THE MECHANISMS MEDIATING THE EFFECTS OF POVERTY ON CHILDREN'S INTELLECTUAL DEVELOPMENT*

GUANG GUO AND KATHLEEN MULLAN HARRIS

Although adverse consequences of poverty for children are documented widely, little is understood about the mechanisms through which the effects of poverty disadvantage young children. In this analysis we investigate multiple mechanisms through which poverty affects a child's intellectual development. Using data from the NLSY and structural equation models, we have constructed five latent factors (cognitive stimulation, parenting style, physical environment, child's ill health at birth, and ill health in childhood) and have allowed these factors, along with child care, to mediate the effects of poverty and other exogenous variables. We produce two main findings. First, the influence of family poverty on children's intellectual development is mediated completely by the intervening mechanisms measured by our latent factors. Second, our analysis points to cognitive stimulation in the home, and (to a lesser extent) to parenting style, physical environment of the home, and poor child health at birth, as mediating factors that are affected by lack of income and that influence children's intellectual development.

By the end of the 1990s, more than one in five children under age 6 in the United States lived in families with incomes below the official poverty line (Lichter 1997; U.S. Census Bureau 1999). Poverty is associated with well-documented negative consequences for children. Childhood poverty is correlated with dropping out of school, low academic achievement, teenage pregnancy and childbearing, poor mental and physical health, delinquent behavior, and unemployment in adolescence and early adulthood (Duncan and Brooks-Gunn 1997a; Duncan, Brooks-Gunn, and Klebanov 1994; Haveman and Wolfe 1994; Huston 1991; Korenman, Miller, and Sjaastad 1995; McLeod and Shanahan 1993). The longer children live in poverty, the lower their educational achievement and the worse their social and emotional functioning (Duncan et al. 1994; McLeod and Shanahan 1993; Miller and Korenman 1994).

Although the adverse outcomes associated with poverty are widely recognized, much less is understood about how poverty affects children's well-being. In theory, this effect operates through a mediating process, in which poverty or lack of income affects some mediating factors and these factors, in turn, affect child outcomes. Two models typically are invoked to explain the mediating process.

According to the financial capital model, an impoverished family has fewer material resources, and children growing up with fewer resources tend to do less well in education and other aspects of life. Although this model offers a reasonable explanation of the effects of poverty on children's well-being, it is specified vaguely. Family material resources are a crucial part of the model; yet these resources are almost never defined explicitly, measured, and incorporated into the analysis of poverty effects. Moreover, the financial capital model may not be the only explanation of the poverty effects. Low income also may be related to nonmaterial family resources.

A second model frequently employed to explain the effects of poverty on children is the family process or parental socialization model. In addition to restraining family material resources, according to this model, poverty may affect the ways in which parents monitor their children and respond to their needs (Brooks-Gunn and Duncan 1997; Huston 1995). In particular, economic hardship diminishes parents' ability to interact with and socialize children in ways that are beneficial to their well-being. For example, there is evidence that poverty, income loss, and unemployment reduce parents' responsiveness, warmth, and supervision while increasing inconsistent disciplinary practices and the use of harsh punishments (Conger et al. 1992, 1994; Elder 1974; Elder et al. 1992; McLeod and Shanahan 1993; McLoyd et al. 1994; Sampson and Laub 1994).

In our analysis we examine both material and nonmaterial mediating factors in a general framework and focus on children's intellectual development. Identification of the key mediating mechanisms will suggest ways of intervening effectively in poor children's lives beyond what income redistribution can achieve. The effectiveness of income redistribution is contingent on how parents allocate the transferred income between children and adults (Currie 1997; Lazear and Michael 1988). Income redistribution policy also is based on the premise that the relationship between poverty and child outcomes is causal. If the causality holds, we would expect that a certain amount of increase in parental income would lead to a certain amount of improvement in a child's cognitive development. Recent work shows that the relationship is more complicated than suggested by nonexperimental studies (Duncan and Brooks-Gunn 1997a;

*Guang Guo and Kathleen Mullan Harris, Department of Sociology, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599; E-mail: guang_guo@unc.edu. This work was supported by the Department of Sociology and the Carolina Population Center at the University of North Carolina at Chapel Hill, by grants to Guo from the National Academy of Education, the Spencer Foundation, and the Office of Educational Research and Improvement (OERI) of the U.S. Department of Education, under Grant R306F60081. We also acknowledge the support of the W.T. Grant Foundation to both Guo and Harris through their Faculty Scholars Program. We thank Janne Abullarade for her extensive assistance in an earlier stage of the project and Boyd Blackburn for his programming work. We are grateful for the helpful comments of Karl Alexander, Greg Duncan, Jane McLeod, and Jay Teachman on an earlier draft.

Huston 1997; Mayer 1997): At least part of the effect of poverty estimated by these studies may not be causal. Examining the mediating factors will help uncover some of the causal pathways through which low income influences children's intellectual development.

Some studies have begun to examine the pathways through which economic deprivation operates to disadvantage poor children. This small body of research focuses on the provision of learning experiences, parents' emotional and physical health, and parenting behavior (Brooks-Gunn 1995; Conger et al. 1994; Conger, Conger, and Elder 1997; Hanson, McLanahan, and Thomson 1997; McLoyd et al. 1994; Smith, Brooks-Gunn, and Klebanov 1997). In these studies, however, the researchers focus on only one of the possible pathways through which poverty effects may operate. Our approach is to examine the simultaneous effects of a broad set of mediating mechanisms.

Below we provide a conceptual framework that specifies the mechanisms mediating the effects of poverty and the links between poverty, the mediating factors, and intellectual development. We first present the results from factor analysis; there we construct the mediating factors using the rich information on child home environment collected in the National Longitudinal Survey of Youth (NLSY). Then we present our main findings of the effects of poverty on the mediating factors, the effects of mediating factors on cognitive development, and the direct effect of poverty on cognitive development. We estimate these effects using structural equation models and the data from the NLSY. In the final sections we synthesize and interpret our results, and discuss the implications.

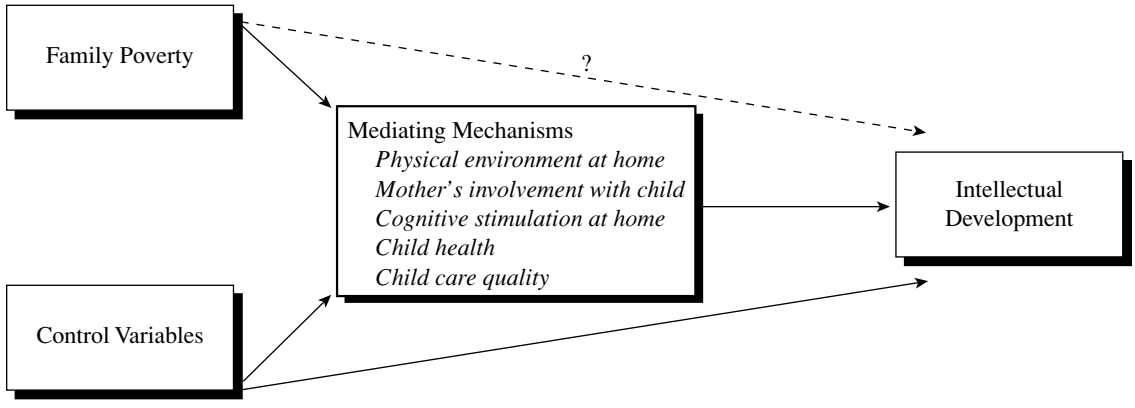
MECHANISMS MEDIATING THE EFFECTS OF POVERTY

The conceptual framework depicted in Figure 1 illustrates the main features of our theoretical model. The variables shown in the central box are mediating mechanisms, without which we would have a conventional regression model. In the conventional approach, the effect of poverty is estimated with controls for other family and child characteristics. Our theoretical model, however, allows poverty to affect each of the mediating mechanisms; these, in turn, are allowed to affect intellectual development. We hypothesize that poverty affects children's intellectual development only through mediating variables. In other words, once a comprehensive set of mediating mechanisms is taken into consideration, there is no theoretical reason why poverty should affect intellectual development directly. This hypothesis, represented by the dotted line between family poverty and intellectual development, is tested empirically.

