Parental Time or Money: What Matters More for Children's School Success?

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ABSTRACT

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Previous research suggests that the home environment explains up to one half of the association between poverty and low cognitive skills. Building on this research, this study provides a more nuanced analysis of the family processes through which socioeconomic status (SES) is associated with children's academic outcomes by: 1) including maternal education and family income as predictors of parenting and children's academic skills, and 2) separating the home environment into parental investments of time and materials. Data are drawn from the Early Childhood Longitudinal Study, Kindergarten Cohort (ECLS-K; n=20,582). Structural equation modeling is used to examine the extent to which these parental investments mediate associations between markers of SES and children's reading and math achievement. Models also test for moderation of the productivity of parental investments. Results indicate that SES is associated with children's school success via a pathway in which maternal education influences the extent to which parents invest in learning materials for their children, and these learning materials in turn foster development of early literacy and numeracy skills. Parental time has an unexpected negative association with children's achievement, which is explained in supplemental models. Family income and maternal education also moderate the productivity of parental investments, such that the negative effect of time and the positive effect of materials are magnified in more advantaged households. Findings suggest that the following interventions may be worthwhile policy priorities: 1) support for low-SES mothers' pursuit of further education, and/or 2) provision of learning materials for children in disadvantaged families.

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Dedication

I dedicate this dissertation to low-income parents who strive to provide the best possible upbringing for their children, despite their limited means.

CHAPTER I: INTRODUCTION

Overview

Among early childhood educators, it is often said that the parent is a child's first teacher, and as James Coleman noted years ago "…schools, of whatever quality, are more effective for children from strong family backgrounds than for children from weak ones" (1987, p. 35). In keeping with the knowledge that family experiences are critical determinants of children's early school success, this dissertation examines the family processes through which socioeconomic status influences children's school performance. Drawing on theories from economics, sociology, and developmental psychology, this dissertation brings an interdisciplinary perspective to research on the family processes that foster children's educational success.

Previous studies demonstrate that low family income, one aspect of low social status, is associated with weaker cognitive skills in early childhood (Duncan, Brooks Gunn, & Klebanov, 1994; Korenman, Miller, & Sjaastad, 1995; Smith, Brooks-Gunn, & Klebanov, 1997). Furthermore, a recent meta-analysis suggests that family socioeconomic status is one of the strongest correlates of school success, with an effect size of about .30 (Sirin, 2005). Children from lower SES families enter kindergarten with substantially lower reading and math skills than children from high SES families (Lee & Burkam, 2002) and initial disparities tend to grow into more sizeable achievement gaps over time (Entwisle & Alexander, 1993).

The goal of this dissertation is to address an ongoing debate about the reasons that children from disadvantaged families do poorly. Some authors believe that poverty itself is the root cause of disadvantaged children's relatively poor performance on measures of cognitive skills and academic achievement, because low-income parents have fewer resources to invest their children (Becker, 1981; Becker & Tomes, 1986; Foster, 2002; Haveman & Wolfe, 1994,

1995). Others believe that parenting cultures and beliefs - which are associated with poverty but not necessarily malleable - are more to blame (Lareau, 2003; Lewis, 1966, 1998; Mayer, 1997). Due to uncertainty about the chain of causation and the difficulty of measuring culture itself, this debate may never be settled. Nevertheless, this dissertation attempts to inform this dialogue.

Study Significance

Early research suggests that the home environment, broadly construed, explains about one third to one half of the association between poverty and low cognitive skills (Brooks-Gunn & Duncan, 1997; Korenman et al., 1995). The home environment as measured in these studies is generally thought to consist of the support and stimulation that a child receives from his/her parents, as well as the physical environment. Several studies have examined the mediating role of home environment more closely and found that lower income parents invest in fewer cognitively stimulating materials and experiences for their children, but these studies typically fail to distinguish time investments from material investments (e.g. Guo and Harris, 2000; Linver, Brooks-Gunn, & Kohen, 2002; Yeung, Linver, and Brooks-Gunn, 2002). The majority of these studies have also given little consideration to the role that parental education may play in shaping the home environment and influencing children's outcomes.

The mediation model I study improves upon previous research in two ways. First, I include income *and* maternal education as predictors of parental investments and children's outcomes. In keeping with some previous studies of parenting (e.g. Bonke & Esping-Andersen, 2009; Guryan, Hurst, & Kearney, 2008), I consider maternal education to be a marker of parenting preferences or "culture." Therefore, comparing the influence of income and maternal education allows me to explore the extent to which low income matters for children's development, as compared to parenting culture. Second, this study contributes to the literature

by taking a more detailed look at children's home environment. Separating parental time from the provision of learning materials in the home allows me to examine the extent to which the things that money can buy matter for children's development.

Research Questions and Hypotheses

This dissertation examines the extent to which parental investments mediate the associations between different components of socioeconomic status and children's learning. I employ structural equation modeling with data from the Early Childhood Longitudinal Study – Kindergarten Cohort. As described below, I test each portion of the model, from markers of SES to parental investments, and from parental investments to children's academic skills, to determine what matters most for children's early reading and math achievement. I also examine whether family income or maternal education moderate the benefits of parental investments. My research questions, hypotheses, and a brief rationale for each hypothesis are described below. A diagram of the dissertation logic model is displayed in Figure 1. A more detailed review of the empirical research supporting each hypothesis is provided in Chapter Two.

Research Question One

Question 1: To what extent do parental investments of time and materials mediate the associations between components of socioeconomic status and children's school performance?

Hypothesis 1.1: Time investments mediate more of the effect of maternal education than material investments.

Hypothesis 1.2: Material investments mediate more of the effect of family income than time investments.

My first research question examines the extent to which parental investments mediate the associations between various components of socioeconomic status and children's achievement. Results for this question will illuminate the pathway that is most important in explaining the association between low socioeconomic status and poor school performance. There are four potential mediation pathways that I will examine:

1) parental education→time investments→ children's achievement,

2) parental education→material investments→children's achievement,

3) income→time investments→children's achievement, and

4) income→material investments→children's achievement.

I expect to find that the effect of parental education on children's academic skills is transmitted primarily via time investments. On the other hand, I expect to find that material investments are the primary mediator of the association between family income and children's reading and mathematics achievement. Studies that examine mediation pathways from socioeconomic status to children's cognitive or academic outcomes provide little evidence to support or refute these hypotheses. As discussed in the literature review below, previous mediation studies typically include only income as an independent variable, and they combine time and material investments in a single home environment measure (e.g. Gershoff, Aber, Raver, & Lennon, 2007; Linver et al., 2002).

Research Question Two

Question 2: Which is the more important determinant of investments in children – maternal education or income?

Hypothesis 2.1 Maternal education is the more important determinant of time investments.

Hypothesis 2.2: Maternal education is the more important determinant of material investments.

For research question two, my first hypothesis predicts that parental education is a more important determinant of time investments than income. This hypothesis is informed by previous research which has found that parental education is one of the primary determinants of the amount of time that parents spend interacting with children (Guryan et al., 2008; Sayer, Gauthier, and Furstenberg, 2004). Mothers with higher levels of education often reduce the amount of time they spend on other activities – including household chores, leisure, and sleep – to spend more time with their children. They also spend more time during which the child is their primary focus, rather than simply having the child in their presence while they do other activities (Guryan et al., 2008). The second hypothesis for research question two predicts that maternal education will also be a stronger predictor of material investments. Empirical research demonstrates that higher income families do spend more on materials to support their children's education, but the amount that parents spend tends to be more strongly related to parents' level of education (Mauldin, Mimura, & Lino, 2001). As discussed in the literature review below, some empirical studies treat parental education as a proxy variable for parental preferences, suggesting that parents with higher levels of education place more value on investments that matter for children's educational outcomes (e.g. Bonke & Esping-Andersen, 2009; Guryan et al., 2008).

Research Question Three

Question 3: All else equal, do time or material investments matter more for children's academic performance?

Hypothesis 3.1: Time investments are more strongly associated with children's reading skills than material investments in a model that conditions on both types of investments.

Hypothesis 3.2: Time investments are more strongly associated with children's math skills than material investments in a model that conditions on both types of investments.

The third research question asks whether the things that money can buy are more strongly associated with children's academic achievement, or if the time that parents invest in their children is more important. I expect to find that time investments are more strongly associated with children's reading and math skills than material investments. Several studies point to the importance of the time that parents spend with their children (Hsin, 2008; Price, 2007; Würtz, 2007). For example, Hsin (2008) finds that the time parents spend on cognitively stimulating activities with preschool-age children has a positive influence on children's verbal skills five years later. One economist's effort to place a value on parental time suggests that time spent reading to children is worth $192 per hour (Price, 2007).

Research Question Four

Question 4: Does maternal education moderate the benefit of parental investments?

Hypothesis 4.1: Parental investments of time are less beneficial in families headed by less educated parents.

Hypothesis 4.2: Parental investments of materials are less beneficial in families headed by less educated parents.

Research question four investigates whether parents' level of education moderates the productivity of parental investments. I hypothesize that parental investments will be less productive in families headed by less educated parents. There are several reasons parental education could moderate the association between time and materials investments and

children's academic skills. Less educated parents may provide their children with less language stimulation (Hart & Risley, 1995; Hoff, 2003; Hsin, 2008; Walker, Greenwood, Hart, & Carta, 1994). As described in the review of empirical research below, they may have different parenting behaviors and expectations for their children (Davis-Kean, 2005; Lareau, 2003). More educated parents are more sensitive and responsive with their children (Lugo-Gil & Tamis-LeMonda, 2008; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004), and these differences have been tied to children's cognitive development (Bornstein & Tamis-LeMonda, 1989; Ryan, Martin, & Brooks-Gunn, 2006; Tamis-LeMonda et al., 2004).

Research Question Five

Question 5: Does family income moderate the benefit of parental investments?

Hypothesis 5.1: Time investments are more beneficial among higher income families.

Hypothesis 5.2: Material investments are more beneficial among higher income families.

I expect to find a cumulative advantage such that children from higher income families are benefit more from time with parents and learning materials at home, such as books, CDs, and a home computer. There are a number of reasons low-income children may benefit less from time with parents. Poverty is associated with a variety of risk factors that are negatively associated with children's cognitive skills, include residence in neighborhoods with high concentrations of disadvantaged families (Klebanov, Brooks-Gunn, McCarton, & McCormick, 1998; Sampson, Sharkey, & Raudenbush, 2008), stress and poor mental health among parents (Cogill, Caplan, Alexandra, Robson, & Kumar, 1986; Gelfand & Teti, 1990; Leventhal & Brook-Gunn, 2003; Lovejoy, Graczyk, O'Hare, & Neuman, 2000;), and parenting practices that place less emphasis on developing children's skills (Hoff-Ginsberg & Tardif, 2002; Lareau, 2003). As such, low-income parents' interactions with children occurs under less optimal conditions and

are likely to be less stimulating. Consistent with the cumulative advantage hypothesis (Walberg & Tsai, 1983), I also expect that higher income children are better positioned to take advantage of learning materials in the home.

CHAPTER II: LITERATURE REVIEW

This chapter is comprised of two sections. The first section provides an overview of two theories that inform research on parental investments and child outcomes: parental investment and culture theory. The second section provides a detailed review of the empirical research that undergirds my hypotheses, including a discussion of the home environment as a mediator of SES effects, family income and parental education as determinants of investments in children, and the relative importance of time and material investments to children's development. I also discuss the reasons why family income and parental education may moderate the productivity of parental investments.

Theoretical Perspectives on Family Processes that Matter for Child Achievement

Parental Investment Theory

The origins of the parental investment theory can be traced back to Malthusian population theory and the Darwinian theory of natural selection (Becker, 1981). Parents must confront a trade-off between feeding and nurturing their offspring and their own survival, according to evolutionary biology. Similarly, the parental investment theory proposes that parents must make choices about investing resources in their children's development versus using family income for their own consumption (Becker, 1981). This theory is grounded in neoclassical micro-economics, which suggests that people seek to increase their subjective sense of well-being, also known as "utility," through their consumption choices. This theory also assumes each person is a rational actor who makes consumption decisions based on perfect information about the costs and benefits of their choices. In essence, the family investment model is a model of household production in which family the can be considered a "little factory" (Bergstrom, 1997).

According to Gary Becker (1981), the father of the parental investment theory, investments in children include the time parents spend fostering their children's development and the goods and services they purchase for them. Haveman and Wolfe (1995) expand on this definition:

> Families make decisions concerning household size and structure, consumption levels and saving, work and leisure, and the allocation of income and time. Even more basically, parents choose the sort of monitoring, disciplinary, nurturing, and expectational environment in which their children are raised. Taken together these choices determine the level of "parental investment in children. (p. 1837)

Indeed, children are quite costly in developed countries during this era. The choice to have children is essentially a form of consumption, because children rarely contribute labor to maintain a family farm or business (Becker, 1981; Foster, 2002). As such, parents invest substantial resources in their children with the most important pay-off being increased utility. According to consumer expenditure data, the median family will spend approximately $286,000 raising a child born in 2009 (Lino, 2010). Similarly, parents spend an average of 31 waking hours each week with their children (Sandberg & Hofferth, 2001).

According to the parental investment theory, "endowments" are also important influences on children's outcomes. According to Becker (1981),

> Children are assumed to receive endowments of capital that are determined by the reputation and "connections" of their families; the contribution of the genetic constitutions of parents to the ability, race, and other characteristics of children; and the learning, skills, and goals acquired through belonging to a particular family culture. (p. 117)

Economists are generally vague about the processes by which endowments influence outcomes (Foster, 2002), but they do generally agree that accounting for them is important in order to arrive at an accurate estimate of the relations between income, parental investments, and children's outcomes. Studies of family contexts and child outcomes with large, longitudinal data sets collected by the federal government often account for endowments by controlling for mother's scores on cognitive skills tests. For example, studies using data from the Panel Study of Income Dynamics control for mother's scores on the Armed Forces Qualifying Test (e.g. Mayer, 1997).

Several factors influence the extent to which parents invest resources in their children, including the household budget and parents' preferences. The household budget is constrained by parents' skills and abilities and by the number of hours in the day (Duncan & Magnuson, 2002; Foster, 2002; Haveman & Wolfe, 1995). As Foster (2002) explains, "Parents who spend more time with their children have less time to spend at work or in their leisure… families must also balance investment of their own time with the use of purchased inputs." (p. 1907). As parents confront these trade-offs, their choices are guided by their preferences, more specifically, the extent to which they value investments in their children over their own consumption and leisure. As discussed in the literature review below, some empirical studies treat parental education as a proxy variable for parental preferences, suggesting that parents with higher levels of education place more value on investments that matter for children's educational outcomes (e.g. Bonke & Esping-Andersen, 2009; Guryan et al., 2008).

Investments are also determined by prices and rates of return, which vary from family to family (Becker, 1981; Haveman & Wolfe, 1995). For example, mothers with more education earn higher wages, therefore their foregone wages from staying home with their children are

greater (Becker, 1981; Foster, 2002). Rates of return are determined in part by children's endowments. Parents are thought to invest more in their children who have greater ability, because these investments are more are more likely to be productive (Becker, 1981; Becker & Tomes, 1986). In fact, it has been suggested that parents invest more in their more able children because they hope those children will care for them in their old age (Becker & Tomes, 1986). Rates of return are also determined by society. For example, Becker (1981) suggests that black families invest less in their children because prejudice and discrimination reduce the return on investments in education.

Culture Theory

Culture theories have been used by both poverty and education researchers. The "culture of poverty" theory originated with Oscar Lewis, an anthropologist who conducted ethnographic studies in slums in Mexico and Puerto Rico in the 1960s (Lewis, 1966, 1998). Lewis suggested over 50 adjectives to describe this culture which can be summarized into five essential traits: 1) lack of participation in the wider world, including politics, the labor movement, or other social organizations, 2) aberrant values and moral beliefs, 3) community disorganization, 4) unstable families characterized by common-law marriage and female-headed households, and 5) personal character weaknesses including a "weak ego structure" and an inability to delay gratification (Lewis, 1966, 1998; Valentine, 1971). In her 1997 book titled, *What Money Can't Buy*, Susan Mayer extends Lewis' work by suggesting that parental "preferences," rather than income, are a primary determinant of parents' investments in their children. She says that the effect of income on children's development has overstated in previous research, because low family income is correlated with other parental characteristics, such as intelligence, attitudes, and work ethic, which determine children's outcomes (Mayer, 1997).

The culture hypothesis in education originated with Bourdieu's (2006) theory of "cultural and social reproduction." Bourdieu (2006) notes that individuals of lower educational and occupational status are less likely to buy and read books, and less likely to visit cultural institutions such as theaters and museums. Because schools place great value on this type of "cultural capital," children from lower SES families are at a disadvantage when they enter school (Bourdieu, 2006). In fact, Bourdieu and Passerson (1990) suggest that schools reinforce social class hierarchies by valuing that which is of the higher classes. As they say, "The essential function of every educational system is to inculcate its students in the cultural arbitrary, thus reproducing a culture arbitrary (cultural reproduction) and contributing to the reproduction of the relations between the groups or classes (social reproduction)" (Bourdieu & Passerson, 1990, p. 44). One of the central concepts in this theory is that of "habitus": an individual's internal sense of cultural meaning which defines what is comfortable and familiar (Bourdieu & Passerson, 1990; Lareau, 2003). To the extent that a person's habitus matches the culture of the environment in which he is operating, he will be at an advantage (Lee & Bowen, 2006).

Drawing on Bourdieu's theory, Lareau (2000, 2003) conducted ethnographic work with elementary school children and their families. Lareau (2003) suggests that middle-class parents engage in a process of "concerted cultivation" in which they deliberately spur their children's academic development by enrolling them in numerous extracurricular activities, participating in activities in their children's schools, and providing extensive verbal and cognitive stimulation at home. In contrast, working-class and poor parents allow for the "accomplishment of natural growth" which involves more free time and less active intervention by parents (Lareau, 2003). Lareau (2000, 2003) also notes that working-class parents are less comfortable interacting with

school officials to advocate on their children's behalf, e.g. for access to gifted and talented classes.

Can culture be changed by changing its antecedents? Most culture theorists imply that culture is not very amenable to change. According to Lewis (1998), "slum children" habituate to the culture of poverty by the age of six or seven and are unable to take advantage of positive changes in life circumstances thereafter. Mayer (1997) also implies that parental tastes and values are not likely to change in response to a change in income. Interpreting Bourdieu, Lareau (2003) says,

> He would never suggest, for example, that more parents could improve their children's school success by adopting particular practices. Instead, he would point out that the number of elite slots in society is limited. Thus, any effort to spread an elite practice to all members of the society would result in the practice being devalued and replaced by another sorting mechanism. (p. 277)

However, while Bourdieau (1990) views cultural capital as being inherited, Attewell and Lavin (2007) suggest it can be acquired. They suggest three pathways through which a mother's pursuit of a college education can help her children acquire cultural capital. First, mothers who attend college may develop an interest in literature, history, and the arts. Second, college-going mothers may learn about and expose their children to various cultural activities. Third, women who attain a college education may marry men of higher socioeconomic status. In other words, the process of pursuing a college education allows disadvantaged mothers to obtain cultural capital, and may lead them to parent in ways that translate into higher cultural capital for their children. This cultural capital in turn fosters children's academic success (Attewell & Lavin, 2007).

Review of Empirical Research

In this section I review empirical research that provides the basis for my hypotheses. This section is structured to correspond to my research questions. The first section discusses the extent to which aspects of the home environment, which I refer to as "parental investments," mediate the association between socioeconomic disadvantage and children's cognitive skills. This section corresponds to my first research question. The second section examines determinants of investments in children and supports my hypotheses for research question two. The third section documents what is known about the association between various parental investments and children's cognitive and academic skills. In the subsequent sections, which correspond to the fourth and fifth research questions, I discuss the reasons that maternal education and family income may moderate the productivity of time and material investments.

Research for Question One: The Home Environment as a Mediator

Early research suggests that the home environment, broadly construed, explains about one third to one half of the association between poverty and low cognitive skills (Brooks-Gunn & Duncan, 1997; Korenman et al., 1995). The home environment as measured in these studies is generally thought to consist of the support and stimulation that a child receives from his/her parents, as well as the physical environment. Several studies have examined the mediating role of home environment more closely and found that lower SES parents invest in fewer cognitively stimulating materials and experiences for their children, but these studies typically fail to distinguish time investments from material investments. In one of the first papers to explore the parental investment theory empirically, Guo and Harris (2000) used data from the National Longitudinal Study of Youth to test potential mediators of the association between poverty and children's cognitive skills. They found that poverty did not have a direct effect on children's

development after accounting for a series of potential mediators associated with either financial capital or parenting. In their structural equation model, cognitive stimulation, physical environment in the home, and parenting style are the three most powerful mediators of poverty's association with children's intellectual development, with cognitive stimulation being the most important. They define cognitive stimulation as consisting of items that money can buy, such as books, record, and tapes, *and* experiences that parents must take the time to provide, such as reading to children or taking them to a museum.

Linver et al. (2002) and Yeung et al. (2002) extended this research by examining parental investment and family stress as two possible mediation pathways that would explain the association between family income and children's cognitive skills. In keeping with their hypothesis, Linver et al. (2002) found that parental investment, as measured by the home environment, did partially mediate the association between income and cognitive skills, but constructs from the family stress model, namely maternal emotional distress and parenting practices, did not mediate this relation. Parental investment was measured using several subscales of the HOME (Home Observation for Measurement of the Environment) instrument, which includes items related to both time parents spend with children and materials they supply. Measures of time included the amount of language stimulation the mother provides for the child, how often the family eats meals together, and experiences the parent provides by taking the child on outings. Material investments in the child are primarily measured through the number of toys and books.

Yeung et al. (2002) also found support for the hypothesis that constructs from the investment theory explained the relation between family income and children's cognitive skills. Cognitively stimulating materials and experiences were the primary mediators of the association

between income and children's early literacy skills, and the physical environment in the home was the most important mediator for early math skills. Yeung et al. (2002) do note the distinction between time investments and material investments in their discussion. However, they do not always treat these variables as items that can be viewed separately. For example, one pathway they test is income→cognitively stimulating materials→activities with child→cognitive test scores. Therefore, they treat time spent on activities as a function of materials, but they do not allow income to relate directly to time spent on activities. This approach does not allow for a full exploration of the extent to which time investments and material investments individually mediate the relation between income and child outcomes.

