

COGNITIVE STIMULATION:
DOES IT MEDIATE OR MODERATE THE RELATIONSHIP BETWEEN
INCOME AND SCHOOL READINESS?

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By

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ABSTRACT

Socioeconomic status is a well-known predictor of school readiness, but the mechanisms through which it operates have been less salient. Using data from the Panel Study for Income Dynamics' Child Development Supplement and a multivariate regression analysis, this study tests the hypothesis that various facets of cognitive stimulation either mediate or moderate the relationship between income and school readiness. Four composites of different cognitive stimulation variables were created using factor analysis: parental engagement, reading-related behaviors in the home, learning materials used in the home, and frequency of taking children on outings for a sample of preschool-aged children. The two main findings show that 1) reading-related behaviors mediate the relationship between income and school readiness and 2) the frequency of outings moderates the relationship. Additionally, taking children on outings or to museums supports cognitive growth more for children at low levels of income than at higher income levels. These findings suggest that universal policies relating to increasing reading activities for young children are valuable. Furthermore, targeted programs focusing on increasing child activities outside the home may be particularly beneficial for low-income children.

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INTRODUCTION

Education policy in the current No Child Left Behind climate has seen a dramatic shift. Greater emphasis is being placed on standards and accountability, with the ultimate goal being for all children between the third and eighth grade to reach proficiency in reading and math by 2014 (Hess & Petrilli, 2006). One major criticism of the No Child Left Behind legislation is that it holds public school systems accountable for factors that are outside of their control: the myriad of experiences children have before they enter kindergarten.

These early childhood experiences vary by many factors including socioeconomic level, maternal education, neighborhood characteristics, and parenting style of children's caregivers. By the time children enter kindergarten, many of the precursors to being a successful student (and in turn a productive member of society) have either been cultivated or crushed. Measures of school readiness show that the achievement gap between low-income and high-income students exists even before children start school (Sadowski, 2006). With greater emphasis being placed on closing that gap in order to provide all children with equal opportunities, a paradigm shift will have to occur where early intervention and prevention become universal policy priorities.

Developmental psychology is a rich field that strives to explain some of the factors associated with early childhood and child outcomes. Attachment relationships form during infancy and serve as the foundation for successful cognitive, social, and emotional development throughout childhood. Children learn language receptively

from the language they hear spoken around them as a result of innate language-learning processes. Children attending center-based preschools tend to have better intellectual outcomes than those children who are cared for at home, and they also tend to be more socially competent. The amount of time that parents spend reading to their children predicts future language skills. These statements are truisms that can be found in any introductory developmental psychology textbook (as cited in Bukatko and Daehler, 2001), and yet, many parents are unaware of the early parenting practices that will lead to their children being as capable as possible.

This study examines these early parent-child experiences, testing the hypothesis that activities such as museum visits, time spent reading together, and other parent-child interactions mediate or moderate the relationship between income and school readiness, defined as emerging literacy skills. In theory, greater exposure to cultural and educational experiences will create opportunities for diversifying the vocabulary of young children that will, in turn, increase their emergent literacy skills. Using the Child Development Supplement to the Panel Study of Income Dynamics (PSID-CDS) and a multivariate analysis, this study identifies what impact these early experiences have on school readiness and then highlights the policy implications of the findings.

BACKGROUND

In 2001, President George W. Bush signed the No Child Left Behind Act into legislation. Because of No Child Left Behind's emphasis on standards and accountability, certain steps were taken to guarantee that all children were meeting the

appropriate levels of proficiency. In order to work towards closing the achievement gap between different groups of children, each sub-group would be tracked separately to ensure that the performance of lower achieving groups was not ignored. The major subgroups include low-income students, minorities, children with disabilities, and English language learners (Hess & Petrilli, 2006). By disaggregating test scores, schools would be more inclined to focus on closing the achievement gap rather than hiding it in average test scores. While No Child Left Behind attempts to eliminate the achievement gap by bringing all students to a proficient level, it does nothing to impact early childhood factors, and ignores the “school readiness gap” that occurs as kindergarteners enter school (Sadowski, 2006).

Early childhood provides an opportunity to impact children when they are still developing and also to intervene when they are most vulnerable to traumatic events such as poverty. In a 2000 review of the literature, Greg Duncan and Jeanne Brooks-Gunn found that deep or persistent poverty in early childhood has lasting impacts on children. Additionally, early childhood is the time period when children are most susceptible to the impacts of poverty as compared to middle childhood and adolescence. They also examined some of the pathways through which income might affect child outcomes, including the home environment, quality of childcare, perceived economic pressure, parental mental health, parent-child relationships, and neighborhood residence (Duncan & Brooks-Gunn, 2000).

In line with Duncan and Brooks-Gunn’s review of the literature, there has been increased attention on early childhood in policies around the country. Programs such as

universal pre-kindergarten, the Harlem's Children Zone, and the Nurse-Family Partnership are a few examples of ways in which children can be affected in their formative years. In addition to a national shift towards early childhood programs, President Barack Obama's agenda also brought early childhood into the national spotlight. Throughout the 2008 presidential campaign, he portrayed educating children as an issue of national and economic security. Senator Obama stated in a major speech entitled "A 21st Century Education" that the kinds of decisions leaders make about education will determine whether or not the United States continues to be a global economic leader (Obama, 2008). In a speech delivered in July of 2007, Senator Obama highlighted the Harlem Children's Zone as his top priority in the fight against poverty, committing to expand the program to twenty cities around the country (Obama, 2007).

Because normal child development is the result of many intertwining factors, it is often challenging to identify which of the factors are at work at any given time. Given the perfect storm of increased funding and an opportunity to improve child outcomes by intervening early, it is critical that more research is done to identify areas where intervention is needed. This study examines one aspect of early childhood that could benefit from a policy intervention: cognitive stimulation both inside and outside the home.

LITERATURE REVIEW

A rich body of research has been performed on factors relating to early childhood in the areas of physical, cognitive, social and emotional development (see Bukatko and Daehler, 2001; Shonkoff & Phillips, 2000). School readiness is a construct that can be operationalized in many different ways depending on which aspects of development are considered. Duncan et al (2007) conducted a comprehensive multivariate analysis in which they examined six different longitudinal data sets to determine which school readiness factors had the greatest predictive power for later academic outcomes. School readiness was defined in several ways, including school-entry reading and math skills, language and verbal ability, attention skills, externalizing and internalizing problems, and social skills. The findings suggest that across all six data sets, school-entry reading and math skills have the greatest predictive power for later achievement, while socio-emotional factors are not statistically significant (Duncan et al, 2007). For the purposes of this study, readiness will be defined in terms of emergent literacy skills because of their significant impact on later academic achievement.

The main factors impacting cognitive outcomes are the home environment, parent-child interactions, and childcare outside of the home. Christian, Morrison, & Bryant (1998) examined the interactions between childcare, maternal education, and the home literacy environment and how these factors predict kindergarten academic skills. They used correlations to show that the family literacy environment was positively associated with reading outcomes, but not with math outcomes. Adi-Japha & Klein

(2009) studied the relationship between parenting quality and three year olds' receptive and expressive language in relation to the amount of time spent in childcare. They found that the correlation between parenting quality and school readiness was stronger for children experiencing medium amounts of childcare than children experiencing primarily maternal care.

