels of and distributions of outcomes.

We begin with a baseline case (in which family incomes are not altered) and then model the effects of two different scenarios. The first scenario (which we refer to as "Case 1") involves raising the income of anyone below poverty up to the poverty line, which entails an average transfer of $10,268 per family to families with incomes below the poverty line in our sample. This scenario should improve outcomes for those in poverty, both in absolute terms and relative to higher-income children. But, it will not change outcomes for anyone with income above the poverty line. The second scenario ("Case 2"), based on a proposal by Duncan and Magnuson (2003), is an income transfer that provides $2,400 per child (or $3,600 if the child is under age 1), for up to two children, in families with annual incomes

below $60,000. In our sample, this scenario provides an average transfer of $4,109 per family to those below the poverty line, an average of $3,692 per family to those with incomes between 100 and 200 percent of poverty, and an average of $1,818 per family to those with incomes above 200 percent of poverty. This scenario benefits children in poverty and near poverty. However, as the amount of the total transfer involved is fairly small (a maximum of $4,800 per year, or $6,000 if there is an infant in the home), its effect on closing gaps between groups may be small as well.

Table 4 presents detailed calculations for the PPVT. Recall that we standardized the PPVT (and other outcome measures) so that its sample mean is zero and its standard deviation is 1. The first row in Table 4 indicates that the poorest group of children have a mean PPVT score that is 0.223 of a standard deviation less than the grand mean, and the wealthiest group have a mean score that is 0.351 of a standard deviation greater than the grand mean. Differences in means across groups are shown in the right-hand panel.

The second panel shows results of simulations based on models that do not include extended SES controls (and that use income measured at age 3). The simulations were conducted by increasing incomes at age 3 by the amounts indicated, computing changes in the measures of the home environment (using the results of equation 1), and then computing changes in the PPVT score that work through the direct effects of income and the effects that work through the measures of the home environment (using equation 2). The third panel shows results that repeat this exercise, using estimates from models that include the extended SES controls (equations 2 and 4). Because the models with the extended SES controls provide the most conservative measures of the effects of income, we focus on these results in the following discussion.

The results of Case 1 indicate that bringing all poor children up to the poverty line is predicted to increase the average PPVT score by 4.2% of a standard deviation (from -.223 to .181), and to shrink the gap between poor and near-poor children from 0.185 to 0.143, a 22.6% reduction. Case 2 represents an

income transfer that is available to children with families much higher in the income distribution. However, as we saw above, the families of children in the lower two groups typically get more, both because they are more likely to have incomes less than $60,000 per year, and because they are more likely to have a sibling who brings in extra money. This program is predicted to shrink the gap in the average PPVT score between poor and near-poor children from -0.185 to -0.168, a 9.2% reduction, and to shrink the gap between the near-poor and the wealthiest children by a much smaller amount (1.0%).

Table 5 summarizes the effects of each of these programs on all five child outcomes. The table shows only how differences between groups are affected, and is based on models that include the extended SES controls. The top panel of the table shows results based on estimates using income at age 3; the bottom panel shows results based on estimates using income averaged over 3 years. Overall, these results indicate that bringing poor children up to the poverty line (Case 1) is predicted to have substantial effects on their behavior problems, and could lead to a substantial narrowing of the "gap" in behavior problems between poor and near-poor children: these reductions range in size from 29 to 60% in estimates based on results using income at age 3 and from 38 to 85% in estimates based on results using average income over 3 years. Transfers under Case 2, which are not targeted solely toward the poorest children, are predicted to yield more modest declines in the "gap" in behavioral outcomes between poor and near-poor children—on the order of 12 to 23% (current income) or 15 to 33% (average income) —along with smaller declines in the gap between near-poor and the wealthiest children—between 3 and 20% (current income), or between 5 and 23% (average income).

V. Conclusions

Forty years after the War on Poverty, one in four American children is born into poverty,[19] and a substantial share of children are being reared in poverty, or near poverty. These children are at risk of

[19] Estimate from the Early Childhood Longitudinal Survey-Birth Cohort, for children born in 2000-2001 (see Flanagan and West, 2004).

worse outcomes in childhood and in adulthood, including raising their children in poverty. Understanding how low income affects child outcomes is thus important for the current generation as well as future generations.

In this paper, we took advantage of a rich new dataset, the Fragile Families and Child Wellbeing Study, which provides a wealth of information on the family characteristics and home environments of a large and diverse sample of low-income children, born in 20 U.S. cities at the close of the 1990s and followed from birth to age 3. Consistent with prior research, we found that low-income children have lower PPVT scores, more mother-reported aggressive, withdrawn, and anxious behavior problems, and also more interviewer-reported problems with behavior than more affluent children. Examining an extensive set of 17 measures of the home environment, we found that low-income children fared worse across all of these measures. For most outcomes, these differences in home environment were sufficient to explain the link between low income and poorer child outcomes. For the remainder, home environment plus extended controls for family characteristics fully explained the link between low income and poorer child outcomes (the only exception here was withdrawn behavior, where a small significant effect of income remained).

Thus, home environment, broadly defined, matters a lot in explaining the poorer outcomes of children from low-income families. This finding makes sense given that the children in this study are only 3 years old. Older children from low-income families face a myriad of challenges in their communities, including poor schools, but for infants and toddlers, the major sources of influence are in the home. Although some of the children in our sample were enrolled in out-of-home child care, adding controls for child care did not change our results. Our results indicate that, if measured well enough, the home environment can fully explain the difference in outcomes between low-income and higher-income children.

Measuring the home environment in such detail, however, poses a challenge. Our 17 measures are correlated with each other and are all attempting to tap an underlying construct that we do not observe directly – the quality of the home environment. To address this challenge, we use a method developed by Lubotsky and Wittenberg (2004). The LW method assigns weights to each of our 17 measures of the home environment, to reflect their association with the underlying quality of the home environment, and provides an estimate of the effect of that underlying quality on the child outcomes of interest. Our results using the LW method indicate that the underlying quality of the home environment matters across all 5 outcomes we consider, with the largest effects on the development of aggressive and anxious behaviors.

Finally, we turn our attention to policy implications. We carry out a set of simulations, using our results to predict the effects of various policy reforms on outcomes for low-income children, and also on the gaps between low- and higher-income children. Assuming our results reflect causal associations, these simulations point to a potentially important role for policy-induced increases in income. For instance, a policy reform that provided a $2,400 per child grant to families with annual incomes below $60,000 would close between 9 and 33% of the gap in outcomes between children in poverty and those with family incomes between 100 and 200% of poverty, while a reform that raised the incomes of families in poverty up to the poverty line would close between 23 and 85% of the gap in outcomes between children in poverty and those with family incomes between 100 and 200% of poverty.