Finally, one of the more recent empirical papers to explore theories about poverty and child development uses ECLS-K and incorporates the construct of material hardship (Gershoff et al., 2007). Gershoff and her coauthors (2007) hypothesized that much of the association between income and child development would be mediated by material hardship. In fact, the path from income to parental investment was slightly reduced after including material hardship in the model, suggesting that material hardship partially explains why families with low income invest less in their children. Unfortunately, Gershoff et al. (2007) included measures of materials *and* time in their parental investment construct, such as providing cognitively stimulating materials, enrolling children in extracurricular activities, taking them on outings, and participating in school events. This approach to measuring parental investments does not sufficiently differentiate between investments of time and materials.

These mediation studies provide limited information on which to base my mediation hypotheses, because they typically focus on income as an independent variable. Similarly, they treat the quality of the home environment as a single measure of parental investment. I address

this weakness in the previous literature, i.e. the failure to differentiate between time and material investments, and include parental education as an additional marker of socio-economic status in my statistical models. To my knowledge, only one previous study (Davis-Kean, 2005) has included parental education as an additional independent variable in a mediation study of this sort. This study was cross-sectional and focused on parents' educational expectations for their children, testing the equivalence of models across racial and ethnic groups.

Research for Question Two: Determinants of Investments in Children

As discussed above, parental investments may be represented by the time parents spend with their children *and* the goods and services they purchase for their children. In this section, I discuss associations between parental education, family income and these two types of investments. The empirical research reviewed below indicates that increasing levels of parental education and family income are both associated with greater investments in children, but parental education seems to be the more important determinant of both time and material investments.

Determinants of time spent with children. When choosing how much time to spend with children, families face different opportunity costs because potential labor market earnings and child care options vary. For example, women with higher levels of education face higher forgone wages from staying home with their children. Some parents may have the option of relying on family members to provide free or low-cost care, while others must purchase market-rate child care. Empirical research on inter-temporal time preference suggests that rates of time preference for low-income individuals are three to five percentage points higher than for high-income individuals (Lawrance, 1991). This research suggests that low-income parents may be less future-oriented when making decisions about how much time to spend with children**.**

Time-use studies also provide some insight into the relation between parental education, family income, and time spent with children. Using data from the Multinational Time Use Study, Sayer et al.(2004) find that highly educated mothers spend an average of 45-50 more minutes per day with their children that mothers with low levels of education in Canada, Italy, and Norway. These associations between maternal education and time spent with children persisted in multivariate models that accounted for parental employment and other background variables, leading Sayer et al. (2004) to conclude that highly educated parents place more value on time with children. Guryan et al. (2008) replicate these findings with the American Time Use Survey, however they also examine income as a potential determinant of time use. They find that higher education and higher income are both associated with greater time spent with children, despite the higher opportunity costs for parents with these demographic characteristics. Highly educated parents also spend more time with their children during which the child is their primary focus, rather than simply having the child in their presence while they do other activities.

In an attempt to understand these findings, Guryan and colleagues (2008) investigated whether parents consider time with their children to be a household production task or a leisure activity. Examining all of the different ways that parents spend their time revealed that the high-education/high-income parents who spend more time with their children spend less time on household production tasks, such as meal preparation and chores, *and* less time on leisure. This finding suggests that child care time is different from both household and leisure tasks.

Guryan et al. (2008) suggest several reasons that higher parental education and income are associated with greater investments of time. First, parents with more education and income may view time spent with children to be more of a luxury good, rather than a form of household

production or leisure. Second, these parents may place a higher value on fostering their children's development than on their own leisure. Both of these hypotheses advanced by Guryan et al. (2008) suggest that parental "preferences" or parenting culture explain why more advantaged parents spend more time with their children. Guryan et al. (2008) say another reason parents with more education and income spend more time with children is that the rate of return on time investments may be higher in these families, because time inputs by these parents may be more productive. I explicitly test this hypothesis in the proposed study, in research questions four and five.

Using time-use data from Denmark, Bonke and Esping-Andersen (2009) conducted a similar study to examine how parents' wage rates and education levels relate to time spent caring for children. They find that wage rates are unrelated to the time mothers and fathers spend with children. Instead, they find that fathers with more education spend more time with their children. They also discover an interaction effect in which families with two highly educated parents spend substantially more time caring for their children than families with one highly educated parent. Bonke and Esping-Andersen (2009) interpret this finding as evidence that parents' preferences are a more important determinant of the time spent with children than parents' labor market opportunities. In keeping with these time-use studies, I expect to find that parental education is a more important determinant of time investments than income.

Determinants of the provision of materials for children. Consumer expenditure data indicate that expenditures on children increase as family income increases (Lino, 2010). In 2009, two-parent two-child families in the lowest income tertile spent an estimated $8,330 to $9,450 on their youngest child, while families in the middle income tertile spent $11,650 to $13,530, and families in the highest income tertile spent $19,380 to $23,180. These data indicate

that families earning over $98,120 spent nearly twice as much on their children as families earning less than $56,670. However, expenditures on children represent a decreasing percentage of the family budget as income increases. These estimated expenditures represent approximately 25% of pretax income for the lowest income families, 16% for families in the middle tertile, and 12% for families in the highest tertile (Lino, 2010).[1]

Mayer (1997) argues that parents' preferences are more important determinants of parental investments and child outcomes than income. She suggests that material hardships that are most likely to influence children's development – such as inadequate food, housing, and medical care – are not as prevalent among low-income families as might be expected. Her analyses of consumer expenditure data indicate that the average low income household typically spends more on food than the USDA's minimum food budget.[2] Comparing the proportion of low- versus middle-income children who experience serious housing problems, she generally finds small differences. Furthermore, Mayer's research suggests that poor children are as likely to see a doctor as middle-income children, after controlling for children's health status. She concludes,

> Because the activities and possessions [that foster children's development]… are inexpensive and not strongly related to income, they mainly reflect parents' tastes and values. Books appear to benefit children because parents who buy a lot of books are likely to read to their children. Parents who do not buy books for their children are probably not likely to read to them even if the books are free, and

[1] Of course, given that our tax system is somewhat regressive, these differences would be smaller if we examined expenditures as a proportion of post-tax income (Lino, 2010).
[2] This food budget serves as the basis for the U.S. Federal Poverty Guidelines. However, it should be noted that many poverty scholars believe this food budget is an outdated metric that should not be used to judge family well-being (Folbre, 2008).

> parents who do not take their children on outings may be less likely to spend time with them in other ways. (Mayer, 1997, p. 113)

In fact, Mayer (1997) suggests that as family income increases, parents spend more on luxuries that do little to foster children's development, such as a second car, a larger house, or more restaurant meals.

Other empirical research supports Mayer's contention that parental preferences are an important determinant of families' spending on children. Mauldin et al., (2001) examine parents' decisions about *whether* and *how much* to spend on their child's education using consumer expenditure data for items such as private school tuition and books and supplies. They find that family income and parental education are both significantly related to parents' decision *whether* to spend money on children's education. However, parental education had a much greater effect on *how much* parents spent. Holding family income constant, parents with a bachelor's degree or more spend about twice as much on private school tuition, books, and other supplies for their children than parents with a high school diploma. In contrast, an additional $10,000 in income has a net effect of just +9% on expenditures (Mauldin et al., 2001).

As such, maternal education may have a greater influence than income on the extent to which parents prioritize investments in children. I posit that parental education shapes parents' preferences for material investments in their children. A handful of recent empirical studies do, in fact, treat parental education as a proxy variable for parental preferences, suggesting that parents with higher levels of education place more value on investments that matter for children's educational outcomes (e.g. Bonke & Esping-Andersen, 2009; Guryan et al., 2008). Therefore, I hypothesize that parental education will be more strongly related to material investments that income in my statistical models.

Research for Question Three: Parental Investments and Child Cognitive Outcomes

Many studies examining the influence of the home environment on children's development fail to distinguish between parental investments that parents must take the time to provide and material investments that parents may purchase. In the section below, I discuss research that may help disentangle these aspects of the home environment. I discuss time-use studies, as well as research on the value of specific types of time investments. I also review research on the importance of material investments, such as learning materials in the home. I conclude by summarizing research that compares the relative value of time and material investments to support my prediction that time investments will have a stronger, positive association with children's reading and math skills than material investments.

Time investments and child cognitive skills. Research on the importance of parental time inputs for children's cognitive skills provide mixed evidence that parental time matters. For example, two studies using data from the NICHD Study of Early Child Care and Development suggest that the time parents spend with children in early childhood does not have a significant association with child cognitive outcomes. Booth, Clarke-Stewart, Vandell, McCartney, and Owen (2002) compared time use of mothers who used full-time child care with the time use of mothers who kept their children at home during the first six months after birth. They found that mothers who placed their children in full-time child care spent about 12 less hours a week with their children, but these differences in time did not relate to children's cognitive skills or vocabulary at 15 months. Huston and Aronson (2005) extended this research with later waves of data and found that maternal time was unrelated to cognitive skills at age two or vocabulary at age three, suggesting the initial null findings were not driven by the difficulty of reliably assessing children's cognitive skills in infancy. Both studies examined total time with children

in addition to separating time spent on social interaction versus instrumental care. One would expect time in social interaction, in particular, to predict cognitive and language skills, but it did not in multivariate regression models that controlled for family demographic characteristics. Of course, the impact of less parental time depends on where children are and what they do when they are not with their parents (Würtz, 2007).

More recently, Hsin (2008) examined the importance of time use among preschool and early school aged children. She separates the time parents spend with preschoolers on developmental activities, such as playing, reading, or talking, versus time spent on other activities, such as watching television and shopping. Findings suggest that the time parents spend on more cognitively stimulating activities has a positive influence on children's' verbal skills five years later, providing that the parents themselves have strong verbal skills. The finding that time matters for school-aged children is also supported by a Danish study that examined a more distal educational outcome. Mother's and father's time spent with children during the elementary school years was significantly related to the likelihood that children chose to continue their education into high school (Würtz, 2007). More specifically, the more time mothers spent with children during the week, and the more time that fathers spent with children on the weekend, the more likely their children were to enroll in high school.

Other research has examined various types of activities parents may engage in with their children to determine how important specific ways of spending time are for children's development. Bradley and Corwyn (2004) have found that children who are exposed to a greater variety of activities and experiences at home are more likely to succeed in school. The extent to which parents engage children in cognitively stimulating activities, such as book reading, has

been found to be a particularly important type of time investment that mediates the association between income and children's cognitive skills (Guo & Harris, 2000; Yeung et al., 2002).

Material investments and child cognitive skills. Numerous studies have documented that middle-class parents are more likely to invest in educational materials and experiences for their children than working-class families (Bradley & Corwyn, 2002, 2004; Lareau, 2003). For example, poor families are significantly less likely to provide their children with books, cuddly toys, or a musical instrument than non-poor families (Bradley & Corwyn, 2004). Differential access to these learning materials in the home could help explain why children from lower SES households have weaker cognitive skills (Bradley, Caldwell, & Rock, 1988). Parents who provide their children with fewer cognitively stimulating materials are also less likely to engage their children in learning activities (Yeung et al., 2002), however, previous research supports the logic of separating time spent on cognitively stimulating activities from the simple provision of learning materials. For example, parent-child book reading is an essential form of early cognitive stimulation according to many studies on literacy development, but there is also evidence that providing children with access to their own books independently contributes to the development of early language skills, because children may amuse themselves with books when they are alone (Johnson, Martin, Brooks-Gunn, & Petrill, 2008).

The value of time vs. money. My review of the literature suggests that few researchers have pitted time investments against material investments to see which matter most for children's development. One exception is Price (2007). This paper estimates the rate of technical substitution (RTS) between time and money. RTS is an economic construct that indicates trade-offs between different inputs to achieve the same level of output (Friedman,

2002), in this case, how much more money a parent would need to earn in order to make up for less time with their child, to ensure their child achieves at the same level.

To examine the relative importance of time versus money, Price (2007) uses sibling fixed effects models to compare first-born children with second-born children. He argues that first-born children receive more time from their parents because parents do not have to split their attention between multiple children when they have only one, and that second-born children receive more material investments because income tends to rise over time for most families. For example, parents own larger homes and are more likely to be able to afford private school tuition as their income increases.

First-born children do score higher on reading than second-born children in Price's (2007) study. This difference in reading scores between first- and second-born is magnified in families where children were spaced further apart, suggesting that parental time is a very important input. Parent-child time and income both have positive effects on reading scores, but while time matters for the full sample, income primarily matters for families in the bottom income quartile. These findings are consistent with other research indicating that the effects of income on children's cognitive skills and academic achievement are nonlinear (Dearing, McCartney, & Taylor, 2001; Duncan & Brooks-Gunn, 1997b; Duncan, Yeung, Brooks-Gunn, & Smith, 1998; Duncan, Ziol-Guest, & Kalil, 2010; Taylor, Dearing, & McCartney, 2004).

Price concludes that "...parental time does matter and the impact of less parental time is not offset by experiencing a higher level of family income" (2007, p. 23). He estimates that the rate of technical substitution between parental time and family income is about $9.25 per hour for low income families – more than the federal minimum wage. Drawing on regression coefficients from Hill and O'Neill (1994), Price (2007) also provides an estimate of the value of

time spent reading: reading to a child one additional day per week is equivalent to about $5,000 in additional family income per year. Given that parents tend to spend an average of 30 minutes reading to their child each day (Price, 2006, as cited in Price, 2007), Price suggests the RTS between family income and time spent reading to children is $192 per hour. These estimates of the dollar value of parental time suggest that parental investments of time may be more valuable than material investments.

Research for Question Four: Maternal Education as a Moderator of Investments

In this section I review research on associations between mothers' level of education and children's learning. There are a variety of reasons time and material investments may be more more beneficial for children of more educated mothers. As described below, more educated mothers may provide their children with more language stimulation. They may be more sensitive, responsive, and warm toward their children. They may also use learning materials with their children in more stimluating ways.

Maternal Education and Time with Children. Maternal education may have a main effect on investments in children, such that less educated mothers simply spend less time engaging their children in learning activities. According to Hoff (2003), "SES may be associated with differences in the time available for leisurely parent-child interaction and in the magnitude of other stresses on parents, and these shape parents' interactions with their children" (p. 1374). However, even if parents of varying education levels spent the same amount of time with their children, it could also be the case that their time would be differentially productive in fostering children's development. I hypothesize that parental time investments will be less productive in families headed by less educated mothers.

One reason parental education may moderate the value of time parents spend with their children is that less educated parents provide their children with less language stimulation (Hart & Risley, 1995; Hoff, 2003; Hsin, 2008; Walker et al., 1994). Conducting naturalistic observations with mothers and their two-year-old children, Hoff (2003) found that maternal language use mediates the relation between SES and children's productive vocabulary. That is, high-SES mothers used longer phrases in their speech with their children than medium-SES mothers. As a result, their children heard more complex grammar, more word types, and more contextual information that allowed them to learn word meanings, and their productive vocabulary grew faster.

Lareau (2003) also notes that middle class parenting styles involve more verbal negotiation and reasoning, whereas working-class parents may use more directives with their children that do not elicit a verbal response. These differences in parenting style may make time spent with less educated parents less "productive" in fostering children's language and reasoning skills. In fact, Hsin (2008) shows that maternal verbal ability moderates the productivity of parental time with children using time-use data. Interacting mothers' verbal skills with the amount of time they spend with their children, Hsin (2008) finds that time spent with mothers who have stronger language skills is more beneficial for children's development of verbal and math skills over time. On the other hand, spending more time with mothers who have weak language skills had a *detrimental* effect on verbal and math skills development (Hsin, 2008).

Less educated parents may have lower educational expectations for their children, and these lower expectations can translate into styles of parenting that are less supportive of children's academic achievement (Davis-Kean, 2005). For example, African American parents with lower educational expectations for their children are less warm, and this dimension of

parenting has been tied to African American children's cognitive development (Davis-Kean, 2005). Lower SES parents also have less complex theories about child development, and parent in ways that place more value on conformity (Hoff-Ginsberg & Tardif, 2002).

Maternal Education and Interactions with Learning Materials. The way that parents use learning materials with their children also varies with parents' level of education. Therefore, I expect that material investments will be less productive in families headed by less educated mothers. More educated mothers read books to their children in ways that foster greater language development (Britto, Brooks-Gunn, & Griffin, 2006). Rather than simply reading the text in the book, more educated mothers engage children in conversation about books by asking questions, making comments, and discussing the meaning of the book in the context of children's every day experiences. More educated parents are also more sensitive and responsive when using toys in play with their children (Lugo-Gil & Tamis-LeMonda, 2008; Tamis-LeMonda et al., 2004), and these differences have been tied to children's cognitive development (Bornstein & Tamis-LeMonda, 1989; Ryan, Martin, & Brooks-Gunn, 2006; Tamis-LeMonda et al., 2004). For example, numerous studies have employed a procedure called the "three-bag task" - in which parents are encouraged to engage in free play with their children using toys from three bags. These interactions between parents and children are assessed for supportiveness, i.e. the extent to which parents exhibit sensitivity and positive regard, and engage the child in a cognitively stimulating manner. Children of parents who exhibit more supportive behavior score higher on cognitive skills assessments in early childhood (Ryan et al., 2006; Tamis-LeMonda et al., 2004).

Research for Question Five: Family Income as a Moderator of Investments

In this section, I review research that points to the potential moderating effect of income on the productivity of parental investments. There are a number of reasons low-income children

may benefit less from time with parents and access to learning materials in the home. As described below, poverty is associated with residence in neighborhoods with high concentrations of disadvantaged families, stress and poor mental health among parents, and parenting practices that place less emphasis on developing children's skills. As such, low-income parents' interactions with children occurs under less optimal conditions and are likely to be less stimulating. Consistent with the cumulative advantage hypothesis, I also expect that higher income children are better positioned to take advantage of materials in the home.

Family Income and Time with Children. The concept of the "developmental niche" (Harkness & Super, 1995) provides a useful theoretical framework for consideration of the potential moderating influence of income on parental investments. The developmental niche is composed of: 1) the physical and social environment in which the child is raised, 2) the psychology of the caretaker, and 3) cultural beliefs about appropriate child rearing practices. Low income affects all three of these domains in ways that may reduce the productivity of parental time with children. As a result, I hypothesize that parental time investments will benefit children less in low-income families.

First, income is associated with the physical and social space in which children are raised. Poor families are more likely to live in low-income neighborhoods, where disadvantaged families are highly concentrated. This concentration of disadvantage has been shown to have a link with children's cognitive skills and verbal ability (Klebanov et al., 1998; Sampson, Sharkey, & Raudenbush, 2008). Children from poor neighborhoods exhibit lower IQ scores relative to children in more affluent neighborhoods by age 3 (Klebanov et al., 1998). This disadvantage persists into the school years. Sampson et al. (2008) find that African American, school-aged children who reside in disadvantaged neighborhoods - characterized by poverty, welfare receipt,

unemployment, and female-headed households - score 25% of a standard deviation lower on a test of verbal skills.

Second, poverty affects parents' mental health. Poverty is associated with stress and poor mental health among parents (Leventhal & Brooks-Gunn, 2003). Depressed parents are less vocal, attentive, and responsive with their children, and less likely to be warm, affectionate and encouraging (Gelfand & Teti, 1990; Lovejoy et al., 2000). Children of depressed parents score lower on tests of cognitive skills in early childhood and exhibit difficulty focusing their attention on complex tasks during middle childhood (Cogill et al., 1986; Gelfand & Teti, 1990). Children who experience more of the risk factors associated with low socioeconomic status – such as poor maternal mental health, maternal anxiety, and a parenting style that emphasizes parental control and child obedience - have lower IQs at age 4 (Sameroff et al., 1987) and experience slower cognitive development into early adolescence (Sameroff et al., 1993).

Third, parenting cultures are situated within social-class. As discussed previously in this literature review, ethnographic research by Lareau (2003) demonstrates that children of middle-class parents spend more of their leisure time on structured activities, such as academic tutoring, sports, music lessons, and other extracurricular activities, while children in working-class families spend more time in unstructured free play. Lareau (2003) refers to these two styles of parenting as "concerted cultivation" versus "accomplishment of natural growth." Higher-income parents may be able afford a greater variety of stimulating leisure time activities for their children, thus children in high-income families may benefit more from parental time.

Family Income and Material Investments. Children from lower SES families enter kindergarten with substantially lower reading and math skills than children from high SES families (Lee & Burkam, 2002) and initial disparities tend to grow into more sizeable

achievement gaps over time (Entwisle & Alexander, 1993). Cook and Campbell (1979) observed this "fan-spread" effect in a variety of quasi-experimental education studies, such that students who had higher pre-test scores gained more from educational interventions. For example, an unintended consequence of the educational television program, *Sesame Street,* was an increase in the skills gaps between poor and middle-class children who viewed the program (Cooke, Appleton, Conner, & Schaffer, 1975 as cited in Walberg & Tsai, 1983). Middle-class children were able to learn more from the program because their parents engaged them in conversations that elaborated on the lessons offered in the television show. Similarly, I expect to find a cumulative advantage such that children from higher income families are able to benefit more from learning materials at home, such as books, CDs, and a home computer.

However, a plausible counter- hypothesis is that material investments may have a compensatory effect. In this case, material investments would have a stronger positive association with low income children's academic skills, as compared to high-income children. Previous studies demonstrate a non-linear association between family income and children's cognitive development such that additional income can be very meaningful for low-income children's cognitive development, but above a certain threshold, more money does not make much of a difference (Dearing et al., 2001; Duncan & Brooks-Gunn, 1997a; Duncan et al., 2010; Taylor, Dearing, & McCartney, 2004; Wagmiller, Lennon, Kuang, Alberti, & Aber, 2006). A similar pattern of diminishing returns may be seen with learning materials. For example, providing one book to a child who has none may have a greater impact that giving a book to a child who already has ten.

CHAPTER III: METHOD

This chapter describes the data I will use to examine my research questions, the way my measures will be constructed, and describes the analytic strategy for each research question. To recap briefly, my study will examine the extent to which parental investments mediate the effects of components of socioeconomic status on children's academic achievement. I will test each step of the model, from markers of SES to parental investments, and from parental investments to children's achievement, to determine what matters most for children's early reading and math skills. I will also examine whether parental education or family income moderate the effects I find. A diagram of the dissertation logic model is displayed in Figure 1.

Data

I answer my questions empirically using data from the Early Childhood Longitudinal Study, Kindergarten Cohort (ECLS-K). The National Center for Education Statistics designed the ECLS-K study to track the academic progress of a nationally representative sample of approximately 20,000 children who entered kindergarten in 1998-1999. ECLS-K employed a stratified sampling procedure to randomly select 1,277 public and private schools that offered kindergarten. From each of these schools, a target sample of approximately 24 children was selected and followed until the spring of eighth grade. The ECLS-K data are suited to address my research questions because the study collected detailed information from children and parents, including information on family income, parental education, home environment, and parenting practices.