The three characteristics of early childhood that exert the most impact on cognitive outcomes (home environment, parent-child interactions, and childcare) are also heavily influenced by socioeconomic factors. Brooks-Gunn and Markman (2005) discuss how parenting differences based on family factors such as socioeconomic status and race contribute to the gap in school readiness in a qualitative analysis. They define parenting as seven separate measures: nurturance, discipline, teaching, language, monitoring, management, and materials. When parenting practices are controlled for in regressions, the school readiness gap between black and white children decreases by anywhere from one third to one half.

Hart and Risley (1992) gathered two years of data through monthly hour-long observations in which they focused on language spoken by the parent to the child. A regression analysis found that toddlers in lower socioeconomic status families received significantly less time and effort from their parents than toddlers in higher socioeconomic status families, holding other factors constant. These differences in amount of time spent parenting per hour were strongly correlated with child IQ measurements. In lower socioeconomic status families, up to 20 percent of parent utterances functioned to limit children's activities. Children in higher socioeconomic

status families heard more questions (up to 45 percent of utterances) and more repetitions of their own topics (up to five percent of utterances). The differences in utterances were also strongly correlated with child IQ. Bracken & Fischel (2008) found that parent education was the demographic characteristic that showed the strongest relationship with family reading behavior. Older parents also showed greater interest in interactive reading with their children. Additionally, there was a significant relationship between parent-child reading interaction (as defined by frequency and duration of shared reading, age it first began, library visits, and book ownership) and early literacy skills.

In addition to the literature that explores the direct relationship between parent-child interactions and cognitive outcomes, many studies have tested various mediating models where school readiness is the dependent variable. Forget-Dubois et al (2009) tested the hypothesis that early child language skills mediate the relationship between the home environment and school readiness and found that socioeconomic status explained the biggest proportion of variance in school readiness. Yeung, Linver, & Brooks-Gunn (2002) allowed several mechanisms to mediate the relationship between average family income and school readiness, including the physical home environment, cognitively stimulating materials, activities with the child, maternal depression, and economic pressures. Maternal cognitive ability was the strongest predictor of cognitive readiness and cognitively stimulating materials was the mediator with the largest effect. Cognitively stimulating materials was a composite of the number of books in the home, whether the child had a compact disc player and at least five CDS, the type of learning

materials used in the home, and whether the family regularly received a newspaper or magazines. These two studies show that regardless of which childhood factors are tested as mediators, it is often control variables such as socioeconomic status and maternal cognitive ability that explain the biggest proportion of the variation in school readiness. Raver, Gershoff, & Aber (2007) tested a similar mediating model for equivalence across three racial groups, finding that parenting should be measured differently across groups. As a remedy, the authors suggest including racial or ethnic group as a moderator in future analyses. While attempts have been made to identify the mechanisms through which income impacts school readiness, maternal education, race, and socioeconomic status continue to be significant factors in children's outcomes.

Guo and Harris (2000) also examined the mechanisms that might mediate the effect of poverty on cognitive development through regression analysis. They identified five factors as mediators: cognitive stimulation, parenting style, physical environment, child health (at birth and during childhood), and childcare. They found that these five factors completely mediate the relationship between poverty and children's intellectual outcomes. In other words, poverty was shown to have no direct effect on cognitive outcomes, but operated through these other pathways. Cognitive stimulation in the home (defined as the presence of reading materials, parent reported reading to child and museum visits) was the most important mediator and parenting style was the second most important mediator. Each of these studies operationalized cognitive stimulation in a different way, and the findings vary on whether or not cognitive stimulation mediates the relationship between socioeconomic status and child outcomes. Yeung, Linver &

Brooks-Gunn (2002) emphasized the importance of materials in the home while Guo and Harris (2000) used a composite of materials and behaviors. Identifying the mechanisms through which income impacts school readiness will be critical to determining what policy intervention will be most successful.

A smaller set of studies has been devoted to determining moderating factors that influence the relationship between various resources and child outcomes. Many of these studies cite a bioecological perspective on child development as the foundation for their research. A chapter from the *Handbook of Child Psychology* by Bronfenbrenner and Morris (2006) describes the impact of certain “proximal processes” which serve to help children actualize their “genetic potential.” The authors hypothesized that the power of proximal processes to buffer children against “developmental dysfunction” will be stronger in more disadvantaged environments and weaker in more advantaged or stable environments. This theory supports the concept of cognitive stimulation as a moderator for the relationship between income and school readiness; lower income children will be more heavily influenced by cognitively stimulating environments than children already living in higher income and thus, more organized environments.

Various studies have examined moderators that buffer children against (or make them more susceptible to) disadvantaged situations. Peisner-Feinberg et al (2001) studied the relationship between childcare quality and behavior outcomes. They found that maternal education moderated the impact of childcare quality in terms of behavior problems; children who experienced low-quality care were more likely to reduce their problem behaviors if their mother was college educated. Klebanov et al (1998)

examined the influence of neighborhood characteristics and family income on child outcomes. They found a significant interaction between an index of family risk factors (including unemployment, father absence, and maternal depression) and family poverty. Family risk factors moderated the relationship between family poverty and developmental test scores. Low-income children's test scores were more negatively affected by the presence of moderate risks than higher-income children.

Cognitive stimulation in the home environment has been found to be an important protective factor that has the potential to buffer children against disadvantaged situations such as poverty. Caughy et al (1994) conducted a study in which they determined that cognitive stimulation (as measured by the Home Observation for Measurement of the Environment short form) moderated the impact of type of childcare on math test scores. Votruba-Drzal et al (2004) tested the hypothesis that the extent, type, and developmental quality of certain childcare arrangements would impact children's outcomes in a primarily low-income sample. They looked for three potential moderators: child characteristics, quality of the home learning environment, and time spent in childcare. All three served as moderators between childcare quality and child outcomes. In particular, the interaction between childcare quality and the stimulating home environment suggested that high quality childcare could not make up for lack of stimulation in the home, but that children were most successful when experiencing both high quality childcare and high levels of stimulation at home. Taken together, these findings suggest that the quality of the home learning environment serves as a protective factor against poverty, although these studies use comprehensive

measures of cognitive stimulation in the home rather than narrowing down the measure to a smaller number of variables. This study will create smaller composites of cognitive stimulation in order to identify which specific variables make the biggest difference for children in low-income environments.

Given the importance of cognitive stimulation, the home environment, and parenting practices in determining outcomes, it is critical that policy efforts be made to help parents make decisions that will assist their children in becoming as successful as possible. More research is needed to identify specific parent-child activities that will help increase children's cognitive development in terms of school readiness. This study takes on that goal by testing certain aspects of the home environment that might impact cognitive outcomes.