We follow two guidelines in deciding what mediating mechanisms to include in the conceptual framework. First, we consider factors that financial resources can influence, both directly and indirectly. Second, we examine factors connected to a child's home and child care environment where the child spends most of his or her time, at home and in the care of adults. Below we describe each of the mediating mechanisms in detail, and specify the directions of the effects of these factors in light of the existing literature.

Among the mediating factors shown in Figure 1, financial resources would seem to have the greatest influence on *physical environment at home*. Poor children's homes are much more likely than others to have open cracks in the wall and ceiling, holes in the floor, a leaky roof, signs of rats, and exposed wires, or to be overcrowded (Mayer 1997). Low-income homes are much less likely than middle-income homes to be supplied with adequate electrical outlets, central heat, or bathrooms. Poor children's households also are less likely to contain a dishwasher, a clothes dryer, a clothes washer, a telephone, or more than one motor vehicle. The neighborhoods in which low-income homes are located are much more likely to be in high-crime areas with abandoned

FIGURE 1. THE CONCEPTUAL FRAMEWORK FOR THE MEDIATING MECHANISMS OF THE EFFECTS OF POVERTY ON INTELLECTUAL DEVELOPMENT



buildings (Massey 1996). The physical environment at home reflects the quality and safety of the housing in which the child lives; a safe, high-quality living environment is conducive to learning (Brooks-Gunn, Klebanov, and Liaw 1995).

The level of cognitive stimulation at home is another condition that may be altered by financial resources. Many elements of cognitive stimulation may be "purchased" with income. For instance, family income can influence the quantity and quality of books, newspapers, and magazines available at home. Family income may have an even larger impact on the number of trips a family can afford, such as museum visits, which serve an intellectual purpose. The relationship between cognitive stimulation and family income, however, may be less strong than that between home physical environment and family income: Not every element related to home cognitive stimulation is expensive. Books and magazines frequently are available free of charge at public libraries. Although the connection between income and home cognitive stimulation is expected to be weaker than that between income and home physical setting, we expect cognitive stimulation to have a stronger and more consistent effect on children's intellectual development than does physical setting because the connection between cognitive stimulation and intellectual development is more direct and more relevant.

A large literature links low income to *child health status*. Studies have shown that children in poverty are at higher risk of infant, child, and adolescent mortality (Children's Defense Fund 1994; NCHS 1990; Stockwell, Swanson, and Wicks 1988), low birth weight (Institute of Medicine 1985), and malnutrition (Miller and Korenman 1994). Children in poverty also suffer more health problems (see review by Klerman 1991): Poverty is associated with higher frequency of several infectious diseases including rheumatic fever, hemophilus influenza, meningitis, gastroenteritis, parasitic diseases, and pediatric AIDS (Egbuonu and Starfield 1982). Other health conditions are more prevalent among the poor than the nonpoor, such as anemia (Yip et al. 1987), activity limitation caused by chronic conditions (Office of Maternal and Child Health 1990), vision and hearing difficulties (Egbuonu and Starfield 1982), learning disabilities (Zill and Schoenborn 1990), lead poisoning, nonfatal injuries (Pless, Verreault, and Tenina 1989), and intentional injuries (National Center on Child Abuse and Neglect 1988).

Poor children tend to suffer ill health for a variety of reasons (Klerman 1991). Poor families may find it difficult to purchase adequate and safe housing, food, medical supplies, and prescribed medications. These families are more exposed to dangerous neighborhoods and to lead poisoning. They are less likely to be engaged in health-promoting activities such as recreation, a program of physical fitness, and maintaining a healthy diet. Parents in poverty tend to have unhealthy lifestyles characterized by smoking, excessive drinking, and illegal drug use. These practices may impair a mother's ability to care for her child (Jones and Lopez 1990). Also, contrary to general belief and in spite of Medicaid, the poor tend to underuse health services. In 1988, about 71.8% of the children age 17 or younger in the United States in families with an income of less than $10,000 were covered by a medical insurance plan or Medicaid, as opposed to 92.4% in families with an income of $40,000 or more (Bloom 1990).

Although the evidence for the link between low income and child health is abundant, much less effort has been made to study the link between children's health and cognitive development. Previous work shows that chronic health conditions are detrimental to emotional and behavioral development (Dougherty et al. 1987). It is also well known that certain health conditions such as anemia and lead poisoning are associated negatively with cognitive development. In this analysis we examine whether children's health status mediates the impact of poverty on children's cognitive development. We measure health status by indicators of ill health to tap the potentially harmful effects of poverty on the infant's viability at birth and on health problems or illnesses in childhood that are chronic and need medical attention.

Unlike all the other mediating factors we have examined so far, *parenting style* cannot be shaped easily by material goods or services, and therefore cannot be "purchased" readily with income. Nevertheless, parenting style is one of the most important factors intervening between poverty and child outcomes (Huston 1995). Evidence shows that poverty affects parenting style indirectly through psychological stress. Parents in poverty are often beset by lack of food, poor housing, dangerous neighborhoods, unemployment, racial and ethnic discrimination, and poor health. Dealing daily with these multiple problems leads to greater psychological stresses among low-income parents than middle- to high-income parents.

Poverty-generated stresses contribute to parenting styles characterized by harsh discipline and punitiveness (Conger et al. 1997; Conger et al. 1994; Dodge, Pettit, and Bates 1994; Hashima and Amoto 1994; McLeod and Shanahan 1993; McLoyd et al. 1994; Sampson and Laub 1994) and by low levels of warmth and support (Dodge et al. 1994; Hashima and Amoto 1994; McLoyd and Wilson 1991). These practices are associated with child behavior problems such as aggression and delinquency (Elder 1974; Sampson and Laub 1994). In this analysis we hypothesize that such stress-related parenting practices also mediate the effect of poverty on children's cognitive development.

Child care is more complicated than the other intervening factors we have considered. We define this variable as nonmaternal care of the child. Child care has two dimensions: amount, referring to the extent to which children are in the care of someone other than their mother; and quality, referring to characteristics of child care arrangements (e.g., group size, child-staff ratios, caregiver training) that lead to positive developmental outcomes for children (Kisker and Maynard 1991). Child care can be a potential mediating factor of poverty only for children who receive nonmaternal child care. In addition to child care quality, the extent to which child care mediates the effects of poverty is also related closely to the amount of child care. Families' use of child care varies greatly. Moreover, the relationship between

income and the amount of child care use is nonlinear: Both low- and high-income families tend to use child care less than middle-income families because both tend to work less when children are young. High-income mothers can afford not to work, while low-income mothers may choose not to work because the economic gains from work are typically less than the costs associated with work, such as child care, transportation, and clothing (Edin and Lein 1997).

In contrast to the amount of child care used, *child care quality* seems to mediate the effect of poverty on children's cognitive development more straightforwardly (Huston 1995). Child care quality tends to be correlated positively with family income (NICHD 1997; Phillips 1987). In the home, infants and toddlers from low-income families receive poorer-quality care than those from high-income families (Galinsky et al. 1994; NICHD 1997). In the absence of government subsidies or interventions, families suffering more stress, both psychological and economic, are more likely to use lower-quality care (Hayes, Palmer, and Zaslow 1990). Family income is associated positively with the frequency and quality of caregiver-child interactions, with the quality of physical environment in child care, and with learning opportunities in child care (NICHD 1997). Most studies on child care centers, however, have failed to find a strong positive relationship between family income and quality of child care (NICHD 1997; Phillips 1995) because middle-income families tend to benefit less from government subsidies for child care than do families with low or middle to high incomes (Phillips et al. 1994).

