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ABSTRACT

Early home learning environments are the result of interactions between the developing child and the opportunity structures provided by the family. Income is one of several resources that affect the cognitive stimulation that children experience. Using data from the National Longitudinal Survey of Youth, this study examines the influence of household income on cognitive stimulation during the transition to school (age 3-4 years to 7-8 years). Cross-sectional and longitudinal fixed effects regressions are estimated to examine income's effect. Household income positively related to the level of cognitive stimulation in children's home environments across both sets of analyses. Home environments of children in low-income households were particularly sensitive to income changes over time. The implications of these results for programs and policies that reduce disparities in school readiness are discussed. (Contains 45 references.) (SM)

Running Head: INCOME CHANGES AND CHILDREN'S HOME ENVIRONMENTS

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# Income Changes and Cognitive Stimulation in Young Children's Home Learning Environments

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Elizabeth Votruba-Drzal

Northwestern University



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## Abstract

Early home learning environments are the result of interactions between the developing child and the opportunity structures provided by the family. Income is one of several resources that affect the cognitive stimulation that children experience. Using data from the National Longitudinal Survey of Youth (N=2174) this study examines the influence of household income on cognitive stimulation during the transition to school (3-4 years old to 7-8 years old). Cross-sectional and longitudinal fixed effects regressions are estimated to examine income's effect. Household income was positively related to the level of cognitive stimulation in children's home environments across both sets of analyses. Home environments of children in low-income households were particularly sensitive to income changes over time. The implications of these results for programs and policies that reduce disparities in school readiness are discussed.

KEY WORDS: INCOME, HOME, HOME ENVIRONMENT, COGNITIVE DEVELOPMENT, PRESCHOOL

Income Changes and Cognitive Stimulation in Young Children's

Home Learning Environments

When children start school, they are not equally ready to learn (U.S. Department of Education National Center for Education Statistics, 2001). Some have developed the basic language, reading, and math skills that are important to early success in school, whereas others have not. Several environmental characteristics of families place children at risk of starting school in a position of relative disadvantage. These include living in a family with limited economic resources, having parents with low levels of education, or being raised by a single parent (U.S. Department of Education National Center for Education Statistics, 2001). Regardless of their source, children's developmental differences at school entry are of serious concern to parents, educators, and policy makers alike. These disparities persist and are exacerbated in the early years of school (Entwisle & Alexander, 1999).

Theoretical insights into sources of developmental differences come from bioecological and transactional models of child development, which describe child development as the result of reciprocal interactions between children and the multiple environments in which they are embedded (Bronfenbrenner & Ceci, 1994; Sameroff, 1994). During early childhood, proximal processes in children's home environments are central to development. The content of the proximal processes a child experiences is the product of his or her biological or genetic endowments and the *opportunity structures* presented by children's social and physical environments. Children's genetic predispositions influence their attention, actions, and the responses they elicit from their environment. In contrast, the *opportunity structures* available in children's most immediate environment determine which inherent predispositions are realized. Combined, these interactions between the child and their opportunity structures influence children's developmental trajectories (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 1998). Although children actively manipulate aspects of their environment, parents are particularly central in shaping young children's environments, since they guide children's learning and engagement in activities. Example of key parental influences on early learning include reading to children, helping them learn the alphabet, numbers, and letters, and taking children on outings or to the library. These proximal processes are linked to better cognitive and literacy skills at school entry (Baharudin & Luster, 1998; Dubow & Ippolito, 1994; Parker, Boak, Griffin, Ripple, & Peay, 1999; Smith, Brooks-Gunn, & Klebanov, 1997).

Over the years, research has begun to identify resources in the family system that are central to opportunity structures related to cognitive stimulation that are available to children. A key resource is the level of economic resources a family possesses. The influence of economic resources, defined here as family income, on learning opportunities in children's home environments are both direct and indirect. By definition, having low levels of economic resources means that families try to meet the most basic needs of food, clothing, and shelter with their limited financial resources. Parents may then be left with few monetary resources and are simply less able to purchase enriching learning materials and experiences that enhance children's cognitive development. Family economic resources may also influence children's home learning environments indirectly through their effects on adult behavior. Low-income individuals suffer from higher levels of psychological distress because they experience more negative life events and suffer from high levels of persistent, economic stress (McLeod & Kessler, 1990; McLoyd, 1990). Economic stress is associated with worse mental health, including higher levels of depression, and anxiety and lower levels of self esteem which may limit parents' ability to provide cognitively rich interactions with their children (Garrett, Ng'andu, & Ferron, 1994; Kessler, 1982; Kessler & Cleary, 1980; Takeuchi, Williams, & Adair, 1991).

Numerous studies have documented the positive relation between family economic resources and cognitive stimulation in children's home environments (Baharudin & Luster, 1998; Garrett, Ng'andu, & Ferron, 1994; Miller & Davis, 1997; Watson, Kirby, Kelleher, & Bradley, 1996). Most researchers have focused specifically on the influence of poverty on cognitive stimulation in the home environment, finding that current and persistent poverty as well the poverty status of a household at the child's birth are all negatively related to cognitive stimulation in children's home learning environments (Watson et al., 1996; Garett et al., 1994). Despite the abundance of literature linking income to children's home learning environments, methodological concerns raise questions about whether this relation is causal and not simply correlational (For discussion see Duncan & Brooks-Gunn, 1997; Rutter, Pickles, Murray, Eaves, 2001).