Because mothers' education and parenting skills are of primary interest in this study, the analytic sample is limited to children who have a mother in their household, whether she is a

biological, step, foster, or adoptive mother. I focus on children in the early elementary grades when family influences on children's educational outcomes are likely to be greatest (Cheadle, 2008: Duncan & Brooks-Gunn, 1997a; Duncan et al., 1998; Entwisle & Alexander, 1993; Wagmiller et al., 2006). Data are drawn from the fall kindergarten, spring kindergarten, and spring first grade waves of data collection for the analyses. The use of sampling weights allows results to generalize to the population of U.S. kindergarteners in 1998. Descriptive statistics for the sample can be found in Table 1. A correlation matrix for all variables is provided in Table 2.

Measures

Independent Variables: Maternal Education and Family Income

Maternal education and family income serve as my independent variables and as moderators in some models. NCES gathered data on mothers' education in the fall of kindergarten. Using this data, I represent mothers' education with a seven category ordinal variable. The categories are: 8th grade or below, 9^{th} to 12^{th} grade, high school diploma or GED, some college or vocational education, a bachelor's degree, a master's degree or some graduate school, or a doctorate or professional degree. I use the income measure from the spring of kindergarten, a continuous measure with a range from $0 to $1,000,000, after log transforming it to improve its distribution.

Note that I treat income and maternal education as continuous variables in most of my statistical models, except for the interaction models described below. In the interaction models, I treat both as dummy variables. (Doing so was necessary in order to facilitate model convergence.) Families in which the mother had attended at least some college or vocational education were coded 1 on the indicator variable for high education. Families with household incomes less than 200% of the federal poverty level were coded 1 on the low income indicator.

Mediator: Time Investment

The time investment construct is a latent variable composed of items indicating how often parents engage in cognitively stimulating activities in the home. In the fall of kindergarten, parents were asked how frequently they did the following eight activities in a typical week: read books, tell stories, sing songs, do arts and crafts, involve the child in chores, play games, do nature or science projects, and build things. These items were measured on a 1 to 4 scale, where 1 represents "not at all," 2 represent "once or twice," 3 represents "3 to 6 times," and 4 represents "every day." I averaged these items together into three "parcels" to create a perfectly identified latent factor. Doing so reduced cross-loading of items and the correlation between the latent factor for time and the latent factor for materials.

Mediator: Material Investment

The material investment construct a latent variable composed of items indicating the presence of cognitively stimulating materials in the child's home including the number of children's books, the number of children's music CDs or tapes, and the presence of a home computer that the child uses. The number of children's books is a continuous variable ranging from 0 to 200. The number of music materials is a continuous variable top-coded at 100. Home computer ownership is indicated with a dummy variable. The information regarding books and music was gathered in the fall of kindergarten, and computer ownership was assessed in the spring.

Dependent Variables: Children's Reading and Math Skills

The outcome variables are children's reading and math skills. The ECLS-K assessments were individually administered to children, with each assessment session lasting 50-70 minutes.

The ECLS-K study utilized a two-stage assessment procedure. The first stage assessed children's skill levels so that test items of appropriate difficulty could be administered in the second stage. This assessment approach minimizes floor and ceiling effects. The content of the literacy assessments focused on pre-reading skills, including print familiarity, letter recognition, vocabulary, and oral comprehension. The mathematics assessments measured knowledge of numbers, shapes, and basic problem solving skills. In my analyses, I use Item Response Theory scale scores which represent the number of items a child would have answered correctly, if he/she had answered all questions in the assessment. In change models, I measure children's learning by lagging children's scores from the fall of kindergarten, while treating scores from the spring of first grade as the dependent variable. In level models, I treat spring of first grade scores as the dependent variables without the lag. I also test a model models with fall kindergarten scores as the outcomes as a sensitivity analysis.

Control Variables

I control for a variety of child and family characteristics that may be associated with SES, parental investments, and/or children's academic outcomes, including child race/ethnicity, child gender, child disability status, whether the child repeated kindergarten, number of children in the household, marital status, mothers' nativity, mothers' work hours, and fathers' education. I account for the focal child's race/ethnicity with a series of dummy variables indicating whether the child is Black, Hispanic, Asian, or "Other," a category which encompasses Native American and multi-racial children. White is the reference category. Child gender is indicated by a variable coded one for female. An indicator for disability is coded one if the child received services for children with special needs or participated in a special education program. If the child was attending kindergarten for the second time, due to being held back a grade, I include an

indicator variable for kindergarten repetition. I also include the number of children in the household under the age of 18, using information from the household roster. Models include an indicator for families in which parents are cohabitating or there is no father in the household, i.e. the mother is single, separated, divorced, or widowed. Married is the reference category. Children whose mothers were foreign born are noted via a dummy variable. Mothers' work hours are measured using a continuous variable ranging from 0 to 80. I control for fathers education with two dummy variables noting if the father has more or less education than the mother. Fathers with the same level of education as the mother serve as the reference group.

Analytic Approach

Structural Equation Modeling

Analyses are conducted using structural equation modeling (SEM) in Mplus version 6.1. This statistical technique allows for the estimation of multiple regression equations simultaneously, thereby accounting for the high degree of correlation among the predictor variables in my model. In other words, the benefit of SEM is that is allows me to examine the relative influence of maternal education and family income simultaneously and identify the specific mediation pathways through which these components of socioeconomic status influence children's achievement.

All models employ maximum likelihood estimation with Huber-White (robust) standard errors. Standard errors are also clustered on schools to account for the nested sampling design of the ECLS-K. This method of analysis yields standard errors and a chi-square test statistic that are robust to non-independence of observations and non-normality (Muthén & Muthén, 2010). I weight the data with the base weights indicated by NCES (2002) for analyses with the specific set of variables and the time horizons I use in my analyses. As a result, my results can be

generalized to the population of U.S. kindergarteners who began school in the fall of 1998, who reside with a mother.

Development of the Measurement Models

I tested a variety of preliminary measurement models before arriving at the latent time and material investment variables used for hypothesis testing. I began by constructing latent time and material investment variables with second-order factor structures that included a greater variety of parental investment indicators. The latent time investment variable included activities parents do with children at home, outings parents take children on, and parental involvement in children's schools. The latent material investment variable included provision of learning materials in the home, enrollment in extracurricular activities, and child care experiences. When tested individually, those models had poor fit and numerous indicators cross-loaded on both the time and material investment factors. The time and material investment factors were also highly correlated.

My final solution was to radically reduce the number of items used to measure each factor, limiting the indicators of the latent variables to measures of the home environment. Time investment includes cognitively stimulating activities that parents do with children at home, such as reading books, playing games, building things, etc. Material investment includes the number of books, number of music CDs or tapes, and the presence of a home computer that children can use. I also employ parceling (averaging items together to create multi-item indicators of the latent construct). I create multi-dimensional parcels using a reverse serpentine balancing technique in which I combine items with relatively high and low factor loadings. This approach to building the measurement model reduces dual factor loadings and improves model fit (Little,

Cunningham, Shahar, & Widaman, 2002). Please see Table 3 for results of the measurement model. See Appendix A for further detail on the development of the measurement models.

Development of the Mediation Models

The mediation model used to test my hypotheses for research questions one, two, and three was developed in a series of preliminary analyses that: 1) tested alternative approaches to including covariates, and 2) added and removed paths to arrive at the most parsimonious model that also had good model fit. Because there are a variety of ways investigators can include covariates in their models, I began by testing various options to determine which approach led to the best model fit. I considered the following options:

1) Simple model that controlled only for children's skills at kindergarten entry,
2) Include a full set of controls only on the independent variables,
3) Include a full set of controls only on the dependent variables,
4) Include a full set of controls on the mediators and dependent variables (semi-partial approach),
5) Include a full set of controls on independent variables, mediators, and dependent variables (full-partial approach).

The full-partial model was the best fitting model and fit significantly better than the semi-partial model according to the chi-square difference test. However, the CFI, TLI, and RMSEA were slightly better in the semi-partial model and the parameter estimates were nearly identical. Therefore, I selected the semi-partial approach, which is more parsimonious, for hypothesis testing.

After estimating a model with all hypothesized paths, I removed paths that were not significant by setting these paths equal to zero. For example, I set the path from income to time

investment to zero. Finally, after examining the modification indices, I added a covariance between the number of children's books and the number children's music CDs and tapes in the household, two indicators for the latent material investment factor. Adding this covariance led to significant improvement in model fit. Remaining modification indices suggested that additional changes to the model would result in less than a 10% improvement in the chi square statistic. Attempts to test additional paths led to problems with model convergence. (The paths indicated by the remaining modification indices included covariances between indicator variables and cross loadings.) See Appendix B for further information on the development of the mediation model.

Assessing Fit of the Mediation Models

I use three commonly accepted fit indices to assess the fit of my mediation models for research questions one, two, and three: the model chi-square statistic, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). First, I present the model chi-square statistic, the most common fit statistic employed in SEM studies. The null hypothesis of the chi square test is that the model fits the data, and a larger model chi-square statistic represents a worse fit (Kline, 2005). The model chi-square is quite sensitive to large sample size (Kline, 2005; Widaman & Thompson, 2003), thus the chi-square test consistently indicates that my model is a poor fit to the data. Therefore, I also present the comparative fit index (CFI) and the root mean square error of approximation (RMSEA).

The CFI is arelative fit index that assesses the fit hypothesized model relative to a null model in which all variables are uncorrelated. It is normed to have a value between 0 and 1. The higher the value of the CFI, the better the model fits the data. A CFI greater than .90 indicates the proposed model fits the data well (Hu & Bentler, 1999).

The RMSEA is an absolute fit index that measures the fit of the hypothesized model relative to the population covariance matrix (Kline, 2005). In other words, this fit statistic indicates the degree to which the hypothesized model deviates from a model that perfectly represents the data. A RMSEA value of .05 or less indicates a good fit, .05-.08 indicates an acceptable fit, and RMSEA greater than or equal to .10 indicates a poor fit (Browne & Cudeck, 1993; McDonald & Ho, 2002).

Development and Fit of the Moderation Models

Moderation models for research questions four and five are estimated using random effect regression analysis with Monte Carlo integration. To reduce multi-collinearity, I test for moderation of investments by parental education and income in two separate models. I test the reading and math outcomes simultaneously and account for the covariance between them to capture the non-independence of the tests. To facilitate model convergence, I dichotomize maternal education, using an indicator variable for some college or more. Similarly, I represent family income with an indicator for income less than 200% of the federal poverty level. Due to the use of Monte Carlo integration, standardized parameter estimates and traditional fit indices are not provided by Mplus. Without the RMSEA, CFI, or TLI, it is not possible to assess the fit of these models. However, it is likely that the models do not fit the data very well given that they took many hours to converge.

Addressing Missing Data

All models employ full information maximum likelihood (FIML) estimation to account for missing data. This approach is asymptotically equivalent to multiple imputation. The FIML method I use accounts for the correlations between all predictor variables in the model, including covariates, to estimate values for cases with missingness. In order to invoke FIML, I treat binary

and ordinal categorical variables as if they were continuous, per the recommendation of Linda Muthén, one of the Mplus software developers (personal communication, June 28, 2011). All cases are part of the FIML analysis, including cases with missing data on the outcome variables. The degree of missingness ranges from 0% on race/ethnicity to 24% on first grade reading skills and 22% on first grade math skills. Six percent of children are missing data on income and maternal education. Sixteen percent are missing data on the time indicators. Twelve to 17% are missing information on material investment indicators.

Due to the high degree of missingness on the outcome variables, I also tested models on a dataset that excluded cases with missing outcomes data. The results are virtually identical to the results for the original models. Thus, the full information maximum likelihood estimates are substantively the same whether or not I include cases with missing data on the dependent variables.

Testing Models for Three Different Time Horizons

I test the models above for three different time horizons. My primary model of interest is a "level model" that examines children's achievement at the end of first grade. This level model assesses children's achievement at a fixed point in time without accounting for baseline skill levels. As a robustness check, I run an additional level model with fall kindergarten reading and math scores as the outcomes, and a change model in which I treat reading and math scores from the spring of first grade as the outcomes while lagging scores from the fall of kindergarten. These models allow me to assess whether parents' influence on their children's academic skills primarily occurs prior to school entry and, conversely, the importance of family influences on children's development of academic skills after school entry. These robustness checks also allow me to investigate whether parental investments are a response to initial achievement levels.

Analytic Approach for Research Question One

My first research question investigates the extent to which time and material investments mediate the associations between components of socioeconomic status - maternal education and family income - and children's academic performance. I answer my research question using the structural equation model shown in Figure 1. This model estimates regression equations simultaneously for each of four dependent variables: time investments, material investments, reading skills, and math skills. The equations for this model are shown in equations 1.1 through 1.4 below. In addition, I account for the covariance between time and material investments, and the covariance between children's reading and math skills.

(Eq. 1.1) $TIME=\beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_x COV + \varepsilon$
(Eq. 1.2) $MATERIAL= \beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_x COV + \varepsilon$
(Eq. 1.3) $READ=\beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_3 TIME + \beta_4 MATERIAL + \beta_x COV + \varepsilon$
(Eq. 1.4) $MATH= \beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_3 TIME + \beta_4 MATERIAL + \beta_x COV + \varepsilon$

When interpreting my results, I first examine the total effects of maternal education and income on reading and math development. Then, in order to identify the pathway that best explains the association between socioeconomic status and school performance, I decompose the total effects into three parts: 1) the direct effect on children's reading and math skills, 2) the portion that is indirectly transmitted via time investments, and 3) the portion that is indirectly transmitted via material investments. This allows me to examine the following four mediation pathways:

a) maternal education→time investments→ children's achievement,

b) maternal education→material investments→children's achievement,

c) income→time investments→children's achievement, and

d) income→material investments→children's achievement.

Analytic Approach for Research Question Two

Is maternal education or income a more important determinant of investments in children? I conduct Wald tests for equality of parameter estimates for specific paths of interest in the structural equation model shown in Figure 1 to answer this question. Specifically, I compare pairs of paths from the independent variables to the mediators. The Wald test examines the null hypothesis that $\beta_1 = \beta_2$. If the test is significant, I reject the null hypothesis and conclude that the path with the larger coefficient is significantly stronger than the path with the smaller coefficient. First, I test whether maternal education or income is more strongly associated with time investments by comparing β_1 and β_2 shown in equation 1.1. Second, I conduct a Wald test comparing β_1 and β_2 in equation 1.2 to determine whether maternal education or income is more strongly associated with material investments.

Analytic Approach for Research Question Three

My third research question asks whether time or material investments matter more for children's academic performance. I examine this question using a similar procedure as in research question 2. I employ Wald tests to compare the magnitude of pairs of paths from the mediators to the dependent variables shown in Figure 1. First, I compare β_3 and β_4 from equation 1.3, to determine whether time or material investments have a greater association with children's reading skills development. Second, I conduct a Wald test for β_3 and β_4 from equation 1.4 to assess the relative influence of time and material investments on math skills development.

Analytic Approach for Research Question Four

My fourth research question asks whether the productivity of parental investments varies by mothers' level of education. To examine moderation of time and material investments by

maternal education, I run a structural equation model with interaction terms as shown in equations 2.1 and 2.2. I test the reading and math outcomes simultaneously and account for the covariance between them to capture the non-independence of the tests, to reduce the likelihood of a Type I error.

Equations for Model Estimating Moderation by Maternal Education

(Eq. 2.1) $READ=\beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_3 TIME + \beta_4 MATERIALS + \beta_5 TIME\boldsymbol{x}EDUC + \beta_6 MATERIALS\boldsymbol{x}EDUC + \beta_x COV\ldots. + \varepsilon$

(Eq. 2.2) $MATH= \beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_3 TIME + \beta_4 MATERIALS + \beta_5 TIME\boldsymbol{x}EDUC + \beta_6 MATERIALS\boldsymbol{x}EDUC + \beta_x COV\ldots. + \varepsilon$

Analytic Approach for Research Question Five

My fifth research question investigates whether income moderates the value of parental investments for children's academic skills. I follow the same procedure as in research question 4. I run a structural equation model with two outcomes: children's reading and math skills. The regression equation predicting these outcomes include interactions between income and parental investments, as shown in equations 3.1 and 3.2. I also account for the covariance between math and reading.

Equations for Model Estimating Moderation by Family Income

(Eq. 3.1) $READ=\beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_3 TIME + \beta_4 MATERIALS + \beta_5 TIME\boldsymbol{x}INCOME + \beta_6 MATERIALS\boldsymbol{x}INCOME + \beta_x COV\ldots. + \varepsilon$

(Eq. 3.2) $MATH\_1st= \beta_0 + \beta_1 EDUC + \beta_2 INCOME + \beta_3 TIME + \beta_4 MATERIALS + \beta_5 TIME\boldsymbol{x}INCOME + \beta_6 MATERIALS\boldsymbol{x}INCOME + \beta_x COV\ldots. + \varepsilon$

CHAPTER IV: RESULTS

This section restates my research questions and hypotheses and summarizes the results in relation to the hypotheses. I also discuss the results of sensitivity analyses I conducted to explore why parental time has a negative association with children's academic outcomes.

Results for Research Question One

Question 1: To what extent do parental investments mediate the associations between components of socioeconomic status and children's school performance?

Hypothesis 1.1: Time investments mediate more of the effect of maternal education than material investments.

Hypothesis 1.2: Material investments mediate more of the effect of family income than time investments.

The results for the full structural equation model are shown in Figure 2. Table 4 provides a summary of total, direct, and indirect effects. All estimates shown are standardized beta coefficients. Note that tables showing the coefficients for all variables, including covariates, are shown in Appendix C. Direct and indirect, AKA mediated, paths are described here. The paths from the independent variables to the mediators are discussed in the section for question 2. The paths from the mediators to the dependent variables are enumerated below in the section question 3. First, I discuss the results for hypothesis 1.1. Then I discuss the results for hypothesis 1.2.

The direct paths from maternal education to children's first grade reading and math scores are not significant. Thus, they are fully mediated by parental investments. However, as shown in Table 4, they are largely mediated by material investments – the very opposite of what was predicted in hypothesis 1.1. The total effect of maternal education on reading skills (TE=.273, $p<.001$) can be decomposed into two indirect effects: the portion that is mediated by

material investments (IE=.293, p<.001), and a trivial negative effect that is transmitted via time investments (IE=-.020, p<.001). Results are similar for children's math skills. The total effect of maternal education on math skills (TE=.278, p<.001) is largely mediated by materials (IE=.303, p<.001), and a very small negative indirect effect of time (IE=-.025, p<.001).

The direct paths from family income to children's first grade reading and math scores are also not significant. Consistent with hypothesis 1.2, the total effects of income on children's reading test scores (TE=.084, p<.001) and math scores (TE=.087, p<.001) are entirely mediated by material investments. See Table 4. Again, see Figure 2 for the results of the full structural model.

The models for the alternative time horizons show similar results. See Figure 3 and Table 5 for the results for children's fall kindergarten skill levels. This model indicates that: 1) the effect of maternal education on reading and math skills is largely mediated by material investments, and 2) the effect of family income on reading and math skills is entirely mediated by material investments. Results are similar for the change model that examines children's learning from school entry to the end of first grade. As shown in Figure 4 and Table 6, the same pattern of mediation is found for math learning: Material investments are the primary mediator of both maternal education and family income. However, no mediation is found for the development of reading skills. That is, maternal education and family income do have significant direct effects on children's literacy learning.

Results for Research Question Two

Question 2: Which is the more important determinant of investments in children – maternal education or income?

Hypothesis 2.1 Maternal education is the more important determinant of time investments.

Hypothesis 2.2: Maternal education is the more important determinant of material investments.

The results of Wald Tests comparing standardized beta coefficients for question 2 are summarized in Table 7. Results for the spring first grade level model support hypothesis 2.1. As shown in Figure 2, maternal education has a small positive association with time investments (β=.205, p<.001), while the effect of income on time is statistically indistinguishable from 0. Predictably, the Wald test rejects the null hypothesis that these two paths are equal (Wald=59.3, d.f.=1, p<.001), as displayed in Table 7. Therefore, with regard to time investments, the results favor my hypothesis, which predicts that maternal education has a greater association with parental investments than family income.

The results also support hypothesis 2.2. Maternal education (β=.518; p<.001) has a greater influence on the degree to which parents provide cognitively stimulating materials for their children than family income (β=.148; p<.001). See Figure 2, which displays the full results for the spring first grade level model or simply review the summary in Table 7. The Wald test rejects the null hypothesis that maternal education and family income are equally important predictors of material investments (Wald=203.6, d.f.=1, p<.001). Again, these results support my hypothesis, because I expected that maternal education would be the stronger driver of parental investments in children.

The results for the models testing different time horizons - the level model for the fall of kindergarten and the change model that examines learning from the fall of kindergarten to the

spring of first grade – yield substantively identical results. Mother's education is consistently a stronger predictor of time and materials investments, as shown in Table 7.

Results for Research Question Three

Question 3: All else equal, do time or material investments matter more for children's academic performance?

Hypothesis 3.1: Time investments are more strongly associated with children's reading skills than material investments in a model that conditions on both types of investments.

Hypothesis 3.2: Time investments are more strongly associated with children's math skills than material investments in a model that conditions on both types of investments.

The results of the full structural equation model shown in Figure 2 contradict hypothesis 3.1. Material investments have a moderately strong positive association ($\beta = .565$; $p<.001$) with children's reading skills at the end of first grade, while time investments have a very small negative association ($\beta = -.098$; $p<.001$). The results of the Wald test comparing standardized path estimates, shown in Table 8, indicate that the difference between these two coefficients is statistically significant (Wald=153.3, d.f.=1, $p<.001$). Thus, investments in learning materials, such as books, music, and a home computer, appear to be a more important influence on children's literacy skills than time investments.

The results also lead me to reject hypothesis 3.2 for children's first grade math skills. The Wald test value, shown in Table 8, rejects the null hypothesis that parental investments of time and materials are equally important determinants of math skills (Wald=188.4, d.f.=1, $p<.001$). As shown in Figure 2, parental time has a small negative association ($\beta = -.123$; $p<.001$) with children's math skills, while material investment has a moderate positive association ($\beta=.585$, $p<.001$).

Material investments generally have a larger positive association with children's reading and math performance than time in the robustness check models, as shown in Table 8. This is true for the level model predicting children's academic skills in the fall of kindergarten. The growth model indicates that both time and material investments have a null association with literacy learning. However, the pattern of results for math learning echo those of the models described above: Material investments have a positive association with children's math learning and time investments have a small negative association. These findings stand in direct opposition to my hypothesis. I expected that time investments would have a greater influence on children's academic performance than material investments, but in fact, parental time has an unexpected negative association with children's reading and math skills. I explore the negative effect of parental time further in sensitivity analyses described below.