The relationship between quality of child care and child outcomes is fairly clear. Available studies show that quality of early child care contributes to later cognitive development, children's perceptions of their own competence, and social development (Howes 1988, 1990; Peisner-Feinberg 1995; Vandell, Henderson, and Wilson 1988). These results are meaningful only for children who spend considerable parts of their day in nonmaternal care provided by child care centers, relatives, friends, or home providers. These children's parents tend to be working parents.

We plan to examine child care as an important mediating factor for effects of poverty, but we face major data constraints. Some of these constraints are due to inadequate design in data collection; others are inherent in the issue of child care. Child care is used mainly by working women; in addition, most surveys, including the NLSY, ask only about working women's child care (Raley, Harris, and Rindfuss forthcoming). Moreover, because we argue that the effects of poverty are mediated more by the quality than by the amount of child care, we are limited further by the availability of measures of child care quality in our data.

Our conceptual framework specifies five mechanisms that mediate the effects of poverty on children's cognitive development. We examine the links between poverty and each of these mechanisms, the links between each of the mechanisms and cognitive development, and the direct link between poverty and cognitive development. Some previous studies have examined part of this framework, but none apparently have examined simultaneously this fuller set of intervening mechanisms and all of the links between poverty, the mediating mechanisms, and cognitive development. Using the 1986 wave of the NLSY, Parcel and Menaghan (1989) derived several scales that correspond closely to three of the mediating mechanisms specified in our framework: physical environment, cognitive stimulation, and parenting style. Their primary purpose, however, was to develop these scales rather than to examine the scales' mediating effects. Mayer (1997) examined children's material well-being, parenting stress, and parenting practices as mechanisms through which income influences child outcomes. Her analysis, however, does not consider these mechanisms simultaneously in a single analysis.

The edited volume *Consequences of Growing Up Poor* (Duncan and Brooks-Gunn 1997b) contains the most up-to-date theoretical and empirical work on potential pathways of the effects of poverty. The potential mediating mechanisms are addressed separately, however. For instance, the NICHD Child Care Research Network (1997) examines the role of hours and quality of child care; Smith et al. (1997) examine the role of cognitive stimulation and emotional support in the home; and Hanson et al. (1997) and Conger et al. (1997) examine the role of parenting behaviors in mediating the impact of poverty and income loss on children's well-being. In our theoretical and empirical model we synthesize these disparate approaches: We address the role of multiple mechanisms that operate simultaneously along separate and overlapping pathways to mediate the impact of poverty experiences on children's intellectual development.

DATA AND MEASURES

The data source for our analysis is the National Longitudinal Survey of Youth (NLSY). The original national sample of the NLSY included a total of 12,686 youths age 14 to 21 as of January 1, 1979; African Americans, Hispanics, and economically disadvantaged whites were oversampled. Starting in 1986, the cognitive outcomes of the female respondents' children were assessed every two years (in 1986, 1988, 1990, and 1992).

We chose the NLSY for several reasons. First, it contains many variables that describe home environments, children's health status at birth and at the time of cognitive tests, and quality of child care. These variables allow us to construct the mediating factors specified in our conceptual framework. Second, the variety of cognitive tests administered to the NLSY respondents provide multiple indicators of intellectual development. Third, longitudinal measures of poverty can be constructed from the yearly information on family income in the NLSY. Previous work shows that longitudinal measures of poverty have a much stronger relationship to cognitive development than do measures of poverty at a single point in time (Korenman et al. 1995).

It is well known that the NLSY tends to overrepresent children born to younger, less highly educated, and minority mothers. To reduce possible bias in the sample, in all statistical models we control for characteristics overrepresented in the sample, such as mother's age at child's birth, race,

mother's educational attainment, and mother's cognitive ability. The overrepresentation of disadvantaged groups is not necessarily a drawback: The 1979 NLSY survey deliberately oversampled African Americans, Hispanics, and low-income whites to increase the variation in socioeconomic conditions represented in the sample. This increase in variation is particularly valuable because of our focus on the disadvantaged children. Below we describe how we measure the elements in our conceptual model (see Figure 1).

We measure intellectual development by four cognitive tests administered to the respondents in the NLSY. We use more than one cognitive test to assess the robustness of our results, or to learn whether our results hold for different measures of cognitive development. (1) The Reading Recognition Assessment of the Peabody Individual Achievement Test (PIATR) measures word recognition and pronunciation. Children are asked to read a word silently and then to say it aloud. This and the two PIAT tests described next are given to all children age 5 or older. (2) The Reading Comprehension Assessment of the Peabody Individual Achievement Test (PIATC) measures the ability to derive meaning from reading sentences silently. (3) The Mathematics Assessment of the Peabody Individual Achievement Test (PIATM) measures a child's achievement in mathematics as commonly taught in American schools. The materials covered range from recognizing numerals to measuring advanced concepts in geometry and trigonometry. (4) The Peabody Picture Vocabulary Test-Revised (PPVT-R) measures an individual's receptive (hearing) vocabulary for Standard American English and provides, at the same time, an estimate of verbal ability or scholastic aptitude (Dunn and Dunn 1981:2). This assessment is administered to children age 3 and older.

Appendix Table A1 presents the means and standard deviations of the variables used in the analysis. The four columns correspond to the four NLSY data sets associated with the four measures of intellectual development: PIATR, PIATC, PIATM, and PPVT. We created a data set by including all children with a valid score on a particular cognitive test. The valid score can be taken from any of the four test years, but each child contributes only one score. The composition of the different samples is very similar, with only a few exceptions: For example, mothers of children in the PIATC sample have slightly higher AFQT scores, and they smoke and drink less than the mothers of children in the other samples. While we control for these differences in the models, we also check for any selection bias associated with these different subsamples by reestimating the models using a uniform sample: that is, only those cases with valid scores on all four cognitive tests.

We use the four measures of intellectual development as four dependent variables in four distinct structural equation models. As an alternative specification, we also construct a latent variable of intellectual development using the four test scores as four indicators. The variety of alternative specifications tests the robustness of our results.

The NLSY HOME scales provide us with the crucial variables for constructing three mediating factors: physical environment at home, level of cognitive stimulation, and parenting style. The variables in the NLSY HOME are a subset of the Home Observation for Measurement of the Environment (HOME; Caldwell and Bradley 1984). The original HOME was created to identify high-risk environments and to facilitate early intervention efforts to reduce developmental problems. Only a subset of the original HOME was included in the NLSY HOME because of the time and administrative restrictions inherent in a survey study.

Different versions of HOME mediate between family income and cognitive development. The score on the HOME is tied closely to family income (Garrett, Ng'andu, and Ferron 1994), and HOME predicts performance on standard cognitive tests (Duncan et al. 1994; Sugland et al. 1995). HOME contains a disadvantage, however, for understanding the mediating mechanisms of the effects of poverty. A typical version of HOME consists of 50 to 60 individual variables. The traditional approach is to sum all these variables, treat the sum as a single variable (HOME), and estimate its effect. The difficulty lies in the interpretation of this effect. A home environment has many aspects, as reflected in the multiple dimensions that make up this scale. If a study showed an effect of HOME, we still would not know which aspect of a home environment would need to be improved to facilitate children's intellectual development.

Our approach is to disaggregate the HOME scale and use the individual variables from HOME to form more interpretable and substantively more meaningful subscales. The variables from the original HOME fall into three main categories: cognitive variables describing the experiences and materials that influence the level of cognitive stimulation in the home; social variables describing parent-child interactions; and physical environment variables describing the organization of the physical environment (Bradley and Tedesco 1982). Three versions of HOME were developed: for infants and toddlers (Bradley and Caldwell 1977), for preschool children (Bradley 1985), and for children of elementary-school age (Bradley et al. 1988). For this paper we constructed mediating subscales from the preschool version of HOME included in the NLSY. We did not use the HOME for elementary-school age because some children in the NLSY were given a test before they attended school.