Of course, these simulation results rest on the assumption that the associations we have found between income, home environment, and child outcomes are causal. Lacking experimental data, this is an assumption that we are not able to test conclusively. Thus, our results must be interpreted with appropriate caution. Our confidence in our results is enhanced, however, by the fact that we have unusually rich data with extensive measures for child and family characteristics that are likely to be correlated with both income and child outcomes. We also have an unusual sample: the children are

primarily low-income, and both the low- and higher-income children are born in the same hospitals across our 20 cities. Nevertheless, it is possible that we are missing controls for important characteristics that vary by income and that could be biasing our estimates of the association between income and child outcomes.

One potentially important omission is the quality of parenting provided by fathers. As in most prior analyses, many of our measures of the home environment tap characteristics of the mother or mother-child interaction. Our measures of direct father involvement are limited to a set of controls for whether the biological father, or another man, is living in the home. If income and child outcomes, are correlated with other aspects of fathers' involvement, our estimates of the effects of income may be biased. However, the fact that our controls were sufficient to fully explain the effect of income on child outcomes for virtually all of our outcomes (with the exception of withdrawn behavior, for which a small direct effect remained) suggests that we may have done a sufficient job of measuring family characteristics that matter. In this regard, it is worth noting that half of our measures of the home environment would be affected by both maternal and paternal behavior (lack of materials, problems with block, problems with home exterior, problems with home interior, home disorganization, safety problems, food insecurity, and hours of TV).

As we said at the outset, a major question in this literature has been whether the effects of income are large or small. Assuming our results are causal, they suggest that the effects of income, for low-income young children, are large enough to be important. Like most prior studies, we find that the effects of income are fairly small in absolute terms. Raising incomes for families in poverty to bring them up to the poverty line—which involves an average transfer of $10,268 per poor family per year in our sample—yields a 4 to 7% of a standard deviation increase in PPVT scores and a 6 to 16% of a standard deviation decrease in behavior problems. But, these effects must be viewed in context.

Like Taylor, Dearing, and McCartney (2004), we find that the effects of income we estimate compare favorably to what would be gained through an intervention such as Early Head Start. Taylor, Dearing, and McCartney (2004) find that raising family incomes by $13,000 per year would improve children's cognitive scores by 15% of a standard deviation and reduce behavior problems by 20% of a standard deviation, which compares favorably to the impact of Early Head Start, which costs about $14,000 and raises cognitive scores by 12 to 15% of a standard deviation and reduces behavior problems by 10 to 11% of a standard deviation. If we use our estimates to project the effect of a $14,000 per year increase in income for poor families, we find roughly comparable effects—a 6 to 10% of a standard deviation increase in PPVT scores, and an 8 to 22% decrease in behavior problems.

Of particular policy relevance is how large these gains are relative to the gaps between low- and higher-income children. Seen in this light, policy reforms that raise family incomes up to poverty, or that provide a per-child allowance to families with low to moderate incomes, look promising. Our estimates suggest that, depending on the specific reform and outcome (and whether income is measured in current or average terms), such reforms could close between 9 and 85% of the gaps in language and behavioral outcomes between poor children and their near poor neighbors.

Appendix:

Construction of Measures of the Home Environment and Child Outcomes

A. Measures of the home environment
All items are coded so that higher numbers correspond to more problematic outcomes.

1. Unresponsive (Interviewer-assessed, 0-6 points; reverse coded): One point was assigned for each affirmative response. The number of affirmative responses was then summed to create a score for the scale. This number was then reverse coded to represent the total number of unresponsive behaviors displayed by the mother (0-6).

T1. Parent spontaneously vocalized to child twice.
T2. Parent responded verbally to child's vocalizations.
T3. Parent told child the name of an object or person during visit.
T7. Parent spontaneously praised child at least twice.
T8. Parent's voice conveys positive feelings toward child.
T9. Parent caressed or kissed child at least once.

2. Harsh (Interviewer-assessed; 0-5 points; reverse coded): One point was assigned for each affirmative response. The number of affirmative responses was then summed to create a score for the scale. This number was then reverse coded to represent the total number of harsh behaviors displayed by the mother (0-5).

T10. Parent did not shout at child (e.g. did not raise voice above level required by distance between mother and child).
T11. Parent did not express annoyance with or hostility toward child.
T12. Parent neither slapped nor spanked child during the visit.
T13. Parent did not scold or criticize child during visit.
T14. Parent did not interfere or restrict child more than 3 times. (Does not include protecting child from harm.)

3. Lack of Maternal Verbal/Social Skills (Interviewer-assessed; 0-3 points; reverse coded): One point was assigned for each affirmative response. The number of affirmative responses was then summed to create a score for the scale. This number was then reverse coded to represent the total number of poor verbal/social skills displayed by the mother (0-3).

T4. Parent's speech was distinct and audible.
T5. Parent initiated verbal exchanges with visitor.
T6. Parent conversed freely and easily.

4. Maternal depression (Mother-assessed; 0-8 points): One point was assigned for each affirmative response. Scores on each item were then summed to create a total score (0-8).

J12. During the past 12 months, has there ever been a time when you felt sad, blue, or depressed for two or more weeks in a row?
J14. During the past 12 months, has there ever been a time lasting two weeks or more when you lost interest in most things like hobbies, work, or activities that usually give you pleasure?
J15A. Thinking about those same two weeks, did you feel more tired out or low on energy than is usual for you?
J15B. Did you gain or lose 10 pounds without trying?
J15C. Did you have more trouble falling asleep than you usually do during those two weeks?
J15D. During those two weeks, did you have a lot more trouble concentrating than usual?
J15E. People sometimes feel down on themselves, no good, or worthless. During that two week period, did you feel this way?
J15F. Did you think a lot about death--either your own, someone else's, or death in general during those two weeks?

5. Maternal stress (Mother-assessed; 0-44 points): For each item, individuals were assigned a score of 0 if they responded that they "strongly disagree," 1 for "disagree," 2 for "not sure," 3 for "agree," and 4 for "strongly agree." Scores on each item were then summed to create a total score (0-44).

G1a. You often have the feeling that you cannot handle things very well?
G1b. You find yourself giving up more of your life to meet your child(ren)'s needs than you ever expected
G1c. You feel trapped by your responsibilities as a parent?
G1d. Since having (CHILD) you have been unable to do new and different things?
G1e. Since having (CHILD) you feel that you are almost never able to do things that you like to do?
G1f. There are quite a few things that bother you about your life?
G1g. Having (CHILD) has caused more problems than you expected in your relationship with men?
G1h. You feel alone and without friends?
G1j. You are less interested in people than you used to be?
G1k. You enjoy things less than you used to?
G1l. You are unhappy with the last purchase of clothing you made for yourself?

6. Maternal anxiety (Mother-assessed; 0-13 points): One point was assigned for an affirmative response to J16 and/or J16a; J18c and/or J18e; J18d, J19, and/or J19a; and all other items. Points were then summed to create a total score (0-13).