Results for Research Question Four

Question 4: Does maternal education moderate the benefit of parental investments?

Hypothesis 4.1: Parental investments of time are more beneficial in families headed by more educated mothers versus less educated mothers.

Hypothesis 4.2: Parental investments of materials are more beneficial in families headed by more educated mothers versus less educated mothers.

Table 9 presents raw parameter estimates for a random effects model testing interactions by maternal education for hypotheses 4.1 and 4.2. Note that maternal education has been dichotomized in order to allow for model convergence. Results do not support hypothesis 4.1. I do not find a significant interaction between maternal education and time in the equation predicting children's first grade reading skills. I find a small negative interaction between maternal education and time for math skills, which indicates that the negative effect of parental

time is even more negative for children from families in which mothers have some college education or more. As shown in Table 9, a one standard deviation increase in parental time is associated with a 2.07 point reduction in math scores in less educated families, and a 3.47 point reduction in math scores in more educated families ($p<.01$). The standard deviation of math scores is 18.11, so the magnitude of the interaction effect is 7.7% of the standard deviation. Models for alternative time horizons show either similar or null results. The level model predicting children's scores at kindergarten entry reveals a negative interaction between maternal education and time for both reading and math skills, as displayed in Table 10. The change model yields null results; none of the interaction terms are statistically significant, as shown in Table 11.

Results displayed in Table 9 do support hypothesis 4.2. I do find a very small, significant interaction between material investment and maternal education, such that material investments have a stronger positive association with children's reading skills in families headed by mothers with some college education versus mothers with no college education (15.09 vs. 13.03 point gain in reading for a one standard deviation increase in materials, $p<.05$), as shown in Table 9. This interaction effect is 8.6% of the standard deviation in reading scores. Results are similar for math. A one standard deviation increase in materials is associated with a 13.96 point increase in math scores for children of more educated mother and a 11.39 point increase in math scores for children of less educated mothers ($p<.001$). This interaction effect is 14.2% of the standard deviation of math scores. The level model I ran as a robustness check (for children's fall kindergarten scores) yields similar results, as shown in Table 10. Interaction terms were not statistically significant in the change model predicting children's learning from kindergarten entry to the end of first grade. See Table 11.

Results for Research Question Five

Question 5: Does family income moderate the benefit of parental investments?

Hypothesis 5.1: Time investments are more beneficial in higher income families.

Hypothesis 5.2: Material investments are more beneficial in higher income families.

Results for the model testing interactions by family income are displayed in Table 12. Coefficients shown are raw parameter estimates from a random effects regression model. These results correspond to hypotheses 5.1 and 5.2. Family income is represented by an indicator variable coded one for income below 200% of the federal poverty level because models did not converge when income was treated as a continuous variable. The pattern of findings is similar to those for hypotheses 4.1 and 4.2. As I discuss below, the negative effect of parental time is magnified for children from more advantaged families, and the positive association between materials and children's academic skills is greater in more advantaged families.

Results do not support hypothesis 5.1. The main effect of time is negative in the regression models predicting children's reading and math skills at the end of first grade. The interaction term between income and time investment is not statistically significant for children's reading skills. For children's math skills, a one standard deviation increase in parental time corresponds to a 3.55 point reduction in children's math scores in families earning 200% of the federal poverty level and above, versus a 2.43 point reduction in math scores for low-income families. This interaction effect is 6.2% of the standard deviation of math scores. Results are similar in models for fall kindergarten outcomes that I run as a robustness check. See Table 13. As displayed in Table 14, the interactions between income and parental investments are not statistically significant in the change models predicting children's development of reading and math skills from kindergarten through first grade.

Results do support hypothesis 5.2 for children's reading and math skills at the end of first grade. As shown in Table 12, a one standard deviation increase in material investments is associated with a 16.09 point increase in children's reading skills among higher income families and a 13.38 point increase in reading skills among lower income families ($p<.05$). A one standard deviation increase in material investments is associated with a 14.63 point increase in reading skills in higher income families and a 11.84 point increase in reading skills in lower income families ($p<.001$). At 11.3% of the standard deviation of reading scores and 15.4% of the standard deviation of math scores, these interaction terms are small. Interaction terms in the level model for the fall of kindergarten are similar in direction and magnitude, as seen in Table 13. The change model for children's learning over time does not yield any statistically significant interactions, as shown in Table 14.

Sensitivity Analyses for the Negative Effect of Parental Time

As discussed in the results for research question three, parental time has a negative association with children's academic skills after conditioning on the presence of cognitively stimulating materials in the home. This finding defies expectations and warrants further consideration. One possible explanation is that parental time is a reaction to children's poor achievement or learning difficulties. To examine this hypothesis, I look to the results of the change model presented in Figure 4 and Table 6. This model includes children's reading and math skills at kindergarten entry as controls in the regression equations predicting parental time investments, material investments, and reading and math achievement at the end of first grade. As shown in Figure 4, parental time has a null association with the change in children's reading skills and a very small negative association with children's math skills development in this change model. Comparing Figure 2 to Figure 4 reveals that the negative effect of parental time

is reduced after controlling for children's skills at baseline, from -.098 to null for reading and from -.123 to -.046 for math, suggesting that parental time may be in part a response to children's achievement challenges. However, this hypothesis does not fully explain the negative effect of parental time.

Second, I test the time investment and material investment variables one at a time in separate models to see if the negative effect of parental time is the result of conditioning on material investment. Time and material investment are highly correlated, and the attempt to separate them may lead to odd results. In fact, the time investment variable is positively associated with children's first grade reading and math skills in the model which excludes material investment, suggesting that the strong correlation between time and materials could help explain the negative effect of time. The positive coefficients on time in this model are, however, quite small, as seen in Figure 5 and Table 15. The effect size of time is .043 ($p<.01$) for reading and .023 for math ($p<.10$). Results for the model that includes only material investment as a mediator are shown in Figure 8 and Table 18. Material investment has a much larger positive association with children's academic skills in this model than time investment in the time-only model. The effect size of material investment for reading is .523 ($p<.001$) and .534 ($p<.001$) for math. The relative magnitude of associations between time, materials, and children's outcomes are the same in the robustness check models. That is, material investments have a stronger, positive association with children's outcomes in the materials-only models than time investments in the time-only models for children's fall kindergarten achievement level (Figures 6 and 7, Tables 16 and 17) and the models for kindergarten through first grade change (Figures 9 and 10, Tables 19 and 20). As such, this model does not alter my conclusion that material investments matter more than time investments.

Next, I consider the possibility that parents' time with children may be beneficial, neutral, or detrimental for children's school achievement, depending on how the time is spent. To test the possibility that some types of parental time are more beneficial than others, I run a path model that treats the time and material investment items as separate, observed variables. The model shown in Figure 11 is tested for spring first grade and fall kindergarten achievement levels, as well as the change in academic skills from the fall kindergarten to the spring first grade. Results for the spring first grade level model are displayed in Table 21. Results for the other time horizons are shown in Table 22 for the level model and Table 23 for the change model. These models confirm that some ways of spending time with children are more beneficial than others. Reading books, playing games, and doing nature or science projects are the three items that most often have positive associations with children's reading and math outcomes. Singing songs, doing arts and crafts, and building things generally show negative associations. Material investment indicators have larger, positive effect sizes than the positive time investment indicators. For example, the number of children's books in the home and the presence of a computer the child uses always have a stronger positive association with children's reading and math skills than time spent reading.

Based on the results of the path model, I redefine the latent time investment variable as a construct measured by the items that are positively associated with children's outcomes: reading books, playing games, and doing nature or science projects. Results are shown in Figure 12 and Table 24. The correlation between the latent time and material investment variables increases from .490 in the model with the original time investment variable (shown in Figure 2) to .653 in the model with the redefined time investment variable. The association between parental time investments and children's reading and math skills are still negative. In fact, the negative effect

of parental time is somewhat larger in this model than in the model with the original time investment variable: The negative path from time investment to reading increases from -.098 to -.108 and the path from time to math increases from -.123 to -.187, as can been seen by comparing Figure 2 to Figure 12. The pattern of results is generally the same for the robustness check models. The level model with the new time investment variable can be seen in Figure 13 and Table 25 for the fall of kindergarten. The change model is shown in Figure 14 and Table 26. These results underscore the problem of multicollinearity between time and material investments; as the correlation between time and materials increases, the negative effect of time becomes more pronounced.

Finally, to explore the effects of other types of parental investments that also have a time component, I run another path model with additional investment variables, as shown in Figure 15. For this model, I create scale variables in the place of latent variables by rescaling the item-level data so that all measures on the same scale and then averaging them together. Time is the average of reading books, playing games, and doing nature or science projects. The materials measure is the average of books, music, and computer ownership. Outings include going to the library, museum, the zoo or aquarium, and concerts, plays, or live shows. Extracurricular activities include dance lessons, organized clubs, music lessons, art lessons, and organized performing. School involvement is the average of attending open houses, PTA meetings, school events, volunteering, and participating in fundraising. Several of these scale variables could be considered to include a time component. Parents must take the time to go on outings with their children. Parents must drop their children off and pick them up from extracurricular activities. School involvement also requires that parents take time away from other activities.

Results for the level model predicting children's first grade academic achievement are presented in Table 27. The coefficients for all of the investment variables are small, generally with an effect size smaller than .10, and little mediation is evident in this model. That is, the associations between maternal education, income, and children's outcomes are largely direct in nature. The results indicate that learning materials in the home have greater positive associations with children's reading and math skills than the other investment variables. These findings are generally robust to alternative model specifications, as shown in Table 28 for the fall kindergarten level model and Table 29 for the change model. Based on these results, I still conclude that material investments are more important for children's academic outcomes than time investments.

Examining the other investment variables more closely reveals that parental involvement in children's schools is the one time-related investment that consistently has positive associations with children's outcomes. Enrolling children in extracurricular activities and the original time variable, which measures the frequency with which parents engage children in cognitively stimulating activities at home, also both have positive associations with children's academic achievement in some models. Finally, the time parents spend taking their children on outings has a negative or null association with children's outcomes. These results reveal that parental time is not a unitary construct. The value of shared parent-child time varies depending on the types of activities families engage in. Furthermore, the fact that the original time variable, which previously had a negative effect, now has a positive association with children's outcomes points to multicollinearity as an explanation for the negative effect of parental time. It may also be the case that children who spend more time in extracurricular activities spend less time doing

activities with parents at home. Thus, holding constant extracurricular activities allows me to more accurately assess the value of parent-child time at home.

CHAPTER V: DISCUSSION

Findings suggest that maternal education is more strongly associated with children's academic outcomes than family income. Maternal education is also more predictive of both time and material investments in children than family income. Material investments have a stronger positive association with both static measures of children's achievement and children's development of math and reading skills over time, as compared to time investments. In fact, parental time has an unexpected negative association with children's achievement and learning over time. On the whole, the results of this study indicate that socioeconomic status is associated with children's school success via a pathway in which maternal education influences the extent to which parents invest in learning materials for their children, and these learning materials in turn foster children's development of early literacy and numeracy skills. Family income and maternal education also moderate the productivity of parental investments, such that the negative effect of time investments and the positive effect of material investments are magnified in more advantaged households.

Findings in Relation to Hypotheses and Previous Research

Research Question One

Research question one examines mediation of associations between components of socioeconomic status, namely maternal education and income, and children's school performance. I hypothesized that time investments would mediate more of the effect of maternal education than material investments (hypothesis 1.1), and material investments would mediate more of the effect of family income (hypothesis 1.2). Results indicate that material investments are the primary mediator of both maternal education and income effects on children's academic skills. This finding contributes to our understanding of the family processes through which

socio-economic status is linked to children's school achievement. Previous mediation studies examining parenting processes in disadvantaged families typically treat only income as an independent variable, and they often combine time and material investments into a single home environment measure (e.g. Gershoff et al., 2007; Linver et al., 2002). In contrast, I include income *and* parental education as predictors, and disaggregate aspects of children's home environment that represent parental investments of time from those that represent material investments.

Research Question Two

As hypothesized for research question two, maternal education is a better predictor than income of the time (hypothesis 2.1) and material investments (hypothesis 2.2) families make in their children. Findings regarding parental time in this dissertation are similar to the results of previous time-use studies. Previous studies indicate that parents of higher socio-economic status spend more time with their children (e.g. Bonke & Esping-Andersen, 2009, Guryan et al., 2008, Sayer et al., 2004). Due to the correlation between parental education and income, increasing levels of education and income are both associated with increased time with children in descriptive analyses, although the education gradient is steeper than the income gradient (Guryan et al., 2008). This dissertation examines the effects of maternal education and family income concurrently in multivariate models that account for a variety of confounding background characteristics. The results reveal that family income is not, in fact, significantly associated with time spent with children, echoing Bonke and Esping-Andersen's (2009) finding that parents' education levels predict time with children while wage levels do not.

My results also show that maternal education has a stronger association with material investments than income, as predicted. While perhaps counter-intuitive, this finding is consistent

with previous research on educational expenditures. Mauldin et al. (2001) find that family income and parental education are both significantly related to parents' decision *whether* to spend money on children's education, but only parental education is related to *how much* parents spent. Holding family income constant, parents with a bachelor's degree or more spent about twice as much on private school tuition, books, and other educational materials for their children than parents with a high school diploma. In contrast, an additional $10,000 in income had a net effect of just +9% on expenditures (Mauldin et al., 2001).

Research Question Three

Unexpectedly, the findings run counter to my hypotheses for research question three. I expected the time that parents spend engaging in cognitively stimulating activities with their children to have a stronger positive association with children's reading skills (hypothesis 3.1) and math skills (hypothesis 3.2) than the provision of learning materials in the home. Results suggest the opposite: Material investments matter more than time investments for children's development of early academic skills. In fact, parental time has an unanticipated negative association with children's academic skills after conditioning on the presence of cognitively stimulating materials in the home.

Perhaps the small negative association between parental time and children's outcomes is not surprising in light of previous studies that find limited evidence that parental time has positive effects on children's development of cognitive skills. For example, two studies using data from the NICHD Study of Early Child Care and Development suggest that the time parents spend with children in early childhood does not have a significant association with child cognitive outcomes (Booth, Clarke-Stewart, Vandell, McCartney, & Owen, 2002; Huston and Aronson, 2005). Booth et al. (2002) compared the time use of mothers who used full-time child

care with the time use of mothers who kept their children at home during the first six months after birth. They found that mothers who placed their children in full-time child care spent about 12 less hours a week with their children, but these differences in time did not relate to children's cognitive skills or vocabulary at 15 months. Huston and Aronson (2005) extended this research with later waves of data and found that maternal time was again unrelated to cognitive skills at age two or vocabulary at age three.

Nevertheless, I conduct a series of sensitivity analyses to explore a variety of post hoc hypotheses about the small negative association between parental time and children's outcomes. I find that this negative effect persists in most models, as described further below. On the whole, these sensitivity analyses do not alter my initial conclusion that material investments matter more for children's outcomes than time investments. The positive associations between learning materials and children's academic outcomes in a mediation model that includes only material investments are 10 to 20 times greater than the positive coefficients for time in a time-only model. Similarly, a series of path models show that material investment indicators are always positively associated with children's outcomes and often have larger effect sizes than the few time investment indicators that do have positive relationships with children's outcomes. For example, the number of children's books in the home and the presence of a computer the child uses always have a stronger positive association with children's reading and math skills than time parents spend reading to their children.

Research Question Four

For research question four, I hypothesized that maternal education would moderate the effects of both parental time and materials, such that children of more educated mothers would benefit more from these types of investments. Results were mixed for this question. I did not

find evidence that time investments are more valuable in families headed by more educated mothers (hypothesis 4.1). That is, I did not find a significant interaction between maternal education and time in the equation predicting children's first grade reading skills. I did find a small negative interaction between maternal education and time for math skills, which indicates that the negative effect of parental time is even more negative for children from families in which mothers have some college education or more. I discuss the negative effect of parental time further below.

The positive associations between material investments and children's outcomes were greater in more educated families, as predicted (hypothesis 4.2). I find a small, significant interaction between material investment and maternal education, such that material investments have a stronger positive association with children's reading and math skills in families headed by mothers with some college education versus mothers with no college education. Previous research demonstrates that more educated mothers tend to exhibit greater sensitivity and warmth toward their children and engage with learning materials in more stimulating ways (Britto et al., 2006, Lugo-Gil & Tamis-LeMonda, 2008; Tamis-LeMonda et al., 2004). These parenting behaviors, in turn, have been linked to higher scores on assessments of children's cognitive skills, vocabulary, and language use (Ryan et al., 2006; Tamis-LeMonda et al., 2004). Parents who score high on sensitivity take their child's perspective more readily. They are also better at perceiving and responding to their child's cues. Responsive parenting may promote children's self-regulation, self-efficacy, and sense of control, which facilitate children's performance on cognitive skills tasks (Bornstein and Tamis-LeMonda, 1989).

Research Question Five

For research question five, I hypothesized that time and material investments would have a greater positive association with children's academic outcomes in families with higher levels of income. The results do not support my hypothesis that time investments would have a greater positive association with children's outcomes in higher income families (hypothesis 5.1). The main effect of time is negative in the regression model predicting children's reading and math skills at the end of first grade. For the equation predicting reading skills, the interaction term between income and time investment is not statistically significant. For children's math skills, I find a small, significant interaction, such that the negative effect of time is greater in higher income families.

My second hypothesis for this question was, however, supported. Material investments have a stronger, positive association with children's reading and math skills in higher income families as compared to lower income families, as predicted (hypothesis 5.2). In sum, the pattern of results for this question is similar to the pattern of results for question four: The negative effect of time and the positive effect of learning materials on children's achievement are magnified in better-off families. The moderation of the value of learning materials in the home is consistent with the Matthew effects found in other educational studies. For example, an unintended consequence of the educational television program, *Sesame Street,* was an increase in the skills gaps between poor and middle-class children who viewed the program (Cooke, Appleton, Conner, & Schaffer, 1975 as cited in Walberg & Tsai, 1983). Middle-class children were able to learn more from the program because their parents engaged them in conversations that elaborated on the lessons offered in the television show.

The Negative Effect of Parental Time

All of the unexpected findings in this dissertation are driven by the negative effect of parental time. As mentioned previously, I conducted a series of sensitivity analyses to explore the small negative association I find between parental time and children's outcomes. First, I tested the hypothesis that parental time may be, in part, a reaction to children's initial achievement problems. I find that the negative effect of parental time is indeed reduced in a change model that controls for children's skill levels at kindergarten entry. This model eliminates the negative association between parental time and children's reading skills and explains about two thirds of the negative association between parental time and children's math skills.

Second, I tested the time investment and material investment variables one at a time in separate models, to see if the negative effect of parental time stems from multicollinearity between time and materials. The time investment variable is positively associated with children's first grade reading and math skills in a model which excludes material investment, suggesting that multicollinearity could indeed explain part of the negative association. In a subsequent model, I redefined the latent time investment variable so that it consists only of time indicators that are positively associated with children's outcomes. For example, I included time spent reading books and exclude time spent involving the child in chores. The correlation between time and material investment is higher in this model than the original model, and the coefficients on the paths from parental time to children's academic outcomes become even more negative. This provides further evidence that multicollinearity is a problem. Simply put, parents who spend more time on educational activities with their children are also more likely to provide

educational materials in the home. As a result, it is difficult to tease apart these two types of parenting behaviors.

A series of supplemental path models test the hypothesis that parents' time with children may be beneficial, neutral, or detrimental for children's school achievement, depending on how the time is spent. To explore this idea, I first examine a path model that includes each time indicator as a separate variable. Then I run a path model that includes additional types of parental investments that include an element of time, such as taking children on outings, or participating in parental involvement activities at children's schools. These models provide evidence that some activities that parents do with children are more beneficial than others. That is, the value of parental time spent with children depends on how that time is spent. Reading books, playing games, and talking about nature or doing science activities are the three items that most often have positive associations with children's reading and math outcomes. Singing songs, doing arts and crafts, and building things generally show negative associations. Taking children on outings generally has a negative or null association with children's academic skills, while school involvement is has a consistent, positive association. While previous studies of parental time use do make a distinction between time spent in the presence of the child, time spent caring for the child's physical needs, and time spent interacting with the child in cognitively stimulating ways (e.g. Booth et al., 2002; Hsin, 2008; Huston & Aronson, 2005; Kalil, Ryan, & Corey, 2009), my sensitivity analyses indicate that studies of parental time with children must be even more detailed in order to understand how and when parental time positively contributes to children's cognitive development.

Strengths and Weaknesses of the Study Design

The research design and statistical method used in this study have both strengths and weaknesses. The structural equation modeling technique allows for the estimation of multiple regression equations simultaneously while accounting for the high degree of correlation among the predictor variables in the model. As such, this method allows for an examination of a chain of regression pathways in sequence and reduces the multicollinearity problems that are common in OLS regression models. With this method, I was able to get inside of the "black box" of the home environment to examine multiple mediation pathways, thus adding to our understanding about the parenting processes that matter for children's academic outcomes. However, structural equation modeling as employed here is better suited to testing theories than establishing causal relations between variables.

Several weaknesses arise due to the limitations of the ECLS-K data set. This study lacks controls for parents' cognitive and verbal ability, which have been important moderators or covariates in other studies of SES, parenting, and child outcomes (e.g. Hsin, 2008; Mayer, 1997; Taylor et al., 2004). For example, Hsin (2008) finds that the time parents spend on cognitively stimulating activities with children has a positive influence on children's' verbal skills only after accounting for the moderating influence of maternal verbal skills. The ECLS-K also lacks information on the quality of parent-child interactions. Data on parental sensitivity, warmth, and engagement would allow for a more nuanced examination of parental time investments.

Finally, as noted by Juster and Stafford (1991), measuring time use with methods other than time-use diaries tends to lead to systematic bias. In this case, the latent time and material investment variables are subject to social desirability bias since the item-level data were collected through a parent survey. The time items were also measured in a rather blunt manner,

i.e. a four-category measure of frequency, rather than the number of hours per week. Finally, the survey question as written only gathered data about the frequency with which the respondent (typically the mother) engaged in these activities, rather than the total time invested by other family members and adults.