Child health status is measured by two mediating latent variables: ill health at birth and ill health in childhood. We measure ill health at birth by birth weight, birth length, and length of gestation; we measure ill health in childhood at the time of the assessments by number of illnesses over the past year, whether the child has conditions that limit school activities, and whether the child has conditions requiring medical attention. Insofar as poverty is associated with the mother's poor health during pregnancy and increases risks or exacerbates health problems for children, our measures capture implications of these problems for children at birth and in early childhood.

We measure *child care quality* by one latent variable, using information on whether the main person responsible for caring for the child received any training related to chil-

dren or child care, the number of children receiving care together in the same group, and the number of care providers in the group. We combine the latter two pieces of information to form a ratio of the number of adults supervising children to the number of children receiving care together. The ratio measures the relative group size in each care setting. Although we do not observe the "quality" of child care received, these indicators represent inputs into a production of quality (i.e., our latent variable) that involves greater attention to the child's needs by trained caregivers.

Poverty is measured by the proportion of the years since child's birth in which the family lived below the official poverty line. If poverty information is missing in some of these years, we use available information to calculate the measure, which ranges from 0 to 1. If the family never lived in poverty, the value is 0. If the family lived in poverty in all of the years, the value is 1. We prefer this long-term poverty measure because longer-term measures using multiple-year family income are superior to single-year or limited-duration window variables; the latter can lead to misleading estimates (Wolfe et al. 1996). In addition, cumulative poverty measures affect children's cognitive development much more strongly than do measures based on single-year family income (Duncan et al. 1994; Korenman et al. 1995).

In addition to family poverty, we include other exogenous variables as controls. These may be regarded as a typical set of independent variables in a regression analysis of the effect of poverty on intellectual development. Mother's cognitive ability is a strong predictor of children's cognitive development (Garrett et al. 1994; Moore and Snyder 1991). This ability is measured by the Armed Forces Qualification Test (AFQT), administered to the mother in 1980. Mother's educational attainment is measured by the number of years of schooling completed at the time of the cognitive tests.

Maternal age is mother's age in the year of the child's birth. It is important to control for maternal age in this analysis because of the relatively large proportion of children born to adolescent mothers. African Americans, about 40% of the total sample, are the largest racial group in each of the five samples, partly because they were originally oversampled and partly because the economically disadvantaged whites originally sampled were dropped after the 1990 survey round due to financial constraints (Baker et al. 1993). Our analysis also includes data available before 1990 for the subsample of disadvantaged whites. Child age is the age at the time of the PPVT assessments; we create this variable by rounding up a child's age at the time of cognitive assessments to the next month if the child was more than 15 days into a given month on the survey date. The NLSY-C manual recommends that the PPVT age be controlled when PPVTs and PIATs are analyzed (Baker et al. 1993).

Family structure and its influences on children are a major topic of research among social scientists (Garrett et al. 1994; Hetherington, Camara, and Featherman 1983; McLanahan and Booth 1989; McLanahan and Sandefur 1994). In this study, we measure family structure by sibship size and by a group of three constructed variables measuring maternal marital status. In any given year, the mother must be married, divorced, or never married. We construct three variables to measure respectively the proportion of the years between the child's birth and an assessment in which the mother was never married, married, or divorced (proportion never married, proportion married, and proportion divorced). Separated mothers are treated as divorced; widowed mothers are combined with married mothers. Very few cases involve widowed mothers. In any regression analysis, only two of the three variables can be entered into an equation at a time because the third variable is a linear combination of the other two.

Also included as controls are dummy variables for region coded as south, west, northeast, and north central.

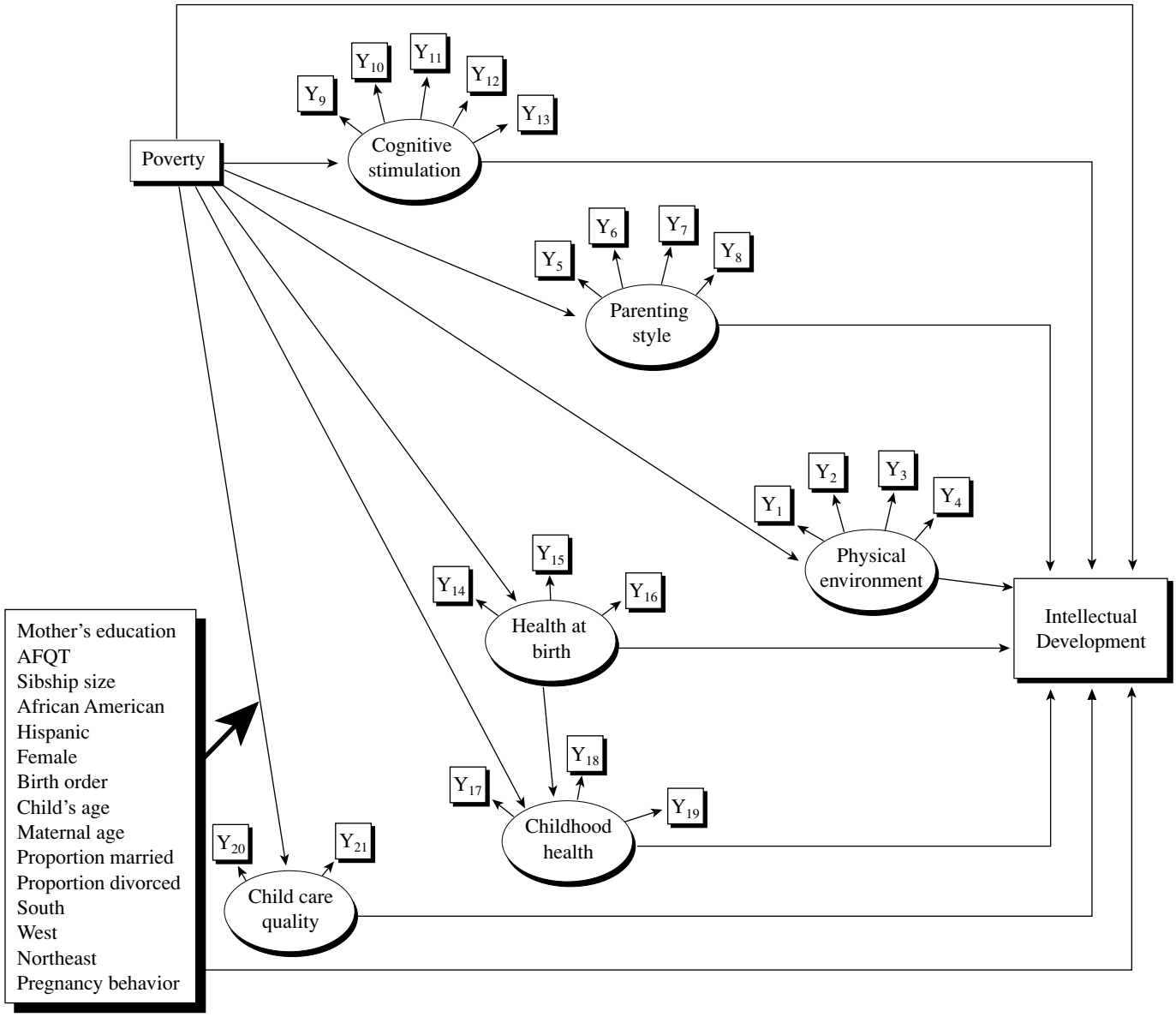
METHODS

We employed both exploratory and confirmatory factor analysis to construct the mediating factors. We first used exploratory factor analysis to identify the number of factors contained in the NLSY HOME and to examine whether these identified factors can be interpreted easily and applied readily in our analysis. We then specified confirmatory factor analysis on the basis of the earlier exploratory factor analysis. The specification includes the number of factors, the number of indicators for each factor, and whether the measurement errors are allowed to correlate. The confirmatory factor analysis is specified as part of the structural equation models that we estimated. In the construction of ill health at birth, ill health at the time of cognitive tests, and child care quality, we applied confirmatory factor analysis from the beginning, partly because the latent variables already make clear what indicators we should be seeking and partly because the fewer indicators are available in the NLSY data set.