CONCEPTUAL FRAMEWORK AND HYPOTHESIS

Figure 1 is a representation of the conceptual model of how cognitive stimulation inside and outside the home might mediate the impact of socioeconomic status on children's school readiness. The latent dependent variable is one component of school readiness- emergent literacy skills, as measured by the child's combined Woodcock-Johnson score on the letter-word and applied problem tests. The latent independent variable is socioeconomic status as measured by family income. Twelve variables serve as proxies for cognitive stimulation: how often the parent takes the child on outings or to any type of museum, how often the parent reads to the child, how many books the child has in the home, whether the parent uses letters, numbers, colors, shapes

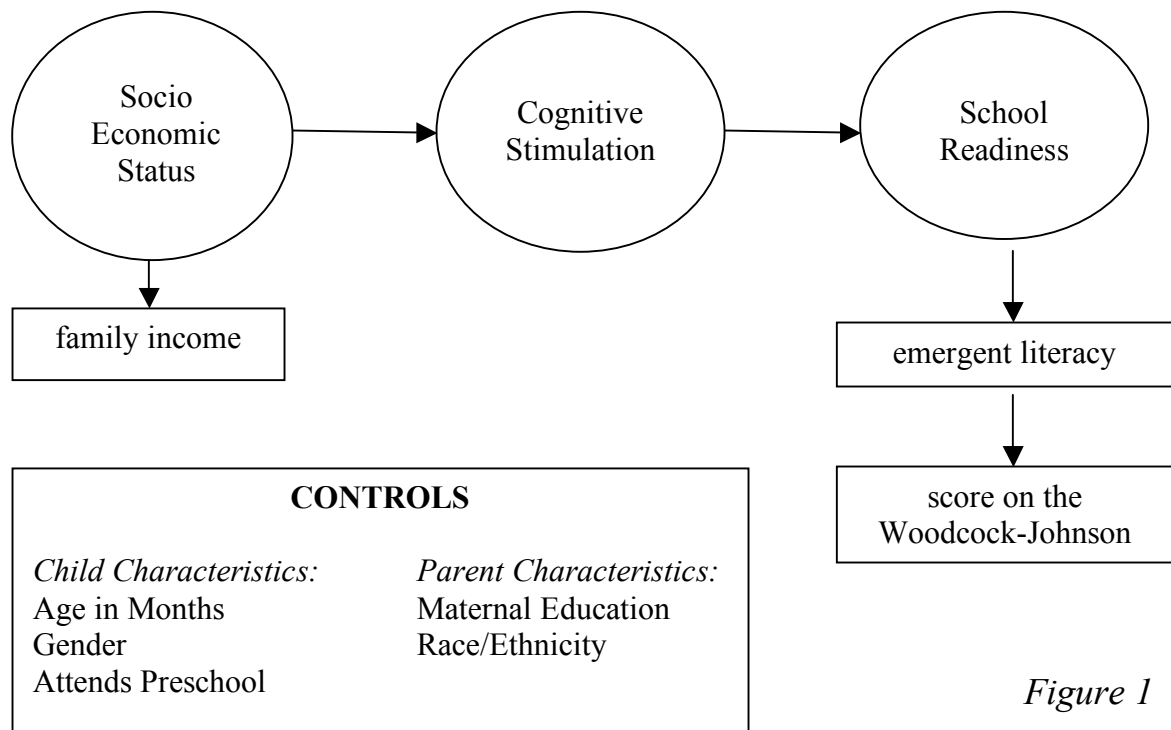


Figure 1

and sizes to help the child learn at home, whether the parent engaged the child in spontaneous conversation, responded to the child’s speech, provided toys for the child, and how monotonous the home environment was.

The controls in the model are child’s age and gender and mother’s race and education level. These controls are typically included when examining the relationship between income, parenting factors and child outcomes (Guo & Harris, 2000; Yeung, Linver, & Brooks-Gunn, 2002). Hart and Risley (1992) found that maternal education level has an impact on the number of words and phrases (utterances) that mothers speak to their children in a given time period. Race has been found to impact parenting styles, with African-Americans exhibiting more authoritative practices than their white counterparts (Brooks-Gunn & Markman, 2005).

Based on the literature, it is to be expected that cognitive stimulation, income, and school readiness will all be correlated positively with each other. The higher the level of cognitive stimulation in the home, the better the child will perform on assessments of school readiness. Additionally, the higher the income level, the higher the level of school readiness.

DATA AND METHODS

Data Source

The data used in this study is the Child Development Supplement to the Panel Study of Income Dynamics. The Panel Study of Income Dynamics (PSID) is primarily sponsored by the National Science Foundation, the National Institute of Aging, and the National Institute of Child Health and Human Development (NICHD) and is conducted by the University of Michigan. The NICHD is the primary sponsor of the Child Development Supplement (CDS).

The PSID is a longitudinal study that started in 1968, collecting information from participants annually until 1997 at which point the survey became biennial. The goal of the PSID was to collect information on labor market participation, emphasizing the dynamic aspects of economic and demographic behavior and including information on sociological and psychological measures. The CDS collected information on human capital development including extensive measures of the children's home environment and family processes. Within the context of family, neighborhood, and school environments, the CDS studied a broad array of developmental outcomes including

physical health, emotional well-being, intellectual and academic achievement, and social relationships with family and peers.

The original PSID sample consisted of two groups; the first group was a nationally representative cross-section drawn by the Survey Research Center at the University of Michigan and the second came from the Survey of Economic Opportunity, conducted by the Census Bureau and sampling low-income families. Over time, the PSID sample has grown to include children and grandchildren of the original respondents. In 1997, the first wave of the CDS was collected. Of the 2,705 families with children ages zero to twelve selected from the PSID core sample, 2,394 families participated in the CDS-I, representing a response rate of 88 percent. The original sample size was 3,563 children. A second wave of data was collected in 2002 and a third wave in 2007. The data collection method varied. The interviewer who contacted a family about their participation in the CDS also visited the home to obtain written permission, child assessments, child interviews, primary caregiver interviews and assessments, and time use diaries. Interviewers also left self-administered instruments for the primary and other caregiver.

Sample Size and Limitations

The sub-sample used for this study is a cross-section of children that were between the ages of 48 and 72 months (four to six years) at the time of their primary caregiver interview and had not yet entered kindergarten. Because the hypothesis of this research is concerned with school readiness, it is appropriate to limit the sample to those children who are about to enter kindergarten, examining the factors that

contributed to their readiness over the 12 months leading up to their interviews. Additionally, the sample was restricted to children whose primary caregiver was their biological mother and for whom the head of household was either their father or mother. Because the primary unit of analysis in the PSID is the head of household, it was imperative to reduce the sample to children whose primary caregiver was either the head or the wife of the head in order to ensure that household level data collected by the PSID applied to the child's home environment. Any child who did not complete the Woodcock-Johnson test was excluded from the sample, regardless of the reason why they did not finish the test. Lastly, five children were excluded based on their family income totaling over 200,000 dollars. These observations were outliers and skewed the sample. Restricting the sample to this group of children results in a new sample size of 274.

Sample size is one of the main limitations of the PSID-CDS. Because the CDS only collects extensive developmental data every five years, there is not enough information to include all children in the CDS as they hit the five-year mark, or to take advantage of the longitudinal nature of this data set, leading to a relatively small sample. Because of missing data in the household booklet questionnaire, certain variables had to be excluded from the model. The three key variables that were left out were whether or not the family received a daily newspaper, how many magazine subscriptions they had, and whether or not the child was taken to the library by their primary caregiver or other caregiver. Additionally, because data for the CDS was only collected every five years, it is not possible to capture children at ages two to four and

again at age five, which would be ideal given this study's hypothesis about early childhood factors. If the interval between data collection times was smaller (i.e., the data was collected every two years), more information could be gathered about the early childhood factors that impact school readiness.

Analysis Plan

This study will undertake a regression model using ordinary least squares (OLS) multivariate regression. Because the second wave of data does not look at any children before they enter kindergarten, it is not appropriate to use a pooled cross-section. The dependent variable (school readiness as measured by the Woodcock-Johnson assessment) is a continuous variable, making OLS the appropriate model. The proposed mediators/moderators are variables related to cognitive stimulation inside and outside the home environment. The independent variable is socioeconomic status for which family income serves as a proxy. The controls are child age and gender, maternal education and race, and whether or not the child attends preschool.