These measurement weaknesses could lead to attenuated estimates of the association between parental time and children's outcomes for two reasons: restricted range and measurement error. Given the four-point scale of the time variables and parents' potential tendency to over-report the frequency with which they engage their children in learning activities, several of these time items had very skewed distributions. For example, 80% of parent report reading to their children at least three times per week. This restricted range could be one reason why the magnitude of the time coefficients was so much smaller than the magnitude of the coefficients on material investment. It may also be the case that parents simply had have difficulty accurately remembering how often they did these activities with children. If the recall error led to both under- and over-reporting, then attenuation bias could help explain the small coefficient on time investment. Ideally, datasets will be available in the future that allow time-use diary data to be linked with consumer expenditure and child outcome data so that more accurate measures of time and material investments can be constructed for additional research on this topic.

Theoretical and Policy Implications

Parental investment theorists from the economics discipline have proposed that parental time and income both matter for children's development (Becker, 1981; Haveman & Wolfe, 1995). Even so, much of the previous empirical literature on family disadvantage and children's outcomes focuses on family income as a primary variable of interest (e.g. Gershoff et al., 2007,

Guo & Harris, 2000, Linver et al., 2002, Yeung et al., 2002). Perhaps this focus on family income occurs because income is a "policy lever" that is more easily manipulated than the way parents spend time with their children. The dearth of high quality time-use data in studies of parenting and child outcomes could also explain this focus on income.

Culture theorists posit that the effect of income on children's development has been overstated in previous research, because low family income is correlated with other parental characteristics - such as intelligence, attitudes, and work ethic - that determine children's outcomes (Mayer, 1997). The materials that foster children's development are inexpensive, and parents tend to spend income increases on luxuries such as a second car, a larger house, or more restaurant meals (Mayer, 1997). Ethnographic research indicates that parenting practices vary with social class, such that middle class place greater emphasis on intentionally fostering their children's skill development (Lareau, 2003). In sum, this strand of literature suggests that parents' taste for investments in children or their parenting "culture" is a primary determinant of the parenting behaviors that matter for children's academic outcomes.

Taking into account these theories and the debate about the "culture of poverty," this dissertation provides a more nuanced analysis of the family processes through which socioeconomic disadvantage is associated with children's outcomes. I consider education an independent variable in addition to income and parental investments into time and materials. To the extent that parental education can be considered a marker of parenting preferences or culture, the results of this dissertation suggest that parenting culture does matter and appears to matter more than income. This study does not doesn't settle the debate over the culture of poverty, however, because it is unknown whether income levels influence parenting beliefs and behaviors or "culture" determines income. It is likely that these associations are reciprocal in nature.

Nevertheless, these results suggest that future studies examining socio-economic disadvantage, parenting, and child outcomes would do well to treat maternal education as an additional predictor of interest, rather than just a covariate.

Because this study is correlational in nature, its results are best considered in tandem with other papers using identification strategies that better account for selection bias when making policy recommendations. While few exogenous sources of variation in parenting behavior exist, previous papers examining change models conclude that income increases are associated with improvements in the home environment (Dearing & Taylor, 2007; Votruba-Drzal, 2003) and children's cognitive skills (Dearing et al., 2001; Morris, Duncan, & Rodrigues, 2004; Morris & Gennetian, 2003; Taylor, Dearing, & McCartney, 2004), especially among the poorest families. Similarly, increases in disadvantaged mothers' education have been linked to improvements in children's academic skills, due in part to improvements in the home environment (Magnuson, 2007).

Previous studies have not compared the relative influence of changes in maternal education to changes in income, but the results of this study suggest that parents' level of education may be the primary driver of the parenting behaviors that matter for children's early cognitive development. As such, programs that support disadvantaged mothers' pursuit of further education may be a worthwhile policy priority. In addition, the positive effect of maternal education on children's outcomes was entirely mediated by the provision of learning materials in the home. Based on the results of this study, it could be argued that the provision of learning materials alone could be an effective intervention. In reality, few parenting intervention programs offer learning materials without encouraging parents to also spend time engaging their children with those materials (Howard and Brooks-Gunn, 2009). As such, this dissertation may

have set up a false dichotomy between time and materials. Rather than being substitutes, these parental investments may simply be complements.

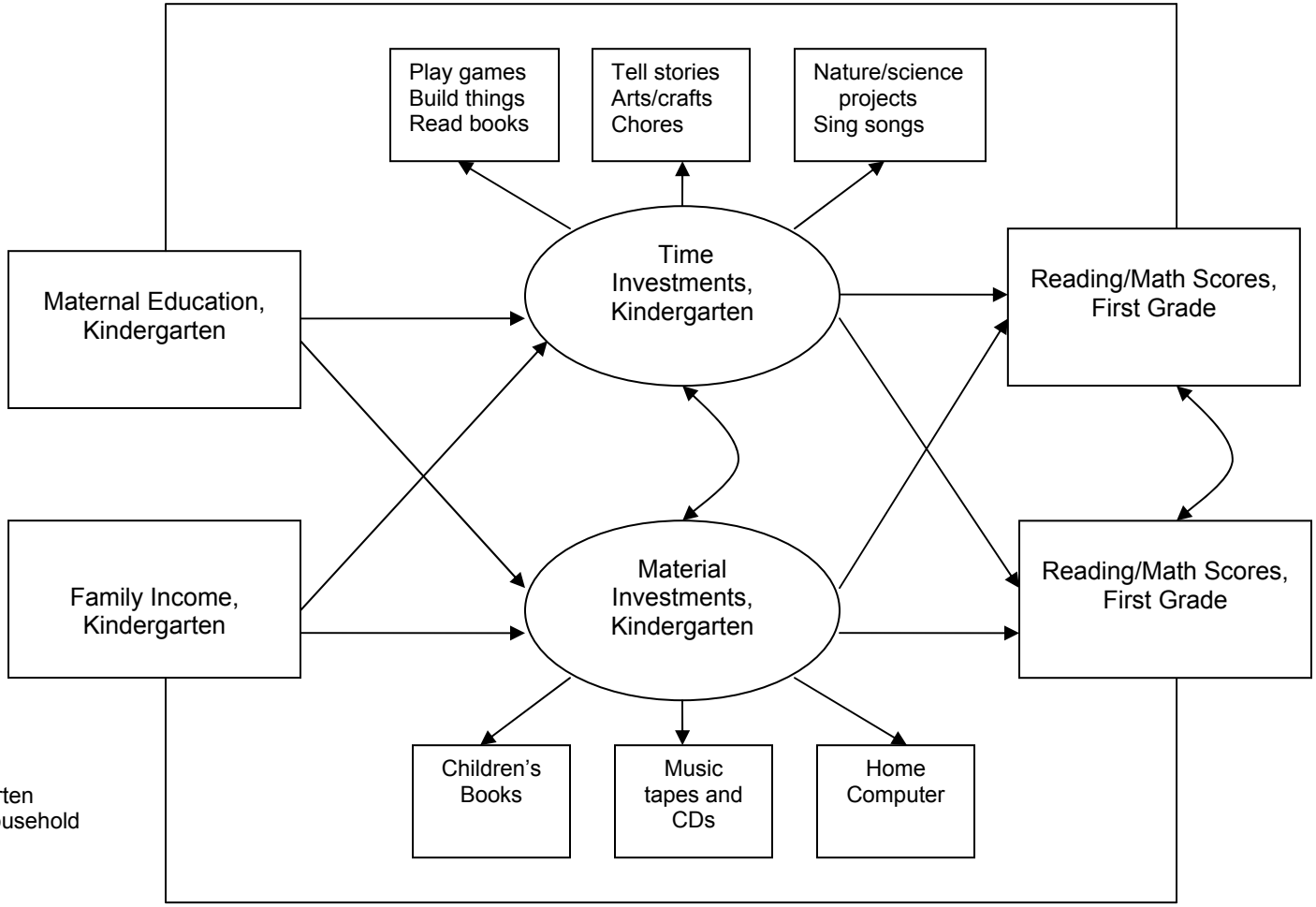
The positive association between material investment and children's academic achievement was greater for children from families with higher levels of maternal education and higher income, perhaps because more advantaged mothers engaged their children with these materials in more stimulating ways than less advantaged mothers. Again, these results support the use of parenting education programs that give families learning materials and model their use. However, further research is needed to identify effective interventions. As other authors have noted, interventions that serve children directly may be the most cost-effective and have the greatest impact (Magnuson & Duncan, 2004).

Future Directions

Future research on this topic may proceed in several directions. First, additional research must be conducted to understand why parental time has such small associations with children's outcomes. To accomplish this goal, the mediation model may be tested again with other data sets that include time-use diary data, such as the Panel Study of Income Dynamics – Child Development Supplement, and the NICHD Study of Early Child Care and Youth Development. Maternal cognitive skills, sensitivity, and responsiveness may be treated as moderators of parental time using these data sets. To conduct a more fine-grained analysis of the value of parental time, interactions between maternal education level and employment status should also be examined. Second, the model may be tested on racial and ethnic subgroups. These subgroup analyses would indicate the equivalence of the mediation model across racial and ethnic groups. This analytic approach may also shed some light on the extent to which parental education can indeed be considered a marker of parenting culture, especially if immigrant families are treated

as separate groups. Third, future research may also examine gender differences in parenting. For example, to what extent do mothers versus fathers take responsibility for spending time with children? Who purchases learning materials for children? How does this differ with the amount of income each parent earns and with each parent's work hours? Comparing families headed by single mothers to married-parent families would also give some insight into the unique contributions that fathers make to their children's development.

Figure 1: The Dissertation Logic Model



Controls:
Child race/ethnicity
Child gender
Child has special needs
Child repeated kindergarten
Number of children in household
Marital status
Mother's nativity
Maternal work hours
Paternal education

Table 1
Descriptive Statistics

Variable	Full Sample (*n*=20,730)	Low Income (<200% FPL) (*n*=7,426)	High Income (>200% FPL) (*n*=10,005)	Low Education (H.S. Diploma or less) (*n*=8,569)	High Education (Some College or more) (*n*=10,855)
Independent Variables					
Income, kinder	50817	19623	77093	32074	67071
	(1078)	(275)	(1420)	(648)	(1490)
Mother's Educ, kinder (%)					
8th grade or less	4.69	9.30	0.81	10.10	---
9-12th grade	10.11	18.62	2.61	21.80	---
High school diploma/GED	31.57	39.51	24.73	68.09	---
Some college or voc. ed.	31.75	27.29	35.87	---	59.20
Bachelor's degree	14.88	3.92	24.11	---	27.75
Master's or some grad. school	5.60	1.21	9.40	---	10.43
Doctorate or prof. degree	1.40	0.15	2.48	---	2.62
Dependent Variables					
Reading, Fall K (Lagged)	35.01	31.77	37.47	31.98	37.34
	(0.18)	(0.22)	(0.20)	(0.21)	(0.20)
Reading, Spring 1st	76.73	69.03	83.28	69.61	82.69
	(0.47)	(0.51)	(0.50)	(0.51)	(0.53)
Math, Fall K (Lagged)	25.79	22.42	28.69	22.69	28.45
	(0.19)	(0.20)	(0.21)	(0.19)	(0.21)
Math, Spring 1st	60.99	54.84	66.37	55.30	65.91
	(0.39)	(0.46)	(0.42)	(0.40)	(0.43)
Demographic Covariates					
Race (%)					
White	58.31	40.03	74.99	46.95	68.17
Black	15.21	24.32	7.80	18.18	12.65
Hispanic	18.93	27.82	10.64	27.41	11.59
Asian	3.53	3.00	3.46	3.30	3.73
Other Race	4.02	4.84	3.12	4.16	3.86
Child is female (%)	48.52	47.48	49.56	48.26	48.79
Child repeated kindergarten (%)	4.20	5.01	3.56	4.90	3.64
Child has special needs (%)	11.81	14.59	9.64	14.02	9.96
Marital Status					
Married (%)	70.09	51.01	86.11	60.69	78.11
Cohabitating (%)	8.46	12.74	5.15	12.44	5.23
Single/separated (%)	21.93	37.93	9.52	27.70	17.23
No. of children	2.52	2.86	2.25	2.66	2.40
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
Maternal work hours	23.58	20.77	25.81	21.98	24.91
	(0.33)	(0.46)	(0.39)	(0.51)	(0.39)
Mother is foreign born	16.59	23.57	10.29	22.43	11.92
Father's education					
Less education	22.27	17.05	26.86	9.53	33.14
Same education	34.93	31.03	37.98	36.83	33.35
More education	42.80	51.92	35.15	53.64	33.51

Table 1, *Descriptive Statistics, continued*

Time Investments					
Read books (%)					
Not at all	1.11	1.85	0.52	1.84	0.50
Once or twice a week	18.89	28.11	11.56	27.46	11.71
3 to 6 times a week	35.21	31.08	38.48	33.26	36.83
Everyday	44.80	38.97	49.44	37.44	50.96
Tell stories to child (%)					
Not at all	7.64	9.08	6.48	9.58	6.01
Once or twice a week	36.07	37.79	34.71	39.58	33.14
3 to 6 times a week	30.96	26.23	34.74	26.85	34.40
Everyday	25.33	26.90	24.08	23.99	26.45
Sing songs (%)					
Not at all	5.06	6.74	3.72	7.39	3.11
Once or twice a week	23.06	23.29	22.87	24.95	21.47
3 to 6 times a week	27.27	22.87	30.77	23.40	30.51
Everyday	44.61	47.10	42.63	44.26	44.91
Do arts and crafts (%)					
Not at all	7.42	10.98	4.59	10.89	4.53
Once or twice a week	40.22	40.64	39.89	41.41	39.22
3 to 6 times a week	32.38	26.81	36.81	26.93	36.94
Everyday	19.98	21.57	18.71	20.78	19.31
Involve child in chores (%)					
Not at all	3.70	5.09	2.59	4.99	2.62
Once or twice a week	18.05	18.99	1.73	20.39	16.09
3 to 6 times a week	25.10	18.25	30.57	10.50	28.88
Everyday	53.15	57.68	49.54	54.02	52.41
Play games (%)					
Not at all	4.03	6.23	2.28	5.78	2.57
Once or twice a week	35.24	37.68	33.29	38.15	32.80
3 to 6 times a week	38.84	31.59	44.62	33.23	43.54
Everyday	21.89	24.50	19.81	22.84	21.10
Nature/science projects (%)					
Not at all	20.31	26.69	15.23	27.77	14.07
Once or twice a week	48.15	45.76	50.05	46.28	49.72
3 to 6 times a week	21.73	16.79	25.66	16.32	26.26
Everyday	9.81	10.76	9.06	9.64	9.96
Build things (%)					
Not at all	17.59	20.41	15.34	20.76	14.93
Once or twice a week	44.53	41.74	46.75	42.39	46.31
3 to 6 times a week	24.52	21.73	26.74	22.48	26.23
Everyday	13.37	16.13	11.18	14.37	12.53
Material Investments					
No. of children's books	72.97	49.85	91.42	52.18	90.45
	(1.19)	(1.47)	(1.12)	(1.18)	(1.34)
No. of music CDs, etc.	14.84	10.98	17.91	11.43	17.70
	(0.30)	(0.38)	(0.31)	(0.35)	(0.33)
Home computer (%)	54.55	34.20	72.11	36.77	69.55

Note: Descriptive statistics are conducted in Stata. The data are weighted, therefore means and *standard errors* are displayed for continuous variables. FIML is not available in Stata, therefore group *n*'s will not match those for the analyses conducted in Mplus.

Table 2
Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Income (log)	1.000										
(2) Maternal education	0.404*	1.000									
(3) Reading, kinder	0.240*	0.343*	1.000								
(4) Reading, 1st	0.259*	0.347*	0.683*	1.000							
(5) Math, kinder	0.291*	0.398*	0.720*	0.656*	1.000						
(6) Math, 1st	0.265*	0.349*	0.536*	0.664*	0.720*	1.00					
(7) Read books	0.164*	0.246*	0.177*	0.176*	0.174*	0.151*	1.000				
(8) Tell stories to child	0.056*	0.111*	0.052*	0.067*	0.050*	0.042*	0.354*	1.000			
(9) Sing songs	0.008	0.079*	0.011	0.032*	0.016*	-0.005	0.180*	0.240*	1.000		
(10) Arts and crafts	0.051*	0.084*	0.020*	0.039*	0.041*	0.039*	0.215*	0.247*	0.201*	1.000	
(11) Chores	0.021*	0.060*	-0.017*	0.010	0.017*	0.029*	0.151*	0.162*	0.215*	0.151*	1.000
(12) Play games	0.044*	0.086*	0.052*	0.062*	0.078*	0.066*	0.226*	0.267*	0.205*	0.265*	0.206*
(13) Nature/science	0.080*	0.168*	0.092*	0.098*	0.109*	0.108*	0.226*	0.266*	0.216*	0.236*	0.203*
(14) Build things	0.021*	0.060*	-0.024*	-0.008	0.011	0.024*	0.194*	0.251*	0.155*	0.250*	0.162*
(15) No. of books	0.291*	0.381*	0.230*	0.238*	0.306*	0.285*	0.295*	0.137*	0.127*	0.112*	0.121*
(16) No. of music CDs	0.186*	0.246*	0.155*	0.148*	0.196*	0.168*	0.192*	0.124*	0.117*	0.105*	0.086*
(17) Home computer	0.343*	0.380*	0.237*	0.249*	0.302*	0.274*	0.181*	0.069*	0.041*	0.077*	0.039*
(18) Black	-0.217*	-0.099*	-0.119*	-0.151*	-0.160*	-0.199*	-0.113*	-0.032*	0.070*	-0.010	0.043*
(19) Hispanic	-0.147*	-0.274*	-0.110*	-0.129*	-0.217*	-0.157*	-0.111*	-0.027*	-0.052*	-0.072*	-0.085*
(20) Asian	0.017*	0.028*	0.078*	0.052*	0.069*	0.000	-0.006	0.022*	-0.091*	0.024*	-0.086*
(21) Other	-0.051*	-0.007	-0.046*	-0.039*	-0.041*	-0.044*	-0.009	0.026*	0.009	0.012	0.010
(22) Child is female	-0.005	0.002	0.060*	0.083*	-0.011	-0.047*	0.041*	0.012	0.126*	0.058*	0.032*
(23) Repeated kindergarten	-0.045*	-0.049*	0.031*	-0.064*	0.012	-0.045*	-0.033*	-0.001	-0.039*	-0.028*	-0.011
(24) Special needs	-0.052*	-0.048*	-0.126*	-0.174*	-0.133*	-0.150*	-0.010	-0.000	-0.017*	-0.006	0.010
(25) Cohabitating	-0.112*	-0.144*	-0.104*	-0.110*	-0.113*	-0.105*	-0.086*	-0.024*	0.002	-0.022*	0.001
(26) Separated/single	-0.357*	-0.173*	-0.151*	-0.168*	-0.174*	-0.169*	-0.103*	-0.021*	0.041*	-0.020*	0.004
(27) No. of children	-0.105*	-0.152*	-0.143*	-0.132*	-0.121*	-0.085*	-0.082*	-0.034*	-0.023*	-0.016*	0.025*
(28) Maternal work hours	0.092*	0.121*	-0.016*	-0.020*	0.000	-0.002	-0.038*	-0.007	0.012	-0.024*	0.016*
(29) Mother foreign born	-0.106*	-0.188*	0.018*	-0.036*	-0.120*	-0.102*	-0.104*	-0.006	-0.129*	-0.052*	-0.153*
(30) Father less educ	0.082*	0.297*	0.008	0.018*	0.022*	0.028*	0.018*	-0.006	0.003	-0.002	0.018*
(31) Father more educ	-0.169*	-0.249*	-0.054*	-0.059*	-0.063*	-0.063*	-0.031*	-0.013	0.017*	-0.001	-0.007

Table 2
Correlation Matrix, continued

	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(12) Play games	1.000										
(13) Nature/science	0.251*	1.000									
(14) Build things	0.308*	0.272*	1.000								
(15) No. of books	0.109*	0.201*	0.114*	1.000							
(16) No. of music CDs	0.106*	0.138*	0.099*	0.410*	1.000						
(17) Home computer	0.070*	0.106*	0.044*	0.312*	0.214*	1.000					
(18) Black	0.022*	-0.071*	-0.006	-0.226*	-0.100*	-0.166*	1.000				
(19) Hispanic	-0.062*	-0.095*	-0.051*	-0.244*	-0.135*	-0.191*	-0.194*	1.000			
(20) Asian	-0.019*	-0.041*	0.003	-0.114*	-0.012	0.004	-0.118*	-0.134*	1.000		
(21) Other	0.018*	0.025*	0.004	-0.017*	-0.020*	-0.023*	-0.087*	-0.099*	-0.060*	1.000	
(22) Child is female	-0.032*	-0.033*	-0.215*	0.023*	0.034*	-0.001	0.006	0.005	0.002	-0.002	1.000
(23) Repeated kindergarten	-0.008	-0.018*	0.003	-0.040*	-0.012	-0.036*	0.015	0.019*	-0.010	0.001	-0.050*
(24) Special needs	0.013	0.002	0.043*	0.003	-0.010	-0.031*	-0.011	-0.030*	-0.030*	0.006	-0.093*
(25) Cohabitating	-0.006	-0.031*	-0.012	-0.103*	-0.074*	-0.114*	0.042*	0.050*	-0.031*	0.051*	-0.009
(26) Separated/single	-0.025*	-0.058*	-0.026*	-0.172*	-0.092*	-0.230*	0.331*	0.023*	-0.070*	0.039*	0.010
(27) No. of children	-0.012	-0.060*	0.032*	-0.062*	-0.024*	-0.074*	0.059*	0.040*	0.047*	0.033*	0.003
(28) Maternal work hours	-0.010	-0.020*	-0.036*	-0.005	0.011	0.011	0.085*	-0.060*	0.002	-0.007	-0.002
(29) Mother foreign born	-0.075*	-0.104*	-0.048*	-0.281*	-0.122*	-0.135*	-0.102*	0.417*	0.413*	-0.035*	0.000
(30) Father less educ	0.002	0.028*	-0.002	0.052*	0.021*	0.034*	-0.077*	-0.006	-0.034*	-0.011	0.002
(31) Father more educ	0.001	-0.031*	-0.010	-0.073*	-0.022*	-0.080*	0.179*	-0.018*	-0.009	0.026*	0.000

Table 2
Correlation Matrix, continued

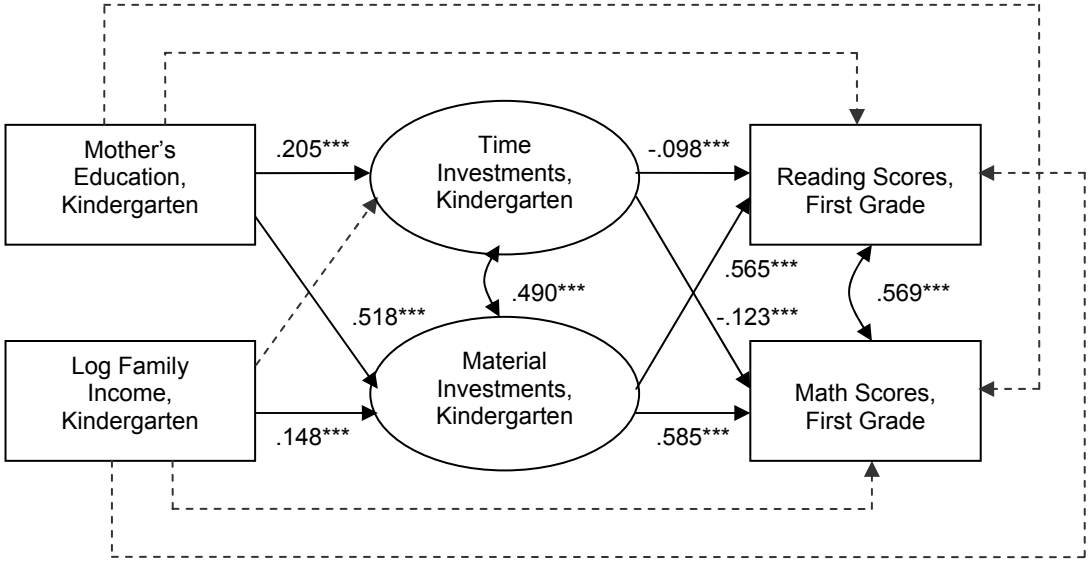
	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)
(23) Repeated kindergarten	1.000								
(24) Special needs	0.099*	1.000							
(25) Cohabitating	0.017*	0.020*	1.000						
(26) Separated/single	0.033*	0.024*	-0.148*	1.000					
(27) No. of children	0.018*	0.019*	0.009	-0.038*	1.000				
(28) Maternal work hours	-0.009	-0.030*	0.029*	0.114*	-0.189*	1.000			
(29) Mother foreign born	0.021*	-0.052*	0.009	-0.048*	0.066*	-0.083*	1.000		
(30) Father less educ	-0.016*	0.000	0.045*	-0.244*	-0.038*	0.088*	-0.042*	1.000	
(31) Father more educ	0.027*	0.017*	-0.093*	0.523*	0.019*	-0.048*	-0.015	-0.461*	1.000

Table 3
Summary of Measurement Model for Time and Material Investment

	Standardized coefficient
Latent time investment indicator loadings	
Time investment → Time parcel a	.703***
Time investment → Time parcel b	.718***
Time investment → Time parcel c	.571***
Latent material investment indicator loadings	
Material investment → Number of children's books	.749***
Material investment → Number of music records, tapes, CDs	.559***
Material investment → Home computer child uses	.413***
Covariance between time and material investment	.418***
Model Fit: $\chi^2(7) = 79.3$; RMSEA = .023, CFI = .989; TLI = .976	

Time parcel a is the mean of play games, build things, and read books.
Time parcel b is the mean of tell stories, arts & crafts, and involve child in chores.
Time parcel c is the mean of talk about nature or do science projects, and sing songs.
The variance of each latent factor is set to 1, so that loadings can be estimated for each indicator.