Indeed, all existing investigations rely on comparisons between the home environments of families with different levels of income using non-experimental data. When making these comparisons, researchers control for measured family differences that might influence income and children's home environments, such as maternal employment and family structure, in order to isolate or "net out" unbiased estimates of income's influence. However, unmeasured differences or omitted variables related to both the level of cognitive stimulation in children's home environments and families' incomes may bias income coefficients, and lead to a spurious relation between income and cognitive stimulation (Rutter et al., 2001). In other words, the same characteristics that put a family at risk for low economic resources may lead to low levels of cognitive stimulation in children's home environments. Suppose for example that children's inherent predispositions lead them toward above average cognitive abilities, which result in their elicitation of high levels of cognitive stimulation from their parents. In other words, such children frequently ask parents to read to them and create new learning opportunities. It is quite likely that children's cognitive abilities are correlated with their biological parents' abilities – characteristics that may relate to their parents' success in the labor market. When these links are unmeasured or not addressed, it is premature to conclude that higher earnings lead to more stimulating parenting practices.

Moreover, the majority of studies on this topic have not dealt with a variety of omitted variables beyond cognitive ability, such as motivation, persistence, and self-efficacy, leaving open the question of whether income has causal effects on children's home learning environments. Yet, whether or not these associations are causal is important to policy makers and researchers interested in reducing disparities in school readiness. If causality were more conclusive, effective policy levers for reducing such disparities might include programs to increase income, such as the federal Earned Income Tax Credit, Supplemental Security Income, or state welfare policies that increase parents' economic resources. If, on the contrary, links between income and children's home environments were spurious, efforts to improve school readiness by increasing family economic resources would not be a top policy priority, and other mechanisms would be explored.

The primary goal of the present study is to provide a more rigorous test for a causal relation between income and children's home environments by accounting for as many sources of bias as possible. One statistical approach that has been used to reduce the threat of omitted variables involves longitudinal fixed effects models (Liker, Augustyniak, & Duncan, 1985). Longitudinal fixed effects models control for the influence of stable omitted variables by comparing individuals to themselves overtime, which holds these characteristics constant. The present study examines whether relations between family economic resources and children's home learning environments are an artifact of stable omitted differences between families or whether these links are also observed when examining changes in economic resources within families overtime. For the purpose of these analyses, families' economic resources are measured using cumulative family income since the birth of a child. This reflects the assumption that children's home environments at any given point in time are the product of a family's cumulative income over the course of the child's life, not simply the family's income in the year of the assessment of children's home learning environment. Since family income is quite volatile from year to year, averaging across all years of a child's life provides a more accurate measure (Duncan, 1988). Furthermore a family's long-term economic status is more highly associated with child development outcomes than income for a single year (Blau, 1999).

*Family and Child Contributions to Children's Home Learning Environments*

Several family characteristics in addition to income are also related to the quality of learning experiences provided in children's home learning environments. On average, the home environments of single parent families tend to be less stimulating than do those of married parents, even after controlling for income, which is typically lower in single parent households (Baharudin & Luster, 1998; Mackinnon, Brody, & Stoneman, 1982; Menaghan & Parcel, 1995; Miller & Davis, 1997). This is primarily because single parents have higher levels of mental health problems and parenting stress than do married parents (McLanahan & Sandefur, 1994). The number of children in a household, which is associated with the financial resources parents are able to spend on children and the attention children receive from parents, tends to be negatively related to the level of cognitive stimulation in the home as well (Downey, 1995; Baharudin & Luster, 1998; Garrett et al., 1994; Miller & Davis, 1997).

Maternal characteristics including race/ethnicity, employment, abilities and achievement, and education are related to the provision of learning experiences in children's home environments as well. Black and Hispanic families tend to score lower than White families on measures of cognitive stimulation in the home (Luster & Dubow, 1990; Menaghan & Parcel, 1991; Watson et al., 1996). Some have argued that the traditional items used to assess children's home environments are more culturally relevant for middle-class, White children than they are for ethnic minority children, and thus are not able to capture the diversity of parenting practices related to cognitive stimulation that exist across cultural groups (Bradley, Caldwell, Rock, Ramey, Barnard, Gray, Hammond, Mitchell, Gottfried, Siegel, & Johnson, 1989). Mothers' levels of education and ability, which are associated with both the quantity and quality of parents' interactions with their children, are positively associated with the quality of children's home learning environments as well (Baharudin & Luster, 1998; Hoff-Ginsberg, 1991; Richman, Miller, & LeVine, 1992; Miller & Davis, 1997). Some studies have shown that maternal employment has a positive influence on cognitive stimulation in the home, partially explained by links between job complexity and parenting practices (Menaghan & Parcel, 1991; Vandell & Ramanan, 1992). However, several studies find no significant differences between the home environments of children with employed parents and their counterparts who are unemployed (Gottfried, Gottfried, & Bathurst, 1988; Miller & Davis, 1997; Owen & Cox, 1988).