In a discussion by Baron & Kenny (1986), the distinction between mediators and moderators is made clear. Mediators and moderators have an effect on the way the independent variable impacts the outcome variable. With regard to mediators, the independent variable may have a direct relationship with the dependent variable, but it also may be mediated by a third variable, yielding an indirect relationship as well. In other words, cognitive stimulation may be a pathway through which income operates on school readiness. If the relationship is mediated entirely, income will have no direct effect on school readiness. Instead, when both income and cognitive stimulation are

included in the full mediation model, only cognitive stimulation will be significantly related to income. In order to test this mediating relationship, a series of four regressions was performed for each factor:

$$(1) \text{ cognitive stimulation} = \beta_0 + \beta_1 \text{socioeconomic status} + \beta_2 \text{controls}$$

$$(2) \text{ school readiness} = \beta_0 + \beta_1 \text{cognitive stimulation} + \beta_2 \text{controls}$$

$$(3) \text{ school readiness} = \beta_0 + \beta_1 \text{socioeconomic status} + \beta_2 \text{controls}$$

$$(4) \text{ school readiness} = \beta_0 + \beta_1 \text{socioeconomic status} + \beta_2 \text{cognitive stimulation} + \beta_3 \text{controls}$$

Again, if income has no effect on emergent literacy when controlling for cognitive stimulation in the full mediation model (4), then it will be concluded that cognitive stimulation fully mediates the relationship between income and school readiness. This only holds true if the independent variable predicts the dependent variable in each of the regressions listed above (1-3).

A moderator, on the other hand, interacts with an independent variable affecting the direction or strength of the relationship between the independent variable of interest and the dependent variable. If cognitive stimulation serves to moderate income, then the impact of income on school readiness will vary at different levels of cognitive stimulation. In order to test this relationship, the following regression was run with each cognitive stimulation factor:

$$(5) \text{ school readiness} = \beta_0 + \beta_1 \text{socioeconomic status} + \beta_2 \text{cognitive stimulation} + \beta_3 \text{ socioeconomic status} * \text{cognitive stimulation} + \beta_4 \text{controls}$$

Figure 2 shows the conceptual mediating model and Figure 3 shows the moderating model with each factor of cognitive stimulation as determined by the factor analysis outlined below.

Factor Analysis

In order to reduce the large number of cognitive stimulation variables into a smaller number of composites, an exploratory factor analysis was conducted. The factor analysis results indicated that there were four factors with an eigenvalue higher than one. These four factors accounted for 58.05 percent of the variance. The first factor, parental engagement, had an eigenvalue of 2.93 and included the variables “parent engaged child in spontaneous conversation,” “parent responded to child’s speech,” and “parent provided toys or other interesting activities for child.” The second factor, reading-related behaviors in the home, had an eigenvalue of 1.77 and included number of books in the home, how often the parent reads to the child, and the monotony of the home environment. The third factor had an eigenvalue of 1.22 and was composed of types of learning materials used in the home: letters, numbers, colors, shapes and sizes. The fourth factor had an eigenvalue of 1.04 and was based on the frequency of activities outside of the home: how often the parent takes the child on any kind of outing, and how often the parent takes the child to a museum of any kind.