Figure 2: Results of Baseline Model for Children's Spring First Grade Achievement



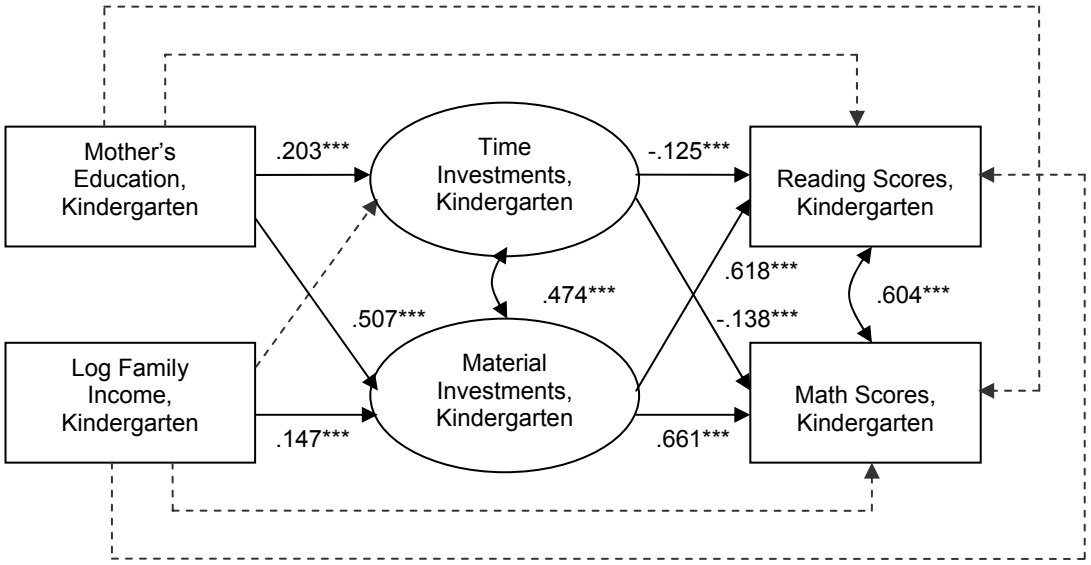
Model Fit Statistics
$\chi^2(84, n = 20{,}582) = 761,\ p<.001$
RMSEA = .020, p=1.0
CFI = .962
TLI = .930

Table 4
Total, Direct, and Indirect Effects in Baseline Model for Children's Spring First Grade Achievement
(*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.273***	(.012)	.278***	(.012)
Total Indirect	.273***	(.012)	.278***	(.012)
Indirect via Time	-.020***	(.004)	-.025***	(.004)
Indirect via Materials	.293***	(.014)	.303***	(.013)
Direct Effect	---	---	---	---
Income → Outcome				
Total Effect	.084***	(.009)	.087***	(.009)
Total Indirect	.084***	(.009)	.087***	(.009)
Indirect via Time	---	---	---	---
Indirect via Materials	.084***	(.009)	.087***	(.009)
Direct Effect	---	---	---	---

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p< 05, ** p< 01, ***p< 001

Figure 3: Results of Baseline Model for Children's Fall Kindergarten Achievement



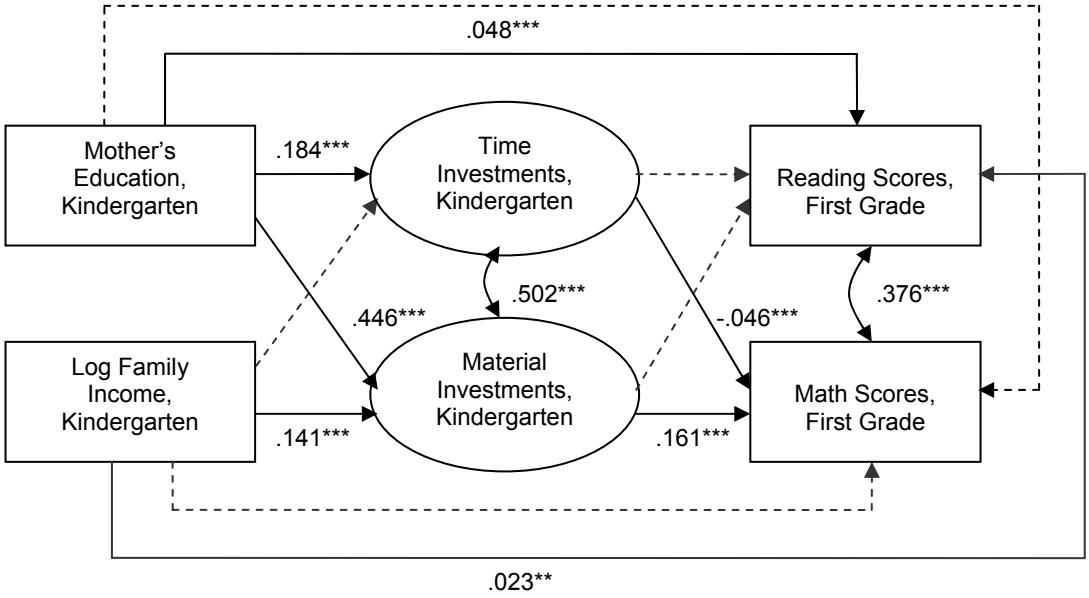
Model Fit Statistics
$\chi^2(84, n = 20{,}582) = 1164$, $p<.001$
RMSEA = .025, p=1.0
CFI = .962
TLI = .929

Table 5
Total, Direct, and Indirect Effects in Baseline Model for Children's Fall Kindergarten Achievement
(*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.288***	(.011)	.307***	(.011)
Total Indirect	.288***	(.011)	.307***	(.011)
Indirect via Time	-.025***	(.003)	-.028***	(.003)
Indirect via Materials	.313***	(.013)	.335***	(.012)
Direct Effect	---	---	---	---
Income → Outcome				
Total Effect	.091***	(.007)	.098***	(.007)
Total Indirect	.091***	(.007)	.098***	(.007)
Indirect via Time	---	---	---	---
Indirect via Materials	.091***	(.007)	.098***	(.007)
Direct Effect	---	---	---	---

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p< 05, ** p< 01, ***p< 001

Figure 4: Results of Baseline Model for Children's Learning From Kindergarten to First Grade



Model Fit Statistics
$\chi^2(92, n = 20{,}582) = 772,\ p<.001$
RMSEA = .019, p=1.0
CFI = .971
TLI = .946

Table 6
Total, Direct, and Indirect Effects in Baseline Model for Children's Learning from Kindergarten to First Grade (n = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.048***	(.011)	.063***	(.008)
Total Indirect	--	--	.063***	(.008)
Indirect via Time	--	--	-.009***	(.002)
Indirect via Materials	--	--	.072***	(.009)
Direct Effect	.048***	(.011)	--	--
Income → Outcome				
Total Effect	.023**	(.007)	.023***	(.004)
Total Indirect	--	--	.023***	(.004)
Indirect via Time	--	--	--	--
Indirect via Materials	--	--	.023***	(.004)
Direct Effect	.023**	(.007)	--	--

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant
* p<.05, ** p<.01, ***p<.001

Table 7
Results of Wald Tests for Research Question Two
(n = 20,582)

	Time Investment	Material Investment
Spring 1st Grade		
Mother's Education	.203***	.518***
Family Income (log)	.007	.148***
Wald Test Statistic	59.3***	203.6***
Fall Kindergarten		
Mother's Education	.203***	.507***
Family Income (log)	-.001	.147***
Wald Test Statistic	81.0***	318.5***
Fall K to Spring 1st		
Mother's Education	.184***	.446***
Family Income (log)	.001	.141***
Wald Test Statistic	51.4***	99.6***

Table displays standardized parameter estimates.
All Wald tests are one degree of freedom tests.
* p<.05, ** p<.01, ***p<.001

Table 8
Results of Wald Tests for Research Question Three
(n = 20,582)

	Reading Achievement	Math Achievement
Spring 1st Grade		
Material Investment	.565***	.585***
Time Investment	-.098***	-.123***
Wald Test Statistic	153.3***	188.4***
Fall Kindergarten		
Material Investment	.618***	.661***
Time Investment	-.125***	-.138***
Wald Test Statistic	269.7***	343.3***
Fall K to Spring 1st		
Material Investment	.031	.161***
Test Investment	.006	-.046***
Wald Test Statistic	.072	42.2***

Table displays standardized parameter estimates.
All Wald tests are one degree of freedom tests.
* p<.05, ** p<.01, ***p<.001

Table 9
Results of Omnibus Test for Interactions by Mother's Education for Children's Spring First Grade Achievement
(*n* = 19,424)

	Reading	Math
Mother has some college or more	-0.76	-1.57
Low income (< 200% of FPL)	1.87	2.53*
Material investment	13.03***	11.39***
Time investment	-2.25***	-2.07***
Material x some college or more	2.06*	2.57***
Time x some college or more	-0.29	-1.40**
Black	6.22**	1.63
Hispanic	4.45**	2.37
Asian	8.03***	1.83
Other race/ethnicity	0.34	-0.14
Child is female	2.19***	-2.93***
No. of children	-2.30***	-1.02***
Father has more education	-1.14	-1.26
Father has less education	-0.22	0.52
Cohabitating	-0.37	0.29
Single or separated	0.74	2.33*
Mother's work hours	-0.04*	-0.01
Mother is foreign-born	3.02*	3.19***
Child has a disability	-12.48***	-8.90***
Child repeated kindergarten	-1.20	0.88

Note: Regression coefficients shown are unstandardized. The standard deviation of reading is 23.91, and the standard deviation of math is 18.11.
* p<.05, ** p<.01, ***p<.001

Table 10
Results of Omnibus Test for Interactions by Mother's Education for Children's Fall Kindergarten Achievement
(*n* = 19,424)

	Reading	Math
Mother has some college or more	-1.29*	-1.37**
Low income (< 200% of FPL)	2.01***	1.96***
Material investment	6.76***	6.67***
Time investment	-1.30***	-1.24***
Material x some college or more	2.69***	2.74***
Time x some college or more	-1.10***	-1.29***
Black	5.82***	3.61***
Hispanic	2.51***	1.64**
Asian	6.39***	4.87***
Other race/ethnicity	2.15**	1.18
Child is female	0.62**	-0.77***
No. of children	-1.24***	-0.77***
Father has more education	-0.41	-0.39
Father has less education	0.10	0.21
Cohabitating	0.27	0.54
Single or separated	0.70	1.02*
Mother's work hours	-0.01	-0.00
Mother is foreign-born	2.07***	1.50***
Child has a disability	-2.92***	-3.36***
Child repeated kindergarten	3.68***	2.56***

Note: Regression coefficients shown are unstandardized. The standard deviation of reading is 23.91, and the standard deviation of math is 18.11.
* p<.05, ** p<.01, ***p<.001

Table 11
Results of Omnibus Test for Interactions by Mother's Education for Children's Learning - Fall of Kindergarten to the Spring of First Grade
(*n* = 19,424)

	Reading	Math
Mother has some college or more	-14.29***	-7.04***
Low income (< 200% of FPL)	13.46***	6.99***
Material investment	30.16***	16.61**
Time investment	-10.20***	-5.51**
Material x some college or more	-0.79	-0.22
Time x some college or more	0.10	-0.56
Black	19.46***	7.04*
Hispanic	16.75***	7.65***
Asian	13.63***	3.21
Other race/ethnicity	8.99**	3.81
Child is female	0.98	-2.46**
No. of children	-2.80***	-1.10***
Father has more education	-5.35***	-2.97**
Father has less education	3.55	1.97
Cohabitating	8.79***	4.34
Single or separated	11.57***	6.69***
Mother's work hours	-0.03	-0.00
Mother is foreign-born	8.78***	5.26***
Child has a disability	-8.20***	-5.08***
Child repeated kindergarten	-4.99	-1.86
Fall Kindergarten Reading	0.86***	
Fall Kindergarten Math		0.80***

Note: Regression coefficients shown are unstandardized. The standard deviation of reading is 23.91, and the standard deviation of math is 18.11.
* p<.05, ** p<.01, ***p<.001

Table 12
Results of Omnibus Test for Interactions by Income for Children's Spring First Grade Achievement
(*n* = 17,431)

	Reading	Math
Mother has some college or more	-1.51	-2.09
Low income (< 200% of FPL)	2.34	2.85*
Material investment	16.09***	14.63***
Time investment	-2.93**	-3.55***
Material x low income	-2.71*	-2.79***
Time x low income	0.55	1.12*
Black	6.67**	1.95
Hispanic	5.19**	2.82*
Asian	8.66***	2.07
Other race/ethnicity	0.91	0.09
Child is female	2.15**	-2.99***
No. of children	-2.32***	-1.05***
Father has more education	-1.41	-1.59*
Father has less education	-0.03	0.64
Cohabitating	-0.22	0.45
Single or separated	1.12	2.71*
Mother's work hours	-0.04*	-0.01
Mother is foreign-born	3.42*	3.58***
Child has a disability	-12.34***	-8.67***
Child repeated kindergarten	-1.14	0.95

Note: Regression coefficients shown are unstandardized. The standard deviation of reading is 23.91, and the standard deviation of math is 18.11.
* p<.05, ** p<.01, ***p<.001

Table 13
Results of Omnibus Test for Interactions by Income for Children's Fall Kindergarten Achievement
(*n* = 17,431)

	Reading	Math
Mother has some college or more	-2.47**	-2.29***
Low income (< 200% of FPL)	3.56***	3.18***
Material investment	12.02***	11.32***
Time investment	-3.22***	-3.19***
Material x low income	-3.87***	-3.49***
Time x low income	1.41**	1.55***
Black	6.99***	4.46***
Hispanic	3.61***	2.46***
Asian	6.89***	5.19***
Other race/ethnicity	2.47**	1.32
Child is female	0.52*	-0.87***
No. of children	-1.31***	-0.80***
Father has more education	-0.99*	-0.88*
Father has less education	0.42	0.43
Cohabitating	0.75	0.91*
Single or separated	1.59**	1.74***
Mother's work hours	-0.00	0.00
Mother is foreign-born	2.67***	1.96***
Child has a disability	-2.77***	-3.23***
Child repeated kindergarten	3.53***	2.41***

Note: Regression coefficients shown are unstandardized. The standard deviation of reading is 23.91, and the standard deviation of math is 18.11.
* p<.05, ** p<.01, ***p<.001

Table 14
Results of Omnibus Test for Interactions by Income for Children's Learning from the Fall of Kindergarten to the Spring of First Grade
(*n* = 17,431)

	Reading	Math
Mother has some college or more	-14.58***	-6.77***
Low income (< 200% of FPL)	14.32***	7.14***
Material investment	29.87***	15.83***
Time investment	-10.02***	-5.45***
Material x low income	0.02	0.20
Time x low income	0.20	0.04
Black	19.89***	6.84**
Hispanic	16.98***	7.27***
Asian	13.40***	2.66
Other race/ethnicity	9.29***	3.45*
Child is female	0.89	-2.50***
No. of children	-2.97***	-1.16***
Father has more education	-5.40***	-2.90**
Father has less education	3.66	1.93
Cohabitating	8.46***	3.99**
Single or separated	11.36***	6.32***
Mother's work hours	-0.03	-0.00
Mother is foreign-born	9.45***	5.58***
Child has a disability	-8.51***	-5.12***
Child repeated kindergarten	-4.85	-1.86
Fall Kindergarten Reading	0.85***	
Fall Kindergarten Math		0.82***

Note: Regression coefficients shown are unstandardized. The standard deviation of reading is 23.91, and the standard deviation of math is 18.11.
* p<.05, ** p<.01, ***p<.001

Figure 5: Results of Time Only Model for Children's Spring First Grade Achievement

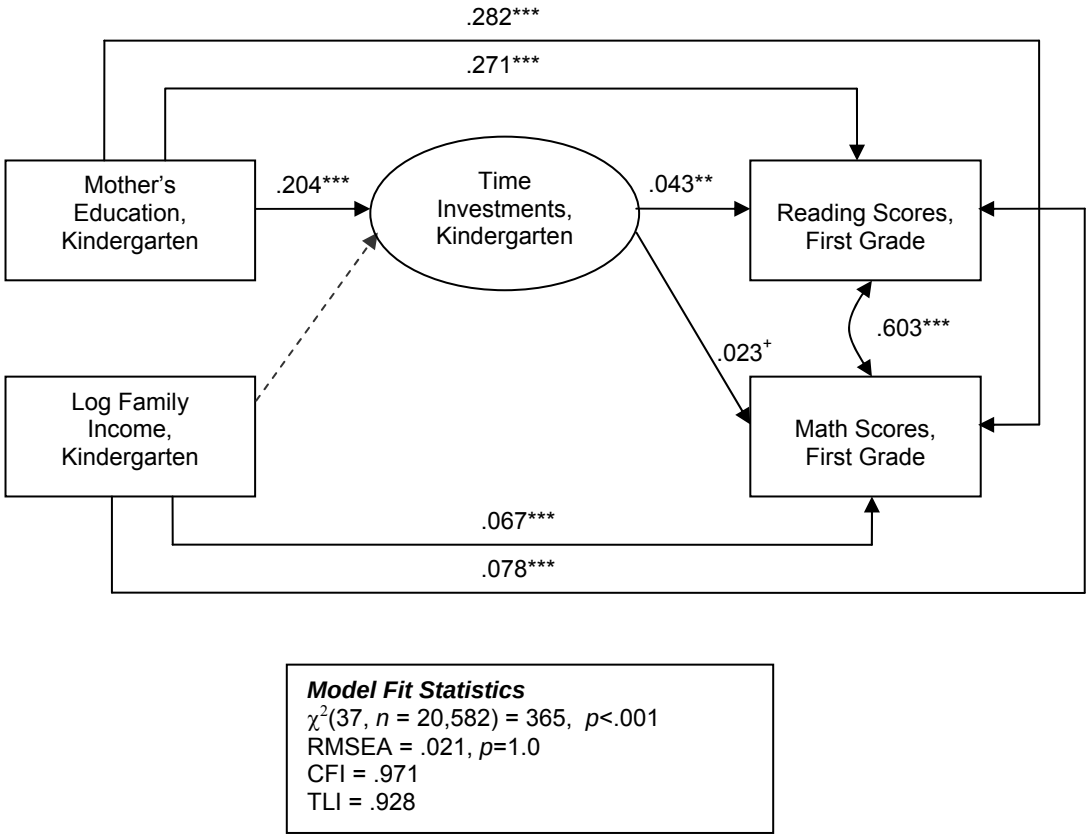
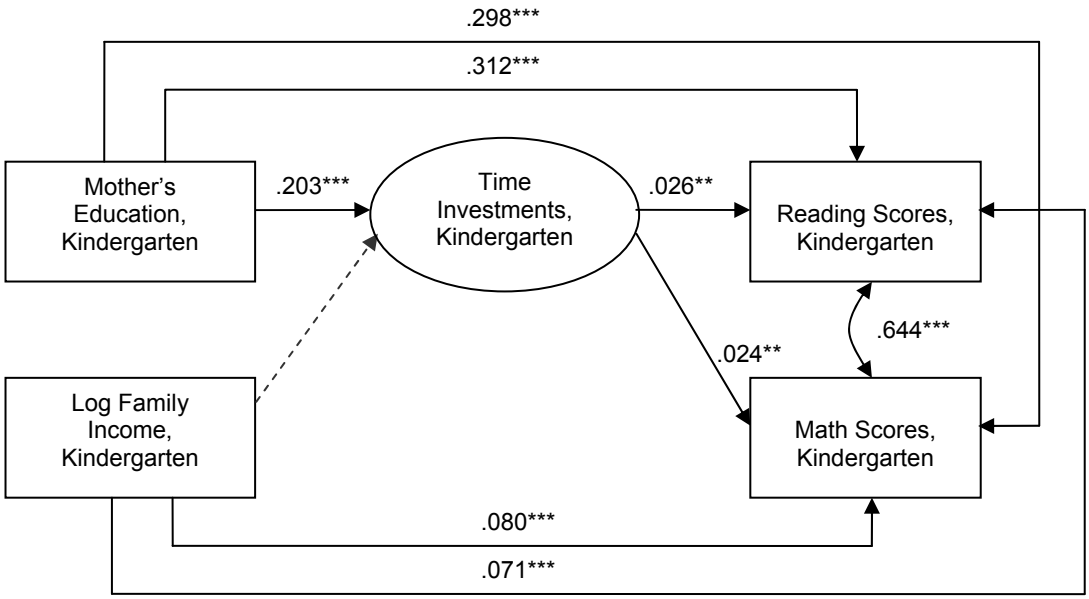