J16. During the past 12 months, did you ever have a period lasting one month or longer when most of the time you felt worried, tense, or anxious?
J16a. People differ a lot in how much they worry about things. Did you have a time in the past 12 months when you worried a lot more than most people would in your situation?
J17. Worry/tension/anxiety lasted 6 months or more.
J18a. During (that/this) period (was/is) your worry stronger than in other people?
J18b. (Did/do) you worry most days?
J18c. (Did/do) you worry about one particular thing, such as your job security or the failing health of a loved one or more than one thing? (affirmative response = more than one thing).
J18d. (Did/do) you find it difficult to stop worrying?
J18e. (Did/do) you have different worries on your mind at the same time?
J19. How often (was/is) the worry so strong you (couldn't/can't) put it out of your mind no matter how hard you (try/tried)? (Was/is) this… (affirmative response = often).
J19a. How often (did/do) you find it difficult to control your worry? (affirmative response = often).
J20a. When you (were/are) worried or anxious, (were/are) you also restless?
J20b. When you (were/are) worried or anxious, (were/are) you also keyed up or on edge?
J20c. When you (were/are) worried or anxious, (were/are) you also easily tired?
J20d. When you (were/are) worried or anxious, (did/do) you also have difficulty keeping your mind on what you were doing?
J20e. When you (were/are) worried or anxious, (were/are) you also more irritable than usual?
J20f. When you (were/are) worried or anxious, (did/do) you also have tense, sore, or aching muscles?
J20g. When you (were/are) worried or anxious, (did/do) you also having trouble falling asleep or staying asleep?

7. Difficult to Interview (Interviewer-assessed; 0-12 points; reverse coded): Each item was scored on a 0 to 3 point scale ranging from "poor" to "excellent" (for item V5, the scale ranged from "very uncooperative" to "very cooperative"). Scores on each item were then summed to create a total score. This number was then reverse coded to represent the total number of difficult behaviors displayed by the mother (0-12).

V2. Respondent's attention to interviewer was...
V3. Respondent's understanding of the questions was...
V4. Respondent's ability to articulate answers was...
V5. Respondent's cooperation throughout most of the interview was…

8. Child neglect (Mother-assessed; 0-125 points): For each item, individuals were assigned a score of 0 if they responded "this has never happened" or "yes, but not in the past year" for a particular item. They were assigned a score of 1 if they reported that the event occurred once in the past year; 2 for twice; 4 for 3-5 times; 8 for 6-10 times; 15 for 11-20 times; and 25 for more than 20 times in the past year. Scores on each item were then summed to compute a total yearly frequency score (0-125).

J15. Had to leave your child home alone, even when you thought some adult should be with him/her

J16. Were so caught up with your own problems that you were not able to show or tell your child that you loved him/her
J17. Were not able to make sure your child got the food he/she needed
J18. Were not able to make sure your child got to a doctor or hospital when he/she needed it
J19. Were so drunk or high that you had a problem taking care of your child

9. Physical response to tantrum (Mother-assessed; 0-1 points): Mothers were asked to state how they would respond if their child had a tantrum in a grocery store. After giving one response, they were asked what they would do if the first strategy did not work. "Physical response to tantrum" is coded as 1 if the mother indicated that she would use a punitive physical response including spanking, slapping, hitting or pinching as either the first or second strategy. Responses such as holding or picking up the child were not coded as "physical responses"; neither were any verbal responses, including those that were punitive (i.e. yelling at or verbally threatening).

10. Lack of materials for stimulation (Mother-assessed; 0-11 points; reverse coded): One point was assigned for each affirmative response (i.e., at least one of each type of toy/item in the household). The number of affirmative responses was then summed to create a score. This figure was then reverse coded so to represent the total lack of language stimulating/literacy supporting characteristics of the household/mother (0-11).

C8. About how many books written for adults do you have in the house?
C1B. About how many, if any, toys that let (CHILD) work (his/her) muscles does (he/she) have?
C1A. About how many, if any, push or pull toys does (CHILD) have?
C1H. About how many, if any, toys with wheels that (he/she) can ride on does (he/she) have?
T15. Parent provided toys for child during the visit
C1E. About how many, if any, cuddly, soft or role-playing toys like dolls or teddy bears does (he/she) have?
C2. Does child have a highchair, a booster, or a child-sized table and chair?
C1C. About how many, if any, toys that have pieces that fit together ... does (he/she) have?
C1D. About how many, if any, toys that can be put together in different ways... does (he/she) have?
C1G. About how many, if any, toys that let (him/her) make music, such as a rattle or toy that plays a musical jingle does (he/she) have?
C1F. About how many, if any, books do you have for (CHILD)?

11. Problems with block (Interviewer-assessed; 0-15 points): Each item was scored on a 0 to 3 point scale with 0 representing no/very few problems in this area and 3 representing the considerable problems. Scores on each item were then summed to create a total score (0-15).

P1. Garbage, litter, or broken glass in street, on sidewalks, or in yards?
P2. How would you rate the general condition of most of the nearby buildings?
P3. Is there graffiti on nearby buildings or walls of nearby buildings?
P4. Are there vacant, abandoned, or boarded-up buildings nearby?
P5. Are there abandoned vehicles nearby?

12. Problems with home exterior (Interviewer-assessed; 0-9 points): Each item was scored 0 for no problems in this area and 1 for problems. Scores on each item were then summed to create a total score (0-9).

P6_a. Does environment outside home have unlit entrance/stairway?
P6_b. Does environment outside home have broken steps?
P6_c. Does environment outside home have broken glass/toys?
P6_d. Does environment outside home have large ditches?
P6_e. Does environment outside home have alcohol/drug paraphernalia?
P6_f. Does environment outside home have strewn garbage/litter?
P7_a. Does the exterior of the building have -- peeling paint?
P7_b. Does the exterior of the building have -- crumbling/damaged walls?
P7_c. Does the exterior of the building have -- broken/cracked windows?

13. Problems with home interior (Interviewer-assessed; 0-6 points): Each item was scored 0 for no problems in this area and 1 for problems. Scores on each item were then summed to create a total score (0-6).

R1. Are there any broken windows or cracked windowpanes?
R2. Is the wiring in the house concealed?
R3. Does the housing unit contain open cracks/holes in walls/ceiling?
R4. Does the housing unit contain holes in floor?
R5. Does housing unit have broken plaster/peeling paint for >1 sq. ft.?
R13. Is house overly noisy from noise outside of the house?

14. Home disorganization (Interviewer-assessed; 0-5 points): Each item was scored 0 for no problems in this area and 1 for problems. Scores on each item were then summed to create a total score (0-5).