We used structural equation models (Bollen 1989; Jöreskog and Sörbom 1988) for the analysis. Figure 2 presents the essential features of a structural equation model for the mediating mechanisms of the effects of poverty on intellectual development. In a conventional analysis, intellectual development usually is regressed on the leftmost column of exogenous variables: poverty, mother's education, AFQT, sibship size, African American, Hispanic, female, birth order, child's age, maternal age, proportion of years since birth in which mother is married, proportion of years since birth in which mother is divorced, west, south, and northeast (north central is the reference category), and pregnancy behavior. Mother's health behavior during pregnancy (pregnancy behavior) with the index child is itself a latent variable with four indicators: whether during pregnancy she drinks, whether she smokes, whether she reduces drinking, and whether she reduces smoking.

Our approach is characterized by the inclusion of the variables mediating between intellectual development and poverty as well as some other exogenous variables such as mother's cognitive ability and mother's education. Two latent variables measure child's health status: ill health at birth and ill health in childhood. We allow ill health at birth to have an effect on ill health in childhood. All the mediating

FIGURE 2. ESSENTIAL FEATURES OF A STRUCTURAL EQUATION MODEL FOR THE MEDIATING MECHANISMS OF THE EFFECTS OF POVERTY ON INTELLECTUAL DEVELOPMENT



Physical environment
- Y_1 Clean
- Y_2 Not dark
- Y_3 Tidy
- Y_4 Safe

Parenting style
- Y_5 Mother conversed with child
- Y_6 Mother hugged and kissed child
- Y_7 Mother's voice positive
- Y_8 Mother answered child verbally

Cognitive stimulation
- Y_9 Books
- Y_{10} Magazines
- Y_{11} Mother read to child
- Y_{12} Record or tape
- Y_{13} Museum visits

Health at birth
- Y_{14} Birth weight
- Y_{15} Length of gestation
- Y_{16} Length of child

Childhood health
- Y_{17} No. of illnesses last year
- Y_{18} Medical attention
- Y_{19} Physical limitations

Child care quality
- Y_{20} Teacher training
- Y_{21} Staff/children ratio

factors are latent variables represented by multiple indicators. The indicators are described in Figure 2 and Table 1.

The mediating effects of poverty on intellectual development are represented by the short arrows that connect the six mediating mechanisms between poverty and intellectual development (Figure 2). The long arrows represent the direct effects of poverty, as well as other exogenous variables, on intellectual development. The thick and very short arrow represents the effects of the exogenous variables other than poverty on the mediating mechanisms. Figure 2 does not specify these effects individually because of the need to simplify the figure.

We took care to construct our analysis (Figure 2) so as to reflect the longitudinal time sequence of our measures. Experience of poverty is measured between birth and the cognitive assessment. We constructed the mediating subscales using the preschool version of the NLSY HOME because the children assessed in our samples are about six years old on average. Childhood poverty experience and the mediating variables thus are measured at about the same time and before the time of assessment.

The structural equation model in Figure 2 can be expressed as

$$\boldsymbol{\eta} = \mathrm{B}\boldsymbol{\eta} + \Gamma\boldsymbol{\xi} + \boldsymbol{\zeta},$$

where $\boldsymbol{\eta}$ stands for a vector of endogenous variables including the observed intellectual development and all the latent mediating variables, $\boldsymbol{\xi}$ represents a vector of exogenous variables including poverty, the control variables, and the latent pregnancy behavior, B and Γ are their respective parameters, and $\boldsymbol{\zeta}$ is a vector of error terms. The following two measurement models describe the dependence of the observed endogenous ($\boldsymbol{Y}$) and exogenous indicators ($\boldsymbol{X}$) on latent variables (η and ξ),

$$\boldsymbol{Y} = \Lambda_Y\eta + \varepsilon$$

$$\boldsymbol{X} = \Lambda_X\xi + \delta$$

where Λ_Y and Λ_X are matrices of parameters. We use AMOS (Arbuckle 1997) to estimate the structural equation models. We use unweighted regression techniques, which result in unbiased, consistent, and efficient estimates when the weights are a function of observed independent variables included in the model (Winship and Radbill 1994).

RESULTS

Table 1 presents three mediating factors—physical environment, cognitive stimulation, and parenting style—derived by exploratory factor analysis from the items in the NLSY preschool HOME. The table shows the factor loadings, eigenvalues, proportion of common variance explained, and number of items for each of the three factors. To extract the factors we used the principal-factor method followed by a varimax rotation. The analysis was conducted in SAS. The eigenvalues and scree tests suggested three prominent factors; we retained only these three for rotation. We regarded an item as loading on a factor if the factor loading was 0.35 or higher. Our final decision on the number of factors depended heavily on whether the factors retained could be interpreted meaningfully.

The rotated factor pattern (not shown here) indicates that the variables that load on a factor clearly share some com-

TABLE 1. THREE MEDIATING FACTORS DERIVED BY EXPLORATORY FACTOR ANALYSIS FROM THE ITEMS OF THE NLSY PRESCHOOL HOME

	Factor 1: Cognitive Stimulation	Factor 2: Parenting Style	Factor 3: Physical Environment
The Items of the NLSY Preschool HOME			
How often mother reads to child	0.63		
Number of children's books child has	0.60		
Child has a record/tape player	0.42		
How often child is taken to museums per year	0.39		
Number of magazines family receives	0.37		
Mother conversed with child twice or more		0.71	
Mother answered child's questions verbally		0.65	
Mother's voice showed positive feeling toward child		0.52	
Mother hugged and kissed child		0.36	
Home interior is reasonably clean			0.87
Home interior is minimally cluttered			0.66
Play environment appears safe			0.39
Home interior is not dark or monotonous			0.35
Eigenvalues	4.49	2.96	1.59
Proportion	0.50	0.33	0.18
Number of Items	5	4	4

mon conceptual meaning. For example, the following five variables, and only the following five, load on the first factor: how often the mother reads to the child, the number of books the child has, whether the child has a record/tape player, number of museum visits, and number of magazines received by the family. All five variables measure experiences and conditions conducive to cognitive development. We labeled this factor *cognitive stimulation*.

The rotated factor pattern also indicates that the variables that load on different factors are measuring different constructs. For example, the following four factors, and only the following four, load on the third factor: home is reasonably clean; home is minimally cluttered; play environment appears safe; and home is not dark. The construct tapped by these four variables is clearly different from that measured by the five mentioned above. The latter measures the structure and organization of the child's physical environment; the former measures the resources and parental efforts that stimulate children's intellectual development. The rotated factor pattern demonstrates a simple structure indicating that the loading variables typically load high on only one of the three factors.

In Table 2, we present the parameter estimates from the structural equation models that estimate only direct effects of poverty and other exogenous variables on intellectual development. This analysis is analogous to conventional linear regression, and provides baseline results or reduced-form estimates. We compare these baseline models with the full model, which incorporates the mediating effects of poverty. Intellectual development in the four models in Table 2 is measured respectively by PIATR, PIATC, PIATM, and PPVT. The arrows in the leftmost column indicate the direction in which the effect operates. For instance, the first number in the column under PIATR is the effect of poverty on intellectual development measured by PIATR. Because the baseline model is essentially a linear regression model, all but one of the effects operate from the exogenous variables to intellectual development. The exception is latent pregnancy behavior, which exerts an effect on intellectual development and which has four indicators: drinking, smoking, reduced drinking, and reduced smoking.