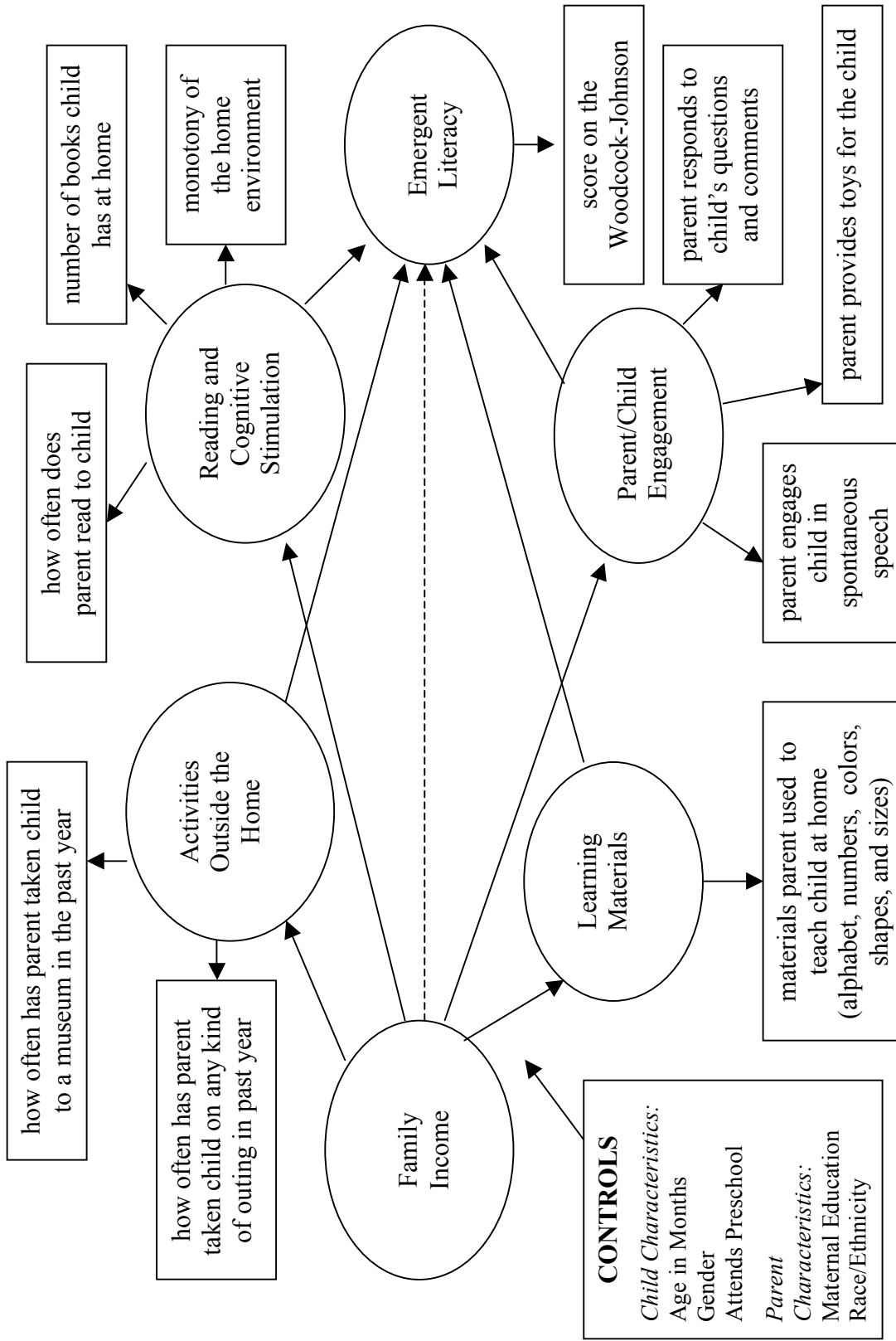


Figure 2

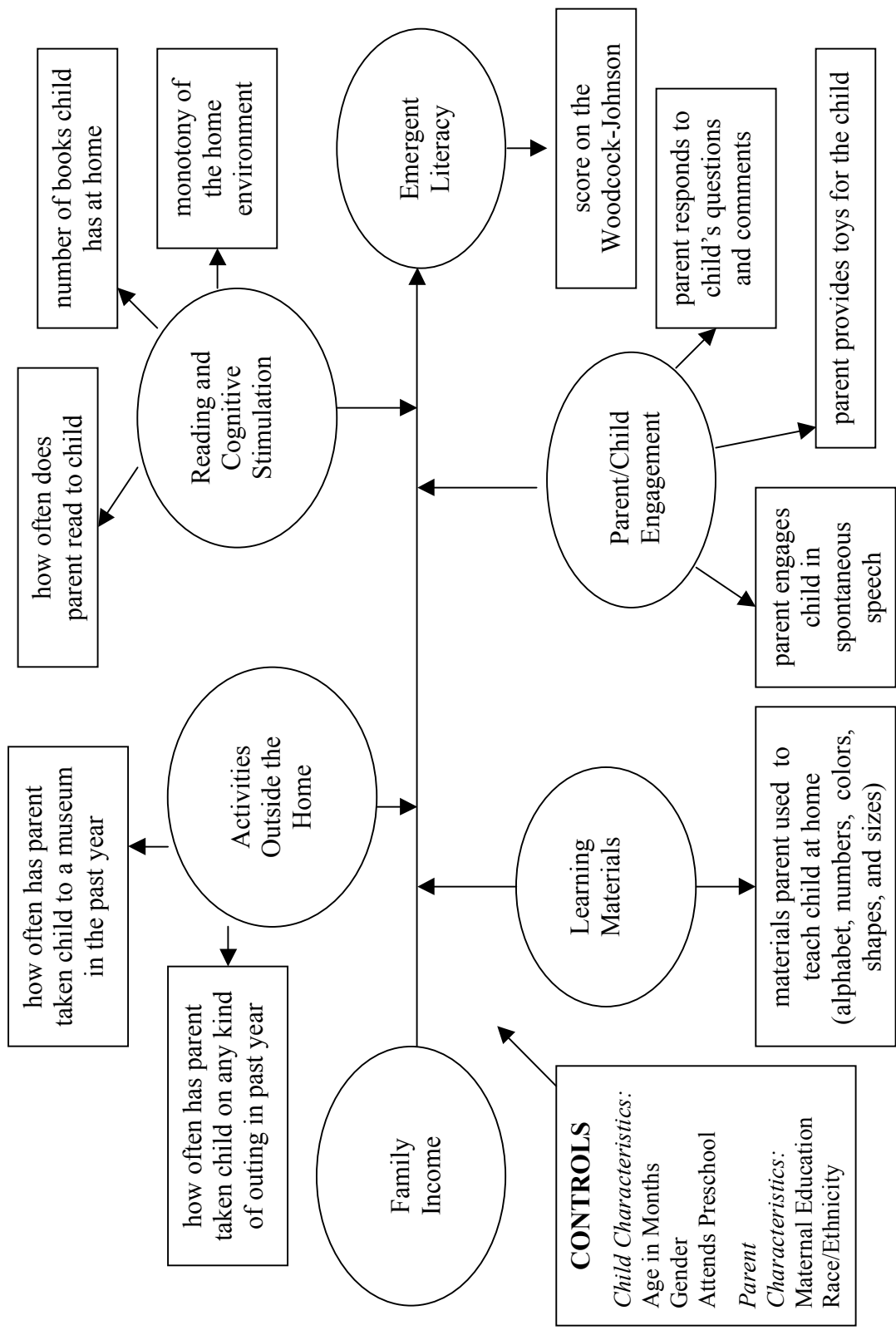


Figure 3

Variables

Dependent Variable. The dependent variable is school readiness and is measured by the sum of the Woodcock-Johnson letter word sub-score and the applied problems sub-score. This score can take on values from zero to 54. These sub-tests of the Woodcock Johnson assessment are the only two that were administered to children younger than six years old. The other portions of the Woodcock-Johnson were administered to children ages six and older. There were no missing values for this variable because the sample was restricted to exclude children who did not complete the test.

Independent Variable. The independent variable of interest is socioeconomic status. Socioeconomic status is operationalized by total family income. Family income is measured in dollars and can take on any value. There are no missing values for income because the PSID is specifically interested in income and as such is careful to collect this information.

Mediators/Moderators. Four composite factors were created to represent cognitive stimulation. Because there were very few missing values on any of the variables, missing values were replaced with the sample mean. Replacing missing values with the sample mean ensured those cases would not be dropped from the regressions, which was particularly important given the already small sample size.

The first composite, parental engagement is composed of the variables “parent engaged child in spontaneous conversation,” “parent responded to child’s speech,” and “parent provided toys or other interesting activities for child.” These three variables

were questions from the Home Observation for Measurement of the Environment (HOME) scale short form. The HOME scale includes a set of questions that were answered by the interviewer who observed the parent and child together in the home. Each of the above variables could take on a value of one (indicating that the interviewer observed it often) through five (it was never observed). These interviewer-observed questions were the only cognitive stimulation variables with missing values. The missing values comprised roughly 20 cases (about seven percent of the sample) and were imputed with the sample mean in all cases.

The second composite, reading-related behaviors in the home, is composed of three variables: number of books in the home, how often the parent reads to the child, and the monotony of the home environment. Monotony of the home environment was observed by the interviewer and could take on values of one through five, where one represents very monotonous and five represents not at all monotonous. The other two variables were collected through the primary caregiver survey. The number of books the child has in the home is a categorical variable that can take on values between one and five where one represented zero books and five represented 20 or more books in the home. How often the parent reads to the child was also a categorical variable ranging in value from one to six where one represented never and six represented daily.

The third composite was made up of four variables regarding use of learning materials in the home: letters, numbers, colors, shapes and sizes. Each variable about types of materials (numbers, alphabet, colors, shapes and sizes) is an indicator variable

where one indicates that the listed material was used at home and five indicates that it was not used. These variables were also obtained through primary caregiver self-report.

The fourth composite was based on activities outside of the home: how frequently the parent takes the child on any kind of outing, and how often the parent takes the child to a museum of any kind. The museum variable can take on a value between one and five; one represents never and five represents more than once a month. The outing variable can take on a value between one and five; one represents a few times a year or less and five represents more than once a month. Again, these variables were obtained through the primary caregiver survey.

Control Variables. The control variables consist of various parent and child characteristics. Child's age is a continuous variable measured in months at the time of the primary care interview. Because this sample is restricted to children ages four to six, the values this variable takes on are between 48 and 72. Maternal education is treated as an ordinal variable measured in final grade completed and ranges in value from one to 17. A value of 17 represents that the mother has completed some graduate education. Maternal education was the only control variable with missing values; those missing values were coded as zero and a dummy variable was included indicating whether maternal education was missing or not.

Other control variables were coded as indicator variables. Child gender takes on a value of one if the child is a boy and two if the child is a girl. The variable on preschool attendance is coded as zero if the child does not attend any preschool programs and one if the child attends a childcare center, pre-kindergarten, preschool

program, or Head Start. Maternal race takes on a value of zero if the mother is white non-Hispanic and a value of one if the mother is non-white, representing a combination of black non-Hispanic, Hispanic, Asian or Pacific Islander and American Indian or Alaskan Native.