R6. Is inside of home dark?
R7. Is inside of home crowded?
R8. Are all visible rooms of house/apt noticeably cluttered?
R9. Are all visible rooms of house/apt dirty/not reasonably cleaned?
R12. Is house/apartment overly noisy from noise in the house?

15. Safety problems in the home (Interviewer-assessed; 0-11 points): If the interviewer responded negatively to R10 (Is environment inside the home unsafe for young children?) then a total score of 0 was assigned. If the interviewer responded affirmatively to R10 then each item in R10A was scored 0 for no problems in this area and 1 for problems. Scores on each item were then summed to create a total score (0-11).

R10. Is environment inside the home unsafe for young children?
R10A. Please check all hazardous conditions you observe:
(1) frayed electrical wires;
(2) mice or rats;
(3) broken glass;
(4) poisonous substances within reach of children;
(5) falling plaster;
(6) broken stairs;
(7) peeling paint;
(8) cleaning materials left out;
(9) flames and heat within reach of young children;
(10) weapons (guns or knives) within reach of children;
(11) other (specify)

16. Food insecurity (Mother-assessed; 0-10 points): One point was assigned for each event that occurred. The number of events was then summed to create a 0-18 point scale score for the scale. This score was then re-coded to a 0-10 point continuous measure of food insecurity (see, Bickel, et al., 2000).

D1 A. Worried food would run out
D1 B. Food bought didn't last
D1 C. Couldn't afford to eat balanced meals
D1 D. Relied on few kinds of low-cost food to feed children
D1 E. Couldn't feed child(ren) balanced meals
D3. Child(ren) were not eating enough
D4. Adult(s) cut size of meals or skipped meals
D5. Adult(s) cut size or skipped meals, 3+ months
D6. Adult(s) ate less than felt he/she should
D7. Adult(s) hungry but didn't eat because couldn't afford
D8. Respondent lost weight
D10. Adult did not eat for whole day
D10 A. Adult did not eat for whole day, 3+ months
D11. Cut size of child(ren)'s meals
D12. Child(ren) skipped meal
D12 A. Child(ren) skipped meal, 3+ months
D13. Child(ren) hungry, but couldn't afford more food
D14. Child(ren) did not eat for whole day

17. Hours of TV per week (Mother-assessed; 0-112 points): Mothers were asked how many hours the child spends watching TV on a typical weekday and weekend day. Daily hours were top-coded at 16. Weekday hours were then multiplied by 5 and weekend hours by 2.Weekday and weekend hours were then summed to create a total number of TV watching hours per week (0-112).

B. Child outcomes

1. Child's PPVT: This is the child's score on the Peabody Picture Vocabulary Test. Raw scores were normed according to the child's age (in months), using standard norming procedures.

2. Problems with Child's Behavior (Interviewer-assessed; 0-20 points; reverse coded where appropriate): Each item was scored on a 0 to 4 point scale. Scores on each item were then summed to create a total score (0-20). Items are coded such that higher scores are "worse."

U1. Did the child display positive emotions during the visit?
U2. Did the child display negative emotions during the visit?
U3. How persistent was the child when completing the PPVT/TVIP?
U4. How cooperative was the child when completing the PPVT/TVIP?
U5. How cooperative was the child while being weighed and measured?

3. Aggressive behavior (Mother-assessed; 0-16 points): This is the scale for aggressive behavior from the Achenbach Child Behavior Checklist. It is based on 8 items reported by the mother. For each item, individuals were assigned a score of 0 if they responded that the statement was "not true," 1 if they responded that the statement was "sometimes or somewhat true," or 2 if they responded that the statement was "very true or often true" of the focal child. Scores on each item were then summed to create a total score (0-16).

M5. He/She is defiant
M6. (His/Her) demands must be met immediately
M7. He/She is disobedient
M13. He/She doesn't seem to feel guilty after misbehaving
M14. He/She is easily frustrated
M18. He/She gets in many fights
M21. He/She hits others
M23. He/She has angry moods
M28. Punishment doesn't change (his/her) behavior
M30. He/She screams a lot
M33. He/She is selfish or won't share
M39. He/She is stubborn, sullen, or irritable
M41. He/She has temper tantrums or hot temper
M44. He/She is uncooperative
M48. He/She wants a lot of attention

4. Withdrawn behavior (Mother-assessed; 0-16 points): This is the scale for withdrawn behavior from the Achenbach Child Behavior Checklist. It is based on 8 items reported by the mother. For each item, individuals were assigned a score of 0 if they responded that the statement was "not true," 1 if they responded that the statement was "sometimes or somewhat true," or 2 if they responded that the statement was "very true or often true" of the focal child. Scores on each item were then summed to create a total score (0-16).

M2. He/She avoids looking others in the eye
M3. He/She clings to adults or is too dependent
M9. He/She doesn't answer when people talk to (him/her)
M29. He/She refuses to play games
M31. He/She seems unresponsive to affection
M35. He/She shows little affection toward people
M36. He/She shows little interest in things around (him/her)
M50. He/She is withdrawn, doesn't get involved with others

5. Anxious behavior (Mother-assessed; 0-30 points): This is the scale for anxious behavior from the Achenbach Child Behavior Checklist. It is based on 15 items reported by the mother. For each item, individuals were assigned a score of 0 if they responded that the statement was "not true," 1 if they responded that the statement was "sometimes or somewhat true," or 2 if they responded that the statement was "very true or often true" of the focal child. Scores on each item were then summed to create a total score (0-30).

M3. He/She clings to adults or is too dependent
M16. (He/She) feelings are easily hurt
M19. He/She gets too upset when separated from parents
M22. He/She looks unhappy w out good reason
M25. He/She has nervous movements, high strung, tense
M32. He/She is self-conscious or easily embarrassed
M42. He/She is too fearful or anxious
M46. He/She is unhappy, sad, depressed

Appendix Table 1: Samples Attrition Analysis

Sample:	A	B	C	D	E
Observations:	4,898	4,231	3,355	2,179	1,699
Baseline measures					
Variable means:					
Mother has less than high school degree	0.347	0.330	0.338	0.352	0.335
Mother has high school degree	0.302	0.305	0.303	0.315	0.311
Mother has more than high school degree	0.350	0.360	0.358	0.332	0.354
Mother is white	0.208	0.216	0.215	0.182	0.197
Mother is black	0.472	0.478	0.486	0.545	0.528
Mother is Hispanic	0.272	0.260	0.257	0.232	0.236
Mother has other race/race unknown	0.048	0.048	0.043	0.041	0.039
Mother married to child's father	0.242	0.249	0.246	0.218	0.240
Mother cohabiting	0.364	0.362	0.365	0.372	0.369
Mother single	0.393	0.380	0.389	0.409	0.391
Measures from 36-month core survey					
Income at 36 months (1999 $)		33210	32526	30254	31195
Mother married to child's father		0.317	0.312	0.282	0.302
Mother cohabiting with child's father		0.217	0.219	0.219	0.219
Mother cohabiting or married to new partner		0.096	0.096	0.100	0.094
Mother single		0.367	0.373	0.398	0.386

Note: Sample A consists of all births in the original Fragile Families sample. Sample B excludes those who did not complete the core survey at age 3. Sample C excludes those who were living apart from their mothers at the time of the Age 3 survey, or whose mothers did not take part in any of the components of the in-home survey. (Note that mothers who conducted the "in home" survey over the telephone are included in this sample.) Sample D excludes those for whom the child was not present for assessment at the time of the in-home study, or for whom the "in home" was conducted over the telephone. Sample E excludes those with missing data for any of the variables used in the analyses. Note that "income at 36 months" is missing for 316 of the Sample B cases, for 230 of the Sample C cases, and for 157 of the Sample D cases.