Table 15
Total, Direct, and Indirect Effects in Time Only Model for Children's Spring First Grade Achievement
(n = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.280***	(.015)	.286***	(.013)
Indirect via Time	.009**	(.003)	.005**	(.002)
Direct Effect	.271***	(.015)	.282***	(.013)
Income → Outcome				
Total Effect	.078***	(.013)	.067***	(.013)
Indirect via Time	---	---	---	---
Direct Effect	.078***	(.013)	.067***	(.008)

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 6: Results of Time Only Model for Children's Fall Kindergarten Achievement



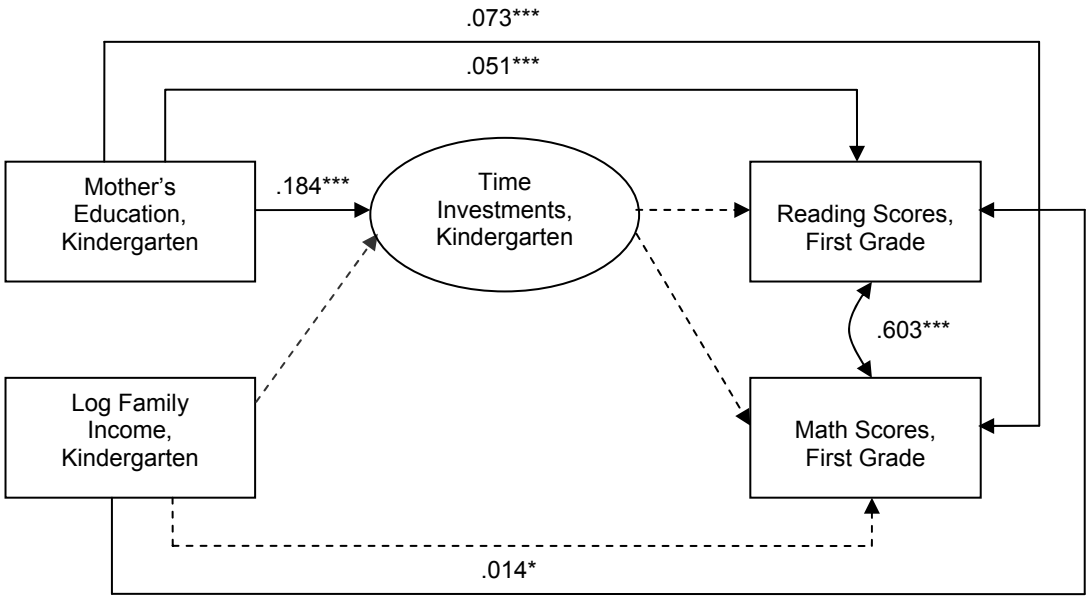
Model Fit Statistics
$\chi^2(37, n = 20{,}582) = 523,\ p<.001$
RMSEA = .025, p=1.0
CFI = .972
TLI = .932

Table 16
Total, Direct, and Indirect Effects in Time Only Model for Children's Fall Kindergarten Achievement
(*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.303***	(.012)	.317***	(.012)
Indirect via Time	.005**	(.002)	.005**	(.002)
Direct Effect	.298***	(.013)	.312***	(.012)
Income → Outcome				
Total Effect	.071***	(.009)	.080***	(.008)
Indirect via Time	---	---	---	---
Direct Effect	.071***	(.009)	.080***	(.008)

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 7: Results of Time Only Model for Children's Learning From Kindergarten to First Grade



Model Fit Statistics
$\chi^2(44n = 20{,}582) = 388$ $p<.001$
RMSEA = .019p=1.0
CFI = .979
TLI = .953

Table 17
Total, Direct, and Indirect Effects in Time Only Model for Children's Learning from Kindergarten to First Grade (n = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.051***	(.011)	.073***	(.010)
Indirect via Time	---	---	---	---
Direct Effect	.051***	(.011)	.073***	(.010)
Income → Outcome				
Total Effect	.014*	(.007)	---	---
Indirect via Time	---	---	---	---
Direct Effect	.014*	(.007)	---	---

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 8: Results of Materials Only Model for Children's Spring First Grade Achievement

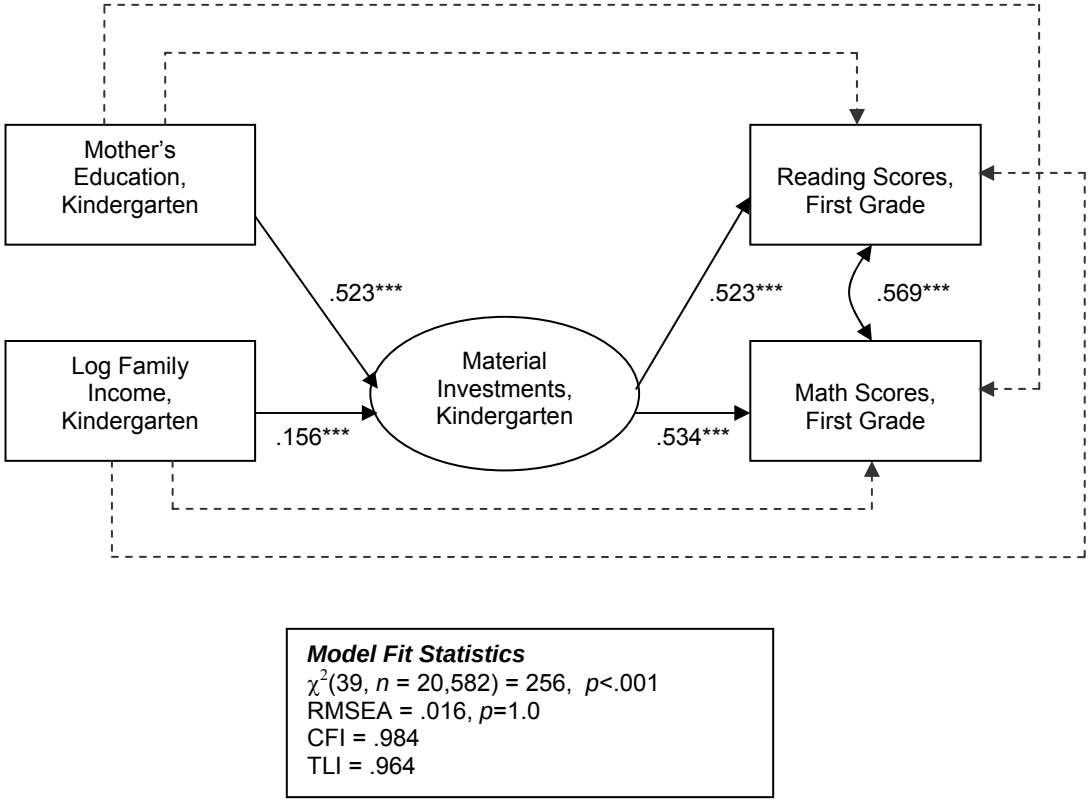


Table 18
Total, Direct, and Indirect Effects in Materials Only Model for Children's Spring First Grade Achievement
(*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.273***	(.012)	.279***	(.011)
Indirect via Materials	.273***	(.012)	.279***	(.011)
Direct Effect	---	---	---	---
Income → Outcome				
Total Effect	.082***	(.009)	.083***	(.009)
Indirect via Materials	.082***	(.009)	.083***	(.009)
Direct Effect	---	---	---	---

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 9: Results of Materials Only Model for Children's Fall Kindergarten Achievement

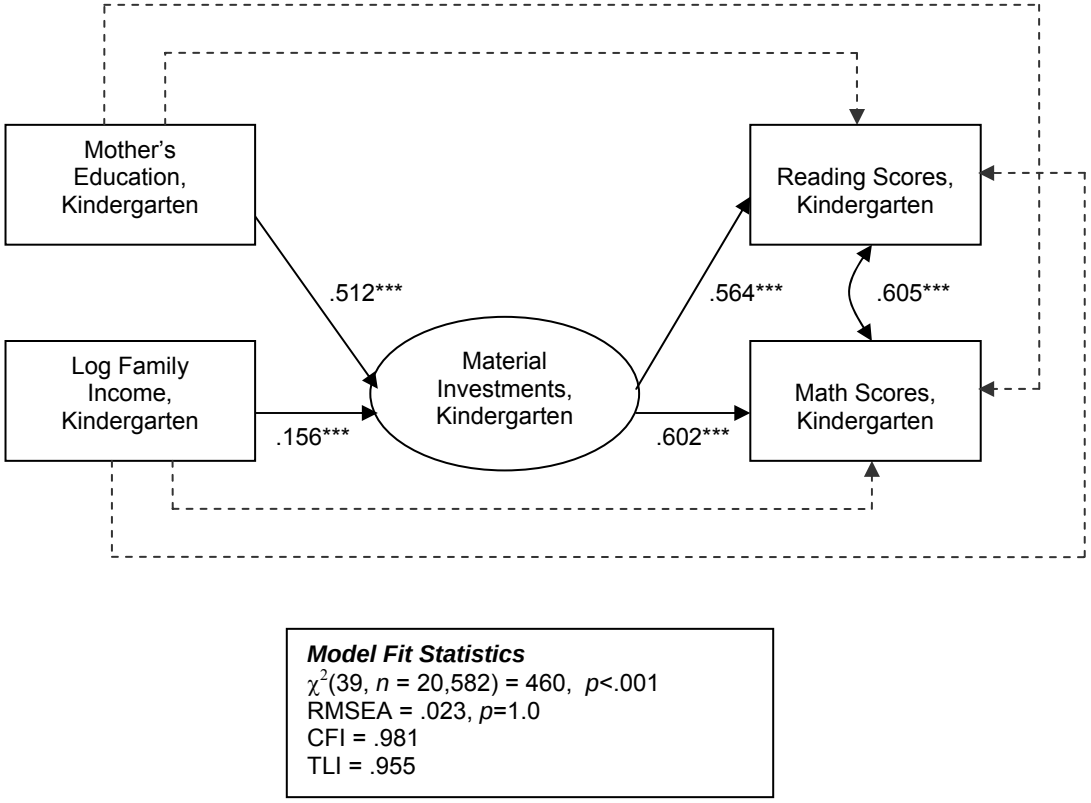
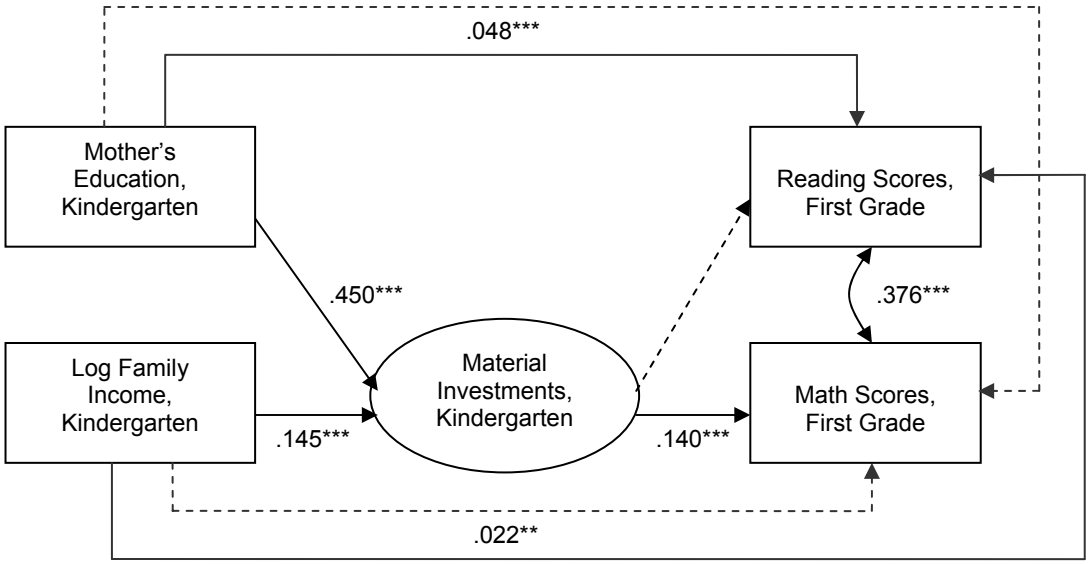


Table 19
Total, Direct, and Indirect Effects in Materials Only Model for Children's Fall Kindergarten Achievement
(*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.289***	(.011)	.308***	(.011)
Indirect via Materials	.289***	(.011)	.308***	(.011)
Direct Effect	---	---	---	---
Income → Outcome				
Total Effect	.088***	(.006)	.094***	(.007)
Indirect via Materials	.088***	(.006)	.094***	(.007)
Direct Effect	---	---	---	---

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 10: Results of Materials Only Model for Children's Learning From Kindergarten to First Grade



Model Fit Statistics
$\chi^2(42, n = 20{,}582) = 256,\ p<.001$
RMSEA = .016, p=1.0
CFI = .989
TLI = .974

Table 20
Total, Direct, and Indirect Effects in Materials Only Model for Children's Learning From Kindergarten to First Grade (n = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.048***	(.011)	.063***	(.008)
Indirect via Materials	---	---	.063***	(.008)
Direct Effect	.048***	(.011)	---	---
Income → Outcome				
Total Effect	.022**	(.007)	.020***	(.003)
Indirect via Materials	---	---	.020***	(.003)
Direct Effect	.022**	(.007)	---	---

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 11: Path Model Examining Time and Material Investment Indicators Separately

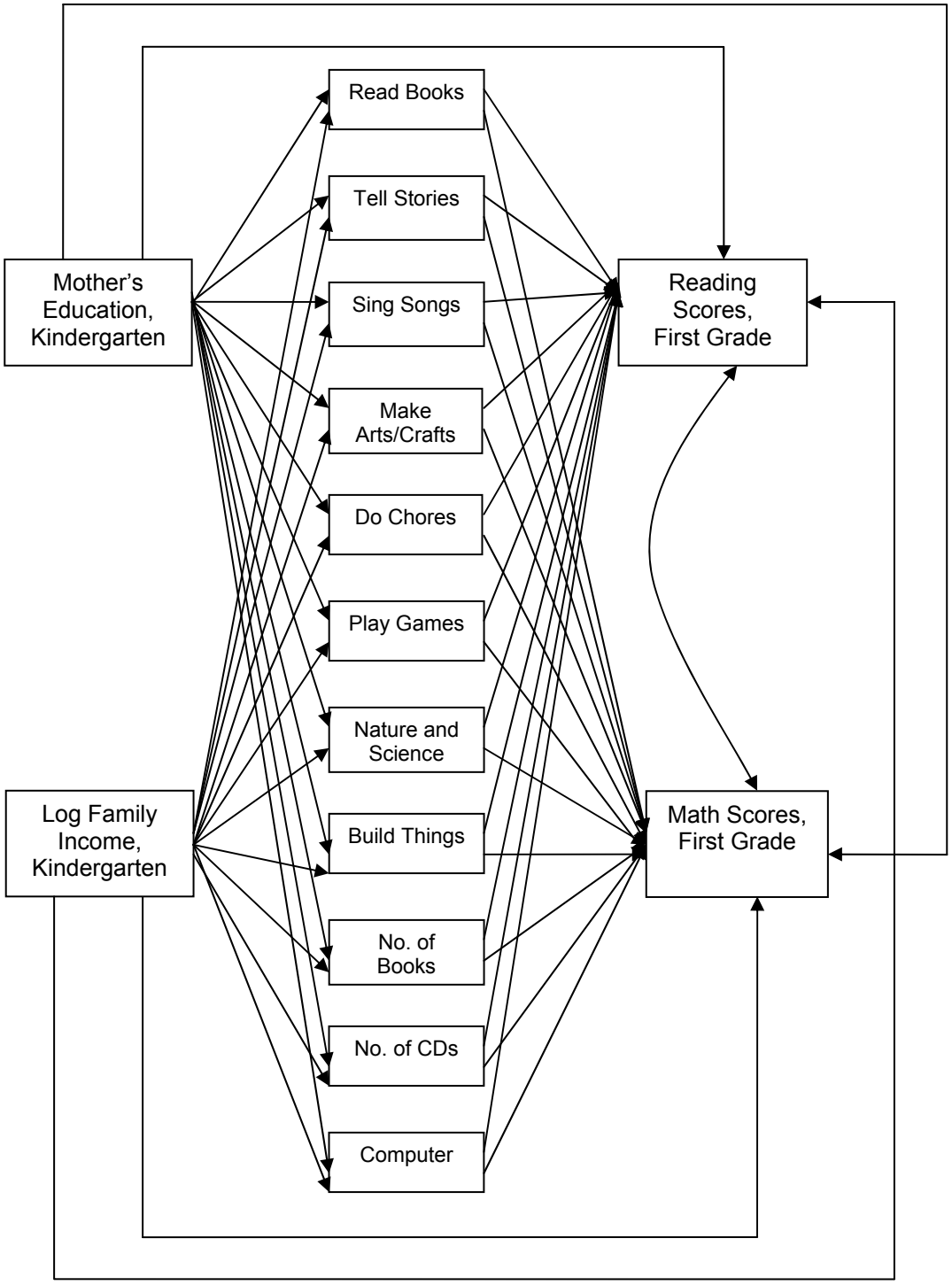


Table 21

Results for Path Model Predicting Children's Spring First Grade Achievement (*n*=20,582)

Panel A Estimates for Paths to and from Mediators				
	Paths from IVs to Mediators		Paths from Mediators to DVs	
Mediators (*Z* variables)	Mother's Ed→ *Z*	Log Income→ *Z*	*Z* →Reading	*Z*→Math
Read Books	.236***	---	.049***	---
Tell Stories	.114***	---	---	---
Sing Songs	.086***	---	---	-.020*
Make Arts and Crafts	.066***	---	---	---
Involve Child in Chores	.039**	---	---	---
Play Games	.072***	---	---	---
Nature/Science Projects	.139***	---	.025*	.032**
Build Things	.053***	---	-.028*	-.028***
Number of Books	.298***	.074***	.062***	.088***
Number of Audio CDs	.190***	.059***	---	---
Home Computer	.288***	.118***	.073***	.087***
Panel B **Total, Direct, and Indirect Effects**				
	Total Effect	Indirect Effect	Direct Effect	
Mom's Education→Reading	.281***	.053***	.228***	
Log Income→Reading	.077***	.013***	.064***	
Mom's Education→Math	.286***	.053***	.234***	
Log Income→Math	.066***	.017***	.050***	
Panel C **Model Fit Statistics**				
$\chi^2(72) = 4935$, $p<.001$; RMSEA = .057, CFI = .771; TLI = .089				

Notes:

Table displays standardized parameter estimates.

* p<.05, ** p<.01, ***p<.001

Dashes signify parameters that were not estimated because initial model results indicated they were not significant.

The following covariates predict both the mediators and the dependent variables:

- Child race/ethnicity (reference group: white)
- Child is female (reference group: male)
- Child repeated kindergarten (reference group: child did not repeat kindergarten)
- Child is disabled (reference group: child is not disabled)
- Number of children in household
- Father has more or less education than mother (reference group: father and mother have same education)
- Marital status: cohabitating; separated/single (reference group: married & living together)
- Mother is foreign-born (reference group: mother is native-born)

Model includes the following covariances:

- Tell stories ↔ Read books
- Build things ↔ Play games
- Number of books ↔ Number of audio CDs
- Reading ↔ Math

Table 22

Results for Path Model Predicting Children's Fall Kindergarten Achievement (*n*=20,582)

Panel A Estimates for Paths to and from Mediators				
	Paths from IVs to Mediators		Paths from Mediators to DVs	
Mediators (*Z* variables)	Mother's Ed→ *Z*	Log Income→ *Z*	*Z* →Reading	*Z*→Math
Read Books	.210***	.030*	.062***	.023**
Tell Stories	.103***	---	---	---
Sing Songs	.075***	---	---	---
Make Arts and Crafts	.069***	---	-.026**	-.020*
Involve Child in Chores	.036**	---	-.015*	---
Play Games	.077***	---	.026**	.043***
Nature/Science Projects	.140***	---	.018**	---
Build Things	.055***	---	-.047***	-.040***
Number of Books	.285***	.073***	.069***	.090***
Number of Audio CDs	.191***	.065***	.031**	.026**
Home Computer	.191***	.065***	.074***	.087***
Panel B **Total, Direct, and Indirect Effects**				
	Total Effect	Indirect Effect	Direct Effect	
Mom's Education→Reading	.303***	.059***	.244***	
Log Income→Reading	.071***	.018***	.053***	
Mom's Education→Math	.317***	.060***	.257***	
Log Income→Math	.079***	.020***	.060***	
Panel C **Model Fit Statistics**				
$\chi^2(65) = 7889$, $p<.001$; RMSEA = .076, CFI = .769; TLI = -.015				

Notes:

Table displays standardized parameter estimates.

* p<.05, ** p<.01, ***p<.001

Dashes signify parameters that were not estimated because initial model results indicated they were not significant.