According to the baseline models, living in poverty has a consistent and significant negative effect on all four measures of intellectual development. Poverty is one of two vari-

TABLE 2. PARAMETER ESTIMATES OF THE STRUCTURAL EQUATION MODEL OF INTELLECTUAL DEVELOPMENT: A BASELINE MODEL OR REDUCED-FORM MODEL

Dependent Variables ← Independent Variables	1 PIATR	2 PIATC	3 PIATM	4 PPVT
Intellec ← Poverty	–2.97**	–2.39*	–2.05*	–5.52***
Intellec ← Black	0.07	–0.52	–2.73***	–11.50***
Intellec ← Hispanic	–1.06	–0.50	–2.66***	–9.71***
Intellec ← Female	3.25***	2.61***	0.75	0.90
Intellec ← Birth Order	–1.49***	–1.21**	–0.12	–1.11†
Intellec ← Child's Age	0.004	0.004	0.006	0.099***
Intellec ← Mother's Education	0.17	0.13	0.29†	0.77***
Intellec ← AFQT	0.017***	0.017***	0.017***	0.023***
Intellec ← Mother's Age	0.027	0.086	0.115	0.147
Intellec ← Sibship Size	–0.12	–0.32	–0.45	–0.88†
Intellec ← Proportion Married	–0.58	–0.32	–1.14	–0.63
Intellec ← Proportion Divorced	–0.83	0.15	0.21	3.71*
Intellec ← North Central	—	—	—	—
Intellec ← South	1.43*	1.94**	0.21	–2.14*
Intellec ← West	1.58†	1.02	1.36†	0.98
Intellec ← Northeast	2.97***	2.54**	1.28	0.14
Intellec ← Pregnancy Behavior	–0.74**	–0.47	–0.43	–0.36
Drinking ← Pregnancy Behavior	1.000	1.000	1.000	1.000
Smoking ← Pregnancy Behavior	0.21***	0.20***	0.20***	0.20***
Drinking Less ← Pregnancy Behavior	0.94***	0.94***	0.94***	0.94***
Smoking Less ← Pregnancy Behavior	0.39***	0.39***	0.39***	0.39***
Sample Size	2,020	1,753	2,029	2,057
Chi-Square	3,655	3,206	3,679	3,723
Degrees of Freedom	65	65	65	65

†$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests)

TABLE 3. PARAMETER ESTIMATES AND STANDARD ERRORS OF THE STRUCTURAL EQUATION MODEL OF INTELLECTUAL DEVELOPMENT: FULL MODEL

Dependent Variables ← Independent Variables	Unstandardized Coefficient	Standard Error
Mediating Effects		
Cognitive stimulation ← Poverty	–0.15***	0.03
Cognitive stimulation ← AFQT	0.006***	0.000
Cognitive stimulation ← Mother's education	0.032***	0.005
Cognitive stimulation ← Sibship	–0.046***	0.008
Cognitive stimulation ← Black	–0.165***	0.025
Cognitive stimulation ← Hispanic	–0.144***	0.024
Cognitive stimulation ← Child's age	0.001†	0.000
Cognitive stimulation ← Mother's age	0.003	0.003
Parenting style ← Poverty	–0.09***	0.03
Parenting style ← Mother's age	0.015***	0.003
Parenting style ← Mother's education	–0.004	0.005
Parenting style ← Sibship	–0.017*	0.008
Parenting style ← Black	–0.024	0.021
Parenting style ← Hispanic	–0.016	0.022
Parenting style ← AFQT	0.000**	0.000
Parenting style ← Child's age	0.001	0.000
Physical setting ← Poverty	–0.096***	0.016
Physical setting ← Mother's age	0.001	0.002
Physical setting ← Black	0.009	0.011
Physical setting ← Hispanic	0.022†	0.01
Physical setting ← AFQT	0.000***	0.000
Ill health at birth ← Poverty by birth	0.046*	0.022
Ill health at birth ← Mother's education	0.000	0.004
Ill health at birth ← Pregnancy behavior	0.094**	0.032
Ill health at birth ← Black	0.064***	0.017
Ill health at birth ← Hispanic	0.050**	0.019
Ill health in childhood ← Poverty	–0.004	0.041
Ill health in childhood ← Ill health at birth	0.249**	0.094
Ill health in childhood ← Mother's education	0.007	0.007
Intellec ← Cognitive stimulation	15.52***	2.49
Intellec ← Physical setting	4.28	3.47
Intellec ← Parenting style	4.39***	1.32
Intellec ← Ill health in childhood	–2.03**	0.74
Intellec ← Ill health at birth	–4.35*	1.92
Direct Effects		
Intellec ← Poverty	0.06	1.31
Intellec ← Mother's education	0.09	0.21
Intellec ← AFQT	0.020***	0.002
Intellec ← Black	–3.99***	0.97
Intellec ← Hispanic	–2.32*	0.97
Intellec ← Female	0.86	0.60
Intellec ← Birth order	–0.44	0.48
Intellec ← Child's age	0.02	0.02
Intellec ← Mother's age	–0.012	0.14
Intellec ← Sibship size	–0.23	0.39
Intellec ← Time married	–0.99	1.12
Intellec ←Time divorced	1.11	1.35
Intellec ← South	0.28	0.79
Intellec ← West	1.34	0.95
Intellec ← Northeast	1.42	1.01
Sample Size	1,735	
Chi-Square	1,948.0	
Degrees of Freedom	681	
Fit Indices		
GFI	0.95	
AGFI	0.93	
Δ_1 (NFI)	0.92	
Δ_2 (IFI)	0.94	
P_1 (RFI)	0.89	
P_2 (TLI)	0.93	
CFI	0.94	

Note: Intellectual development constructed as a latent variable with PIATR, PIATC, PIATM, and PPVT as indicators. (See Appendix Table A2 for the measurement model.)

†$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests)

ables (the other is AFQT) that exert a consistent effect on intellectual development across the four measures. Mother's education has a significant effect on PPVT and a nearly significant effect on PIATM; it does not seem to be related to PIATR and PIATC. A researcher estimating a reduced-form model without taking mediating mechanisms into account would report an expected, but uninformative, significant effect of poverty on children's intellectual development. A much more complicated and more informative picture emerges, however, when we incorporate the intervening mechanisms into the analysis.

In Table 3, we show the parameter estimates of our final structural equation model of intellectual development. To reduce the length of the table, we present the measurement model in Appendix Table A2. The final model differs from the models in Table 2 in two respects. First, the outcome variable, intellectual development, is measured by a latent construct with PIATR, PIATC, PIATM, and PPVT as indicators. Second, the model allows for the mediating effects of poverty and some other exogenous variables. The mediating factors incorporated into these models include cognitive

stimulation, physical environment, parenting style, and child's health. The models that include child care as an intervening mechanism were estimated in a separate analysis on a much smaller sample of working mothers; we discuss these models later.

The arrows in the leftmost column in Table 3 play the same role as those in Table 2. These arrows should be more useful for understanding Table 3 because the full model contains numerous endogenous variables. The parameter estimates of the final model are of three types: mediating effects, direct effects, and effects on indicators. Mediating effects go into or come out of a mediating variable. Direct effects are represented by the arrows that link exogenous variables directly to intellectual development in Figure 2. Effects on indicators, presented in Appendix Table A2, are the effects of latent constructs on their indicators as estimated by the measurement models. We sorted the mediating effects by endogenous variables so that all mediating effects from one equation would be presented together in Table 3.

In our final model, poverty has a highly significant effect on cognitive stimulation (first row: "Cognitive stimulation ← Poverty"), physical environment, and parenting style. The more persistent the poverty, the lower is the level of cognitive stimulation in the household, the worse the physical environment at home, and the less favorable the parenting style. The three mediating variables, in turn, all exert a highly significant and expected effect on intellectual development. (For example, see the row labeled "Intellec ← Cognitive stimulation" near the end of the list of mediating effects.)