Appendix Table 2: Coefficients on proxies and LW weights.
Current income; extended controls

	Behavior problems		Aggressive behavior		Withdrawn behavior		Anxious Behavior	
	α	ω	α	ω	α	ω	α	ω
Ln(y)	–0.013 (0.025)		–0.005 (0.026)		–0.069 (0.026)		–0.053 (0.026)	
Unresponsive	0.155 (0.028)	1	0.075 (0.029)	1		1	0.037 (0.029)	1
Harsh	0.179 (0.023)	1.05	0.152 (0.024)	2.00	0.059 (0.029)	1.03	0.033 (0.024)	1.49
Lacking verbal skills	0.013 (0.026)	0.66	–0.056 (0.027)	–0.12	0.061 (0.025)	0.44	–0.080 (0.027)	–0.78
Maternal depression	–0.018 (0.025)	0.25	0.041 (0.026)	1.27	–0.007 (0.026)	0.38	0.035 (0.026)	2.01
Maternal stress	0.037 (0.025)	0.27	0.249 (0.027)	2.99	0.177 (0.027)	2.09	0.179 (0.026)	4.39
Maternal anxiety	0.002 (0.025)	–0.02	0.008 (0.026)	0.89	–0.029 (0.026)	0.13	0.009 (0.026)	1.50
Difficult to interview	0.184 (0.027)	0.99	–0.021 (0.028)	0.40	0.014 (0.028)	0.60	0.054 (0.028)	1.51
Neglect scale	0.009 (0.023)	0.26	0.021 (0.024)	1.39	0.037 (0.024)	1.14	0.053 (0.024)	2.63
Physical response to tantrum	–0.009 (0.023)	0.13	0.098 (0.024)	1.48	0.004 (0.024)	0.42	0.024 (0.024)	1.07
Home disorganization	0.058 (0.026)	0.66	0.002 (0.028)	0.43	0.010 (0.028)	0.49	0.040 (0.028)	1.48
Safety problems in home	0.058 (0.023)	0.56	0.024 (0.025)	0.16	–0.014 (0.025)	–0.10	0.010 (0.025)	0.41
Hours of TV per week	0.019 (0.023)	0.20	0.022 (0.024)	0.81	0.042 (0.024)	0.78	–0.000 (0.024)	0.81
Lack of materials for stimulation	0.000 (0.025)	0.22	0.040 (0.026)	–0.12	0.073 (0.026)	0.87	0.045 (0.026)	1.11
Problems with block	–0.008 (0.031)	0.30	0.011 (0.033)	0.17	0.024 (0.033)	0.38	0.053 (0.033)	1.21
Problems with home exterior	–0.008 (0.031)	0.38	–0.026 (0.033)	–0.02	0.009 (0.033)	0.22	–0.032 (0.033)	0.53
Problems with home interior	0.028 (0.025)	0.45	–0.021 (0.027)	0.10	–0.048 (0.027)	–0.05	–0.010 (0.026)	0.48
Food insecurity	0.005 (0.024)	0.09	0.040 (0.025)	1.44	0.029 (0.025)	0.03	–0.009 (0.025)	1.54
LW Index	0.626 (0.033)		1.458 (0.097)		0.688 (0.073)		1.405 (0.124)	

Notes: 1,647 observations. All models include city fixed effects, an indicator for the child's gender, and the child's age in months, and the full set of extended controls including indicators for the mother's race, indicators for mother's educational attainment, number of children in the household, total number of household members, indicators for family structure, the mother's PPVT score, and an indicator for whether the mother took the PPVT in Spanish. Standard errors in parentheses unless otherwise noted.

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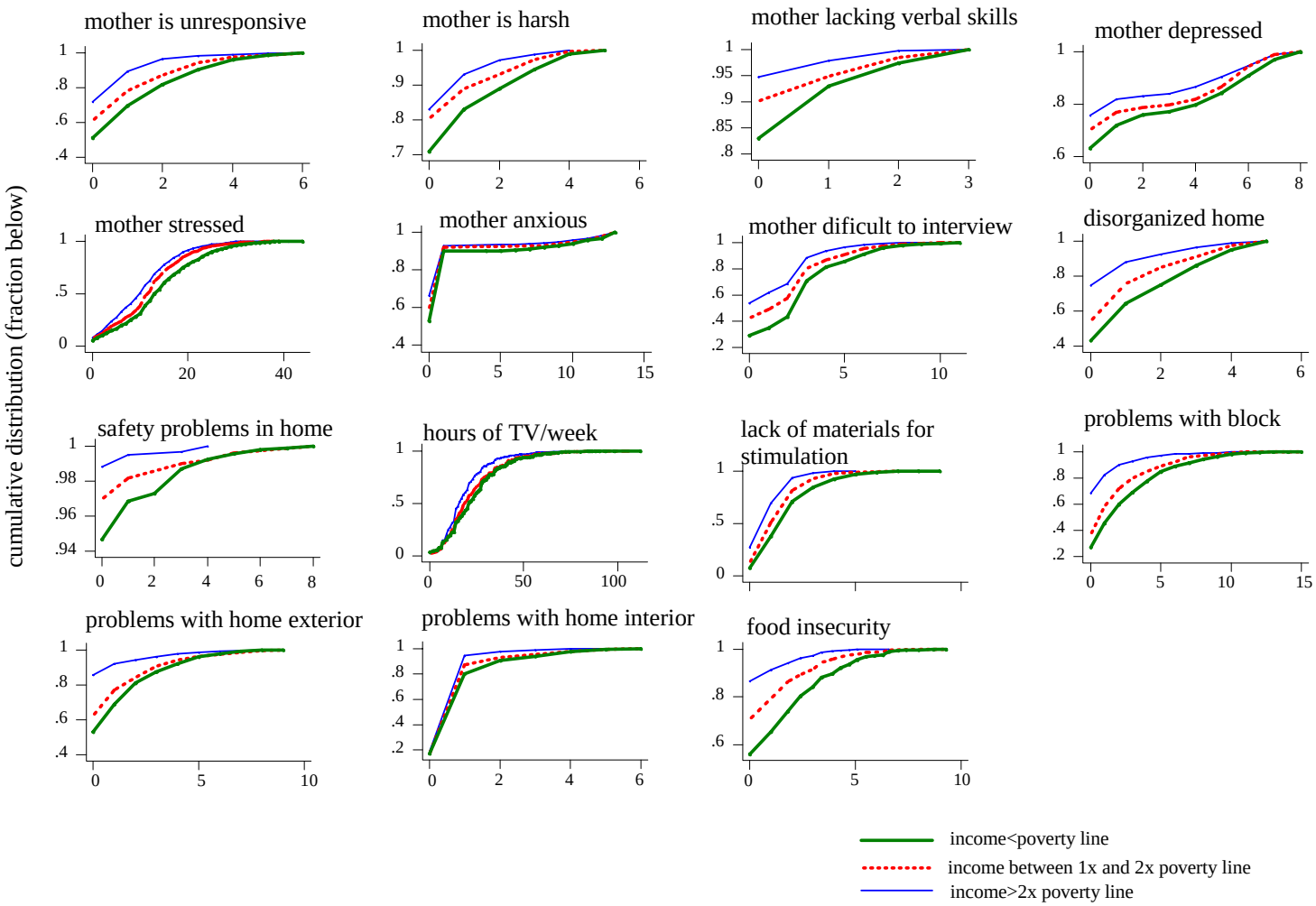