DESCRIPTIVE STATISTICS

Tables 1 and 2 present summary statistics describing the sample for this study. The sample has 274 children ranging in age from 48 months (four years) to 70 months (five years, ten months). The average age is four years, nine months. Sixty percent of the children are boys and 40 percent are girls. In the unrestricted sample of children ages 48 months to 72 months (four to six years), 54 percent of the children are boys and 46 percent are girls (results not shown). In other words, the unrestricted sample is not

Table 1: Distribution of categorical variables

Characteristic	Total Number	Percentage
Sex of child		
Male	166	60.58
Female	108	39.42
Child attends preschool		
Yes	187	68.25
No.....	87	31.75
Maternal race		
White	146	53.28
Non-white.....	128	46.72

Table 2: Summary statistics of continuous variables

	Mean	Standard Deviation	Range
Total family income.....	43,918	33,708	648 – 173,500
Child’s age in months.....	56.78	5.51	48.0 – 69.9
Maternal education.....	12.92	3.07	0 – 17
Parental engagement.....	0	0.81	–2.65 – 1.09
Reading-related behaviors in the home.....	0	0.75	–2.49 – 0.67
Learning materials in the home.....	3.76	0.60	0 – 4
Activities outside the home.....	2.63	0.84	1 – 5
Woodcock-Johnson assessment.....	18.83	7.87	0 – 54

balanced by sex. The skewed nature of the restricted sample could be due to more boys being held back at school entry or fewer girls completing the Woodcock-Johnson test.

Roughly 70 percent of the sample attends some form of preschool or daycare outside of the home. Of the 128 non-white mothers, 107 were African-American and the rest represented other minorities. Annual family income ranges from 648 dollars to 173,500 dollars, but the median income in the sample was 38,146 dollars. On average, maternal education was 12.92, meaning the mother had a high school degree. The mean score on the Woodcock-Johnson assessment was 18.83 with a standard deviation of 7.87.

Table 3 presents the correlation coefficients amongst all the variables of interest. The strongest correlations are between the frequency of reading behaviors in the home and all the other variables. The relationship between income and reading had a correlation coefficient of 0.443; the relationship between school readiness and reading behaviors had a correlation coefficient of 0.428.

Table 3: Correlations between independent and dependent variables

	School Readiness	Income	Outings	Learning Materials	Parental Engagement	Reading
School Readiness	1.00	-	-	-	-	-
Income	0.333	1.00	-	-	-	-
Outings	0.241	0.259	1.00	-	-	-
Learning Materials	0.211	0.158	0.246	1.00	-	-
Parental Engagement	0.153	0.224	0.128	0.132	1.00	-
Reading	0.428	0.443	0.313	0.359	0.310	1.00

*All correlations are statistically significant with a p-value of 0.05 or smaller.

RESULTS

Tables 4A through 4D present the regression results for the mediation models.

Recall the four regression equations from the analysis section of this paper:

(1) cognitive stimulation = $\beta_0 + \beta_1$ socioeconomic status + β_2 controls

(2) school readiness = $\beta_0 + \beta_1$ cognitive stimulation + β_2 controls

(3) school readiness = $\beta_0 + \beta_1$ socioeconomic status + β_2 controls

(4) school readiness = $\beta_0 + \beta_1$ socioeconomic status + β_2 cognitive stimulation +
 β_3 controls

Each table corresponds to one of the above equations and each column contains the parameter estimates for a different cognitive stimulation factor. In order for a cognitive stimulation factor to qualify as a mediator, the parameter estimates on the independent variable of interest must be significant in each of the four regressions, one of which is in

each table. Therefore if income is not statistically significant in Table 4A, then that cognitive stimulation factor cannot be a mediator. In each instance, the positive impact of income appears as zero in the table due to rounding; in only one case was the parameter estimate statistically significant. Of note is the fact that in each regression the relationship between maternal race and cognitive stimulation is statistically significant and negative, meaning that the children of white mothers had higher values on each cognitive stimulation factor than those of non-white mothers.

Table 4A: Parental engagement, reading, learning materials or outings regressed on income

	Parental Engagement	<u>Dependent variable</u>		
		Reading	Learning Materials	Outings
<u>Independent variables</u>				
Intercept	-0.78 (0.62)	-0.97* (0.49)	3.78* (0.47)	1.27† (0.65)
Income	0.00 (0.00)	0.00* (0.00)	0.00 (0.00)	0.00 (0.00)
Child's age	0.01 (0.01)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
Child's sex	0.04 (0.10)	0.01 (0.08)	-0.09 (0.07)	-0.07 (0.10)
Attends preschool	0.13 (0.10)	0.08 (0.08)	0.14† (0.08)	-0.09 (0.11)
Maternal education	0.04 (0.03)	0.08* (0.02)	0.01 (0.02)	0.09* (0.03)
Maternal race	-0.55* (0.10)	-0.53* (0.08)	-0.25* (0.08)	-0.24* (0.11)
R ²	0.17	0.36	0.09	0.14

† p < 0.10, * p < 0.05

Table 4B: School readiness regressed on parental engagement, reading, learning materials or outings

<u>Independent variables</u>	<u>Dependent variable</u>			
	School Readiness (WJ-R Score)			
Intercept	-25.62*	-22.00*	-30.42*	-26.31*
	(5.23)	(5.08)	(5.76)	(5.21)
Parental engagement	-0.43	-	-	-
	(0.52)			
Reading	-	2.80*	-	-
		(0.62)		
Learning materials	-	-	1.38*	-
			(0.67)	
Outings	-	-	-	0.91†
				(0.49)
Child's age	0.56*	0.56*	0.56*	0.55*
	(0.07)	(0.07)	(0.07)	(0.07)
Child's sex	0.84	0.73	0.95	0.88
	(0.81)	(0.78)	(0.81)	(0.81)
Attends preschool	1.21	0.83	0.95	1.21
	(0.88)	(0.85)	(0.88)	(0.88)
Maternal education	0.97*	0.66*	0.93*	0.85*
	(0.20)	(0.20)	(0.20)	(0.21)
Maternal race	-4.96*	-3.00*	-4.36*	-4.45*
	(0.86)	(0.86)	(0.82)	(0.81)
R ²	0.35	0.40	0.36	0.36

† p < 0.10, * p < 0.05

Table 4B presents the regression results from equation (2) for each cognitive stimulation factor. The coefficients on reading, learning materials in the home, and outings are statistically significant. A one-unit increase in reading in the home will result in an increase of roughly three points on the Woodcock-Johnson assessment when controlling for child age, sex, maternal education and maternal race.

Table 4C: School readiness regressed on income

	<u>Dependent variable</u>	
<u>Independent variables</u>	School Readiness (WJ-R Score)	
Intercept	-24.02*	(Does not include cognitive stimulation)
	(5.21)	
Income	0.00*	
	(0.00)	
Child's age	0.55*	
	(0.07)	
Child's sex	0.70	
	(0.81)	
Attends preschool	0.94	
	(0.88)	
Maternal education	0.79*	
	(0.21)	
Maternal race	-4.17*	
	(0.85)	
R ²	0.36	

† p < 0.10, * p < 0.05

Table 4C presents the regression results from equation (3), which tests the relationship between income and school readiness. The coefficient on income is positive and statistically significant, implying that as income increases, test scores also increase. The effects of child age, maternal education and maternal race are all statistically significant. A one-month increase in age will lead to a 0.55 increase in test scores. On average, a five-year-old would be expected to score 6.6 points higher than a four-year-old, holding other factors constant. The effect of an additional year of maternal education is slightly less than a one-point increase in test scores. A child whose mother

graduates from college will score 3.16 points higher than a child whose mother merely graduates from high school, holding other factors constant.