Finally, characteristics of the developing child including gender, age, birth weight, temperament, and other genetic predispositions are also important to consider when examining links between family economic resources and children's home learning environments. Though few studies have focused on child gender specifically, several have shown that the home environments of girls tend to be characterized by slightly higher levels of cognitive stimulation than do those of boys (Garrett et al., 1994; Miller & Davis, 1997). As children age, the level of cognitive stimulation they elicit from parents increases. In addition, research on low birth weight children shows that they often experience developmental delays which may related to slower evolution of their home learning environments over time (Lee & Barratt, 1993).

## Method

### *Sample*

The sample used in these analyses was drawn from a merged mother-child data set from the National Longitudinal Survey of Youth (NLSY) and the NLSY Child Supplement (NLSY-CS). The NLSY began studying the educational and labor market experiences of young adults in America in 1979. The original sample consisted of a nationally representative group of 6,283 women between the ages of 14 and 21, with purposive over-sampling to increase the number of poor and minority individuals in the sample. Each year since 1979 the NLSY has gathered data on such topics as education, employment, income, and fertility (CHRR, 1997). Starting in 1986, the NLSY began collecting biennial information about the children of women in the NLSY in the NLSY-CS (Chase-Lansdale, Mott, Brooks-Gunn, Phillips, 1991). These data include assessments of children's social, cognitive, and behavioral development as well as measures of environmental factors associated with child development (CHRR, 1993).

This study focuses on five birth cohorts of children captured in the NLSY-CS at age 3-4 (time 1) and then again at age 7-8 (time 2), to maximize the focus on school readiness. The first cohort consists of children who were 3 to 4 years old at the beginning of the first Child

Supplement in 1986 and who were successfully followed until they were 7-8 in 1990. The second, third, fourth, and fifth cohorts include children who passed through this same developmental period between 1988-1992, 1990-1994, 1992-1996, and 1994-1998 respectively. Combined, 2,174 children were observed along with their parents from age 3-4 until they made the transition into school. Children were fairly evenly distributed across the five birth cohorts with 386, 539, 438, 384, 427 children falling into the first through fifth cohorts respectively.

Because many women gave birth to multiple children during this twelve-year time period, data on these children are not independent. The 2,174 children in the sample come from 1,556 independent households. Huber-White statistical techniques (STATA) were used to adjust for autocorrelation in the data. All analyses are weighted using the child sampling weights assigned by the Center for Human Resource Research to each child at the time of their assessment at age 7-8. Weighted, this sample is nationally representative of all children who aged from 3 and 4 to 7 and 8 between 1986 and 1998 and who were born to women between 14 to 21 years old in 1979.

*Measures*

*Cognitive Stimulation in Home Environment.* The central dependent variable of interest for the present study is based on the Home Observation for Measurement of the Environment (HOME) Inventory, a widely used measure designed by Caldwell and Bradley (1979). The HOME Inventory assesses multiple dimensions of children's home environments using both interviewer observation and maternal report. Bradley and Caldwell developed an abbreviated version of the HOME Inventory for the NLSY-CS, often referred to as the HOME Short Form (HOME-SF). It includes a subset of items from the original HOME Inventory and has been shown to have good psychometric properties and adequately capture the same domains as the longer version of the instrument (Baker & Mott, 1989; CHRR, 1993). Each item on the HOME-SF is scored dichotomously where a score of one indicates the presence of a developmentally supportive aspect in the child's home environment and a score of zero indicates its absence. Three scores are reported by the NLSY-CS from the HOME-SF: a total score, cognitive stimulation score, and an emotional support score (CHRR, 1993). Cognitive stimulation subscale scores are the focus of this study.

The NLSY-CS uses developmentally appropriate versions of the HOME-SF for children of different ages. The preschool version of the HOME-SF measures children's home environment at ages 3-4 and the elementary school version assesses children's home environments at age 7-8. Items in the preschool version relate to how often someone reads to the child, helps them learn numbers, the alphabet, colors, shapes, and sizes. The elementary school version addresses such things as how often someone reads to the child, encourages them to do hobbies, and takes them to a museum or theater. The cognitive subscale of the HOME-SF has been shown to have good reliability and predictive validity over time (Baker & Mott, 1989; CHRR, 1993). Numerous studies show significant associations between HOME scores and children's school performance, IQ, and cognitive development (Brooks-Gunn, Klebanov, Duncan, 1996; Smith et al., 1997; Linver, Brooks-Gunn & Kohen, 1999). Because different instruments were used to assess the nature of children's home environments over time, raw scores were converted to age standardized scores to remove instrumentation effects that may influence the regression coefficients and to allow for comparisons to be drawn between income coefficients across several models.

*Income.* Income is the primary independent variable of interest in these regression analyses. At time 1 and time 2 income is represented cumulatively as the mean annual household income, expressed in year 2000 dollars, from birth to age 3-4 and birth to age 7-8 respectively.

Prior research on the relation between income and cognitive stimulation in children's home environments has suggested that the association between these two variables is nonlinear. The home environments of families living far below the poverty line are more sensitive to income increases than are the home environments of families living at or above the poverty line (Garrett et al., 1994; Miller & Davis, 1997). Consequently the influence of income will be modeled with both linear and nonlinear (semilog) functions.