Figure 1: Cumulative Distributions of Parenting Measures, by Poverty Group

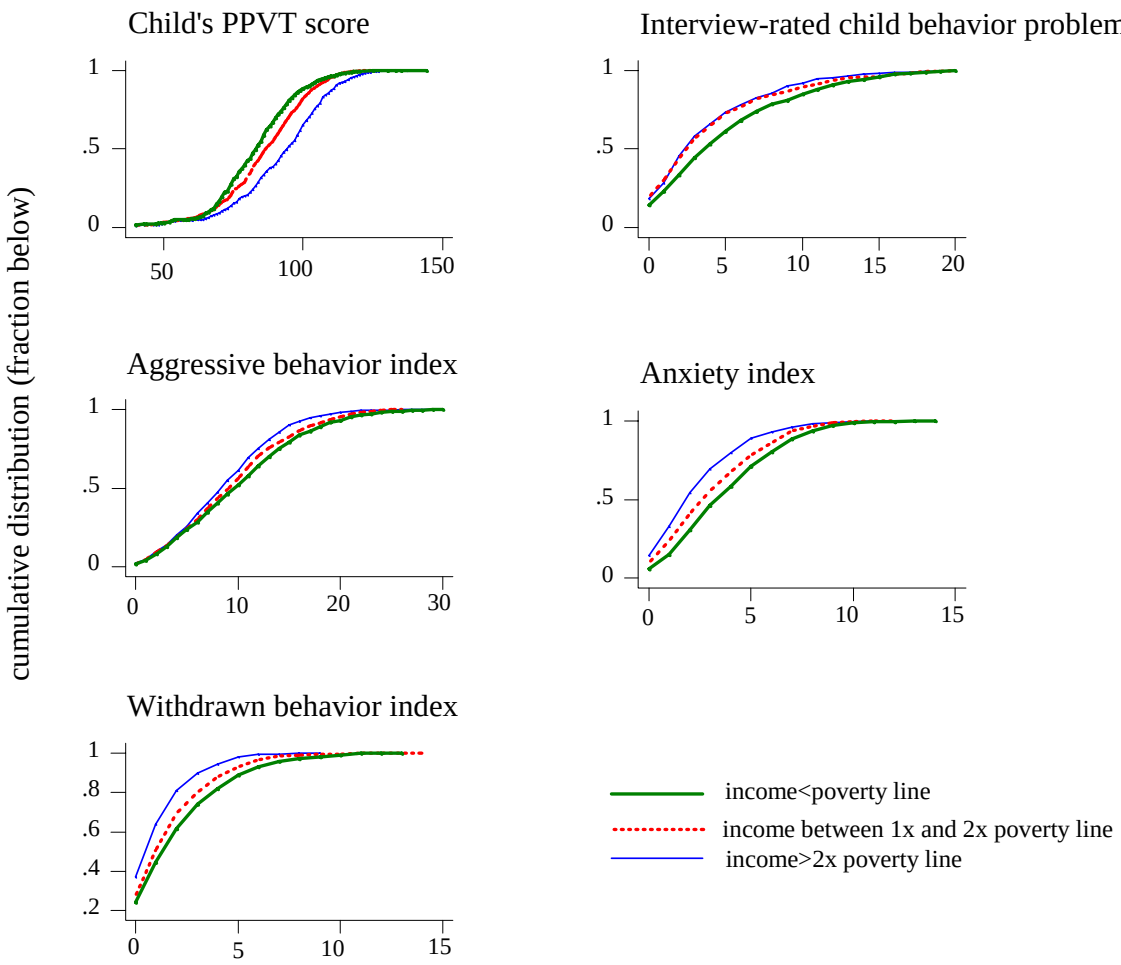

Figure 2: Cumulative Distributions of Child Outcomes, by Poverty Group

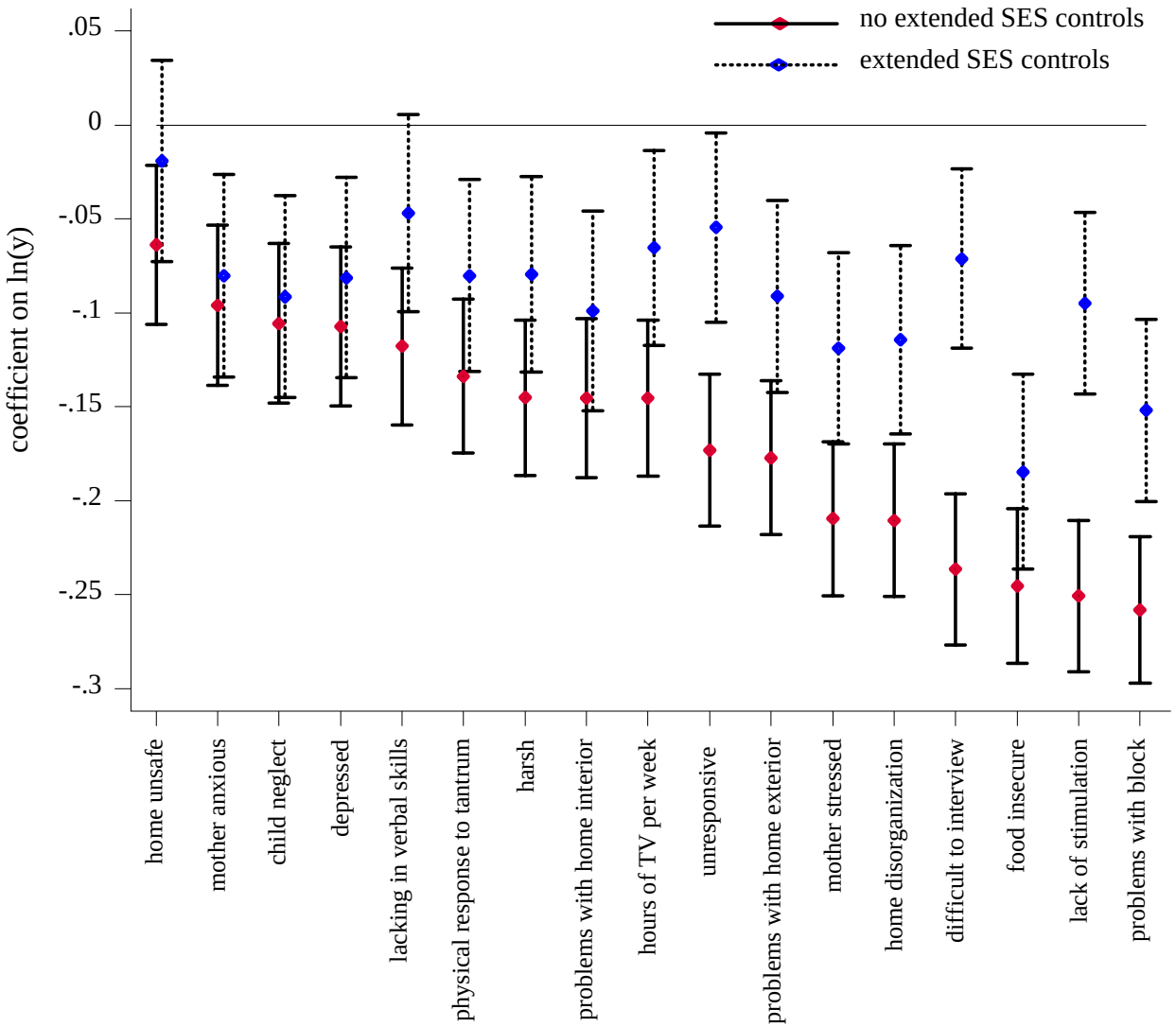

Figure 3: Coefficients and Confidence Intervals From Regressions of Standardized Parenting Measures on Income

Table 1: PPVT Scores: Associations with Income and Parenting Measures

Extended SES controls?	No	No		Yes	
	α	α	ω	α	ω
Ln(y)	0.212 (0.021)	0.089 (0.023)		0.005 (0.025)	
Unresponsive		–0.102 (0.029)	1	–0.102 (0.028)	1
Harsh		–0.044 (0.025)	0.59	–0.032 (0.024)	0.63
Lacking verbal skills		–0.048 (0.028)	0.81	–0.038 (0.027)	0.76
Maternal depression		–0.002 (0.026)	0.12	–0.015 (0.025)	0.24
Maternal stress		–0.048 (0.026)	0.45	–0.026 (0.026)	0.34
Maternal anxiety		0.006 (0.026)	0.07	–0.014 (0.025)	0.17
Difficult to interview		–0.116 (0.027)	1.03	–0.063 (0.027)	0.75
Neglect scale		0.016 (0.024)	0.16	0.008 (0.023)	0.18
Physical response to tantrum		0.009 (0.024)	0.13	0.021 (0.023)	0.00
Home disorganization		–0.030 (0.028)	0.71	–0.010 (0.027)	0.54
Safety problems in home		0.001 (0.025)	0.37	–0.004 (0.024)	0.35
Hours of TV per week		–0.051 (0.024)	0.42	–0.015 (0.023)	0.19
Lack of materials for stimulation		–0.076 (0.025)	0.72	–0.033 (0.025)	0.43
Problems with block		–0.089 (0.033)	0.70	–0.062 (0.032)	0.54
Problems with home exterior		0.016 (0.033)	0.56	0.008 (0.032)	0.45
Problems with home interior		–0.013 (0.027)	0.41	–0.013 (0.026)	0.39
Food insecurity		–0.018 (0.025)	0.25	–0.017 (0.024)	0.22
F-statistic (p-value): Parenting measures jointly insignificant		10.21 (0.000)		4.61 (0.000)	
LW Index		–0.464 (0.039)		–0.285 (0.036)	

Notes: 1,647 observations. Income is measured as income when the child was three years old. All models include city fixed effects, an indicator for the child's gender, and the child's age in months. The models shown in the columns marked "Extended SES controls" also include indicators for the mother's race, indicators for mother's educational attainment, number of children in the household, total number of household members, indicators for family structure, the mother's PPVT score, and an indicator for whether the mother took the PPVT in Spanish. Standard errors in parentheses unless otherwise noted.