Finally, Table 4D shows the full mediation model for each cognitive stimulation factor. Because the coefficient on income is statistically significant in three of the four mediation models, the impact of income on school readiness is not mediated by any of those cognitive stimulation factors (parental engagement, learning materials in the home and outings). In these cases, income continues to have a direct impact on test scores irrespective of cognitive stimulation. The coefficient on income in the mediation model testing the impact of reading behaviors was not statistically significant, indicating that income does not have a direct effect on test scores when reading behaviors are included in the model. Recall that the parameter estimate on the primary variable in each of four equations must be significant in order for reading-related behaviors to be considered a mediator. Because the coefficients were significant for each of the pertinent parameter estimates in the set of regressions for reading behaviors in the home, reading serves to mediate the relationship between income and school readiness. In other words, income works through the mechanism of reading in the home to improve school readiness.

A one standard deviation (0.75) increase in reading in the home will lead to an increase of 1.99 points on test scores. A one-unit increase in the learning materials used at home will lead to an increase of 1.33 on test scores. The effect of using additional learning materials at home does not have the same impact as increasing the amount of time spent reading to children, but it still has a significant effect.

Table 4D: School readiness regressed on income and parental engagement, reading, learning materials or outings

<u>Independent variables</u>	<u>Dependent variable</u>			
	School Readiness (WJ-R Score)			
Intercept	-24.38*	-21.44*	-29.03*	-25.06*
	(5.23)	(5.09)	(5.77)	(5.23)
Income	0.00*	0.00	0.00†	0.00†
	(0.00)	(0.00)	(0.00)	(0.00)
Parental engagement	-0.46	-	-	-
	(0.52)			
Reading	-	2.65*	-	-
		(0.63)		
Learning materials	-	-	1.33*	-
			(0.67)	
Outings	-	-	-	0.82†
				(0.49)
Child's age	0.56*	0.56*	0.55*	0.55*
	(0.07)	(0.07)	(0.07)	(0.07)
Child's sex	0.72	0.66	0.82	0.76
	(0.81)	(0.78)	(0.80)	(0.80)
Attends preschool	1.00	0.72	0.75	1.01
	(0.89)	(0.86)	(0.88)	(0.88)
Maternal education	0.81*	0.58*	0.78*	0.72*
	(0.21)	(0.21)	(0.21)	(0.22)
Maternal race	-4.42*	-2.77*	-3.84*	-3.97*
	(0.89)	(0.88)	(0.86)	(0.85)
R ²	0.36	0.40	0.37	0.37

† p < 0.10, * p < 0.05

Table 5 presents the results from the regressions testing whether cognitive stimulation moderates the relationship between income and school readiness. In order to test this hypothesis, an interaction term between income and cognitive stimulation was added to each regression. The interaction between income and outings was the

only statistically significant one. The frequency with which parents take children on outings moderates the relationship between income and school readiness.

Table 5: School readiness regressed on income and parental engagement, reading, learning materials or outings with an interaction term

<u>Independent variables</u>	<u>Dependent variable</u>			
	School Readiness (WJ-R Score)			
Intercept	-23.71*	-21.43*	-31.15*	-28.06*
	(5.34)	(5.10)	(6.36)	(5.39)
Income	0.00*	0.00	0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Parental engagement	-0.07	-	-	-
	(0.79)			
Reading	-	2.28*	-	-
		(0.78)		
Learning materials	-	-	1.92†	-
			(1.00)	
Outings	-	-	-	2.03*
				(0.75)
Interaction of income and cognitive stimulation	0.00	0.00	0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Child's age	0.55*	0.56*	0.56*	0.54*
	(0.07)	(0.07)	(0.07)	(0.07)
Child's sex	0.72	0.67	0.81	0.82
	(0.81)	(0.78)	(0.80)	(0.80)
Attends preschool	1.03	0.77	0.72	1.03
	(0.89)	(0.86)	(0.88)	(0.87)
Maternal education	0.79*	0.56*	0.76*	0.73*
	(0.22)	(0.21)	(0.21)	(0.22)
Maternal race	-4.41*	-2.75*	-3.80*	-3.87*
	(0.89)	(0.89)	(0.86)	(0.85)
R ²	0.36	0.40	0.37	0.38

† p < 0.10, * p < 0.05

Table 6: School readiness regressed on income at three levels of outings

<u>Independent variable</u>	<u>Dependent variable</u>		
	School Readiness (WJ-R Score)		
	Low outings	Average outings	High outings
Income	0.00006* (0.00)	0.00003* (0.00)	0.000006 (0.00)

† p < 0.10, * p < 0.05

In order to better understand the significant interaction between income and outings, three additional regressions were conducted. Table 6 presents the regression results. These regressions examine the relationship between income and school readiness at three different levels of outings. In each regression the interaction term is composed of income centered on its mean and outings centered either one standard deviation above its mean, at its mean, or one standard deviation below its mean. In this model, it is appropriate to interpret the direct effect of income on school readiness. The first column shows the results when test scores are regressed on income at below average levels of outings. A one dollar increase in income would lead to a 0.00006 increase in test scores; a one hundred thousand dollar increase in income would lead to a six point increase. In the second column, income and outings are both centered so that the mean of the two variables are zero. At the mean of activities outside the home, a one dollar increase in family income would result in a 0.00003 unit increase in test scores. A one hundred thousand dollar increase in income would lead to a three point increase in test scores. The third column shows the results from regressing school

readiness on income at above average levels of outings. In this instance, the impact of income on school readiness is not statistically significant. Therefore, income matters more for children experiencing low frequencies of outings and is not statistically significant for children experiencing high frequencies of activities outside the home.

Figure 4 is a visual representation of the relationship between income and school readiness at three levels of outings: one standard deviation below the mean, at the mean, and one standard deviation above the mean. At high frequencies of outings, increasing income from 10,210 to 77,626 dollars has a small impact on school readiness. At the mean of outings, this dollar increase has a larger effect. The largest effect of income is at low levels of outings where this monetary increase improves test scores by roughly five points. The figure clearly illustrates that income matters most at low levels of outings; at high levels income does not make much of a difference.