The mediating mechanisms related to child health are less straightforward. We employed a different measure of poverty when estimating the effect of poverty on ill health at birth. The general poverty measure we used measures a child's exposure to poverty after the birth and before the cognitive assessment. The poverty that affects child health at birth is measured by the proportion of the four years before a child's birth in which the family lived in poverty. Poverty before birth has a significant effect on ill health at birth, which in turn has a significant effect on both intellectual development and ill health in childhood. In comparison, ill health in childhood is related significantly to intellectual development, but poverty does not seem to have an effect on ill health in childhood.

The model has estimated a large number of other mediating effects beside those related to poverty (Table 3). In addition to poverty, AFQT, and mother's cognitive ability, for example, mother's education, sibship size, being black, and being Hispanic exert a significant effect on cognitive stimulation. The effect of mother's education on cognitive stimulation is especially interesting. In the reduced-form model of PIATR, PIATC, or PIATM displayed in Table 2, mother's education does not directly affect intellectual development. Researchers estimating only a reduced-form model would report that they had failed to find an effect of mother's education on children's intellectual development. As shown by the full model in Table 3, however, mother's education has an indirect effect on intellectual development that operates through cognitive stimulation, and its importance cannot be dismissed. Also, as mentioned above, pregnancy behavior is a latent variable measuring mother's health behavior during pregnancy. This latent construct has a significant effect on poor child health at birth.

The direct effects in the full model are broadly similar to those in the reduced-form models except for poverty. In the full model, once the mediating variables are incorporated, poverty no longer has a significant direct effect on intellectual development. Poverty appears to operate entirely through the mediating mechanisms without directly affecting intellectual development.

AFQT apparently affects intellectual development through a number of routes. Both AFQT and mother's education have a significant indirect effect on intellectual development through cognitive stimulation, but only AFQT exerts a significant direct effect on intellectual development. Moreover, AFQT has a significant indirect effect on intellectual development via parenting style and physical environment.

It is also informative to compare AFQT with poverty. In the baseline reported in Table 2, both AFQT and poverty exert a significant effect on intellectual development. Once the mediating variables are included in the analysis, the effects of poverty disappear completely, whereas the direct effect of AFQT on intellectual development remains almost as large as in the baseline model (Table 3). These results indicate a substantial component in mother's cognitive ability, which influences the child's cognitive development and which passes on from mother to child without being mediated by mother's learned behavior or environmental influences. Without explicit genetic analysis on genetic data, however, we cannot draw any further conclusions about the effect of AFQT.

In Appendix Table A2 we present the effects of the latent variables on indicators from the measurement model. These effects are also called factor loadings. For all six latent constructs, all the factor loadings are highly statistically significant. The large ratios of the factor loadings to their standard errors provide some evidence for the validity of the constructs and thus confirm us in our decision to include these individual items in the measurement model. The squared multiple correlation coefficient, or R^2, for each indicator shows the proportion of variance explained by the latent construct. The coefficient is another measure showing how each individual item fits the model. These coefficients are moderate to high in our analysis (not shown here); this result suggests that individual components fit the model reasonably well.

The final model in Table 3 can be evaluated by comparing it with a theoretical saturated model. The chi-square 1,948.0 with 681 degrees of freedom is statistically significant, indicating that the observed covariance matrix is significantly different from the covariance matrix derived from the model. For large samples, however, the chi-square statistic is generally considered overstringent because it often detects substantively unimportant small deviations from a perfect model. For this reason, numerous alternative fit indices

have been developed to evaluate the structural equation model (Bollen 1989). Toward the bottom of Table 3, we report seven fit indices generally used in the literature. For the model, these seven indices range mostly from 0.90 to 0.95, indicating a reasonably good fit.

To test for the robustness of our results, we estimated a number of alternative specifications of the structural equation model. None of the alternative specifications altered the substantive conclusions of our analysis. For instance, we reestimated our full model four times, measuring intellectual development by PIATR, PIATC, PIATM, and PPVT respectively. (Results are not shown, but are available on request.) These four models can be compared more directly with the baseline models displayed in Table 2. The results are very similar to those presented in Table 3.

When latent constructs are involved, interpreting the magnitudes of the coefficients is somewhat less straightforward than interpreting single-dimension observed variables. The unit of a latent construct is determined by the unit of the indicator, to which the path from the latent construct is fixed. In our analysis, for example, the unit of cognitive stimulation is determined by the unit of museum visits, to which the path from cognitive stimulation is fixed at 1. The "museum visits" variable ranges from 0 to 5. The model reported in Table 3 indicates that one unit of cognitive stimulation, which corresponds to one museum visit, is associated positively with 15.52 PPVT points. The unit of PPVT is the unit of intellectual development because the path to PPVT is fixed at 1. Similarly, one unit of physical setting, which corresponds to one unit of home safety (interviewer-rated safety of play environment, ranging from 0 to 2), is associated positively with 4.28 PPVT points.

The magnitudes of the coefficients also can be interpreted through standardized coefficients. Table 4 shows the standardized coefficients for the effects of poverty on the mediating mechanisms and for the effects of mediators on the latent construct of intellectual development. These results also suggest that cognitive stimulation is the most influential of all the mediators we have considered.

We used the same modeling approach as shown in Table 3 to estimate the mediating effects of child care quality. Because quality of child care is relevant only as a mediating context for children who receive nonmaternal care, we restricted our sample to employed mothers. This restriction left us with a sample of about 290 children. We estimated structural equation models identical to those shown in Table 3 except for the addition of child care quality as a latent mediating variable. The results (not shown here) are consistent across all structural equation models estimated. Quality of child care does not exert a statistically significant or sizable effect on intellectual development; nor does poverty exert a significant or sizable effect on quality of child care.

TABLE 4. STANDARDIZED COEFFICIENTS FOR THE EFFECTS OF POVERTY ON THE MEDIATING MECHANISMS AND THE EFFECTS OF MEDIATORS ON THE LATENT VARIABLE OF INTELLECTUAL DEVELOPMENT

Poverty	→	Mediator	→	Intellectual Development
–0.18		Cognitive Stimulation		0.34
–0.11		Parenting Style		0.10
–0.25		Physical Setting		0.04
0.08		Ill Health at Birth		–0.07
–0.003		Ill Health in Childhood		–0.08

CONCLUSIONS

Although adverse effects of poverty on children have been documented widely, social scientists have not learned much about the mechanisms through which the effects of poverty disadvantage young children. In this paper we attempt to fill this void, first by articulating the multiple pathways by which poverty might influence children and then by applying the structural equation model to examine a set of mechanisms that potentially mediate the effects of poverty on children's intellectual development. We have constructed five latent factors (cognitive stimulation, parenting style, physical environment, child health at birth, and childhood health) and have allowed these factors, along with child care, to mediate the effects of poverty and other exogenous variables.

We offer two main findings. First, the influence of family poverty on children's intellectual development is mediated completely by the intervening mechanisms measured by our latent factors. Poverty has no direct effect on children's intellectual development; this absence suggests that focusing directly on the intervening mechanisms that affect children's educational achievement may prove to be an effective alternative to income transfer.

Second, our analysis indicates specific components in the home environment that are affected by lack of income and that influence children's intellectual development. Our various model specifications indicate that cognitive stimulation in the home is by far the most important influence mediating the effect of poverty on such development. Poverty exerts a large negative effect on cognitive stimulation, and cognitive stimulation exerts a large positive effect on intellectual development; this finding demonstrates that much of poverty's effect on children's intellectual development operates along this pathway (Table 4). Second in importance is parenting style, which is influenced less strongly by poverty experience. Its effect on intellectual development, on average, is only about one-fourth the size of the standardized effect of cognitive stimulation. Finally, although the effect of poverty on the physical setting of the home is the largest in size, physical setting exerts the smallest and least consistently significant effect on children's intellectual development.

These findings have implications for policies designed to ameliorate the effects of poverty on children. Although our findings cannot address the advantage of one policy over another, they indicate the possible effectiveness of targeted interventions in the mediating processes that affect children's intellectual achievement. In particular, our results suggest that

intervening in children's cognitive environments and adults' parenting behaviors is probably more effective and less expensive than intervening in children's home physical environment.