*Maternal and Household Characteristics.* Several maternal and household characteristics related to children's home environments are included in the models as controls. Maternal education is measured continuously as the mother's total years of schooling. Armed Forces Qualification Test (AFQT) scores, measuring women's math, verbal, and reasoning skills, are included in the models as well. They are based on the Armed Services Vocational Aptitude Batter (ASVAB) given to NLSY respondents in 1980 (CHRR, 1997). The influence of contemporaneous maternal employment is represented with a series of dummy variables indicating maternal employment status, where work hours of 35 hours per week or more is considered full-time employment, between 10 and 35 hours part-time, and less than 10 hours a week unemployed. Three different patterns of marital history are modeled with a series of dummy variables indicating whether mothers were married, never married, or divorced. Household care taking responsibilities are measured with a continuous variable indicating the number of biological, adopted, step, and foster children in the household. Maternal race/ethnicity is included in the regression equations with a series of dummy variables representing whether mothers are of non-Hispanic black, non-Hispanic white, or of Hispanic origin. Finally maternal age at first birth is represented with an indicator of whether or not a child's mother was a teenager when she had her first child.

*Child Characteristics.* Child characteristics often related to cognitive stimulation are included in the models. Gender is included in the models with a dummy variable along with child age measured in months. An indicator of low birth weight is included in the models to represent whether or not the child weighed less than 5.5 pounds at birth.

*Analytic Plan*

The influence of income on children's home environments will be explored in three sets of analyses. The first two consist of Ordinary Least Squares (OLS) regressions modeling the influence of income on children's home environments at age 3-4 and then again at ages 7-8, while controlling for important maternal, household, and child characteristics. Cross-sectional OLS regressions will model the level of cognitive stimulation provided by children's home environments as the product of cumulative and contemporaneous maternal, household, and child characteristics. The form of these regressions can be seen in equation 1.

$$(1)\ Home_{1i} = B_0 + B_1\Sigma Income_{ti} + B_2 Child_{ti} + B_3 House_{ti} + B_4 Parent_{ti} + B_5 Child_i + B_6 House_i + B_7\ Parent_i + \varepsilon_{1i}$$

Post-hoc regression analyses will then be conducted to test whether there are significant differences in coefficients across the cross-sectional regression equations at time 1 and time 2. These will be estimated on a stacked panel, in which data from time 1 and time 2 are collapsed so that each child is represented by two observations, the first is from time 1 and the second is from time 2. In these analyses, cross-sectional regressions at time1 and time 2 are estimated in a single regression equation using interactions between an indicator of the time of data collection and every coefficient in the cross-sectional regression equation. The results of the post-hoc analyses are available from the author upon request.

In the third set of analyses longitudinal fixed effects models will be used to estimate the impact of income on changes in cognitive stimulation provided by a child's home environment overtime. The longitudinal fixed effects models result from the first difference or the subtraction of the two cross-sectional regressions at time 1 and time 2. This difference eliminates the threat of bias posed by stable child, household, and family characteristics that are omitted from the regression equation, but are nevertheless related to children's home environments and income. The fixed effect model is presented in equation 2 below, where "Δ" indicates the change in variables taking place between time 1 and time 2:

(2) $\Delta Home_{t,\, t+4i} = B_0 + B_1 \Delta\, \Sigma Income_{t,\, t+4i} + B_2 \Delta Child_{t,\, t+4i} + B_3 \Delta House_{t,\, t+4i} + B_4 \Delta Parent_{t,\, t+4i} + \Delta\, \varepsilon_{t,\, t+4i}$

The continuous variables in the fixed effects model are simple differences between the time 1 and time 2 measures. Dummy variables in the model represent changes in categorical variables, including mother's employment and marital status. In the cross-sectional and fixed effects regressions, linear and nonlinear associations, using a semilog function, will be examined.

Although the dependent variable of interest in the longitudinal fixed effects model is the change in cognitive stimulation provided by children's home environments, it is important to recognize that the income coefficients in all three sets of regressions represent the change in children's home learning environments that is associated with a unit change in income. The longitudinal fixed effects regressions are simply a way to obtain less biased estimates of this coefficient. Fixed-effects models, however, do not eliminate the threat of omitted variables entirely. Indeed dynamic characteristics of children, parents, or households that are unmeasured may give rise to changes in children's home environments and families' incomes over time. The presence of such characteristics may continue to bias estimates of the relation between income and children's home environments in the longitudinal fixed effects models as well. Despite this shortcoming, longitudinal fixed effects models are superior to traditional between subject designs in their ability to eliminate the potential influence of stable unmeasured variables (Liker et al., 1985).

If the relation between income and children's home environments is in fact causal as the Ordinary Least Squares estimates have suggested, they should be robust under the longitudinal fixed effects model specification. If the relation is not robust, it would be difficult to rule out the possibility that significant relation found between income and children's home environments in the existing research may be the spurious result of unmeasured family differences.

## Results

Table 1 presents descriptive statistics for the sample of 2174 children. Weighted proportions and means are reported with standard errors.