Table 2: Associations of Children's Outcomes With Income and the Home Environment

	Child's PPVT	Behavior problems	Aggressive behavior	Withdrawn behavior	Anxious Behavior
Income measured at age 3					
No extended SES controls; no proxies					
ln(y)	0.212	–0.094	–0.113	–0.200	–0.217
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
No extended SES controls, all proxies					
ln(y)	0.089	0.017	0.001	–0.090	–0.101
	(0.023)	(0.022)	(0.023)	(0.023)	(0.023)
LW index	–0.464	0.597	1.367	0.696	1.071
	(0.039)	(0.032)	(0.090)	(0.059)	(0.085)
Extended SES controls, all proxies					
ln(y)	0.005	–0.013	–0.005	–0.069	–0.053
	(0.025)	(0.025)	(0.026)	(0.026)	(0.026)
LW index	–0.285	0.626	1.458	0.688	1.405
	(0.036)	(0.033)	(0.097)	(0.073)	(0.124)
Observations	1647	1685	1698	1698	1698
Income averaged over three years					
No extended SES controls; no proxies					
ln(y)	0.302	–0.127	–0.170	–0.274	–0.288
	(0.026)	(0.025)	(0.026)	(0.026)	(0.026)
No extended SES controls, all proxies					
ln(y)	0.148	0.013	–0.029	–0.130	–0.134
	(0.029)	(0.027)	(0.029)	(0.029)	(0.029)
LW index	–0.436	0.606	1.702	0.767	1.349
	(0.030)	(0.033)	(0.101)	(0.069)	(0.102)
Extended SES controls, all proxies					
ln(y)	0.020	–0.023	–0.036	–0.098	–0.052
	(0.033)	(0.033)	(0.034)	(0.034)	(0.034)
LW index	–0.297	0.626	1.762	0.771	1.881
	(0.032)	(0.038)	(0.110)	(0.083)	(0.154)
Observations	1762	1803	1814	1814	1814

Notes: All models include city fixed effects, an indicator for the child's gender, and the child's age in months. The list of proxy measures of parenting are those shown in Figure 1 and Table 1. Models shown in the panel marked "Extended SES controls" also include indicators for the mother's race, indicators for mother's educational attainment, number of children in the household, total number of household members, indicators for family structure, the mother's PPVT score, and an indicator for whether the mother took the PPVT in Spanish. Standard errors in parentheses.