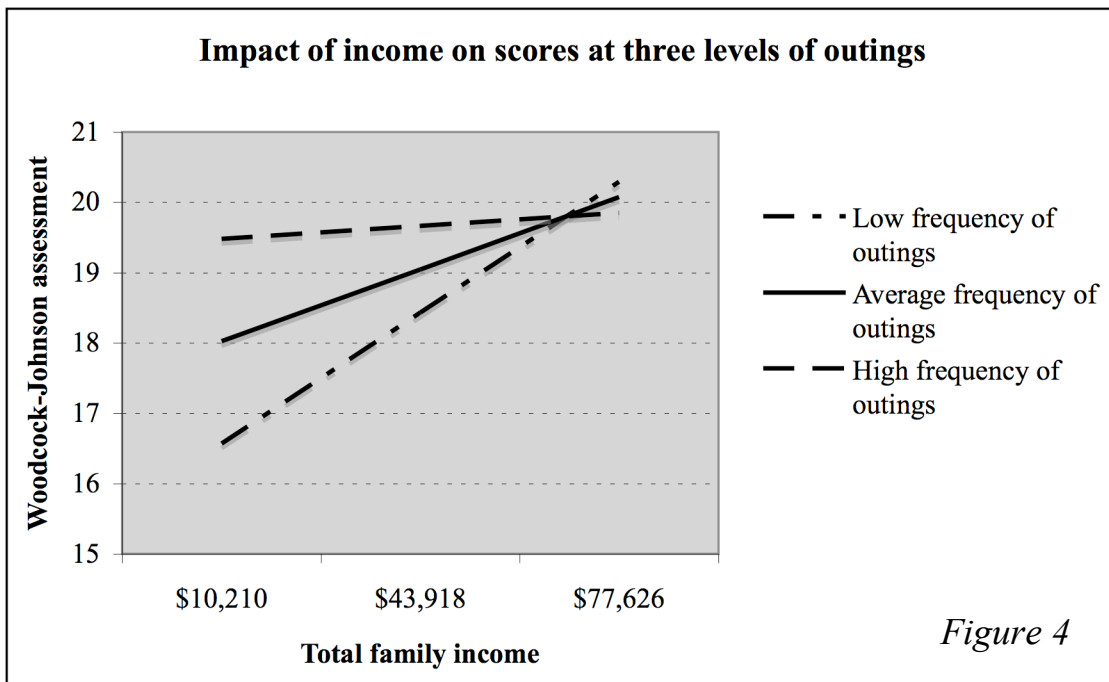


Figure 4

DISCUSSION

Main Findings

The main premise of this study is that different aspects of cognitive stimulation in the home have an impact on the relationship between income and school readiness. Four different components were examined: parental engagement of the child, reading-related behaviors in the home, learning materials used to teach the child, and the frequency of activities outside the home. Through an extensive regression analysis, it was determined that two of these facets of cognitive stimulation have an impact on the relationship between income and school readiness and as such, the study has two main findings.

The first finding is that reading-related behaviors in the home function as a mechanism through which income impacts school readiness. When controlling for reading-related behaviors, income does not have a direct effect on school readiness. Rather, the effect of income operates through reading to improve children's school readiness outcomes. Similarly, Guo and Harris (2000) found that cognitive stimulation in the home as measured in terms of time spent reading together and number of books in the home was the strongest mechanism through which poverty impacted developmental outcomes. This study found that the frequency with which parents read to their children, the number of books the child has, and the monotony of the home environment impact children's school readiness skills. This finding is consistent with the body of literature which found that time spent reading or number of books in the home are strong predictors of children's literacy skills and cognitive outcomes (Bracken &

Fischel, 2008; Yeung, Linver, & Brooks-Gunn, 2002). These three elements of early development provide opportunities for intervention that will have a positive impact on school readiness.

The second main finding is that the impact of income on school readiness varies depending on the frequency with which children are taken on outings or to museums. Children who are taken on outings more frequently are better prepared for school than children who are taken on outings less frequently and the impact of frequent outings makes a bigger difference for low-income children. In other words, outings serves as a protective factor for children in low-income households. Other studies that have examined cognitive stimulation as a protective factor tended to focus on measures of stimulation inside the home rather than cultural activities outside the home. This study's finding that the frequency of outings is a buffer against poverty contributes to the existing body of research on how stimulation in the home can improve child outcomes. Increasing the frequency of activities outside the home would be a good starting point for a targeted intervention since these outings benefit low-income children more than high-income children.

Parental engagement and the type of learning materials used in the home were not found to have any impact on the relationship between income and school readiness. There are a number of possible explanations for this result. The first is that the sample size may not have been large enough to achieve statistical significance in the regression models. Performing a similar analysis with a larger data set would be one way to test whether or not this was the case. The second potential explanation is that parental

engagement and learning materials did not accurately measure cognitive stimulation as well as reading-related behaviors and outings. Parental engagement was measured based on the observations of a researcher in the home. It is possible that parents modified their parenting behaviors because they were in the presence of a researcher. While reading-related behaviors and outings measured the frequency with which parents engaged children in these activities, learning materials in the home was a composite of indicator variables stating whether or not these materials were used, not how frequently they were used. Because of the lack of information on frequency of use, it is possible that there was not enough variation in these variables to impact the relationship between income and school readiness.

Another possible explanation for why parental engagement and learning materials in the home did not impact the relationship between income and school readiness has less to do with those factors and more to do with the powerful influence of income. This study found that income continues to have a direct effect on school readiness even when controlling for parental engagement and learning materials in the home. Specifically, the analyses indicated that the more money a family earns, the better their children perform on school readiness tests, even when controlling for a variety of other factors. Although the effect of income is relatively small (and rounds to zero in most of the tables presented), it is highly statistically significant throughout most of the analysis.

The control variables themselves also play an important role in this study. Throughout the analysis, maternal education and maternal race continue to have a

strong and highly statistically significant impact on children's test scores. This result is consistent with several studies that found socioeconomic-related factors such as maternal education and race or ethnicity to be the strongest predictors of developmental outcomes (Forget-Dubois et al, 2009; Yeung, Linver, & Brooks-Gunn, 2002; Raver, Gershoff, & Aber, 2007; Peisner-Feinberg et al, 2001).

Policy Implications

Given that the current climate for education policy fails to account for early childhood as a factor in student performance, it is critical for research to focus on determining which early childhood factors offer opportunities for policy intervention at a time when children are most vulnerable to traumatic events such as living in poverty (Duncan & Brooks-Gunn, 2000). As federal programs are shifting away from cash transfers to low-income families and towards in-kind programs such as Food Stamps, Medicaid, childcare subsidies and universal preschool (see Currie, 2006), it is important for research to focus on the specific types of cognitive stimulation that will improve child outcomes rather than increasing family income as a means to that end. The findings of this study suggest two strong implications for public policy: enhance the reading experiences of young children and increase the frequency with which they are taken on excursions outside of the home including cultural experiences such as museum visits.

While this study does not attempt to quantify the impact of any particular program or policy, generally speaking, improving children's environments with respect to these two aspects of cognitive stimulation should greatly improve their outcomes on

school readiness assessments, particularly for children in low-income households. One existing policy solution is the Harlem Children's Zone project. The mission of the project is to provide a safety net of social programs for young children. By intervening early, the program has had widespread success. Some of the early interventions encourage reading and teach parents how to engage their children through the course of everyday activities such as trips to the grocery store. The results achieved by Harlem Children's Zone interventions echo the findings of this study. When parents are taught to capitalize on learning opportunities in commonplace activities, children's outcomes improve. Through parenting classes and preschool attendance, children in Harlem enter school with test scores similar to their middle-class counterparts. President Obama is making good on his campaign promise to expand this program to twenty cities nationwide, giving these "Promise Neighborhoods" the opportunity to replicate the success of Harlem Children's Zone.

Additional possibilities for reaching these policy goals are infinite. Ensuring that public libraries receive adequate funding for outreach to families with young children is one potential intervention to highlight the importance of early reading experiences. Programs that supply children's books to low-income families are another option. Encouraging parents to take their children with them on household errands or to plan trips to the zoo or a local museum are other potential solutions. Parenting interventions that teach parents how to maximize their children's cognitive experiences in all of these activities is an important option. There is a wide range of opportunities

for improving the cognitive stimulation young children receive, but any of these programs should be evaluated rigorously before being enacted on a large scale.

Limitations

The main limitation of this study is the small sample size of children studied (as discussed in the data and methods section). With a larger sample and more variation, it is possible that other findings would have been statistically significant. It has long been hypothesized that socioeconomic status and cognitive stimulation interact in some way to influence school readiness. This study takes existing research a step further by identifying specific aspects of cognitive stimulation and allowing them to interact with income. While past studies have focused on similar research questions, this study narrows the definition of cognitive stimulation and determines two concrete areas for potential interventions. Further research should be conducted in this area with a larger sample of young children to determine other aspects of cognitive stimulation both inside and outside the home that may mediate or moderate the relationship between income and school readiness. Determining the exact nature of cognitive stimulation's impact on school readiness will help establish a comprehensive set of policy implications that could improve the outcomes of all children.

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