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Insert Table 1 here

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### *Cross-sectional Regressions*

The first goal of this investigation is to examine whether or not income is associated with the quality of cognitive stimulation provided by children's home environment cross-sectionally during the preschool and early elementary school years. To address this question, two OLS regressions were estimated regressing scores on the cognitive subscale of the HOME at ages 3-4 and ages 7-8 on average annual family income from birth. Maternal, household, and child characteristics were included in the models as controls. Models 1 and 3 in Table 2 represent the influence of average annual income since birth in a linear fashion at time 1 and time 2 respectively. In these models income is scaled in $10,000 increments. At both time points income's influence on cognitive stimulation in children's home environment is modest,

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Insert Tables 2 & 3 here

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but significant. A $10,000 increase in mean household income since birth is linked to a .06 standard deviation increase in cognitive stimulation. Post-hoc regression analyses reveal that the coefficients on income in the linear models at time 1 and time 2 were not significantly different from each other.

Models 2 and 4 in Table 2 examine nonlinear associations between income and children's home learning environments using the natural log of income at ages 3-4 and ages 7-8 respectively. At both time points the natural log of income is significantly related to cognitive stimulation in children's home environments, such that a log unit increase in income is associated with roughly a third of a standard deviation increase in cognitive stimulation. As in the linear models, post-hoc analyses show that the coefficients on the log of income at time 1 and time 2 are not significantly different from each other. At time 1 the income coefficient increases from $B = .06$ in the linear model to $B = .33$ in the semilog model, which suggests that the semilog function provides a better representation of the relation between income and cognitive stimulation in children's home environments. Similarly, at time 2 the income coefficient increases from $B = .06$ in the linear model to $B = .35$ in the semilog function.

Along with income, several maternal, household, and child characteristics are consistently related to cognitive stimulation in children's home environment in the cross-sectional analyses at ages 3-4 and ages 7-8. Both maternal education and achievement test scores are positively related to the quality of children's home learning environments. Similarly, the home environments of mothers who were employed part-time provide higher levels of cognitive stimulation than did those of mothers who worked full-time. In contrast, the home learning environments of ethnic minority children and boys presented children with fewer learning opportunities over time. The number of children in a household is also negatively related to the provision of cognitive stimulation at both time points.

In addition, a few maternal, household, and child characteristics are inconsistently associated to cognitive stimulation over time. At time 1, the households of women who were not employed provide marginally higher levels of cognitive stimulation when compared to the households of mothers who worked full-time. This no longer holds true when children are 7-8 years old, although post-hoc analyses reveal that the coefficients on non-employment in the regression models at ages 3-4 and ages 7-8 do not differ significantly from each other. The home environments of women who first gave birth when they were teenagers provide slightly less rich learning environments for children ages of 7-8, though not when children are 3-4 years old, but the coefficients on the indicators of teen motherhood at ages 3-4 and ages 7-8 are not significantly different from each other. At time 2 but not at time 1, divorced and never married families offer less cognitive stimulation than do married parents. In post-hoc analyses the coefficients on indicators of never married households at time 1 and time 2 are not significantly different from each other. But the coefficients for divorced households are significantly different from each other, perhaps reflecting the particular vulnerability to divorce of parenting older children. Finally, child age positively relates to the quality of cognitive stimulation at time 1, but not at time 2, representing a significant difference between the coefficients at time 1 and time 2.

This likely reflects the steep cognitive developmental trajectories of children during early childhood, which lead them to elicit increasingly complex forms of cognitive stimulation.

*Fixed Effects Model*

The second aim of these analyses is to examine whether income's influence on cognitive stimulation in children's home environments from the cross-sectional regressions are robust under fixed effects model specifications. Using OLS regressions, fixed effects models were estimated predicting changes in cognitive stimulation between time 1 and time 2 with changes in income, maternal, child, and household characteristics. As in the cross-sectional regressions, both linear and semilog functions were estimated to examine linear and nonlinear effects.

Table 3 presents the fixed effects models. Income changes during the early school years are significant predictors of changes in the level of cognitive stimulation provided by children's

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Insert Table 3 here

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home environments in the linear and semilog, fixed effects models. Under the semilog specification, a log-unit increase in income is associated with about one-fifth of a standard deviation change in children's home environments. In the linear, fixed effects model, a $10,000 increase in income is linked to a .08 standard deviation change in cognitive stimulation in children's home learning environments. The income coefficients increases from $B$ = .08 in the linear model to $B$ = .23 in the semilog model, which like the cross-sectional regressions, suggests that the semilog function provides a better representation of the relation between income and cognitive stimulation in children's home environments.

The income coefficient is significant in the fixed effects models while controlling for changes in maternal, child, and household characteristics. The influences of only two of these characteristics are robust under the fixed effects model specification. Maternal education continues to be positively related to cognitive stimulation in children's home environments in the fixed effects model. The magnitude of this effect is small and similar in magnitude to the coefficients on education in the cross-sectional regressions at ages 3-4 or ages 7-8. A mother's marital status also relates to changes in children's home learning environments over time. Specifically, children of parents who remain divorced between time 1 and time 2 experience a decline in the level of cognitive stimulation provided by their home environments, when compared to children with parents who are married continuously throughout the two assessments. Finally, only one child characteristic is associated with children's home environments in the fixed effects regressions. The more children age between time 1 and time 2 the greater improvements they experience in their home learning environments over time.