If a variable is to be relevant for policy, it must exert a sizable effect, operate in the desired direction, and be manipulable. Intervention programs that increase the amount of cognitive stimulation in the home or encourage positive parenting behaviors and interactions with children may improve the cognitive outcomes associated with poverty among children. Numerous parenting and child intervention programs have been implemented in both experimental and applied settings. According to several evaluation studies using randomized designs, these programs improve cognitive outcomes in poor children by influencing parenting behaviors and interactions with children (Barnes 1995; Olds and Kitzman 1993; St. Pierre, Layzer, and Barnes 1995; Yoshikawa 1995). The most successful parenting interventions involve parent education through frequent home visits or "hands-on" parent education. Especially effective are interventions that focus on working with parents in learning-oriented programs that provide them with instruction, materials, and role playing in learning experiences (Brooks-Gunn and Duncan 1997).

Head Start is one example of a successful program designed to enhance poor children's cognitive environments, and the program has been relatively inexpensive (approximately $500 per child per year; Currie 1997). Head Start may supply poor families with materials such as educational toys and games, books, and magazines that stimulate children's intellectual curiosity and encourage their learning experience. More directly still, high-quality all-day free educational TV programs, as suggested by Huston (1995), would greatly enhance poor children's cognitive environment. These interventions are not expensive; yet they directly affect the mediating mechanisms that our analysis finds most influential for young children's intellectual development.

The purpose of our research has been to understand the mediating processes through which poverty affects children's intellectual development. Although our findings are reassuringly consistent and robust, they only suggest some of the causal pathways through which poverty exerts its influence; therefore they can inform possible policy initiatives.

APPENDIX TABLE A1. MEANS AND STANDARD DEVIATIONS FOR THE VARIABLES USED IN ANALYSIS

	PIATR		PIATC		PIATM		PPVT	
Variables	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Test Score	103.3	12.67	104.4	12.29	99.6	12.16	89.2	20.25
Poverty	0.31	0.36	0.30	0.36	0.31	0.36	0.31	0.36
Black	0.29	0.46	0.30	0.46	0.30	0.46	0.29	0.46
Hispanic	0.19	0.40	0.18	0.39	0.19	0.40	0.20	0.40
Female	0.50	0.50	0.52	0.50	0.50	0.50	0.50	0.50
Birth Order	1.7	0.89	1.6	0.87	1.7	0.90	1.7	0.90
Child's Age	71.1	20.63	71.5	21.00	71.0	20.59	70.9	20.58
Mother's Education	11.9	2.05	11.9	2.02	11.9	2.06	11.8	2.06
AFQT	610.7	204.95	617.5	203.01	609.9	205.74	609.5	206.61
Mother's Age	22.0	2.73	21.9	2.69	22.0	2.73	22.0	2.73
Sibship Size	2.3	1.07	2.2	1.06	2.3	1.08	2.3	1.08
Proportion Married	0.636	0.41	0.638	0.41	0.637	0.41	0.638	0.41
Proportion Divorced	0.129	0.25	0.124	0.25	0.128	0.25	0.128	0.25
North Central	0.249	0.43	0.240	0.43	0.249	0.43	0.249	0.43
South	0.405	0.49	0.411	0.49	0.405	0.49	0.405	0.49
West	0.209	0.41	0.209	0.41	0.208	0.41	0.209	0.41
Northeast	0.137	0.34	0.140	0.35	0.137	0.34	0.136	0.34
Mother Reads	4.26	1.29	4.30	1.27	4.26	1.29	4.26	1.29
Books	3.61	0.72	3.63	0.70	3.60	0.72	3.60	0.73
Magazines	2.76	1.43	2.78	1.43	2.75	1.43	2.75	1.43
Museum Visits	2.01	0.99	2.02	0.98	2.01	0.99	2.01	0.99
Tape/Record Player	0.692	0.46	0.702	0.46	0.690	0.46	0.689	0.46
Home Safe	0.922	0.29	0.926	0.29	0.922	0.29	0.921	0.29
Home Tidy	0.825	0.31	0.827	0.38	0.824	0.39	0.824	0.39

(continued)

(Appendix Table A1, continued)

Home Not Dark	0.895	0.31	0.897	0.30	0.894	0.31	0.895	0.31
Home Clean	0.896	0.31	0.902	0.30	0.894	0.31	0.895	0.31
Talks to Child	0.877	0.33	0.873	0.34	0.878	0.33	0.877	0.34
Answers Verbally	0.845	0.38	0.843	0.38	0.847	0.38	0.845	0.38
Voice Positive	0.901	0.32	0.904	0.32	0.901	0.33	0.899	0.33
Hugs and Kisses	0.465	0.54	0.464	0.54	0.466	0.54	0.466	0.54
Drinking	1.52	1.25	1.49	1.23	1.52	1.25	1.51	1.25
Smoking	0.421	0.68	0.406	0.67	0.421	0.68	0.419	0.68
Drinking Less	0.870	1.02	0.853	1.01	0.868	1.02	0.865	1.02
Smoking Less	0.792	1.11	0.771	1.09	0.792	1.11	0.791	1.11
Birth Weight	0.908	0.55	0.899	0.44	0.908	0.55	0.909	0.55
Length of Child	5.03	0.53	5.03	0.54	5.03	0.53	5.03	0.53
Gestation Length	2.58	0.16	2.58	0.16	2.58	0.16	2.58	0.16
No. of Illnesses	0.750	1.54	0.769	1.57	0.752	1.55	0.756	1.56
Learning Limitation	0.044	0.20	0.039	0.19	0.043	0.20	0.044	0.20
Medical Limitation	0.077	0.27	0.076	0.27	0.078	0.27	0.079	0.27
Sample Size	2,014		1,748		2,023		2,032	

APPENDIX TABLE A2. THE MEASUREMENT MODEL OF THE FULL STRUCTURAL EQUATION MODEL PRESENTED IN TABLE 3

Dependent Variables ← Independent Variables Effects on Indicators (Measurement Models)	Unstandardized Coefficient	Standard Error
PPVT ← Intellec	1.0	
PIATR ← Intellec	0.59***	0.03
PIATC ← Intellec	0.59***	0.03
PIATM ← Intellec	0.63***	0.03
Museum Visits ← Cognitive Stimulation	1.0	
Mother Reading ← Cognitive Stimulation	2.59***	0.26
Books ← Cognitive Stimulation	1.67***	0.16
Magazines ← Cognitive Stimulation	1.91***	0.22
Tapes and Records ← Cognitive Stimulation	0.72***	0.08
Home Safe ← Physical Setting	1.0	
Home Tidy ← Physical Setting	0.82***	0.11
Home Not Dark ← Physical Setting	1.31***	0.13
Home Clean ← Physical Setting	1.03***	0.11
Answers Verbally ← Parenting Style	1.0	
Talks to Child ← Parenting Style	0.84***	0.05
Voice Positive ← Parenting Style	0.69***	0.04
Hugs and Kisses ← Parenting Style	0.70***	0.06
Drinking ← Pregnancy Behavior	1.0	
Smoking ← Pregnancy Behavior	2.35***	0.24
Reduced Drinking ← Pregnancy Behavior	1.00***	0.07
Reduced Smoking ← Pregnancy Behavior	4.09***	0.42
Birth Weight ← Ill Health at Birth	1.0	
Length of Child ← Ill Health at Birth	1.48***	0.14
Gestation Length ← Ill Health at Birth	0.43***	0.04
No. of Illnesses ← Ill Health in Childhood	1.0	
Physical Limitations ← Ill Health in Childhood	0.19***	0.02
Medical Attention ← Ill Health in Childhood	0.45***	0.07

(continued)

(Appendix Table A2, continued)

***$p < .001$ (two-tailed test)

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