Table 3: Extensions

	Child's PPVT	Behavior problems	Aggressive behavior	Withdrawn behavior	Anxious Behavior
Panel 1: Proxies for material aspects of parenting are excluded					
ln(y)	0.016	–0.014	–0.011	–0.078	–0.058
	(0.025)	(0.024)	(0.026)	(0.026)	(0.026)
LW index	–0.255	0.623	1.422	0.613	1.334
	(0.035)	(0.034)	(0.094)	(0.074)	(0.122)
Panel 2: Interviewer fixed effects					
ln(y)	0.010	–0.013	–0.001	–0.068	–0.044
	(0.025)	(0.025)	(0.027)	(0.027)	(0.027)
LW index	–0.373	0.582	1.377	0.675	1.469
	(0.051)	(0.043)	(0.096)	(0.073)	(0.128)
Panel 3: Interviewer fixed effects; maternal-assessed proxies are excluded					
ln(y)	0.017	–0.015	–0.049	–0.095	–0.073
	(0.025)	(0.025)	(0.028)	(0.027)	(0.027)
LW index	–0.339	0.575	0.488	0.267	0.502
	(0.045)	(0.042)	(0.067)	(0.049)	(0.093)
Panel 4: First principal component of all proxies					
ln(y)	0.005	0.003	–0.036	–0.087	–0.072
	(0.025)	(0.025)	(0.027)	(0.026)	(0.026)
First principal component	–0.061	0.111	0.080	0.054	0.111
	(0.008)	(0.008)	(0.012)	(0.010)	(0.020)
Observations	1647	1685	1698	1698	1698

Notes: Income is measured at age 3. All models include the child's age in months, an indicator for the child's gender, and the extended SES controls. Standard errors in parentheses.
Panel 1 includes city fixed effects, and includes all proxy variables shown in Table 1 except "Lack of materials for stimulation"; problems with the block, home exterior, and home interior; and food insecurity.
Panel 2 includes a set of interview/city fixed effects and all proxies. (Note that several interviewers conducted interviews in more than one city.)
Panel 3 includes interviewer/city fixed effects, and excludes the maternal-assessed proxy measures of depression, stress, anxiety, neglect, physical response to tantrum, hours of TV per week, and food insecurity.
Panel 4 include city effects, and includes the first principal component of the full list of proxy measures. The first principal component has been scaled so that its coefficient is comparable to that of the LW index.

Table 4: Simulated Effects of Income Transfers on PPVT Scores Across Poverty Groups
Based on estimates using age 3 income

	Means within groups			Differences in means across groups		
	Group1: In poverty	Group2: 1x to 2x poverty	Group3: Over 2x poverty	Group1– Group 2	Group 2 – Group 3	Group 1 – Group 3
Baseline Case	–0.223	–0.038	0.351	–0.185	–0.390	–0.574
No extended SES controls						
Case 1: Income floor set equal to poverty line	–0.011	–0.038	0.351	0.027 (115%)	–0.390 (0%)	–0.362 (37%)
Case 2: Income transfer of $2400 if income<$60K	–0.110	–0.009	0.360	–0.102 (44.9%)	–0.369 (5.4%)	–0.471 (17.9%)
Extended SES controls						
Case 1: Income floor set equal to poverty line	–0.181	–0.038	0.351	–0.143 (22.6%)	–0.390 (0%)	–0.532 (7.3%)
Case 2: Income transfer of $2400/child ($3600 for infant) if income<$60K, for up to two children	–0.201	–0.032	0.353	–0.168 (9.2%)	–0.386 (1.0%)	–0.554 (3.5%)

Table 5: Simulated Effects of Income Transfers on Child Outcomes Across Poverty Groups

	Group 1 – Group 2			Group 2 – Group 3			Group 1 – Group 3		
	Baseline	Case 1	Case 2	Baseline	Case 1	Case 2	Baseline	Case 1	Case 2
Based on estimates using income at age 3									
PPVT	–0.185	–0.142 (23.2%)	–0.168 (9.2%)	–0.390	–0.390 (0%)	–0.385 (1.3%)	–0.574	–0.532 (7.3%)	–0.553 (3.5%)
Behavior problems	0.215	0.152 (29.3%)	0.190 (11.6%)	0.035	0.035 (0%)	0.028 (20.0%)	0.249	0.187 (24.9%)	0.219 (12.0%)
Aggressive behavior	0.157	0.087 (44.6%)	0.130 (17.2%)	0.088	0.088 (0%)	0.082 (6.8%)	0.245	0.176 (28.2%)	0.211 (13.9%)
Withdrawn behavior	0.190	0.076 (60.0%)	0.146 (23.2%)	0.320	0.320 (0%)	0.309 (3.4%)	0.511	0.396 (22.5%)	0.455 (11.0%)
Anxious behavior	0.236	0.137 (41.9%)	0.197 (16.5%)	0.306	0.306 (0%)	0.296 (3.3%)	0.542	0.442 (18.5%)	0.493 (9.0%)
Based on estimates using income averaged over three years									
PPVT	–0.185	–0.116 (37.3%)	–0.158 (14.6%)	–0.390	–0.390 (0%)	–0.383 (1.7%)	–0.574	–0.505 (12.0%)	–0.541 (5.9%)
Behavior problems	0.215	0.133 (37.9%)	0.183 (14.9%)	0.035	0.035 (0%)	0.027 (22.8%)	0.249	0.168 (32.6%)	0.209 (16.0%)
Aggressive behavior	0.157	0.037 (76.2%)	0.110 (29.9%)	0.088	0.088 (0%)	0.076 (13.2%)	0.245	0.125 (48.8%)	0.186 (23.9%)
Withdrawn behavior	0.190	0.028 (85.1%)	0.126 (33.4%)	0.320	0.320 (0%)	0.303 (4.9%)	0.511	0.347 (31.7%)	0.430 (15.5%)
Anxious behavior	0.236	0.119 (49.5%)	0.190 (19.4%)	0.306	0.305 (0%)	0.294 (4.9%)	0.542	0.425 (21.6%)	0.484 (10.6%)

Notes: The table shows differences in mean scores across groups, and the percent difference in mean scores from the "baseline" case. All results are from models with extended SES controls.

Group 1: Income less than the poverty line
Group 2: Income between 1x and 2x the poverty line
Group 3: Income greater than 2x the poverty line
Case 1: Income floor set equal to poverty line
Case 2: Income transfer of $2400/child ($3600 for infant) if income<$60K, for up to two children