*Nonlinear Relation Between Income and Children's Home Environments*

Comparing linear models to the nonlinear, semilog models across both the cross-sectional and fixed effects regressions revealed that a nonlinear function best described the relation between income and cognitive stimulation in children's home learning environments. Using semilog functions for these regression equations fits a steeper slope at lower income levels, thereby implying low-income families' home environments are more responsive to improvements in family income than are the home environments of families at the middle and upper ends of the income distribution. It is important to consider what this log function suggests about the differential sensitivity of children's home environments to increases or reductions in household income. Figure 1 represents the effect of a $10,000 income increase on cognitive

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Insert Figure 1 here

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stimulation in the home across the income distribution. At higher levels of family income, additional increments of income are associated with diminishing returns to children's home environments.

For example a $10,000 annual income increase for someone whose income falls into the bottom one percent of the income distribution (e.g., $6,295 per year or less) is associated with a one-third of a standard deviation increase in HOME cognitive subscale scores under the semilog, cross-sectional regression estimates and one-fifth of a standard deviation increase under the semilog, fixed effects model. In contrast, increasing the income of households at the median income level (e.g., 43,554) by $10,000 has a small influence, resulting in a little less than one-tenth or one-twentieth of a standard deviation change under the semilog, cross-sectional and fixed effects regressions respectively. Finally, children in families whose income is in the top tenth of the income distribution (e.g., $82,560 per year or more) experience a negligible effect of a $10,000 increase. Thus, a $10,000 a year income change at the low end of the income distribution under both the semilog, cross-sectional and semilog, fixed effects models leads to changes in the home environment that are about eight times the size of the effect for households in the top tenth of the income distribution, and about four times the improvement experienced by households with the median income level.

## Discussion

The primary goal of this investigation was to examine whether income influences the opportunity structures and the content of proximal processes related to cognitive stimulation in children's home learning environments. Consistent with prior research, the results of cross-sectional analyses show that in early and middle childhood, cumulative family income is associated with quality of cognitive stimulation children experience in their home environments. A significant concern with these cross-sectional models, however, is that they rely on between subjects comparisons to identify income's effects and therefore fail to take into account stable omitted differences, such a children's cognitive predispositions, persistence, or motivation. Thus, longitudinal, fixed effects regressions were used to control for stable omitted differences. These analyses affirmed cross-sectional links between income and children's home environments, suggesting that income has an independent influence on parenting behaviors that is not explained by stable characteristics of individuals. Furthermore, this study supports existing research showing that income increases are the particularly beneficial for the most vulnerable families (Dearing, McCartney, & Taylor, 2001; Garrett et al., 1994; Miller & Davis, 1997). However, the size of income's effect on even these families is moderate, amounting to just one-fifth of a standard deviation.

This study also provided the first empirical test of whether changes in family income are linked to changes in parenting practices related to cognitive stimulation. Specifically, it finds that improvements or reductions in families' economic resources have significant implications on children's early learning experiences in their home environments. Identifying these direct effects of income addresses the important policy question of whether income supplements, like those provided by public assistance and the EITC, can produce direct effects on children's leaning experiences in their home environments.

Understanding the implications of the direct associations between income and cognitive stimulation in children's home environments requires a more thorough reflection on the magnitude of income change under consideration and the size of their effect on children's home environments. In the interpretation of the linear and semilog fixed effects models, the influence of a $10,000 increase in cumulative average family income over four years was examined. An income change of this magnitude translates into $40,000 of income supplements over 4 years. This represents a substantial income treatment when compared to current income transfer programs aimed primarily at low-income families. For example, the maximum benefit for a family with two or more children under the Federal Earned Income Tax (EITC) is $4,008 dollars per year and for a family with one child is $2,428 per year (Department of Treasury, Internal Revenue Service, 2001). Thus, the income change under consideration in the current analysis is roughly two and a half times the maximum EITC benefit received by families with two children and about four times the maximum EITC benefit for a family with one child. Under the semilog, fixed effect regression, the largest effect of an income change of this magnitude was experienced by children living in families whose incomes were at the bottom of the income distribution. On average they experienced one-fifth of a standard deviation improvement in their home learning environment. This is a relatively modest effect of quite a substantial influx of income.

Nevertheless, this is a lower-bound estimate of income's total effect on cognitive stimulation in children's home learning environments. Income may exert additional indirect influences on parenting practices through its effects on other characteristics of the family system that are included in the regression equation as control variables. Indeed, several familial characteristics that are significantly associated with cognitive stimulation in children's home learning environments in the regression equations, such as maternal education, employment, and marital status, may also be indirectly influenced by family income. For example, having more income enables parents to purchase additional years of education, which may in turn influence their home learning practices. Including both income and maternal education in the regression equation simultaneously may underestimate income's effect. Any influence of income that is mediated by control variables, in the context of the current analyses, will be attributed to the control variable itself and not income. In this respect, these analyses do not capture of totality of income's influence. Because the present study could not employ a family systems model, effects of income may be underestimated.

Further caution should be taken when examining the magnitude of the nonlinear association between income and cognitive stimulation that was uncovered in these analyses. A limitation of using the HOME-SF as the dependent variable in these analyses is that it is a global measure of cognitive stimulation that is most effective at differentiating between minimally and moderately stimulating environments. It is less effective at discriminating between moderate and highly stimulating environments. Thus, the larger effect of income changes among low-income families when compared to middle- and upper-income families may to some extent be an artifact of measurement. However, it is unlikely that this issue of measurement could explain the nonlinear relations uncovered in these analysis entirely, since studies have shown great variability in cognitive stimulation within low- and high-income samples (Bradley et al., 1989).

The results of this study suggest that programs providing income supplements targeted at the most economically vulnerable families may be part of an effective strategy to improve young children's home learning environments and reduce school readiness disparities. It should be heartening to policy makers to know that families utilize additional economic resources in ways that improve the quality of children's home learning environments. Yet, this investigation implies that the benefits accrued from income supplement programs alone may be limited, given the modest associations between income increases and improvements in the provision of cognitive stimulation in children's home environments for even the most disadvantaged families. Instead, researchers and policy makers should continue to consider programs providing income supplements along with other policy alternatives, like home visitation or parent education programs, that involve more intensive interventions aimed directly at improving children's learning experiences in their homes (Brooks-Gunn, Berlin, & Fuligni, 2000). Designing interventions that place children on more equal ground when they first set foot into the school classroom will be an important challenge for policy makers and researchers in the future.

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Table 1

*Characteristics of Sample By Age of Assessment for 5 NLSY Cohorts N=2174*

| Variable | Ages 3-4 Assessment | Ages 7-8 Assessment |
|---|---|---|
| HOME scores [a] | 0.20 | 0.17 |
| | (0.02) | (0.03) |
| Income [a] | 46,723.02 | 48,887.34 |
| | (843.94) | (877.09) |
| Mothers marital status | | |
| Never married | 9.15 | 6.97 |
| | (0.73) | (0.61) |
| Married | 78.05 | 75.09 |
| | (1.12) | (1.19) |
| Divorced | 12.80 | 17.94 |
| | (0.90) | (1.07) |
| Mother's employment status | | |
| Not employed | 32.64 | 27.91 |
| | (1.39) | (1.31) |
| Part-time | 17.23 | 17.58 |
| | (1.09) | (1.10) |
| Full-time | 50.13 | 54.51 |
| | (1.45) | (1.46) |

| Variable | Ages 3-4 Assessment | Ages 7-8 Assessment |
|---|---|---|
| Number of children in household [a] | 2.24 | 2.53 |
| | (0.03) | (0.03) |
| Armed Forces Qualification Test [a] | 47.16 | |
| | (0.86) | |
| Mother's and child demographic characteristics | | |
| Mother's education [a] | 12.93 | 13.07 |
| | (0.07) | (0.07) |
| Age at first birth [a] | 22.64 | |
| | (0.12) | |
| Teen mothers | 9.15 | |
| | (0.80) | |
| Black | 13.23 | |
| | (0.76) | |
| Hispanic | 6.34 | |
| | (0.46) | |
| White | 80.43 | |
| | (0.91) | |
| Child male | 50.54 | |
| | (1.21) | |

| Variable | Ages 3-4 Assessment | Ages 7-8 Assessment |
|---|---|---|
| Child age [a] | 47.10 | 95.17 |
| | (0.16) | (0.16) |
| Low birth weight | 6.17 | |
| | (0.64) | |

Note: Values in table are weighted percentages and standard error in parentheses. [a] Weighted means and standard errors in parentheses.

Table 2

*Cross-sectional Regressions Examining the Influence of Income Maternal, Child, and Household Characteristics on HOME Scores at Ages 3-4 and Ages 7-8*

| Variable | Model 1<br>Ages 3-4<br>Linear Function<br>*B*<br>(SE *B*) | Model 2<br>Ages 3-4<br>Semilog Function<br>*B*<br>(SE *B*) | Model 3<br>Ages 7-8<br>Linear Function<br>*B*<br>(SE *B*) | Model 4<br>Ages 7-8<br>Semilog Function<br>*B*<br>(SE *B*) |
|---|---|---|---|---|
| Average annual income since birth | 0.061** | | 0.062** | |
| | (0.008) | | (0.010) | |
| Natural logarithm of average annual income since birth | | 0.330** | | 0.352** |
| | | (0.041) | | (0.049) |
| Mothers marital status (omitted married) | | | | |
| Never married | -0.138 | -.001 | -0.332** | -.199 |
| | (0.097) | (0.102) | (0.100) | (0.102) |
| Divorced | -0.004 | 0.096 | -0.260** | -0.180** |
| | (0.066) | (0.070) | (0.060) | (0.062) |
| Mother's employment status (omitted full-time) | | | | |
| Part-time | 0.164** | 0.178** | 0.126* | 0.144** |
| | (0.049) | (0.049) | (0.054) | (0.054) |

| Variable | Model 1<br>Ages 3-4<br>Linear<br>Function<br>*B*<br>(SE *B*) | Model 2<br>Ages 3-4<br>Semilog<br>Function<br>*B*<br>(SE *B*) | Model 3<br>Ages 7-8<br>Linear<br>Function<br>*B*<br>(SE *B*) | Model 4<br>Ages 7-8<br>Semilog<br>Function<br>*B*<br>(SE *B*) |
|---|---|---|---|---|
| Not in paid labor | 0.091* | 0.133** | 0.007 | 0.042 |
| | (0.041) | (0.047) | (0.053) | (0.053) |
| Number of children in household | -0.104** | -0.103** | -0.068** | -0.066** |
| | (0.027) | (0.026) | (0.023) | (0.023) |
| Mother's education | 0.047** | 0.049** | 0.079** | 0.081** |
| | (0.012) | (0.012) | (0.014) | (0.014) |
| Armed Forces Qualification Test | 0.004** | 0.004** | 0.003** | 0.003* |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Teen mothers | -0.097 | -0.084 | -0.187* | -0.179* |
| | (0.085) | (0.085) | (0.079) | (0.079) |
| Mother's race (omitted White) | | | | |
| Black | -0.265** | -.249** | -0.169* | -0.154* |
| | (0.079) | (0.078) | (0.071) | (0.071) |
| Hispanic | -0.250** | -0.233** | -0.291** | -0.282** |
| | (0.074) | (0.072) | (0.066) | (0.066) |

| Variable | Model 1 Ages 3-4 Linear Function *B* (SE *B*) | Model 2 Ages 3-4 Semilog Function *B* (SE *B*) | Model 3 Ages 7-8 Linear Function *B* (SE *B*) | Model 4 Ages 7-8 Semilog Function *B* (SE *B*) |
|---|---|---|---|---|
| Child male | -0.104** | -0.102** | -0.081* | -0.082* |
| | (0.035) | (0.035) | (0.037) | (0.037) |
| Child age | 0.009** | 0.008** | 0.002 | 0.002 |
| | (0.003) | (0.002) | (0.003) | (0.003) |
| Low birth weight | -0.084 | -0.087 | 0.126 | 0.126 |
| | (0.103) | (0.100) | (0.099) | (0.095) |
| Constant | -1.018 | -1.233 | -1.122 | -1.375 |
| $R^2$ | .303 | .313 | .295 | .304 |

Note: All models control for child birth year. * $p < .05$ ** $p < .01$.

Table 3

*Fixed Effects Models Examining the Influence of Changes in Income Maternal, Child, and Household Characteristics on HOME Score Changes*

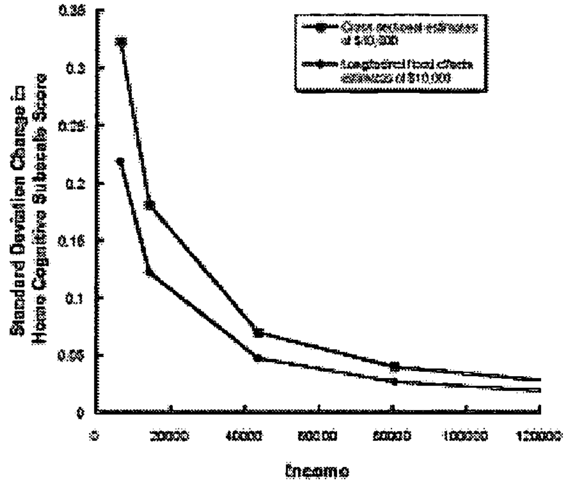
| Variable | Model 1<br>Linear Function<br>*B*<br>(SE *B*) | Model 2<br>Semilog Function<br>*B*<br>(SE *B*) |
|---|---|---|
| Difference between average annual income from birth to 3-4 and the average annual income birth to 7-8 | 0.080**<br>(0.027) | 0.229*<br>(0.117) |
| Mothers marital status (omitted remained married) | | |
| Remained unmarried | -0.084<br>(0.095) | -0.104<br>(0.095) |
| Remained divorced | -0.224**<br>(0.076) | -0.246**<br>(0.076) |
| Became married | -0.071<br>(0.094) | -0.085<br>(0.099) |
| Became divorced | -0.117<br>(0.086) | -0.143<br>(0.086) |
| Mother's employment status (omitted remained full-time) | | |
| Remained employed part-time | 0.001<br>(0.072) | 0.002<br>(0.073) |
| Remained out of the labor force | 0.003<br>(0.062) | 0.002<br>(0.063) |

| Variable | Model 1 Linear Function B (SE B) | Model 2 Semilog Function B (SE B) |
| --- | --- | --- |
| Increased hours of employment | -0.064 | -0.071 |
| | (0.056) | (0.056) |
| Decreased hours of employment | 0.083 | 0.078 |
| | (0.068) | (0.069) |
| Change in number of children in household | -0.035 | -0.030 |
| | (0.036) | (0.036) |
| Change in mother's education | 0.090** | 0.090** |
| | (0.036) | (0.036) |
| Change in child's age | 0.027** | 0.027** |
| | (0.008) | (0.008) |
| Constant | -1.284 | -1.266 |
| $R^2$ | .02 | .02 |

Note: All models control for child birth year. * $p < .05$ ** $p < .01$

Figure Caption

*Figure 1*: Illustrates the influence of a $10,000 income changes on the level of cognitive stimulation provided by children's home environments under the semilog, cross-sectional and longitudinal fixed effects models. The slopes of the curves represent the differential sensitivity of children's home environments to income changes. These curves show that the home environments of families with incomes at the lower end of the income distribution are more sensitive to income changes than are those of children at the upper end of the income distribution.

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