The following covariates predict both the mediators and the dependent variables:

- Child race/ethnicity (reference group: white)
- Child is female (reference group: male)
- Child repeated kindergarten (reference group: child did not repeat kindergarten)
- Child is disabled (reference group: child is not disabled)
- Number of children in household
- Father has more or less education than mother (reference group: father and mother have same education)
- Marital status: cohabitating; separated/single (reference group: married & living together)
- Mother is foreign-born (reference group: mother is native-born)

Model includes the following covariances:

- Tell stories ↔ Read books
- Build things ↔ Play games
- Number of books ↔ Number of audio CDs
- Reading ↔ Math

Table 23

Results for Path Model Predicting Children's Learning from Fall Kindergarten to Spring First Grade (*n*=20,582)

Panel A Estimates for Paths to and from Mediators				
	Paths from IVs to Mediators		Paths from Mediators to DVs	
	Mother's Ed→*Z*	Log Income→*Z*	*Z*→Reading	*Z*→Math
Read Books	.207***	---	.027**	---
Tell Stories	.105***	---	---	---
Sing Songs	.080***	---	---	-.023***
Make Arts and Crafts	.063***	---	---	---
Involve Child in Chores	.036*	---	---	.021**
Play Games	.052***	---	---	---
Nature/Science Projects	.121***	---	---	---
Build Things	.059***	---	---	---
Number of Books	.260***	.064***	---	.028**
Number of Audio CDs	.161***	.052***	---	---
Home Computer	.253***	.108***	.036***	.038***
Panel B **Total, Direct, and Indirect Effects**				
	Total Effect	Indirect Effect	Direct Effect	
Mom's Education→Reading	.104***	.015***	.089***	
Log Income→Reading	.027***	.004***	.023***	
Mom's Education→Math	.108***	.016***	.092***	
Log Income→Math	.006***	.006***	---	
Panel C **Model Fit Statistics**				
$\chi^2(79) = 5673$, $p<.001$; RMSEA = .059, CFI = .793; TLI = .182				

Notes:

Table displays standardized parameter estimates.

* p<.05, ** p<.01, ***p<.001

Dashes signify parameters that were not estimated because initial model results indicated they were not significant.

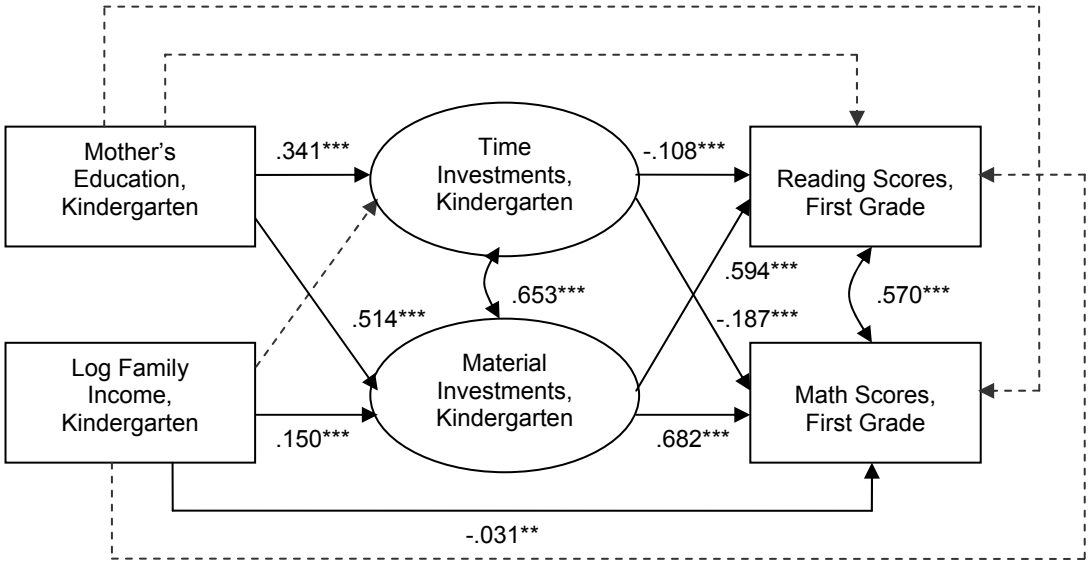
The following covariates predict both the mediators and the dependent variables:

- Child race/ethnicity (reference group: white)
- Child is female (reference group: male)
- Child repeated kindergarten (reference group: child did not repeat kindergarten)
- Child is disabled (reference group: child is not disabled)
- Number of children in household
- Father has more or less education than mother (reference group: father and mother have same education)
- Marital status: cohabitating; separated/single (reference group: married & living together)
- Mother is foreign-born (reference group: mother is native-born)
- Reading ↔ Math

Model includes the following covariances:

- Tell stories ↔ Read books
- Build things ↔ Play games
- Number of books ↔ Number of audio CDs

Figure 12: Results of Model with Redefined Time Investment Variable for Children's Spring First Grade Achievement



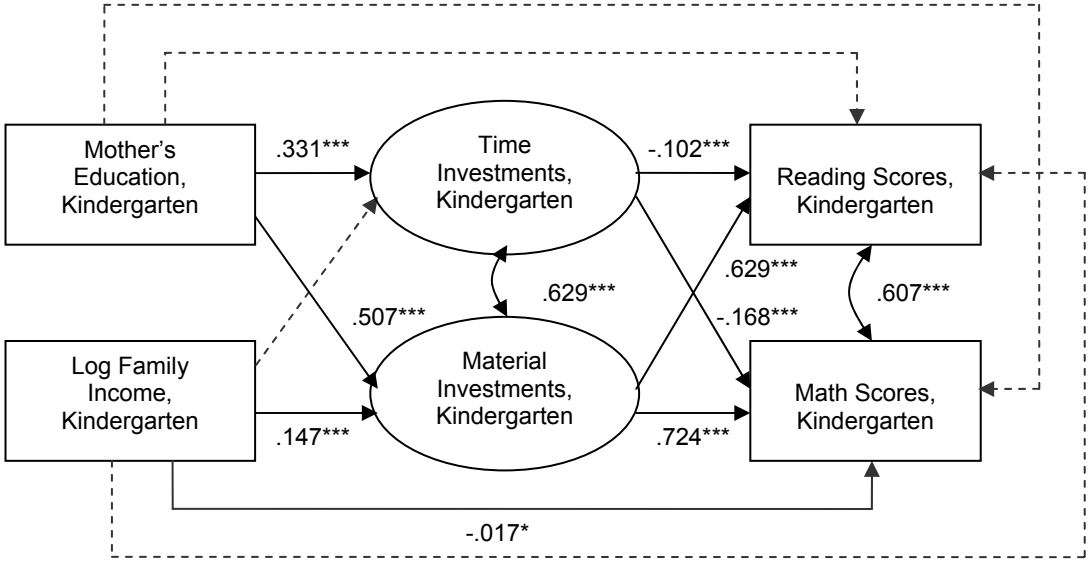
Model Fit Statistics
$\chi^2(83, n = 20{,}582) = 646$, $p<.001$
RMSEA = .018, p=1.0
CFI = .963
TLI = .931

Table 24
Total, Direct, and Indirect Effects in Model with Redefined Time Investment Variable for Children's Spring First Grade Achievement from Model with Redefined Time Investment Variable (*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.269***	(.012)	.287***	(.012)
Total Indirect	.269***	(.012)	.287***	(.012)
Indirect via Time	-.037***	(.010)	-.064***	(.010)
Indirect via Materials	.305***	(.018)	.351***	(.018)
Direct Effect	---	---	---	---
Income → Outcome				
Total Effect	.089***	(.009)	.071***	(.011)
Total Indirect	.089***	(.009)	.102***	(.011)
Indirect via Time	---	---	---	---
Indirect via Materials	.089***	(.009)	.102***	(.011)
Direct Effect	---	---	-.031**	(.010)

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant

Figure 13: Results of Model with Redefined Time Investment Variable for Children's Fall Kindergarten Achievement



Model Fit Statistics
$\chi^2(83, n = 20{,}582) = 1066,\ p<.001$
RMSEA = .024, p=1.0
CFI = .960
TLI = .925

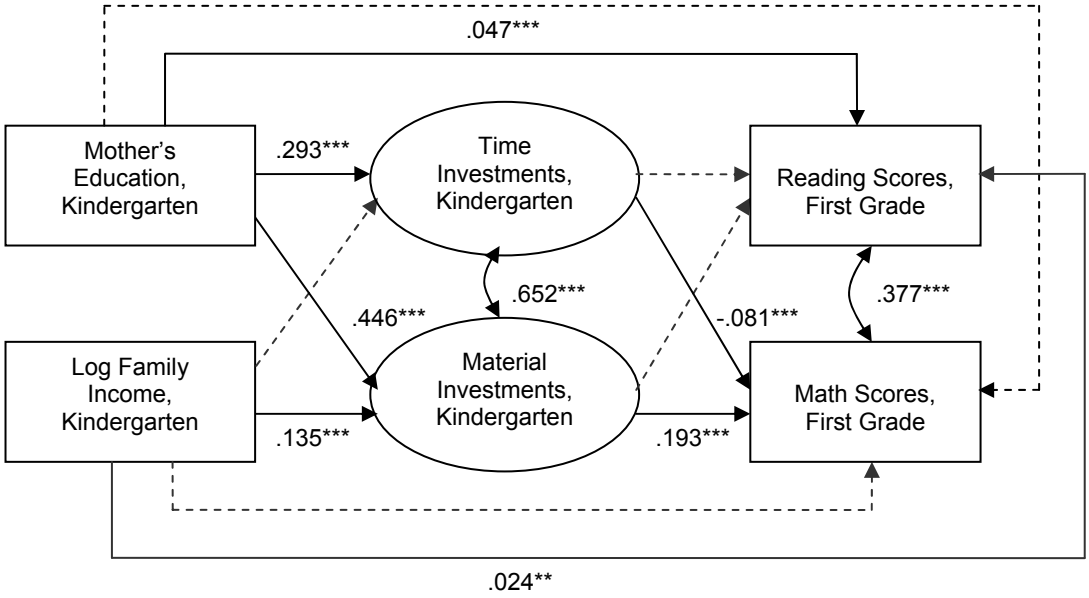
Table 25
Total, Direct, and Indirect Effects in Model with Redefined Time Investment Variable for Children's Fall Kindergarten Achievement

(*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.285***	(.011)	.311***	(.011)
Total Indirect	.285***	(.011)	.311***	(.011)
Indirect via Time	-.034***	(.008)	-.056***	(.008)
Indirect via Materials	.319***	(.016)	.367***	(.015)
Direct Effect	---	---	---	---
Income → Outcome				
Total Effect	.093***	(.007)	.090***	(.008)
Total Indirect	.093***	(.007)	.107***	(.008)
Indirect via Time	---	---	---	---
Indirect via Materials	.093***	(.007)	.107***	(.008)
Direct Effect	---	---	-.017*	(.008)

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
* p<.05, ** p<.01, ***p<.001

Figure 14: Results of Model with Redefined Time Investment Variable, for Children's Learning From Kindergarten to First Grade



Model Fit Statistics
$\chi^2(92, n = 20{,}582) = 2660,\ p<.001$
RMSEA = .017, p=1.0
CFI = .973
TLI = .950

Table 26
Total, Direct, and Indirect Effects in Model with Redefined Time Investment Variable for Children's Learning from Kindergarten to First Grade (*n* = 20,582)

	Reading		Math	
	Estimate	S.E.	Estimate	S.E.
Mother's Educ → Outcome				
Total Effect	.047***	(.011)	.063***	(.008)
Total Indirect	--	--	.063***	(.008)
Indirect via Time	--	--	-.024***	(.005)
Indirect via Materials	--	--	.086***	(.011)
Direct Effect	.047***	(.011)	--	--
Income → Outcome				
Total Effect	.024**	(.008)	.026***	(.004)
Total Indirect	--	--	.026***	(.004)
Indirect via Time	--	--	--	--
Indirect via Materials	--	--	.026***	(.004)
Direct Effect	.024**	(.008)	--	--

Table displays standardized parameter estimates.
Dashes signify parameters that were not estimated because initial model results indicated they were not significant
* p<.05, ** p<.01, ***p<.001

Figure 15: Path Model with Additional Investments

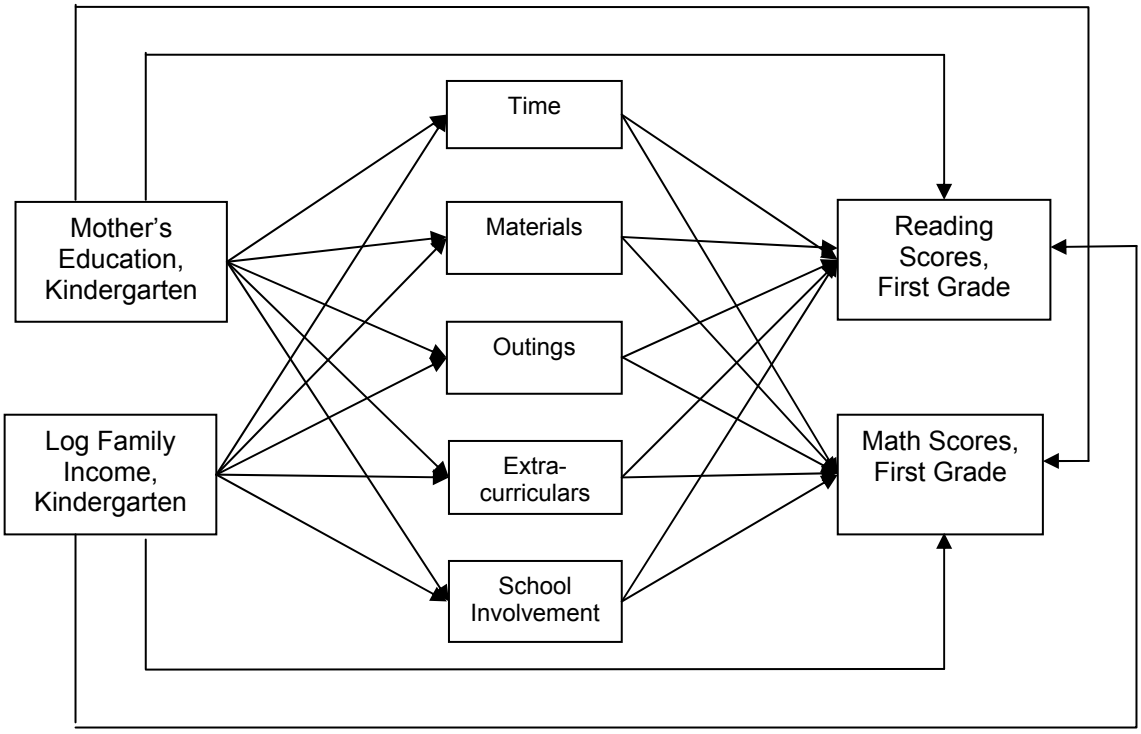


Table 27
Results of Path Model with Additional Parental Investments for Spring First Grade Achievement (*n*=20,582)

Panel A Estimates for Paths to and from Mediators				
	Paths from IVs to Mediators		Paths from Mediators to DVs	
	Mother's Ed→*Z*	Log Income→*Z*	*Z*→Reading	*Z*→Math
Time	.209***	---	.029***	---
Materials	.354***	.096***	.082***	.103***
Outings	.253***	.080***	-.027*	-.024*
Extracurricular Activities	.275***	.038***	.050***	.057***
School Involvement	.254***	.117***	.071***	.085***
Panel B Total, Direct, and Indirect Effects				
	Total Effect	Indirect	Direct	
Mom's Education→Reading	.280***	.060***	.220***	
Log Income→Reading	.078***	.016***	.062***	
Mom's Education→Math	.286***	.068***	.219***	
Log Income→Math	.067***	.020***	.047***	
Panel C Model Fit Statistics				
$\chi^2(3) = 62.8$, $p<.001$; RMSEA = .031, CFI = .996; TLI = .834				

Notes:
Table displays standardized parameter estimates. * p<.05, ** p<.01, ***p<.001
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
Model accounts for selected correlations between mediators to improve model fit.

Table 28
Results of Path Model with Additional Parental Investments for Fall Kindergarten Achievement (*n*=20,582)

Panel A Estimates for Paths to and from Mediators				
	Paths from IVs to Mediators		Paths from Mediators to DVs	
	Mother's Ed→*Z*	Log Income→*Z*	*Z*→Reading	*Z*→Math
Time	.210***	---	.038***	.022**
Materials	.354***	.123***	.110***	.129***
Outings	.260***	.056***	---	---
Extracurricular Activities	.264***	.046***	.073***	.067***
School Involvement	.254***	.097***	.040***	.060***
Panel B **Total, Direct, and Indirect Effects**				
	Total Effect	Indirect	Direct	
Mom's Education→Reading	.303***	.076***	.226***	
Log Income→Reading	.071***	.021***	.050***	
Mom's Education→Math	.317***	.084***	.233***	
Log Income→Math	.080***	.025***	.055***	
Panel C **Model Fit Statistics**				
$\chi^2(4) = 83.3$, $p<.001$; RMSEA = .031, CFI = .997; TLI = .896				

Notes:
Table displays standardized parameter estimates. * p<.05, ** p<.01, ***p<.001
Dashes signify parameters that were not estimated because initial model results indicated they were not significant.
Model accounts for selected correlations between mediators to improve model fit.

Table 29

Results for Path Model with Additional Parental Investments for Children's Learning From Kindergarten to First Grade

(*n*=20,582)

Panel A Estimates for Paths to and from Mediators				
	Paths from IVs to Mediators		Paths from Mediators to DVs	
	Mother's Ed→*Z*	Log Income→*Z*	*Z*→Reading	*Z*→Math
Time	.178***	---	---	---
Materials	.309***	.085***	.023**	.037***
Outings	.241***	.078***	---	---
Extracurricular Activities	.237***	.028*	---	---
School Involvement	.219***	.110***	.045***	.045***
Panel B Total, Direct, and Indirect Effects				
	Total Effect	Indirect	Direct	
Mom's Education→Reading	.103***	.017***	.086***	
Log Income→Reading	.029***	.007***	.022**	
Mom's Education→Math	.107***	.021***	.085***	
Log Income→Math	.008***	.008***	---	
Panel C Model Fit Statistics				
$\chi^2(18) = 1613$, $p<.001$; RMSEA = .066, CFI = .926; TLI = .399				

Notes:

Table displays standardized parameter estimates. * p<.05, ** p<.01, ***p<.001

Dashes signify parameters that were not estimated because initial model results indicated they were not significant.

Model accounts for selected correlations between mediators to improve model fit.

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APPENDIX A: Development of the Measurement Models

Below I provide a complete synopsis of the steps I went through to create my measurement models. I have included detailed tables in this Appendix showing results for the various steps in the process.

1. First, I tested first-order factors individually, dropping items that with relatively low loadings in order to improve the fit.
    - Results: All first-order factors met the criteria for good fit and indicator variables generally had moderate to high loadings. See Tables 1A-6A below.
2. Second, I tested second-order factors individually to see how they fit.
    - Results: These models did not meet the criteria for good fit; TLI<.95 for both time and material investment. See Tables 7A-10A below for detailed results.
3. Third, I tested the second-order factors in a single model that allowed the latent factors to be correlated.
    - Results: Model fit dramatically worsened when the second-order time and material investment factors were permitted to correlate (CFI & TLI < .90). Modification indices suggested that numerous indicator cross-loaded on both factors. Furthermore the factors were highly correlated (r = .877). Finally, structural models for preliminary hypothesis testing did not converge when I specified the latent factors this way.
4. Fourth, I ran an exploratory factor analysis.
    - Results: The most parsimonious model with good fit was a six factor solution, which was largely identical to the models I tested in step 1, as shown in Table 11A. The correlations among these latent factors, shown in Table 12A, are generally low to moderate, suggesting there may not be a higher order factor structure.
5. Fifth, I abandoned the second-order factor structure, testing alternative latent factors with more simple structures that could serve as the measures of time and material investment in the hypothesis testing models.
    - Results: I settled on a time investment factor that includes only time spent on cognitively stimulating activities at home and a material investment factor that includes only educational materials in the home, as shown below in Figure 3A. I employed parceling to reduce cross-loading of items and the correlation between the two latent factors. I applied the serpentine method of parceling time items, averaging items that had high factor loadings with those that had relatively low factor loadings in the previous model. Parcel 1 is the mean of play games, build things, and read books. Parcel 2 is the mean of tell stories, arts & crafts, and involve child in chores. Parcel 3 is the mean of talk about nature, do sports, and sing songs. Again, this parceling approach minimized cross-loading of items and reduced the correlation between the two latent factors (from r=.877, p<.001 to r=.406, p<.001). Fit is very good for this model (RMSEA .022, p=1.0; CFI & TLI>.95)

Time Investments

Table 1A: Activities at Home

Indicator	lambda[3]	*p* value
Read books	.522	<.001
Tell stories to child	.577	<.001
Sing songs	.459	<.001
Help child do arts and crafts	.518	<.001
Involve child in chores	.417	<.001
Play games	.582	<.001
Talk about nature/science	.549	<.001
Build things	.551	<.001
Do sports	.498	<.001
Chi-Square test (.d.f.)[4]	663.052(27), p<.001	
90% conf. interval of RMSEA	.034 - .039, p=1.0	
CFI / TLI	.967 / .956	

Table 2A: Educational Outings[5]

Indicator	lambda	*p* value
Visited the library	.461	<.001
Gone to concert, play, show	.440	<.001
Visited a museum	.680	<.001
Visited a zoo, aquarium	.508	<.001
Chi-Square test (.d.f.)	1.681(2), p>.05	
90% conf. interval of RMSEA	.000 - .014, p=1.0	
CFI / TLI	1.000 / 1.001	

Table 3A: School Involvement

Indicator	lambda	*p* value
Attend open house	.644	<.001
Attend PTA meeting	.476	<.001
Attend school event	.595	<.001
Acted as school volunteer	.705	<.001
Participated in fundraising	.532	<.001
Chi-Square test (.d.f.)	44.152(5), p<.001	
90% conf. interval of RMSEA	.015 - .026, p=1.0	
CFI / TLI	.990 / .981	

[3] All lambda coefficient shown are standardized.

[4] Note that chi-square value is very sensitive to sample size and is therefore not an accurate measure of fit for my models.

[5] I removed the indicator for attending sporting events from the model due to its low loading (λ=.31). Doing so significantly improved model fit ($\Delta\chi^2$ =117.16, d.f. = 3, p<.001).

Material Investments

Table 4A: **Educational Materials**

Indicator	lambda	*p* value
How many books child has	.802	<.001
Children's records, tapes, CDs	.705	<.001
Home computer child uses	.568	<.001

Note: Fit statistics are not available because a single factor model with three indicators is exactly identified.

Table 5A: **Extracurricular Activities**

Indicator[6]	lambda	*p* value
Dance lessons	.740	<.001
Participate in organized clubs	.398	<.001
Take music lessons	.568	<.001
Takes art lessons	.451	<.001
Participates in organized performing	.756	<.001
Chi-Square test (.d.f.)	72.406(5), p<.001	
90% conf. interval of RMSEA	.022 - .033, p=1.0	
CFI / TLI	.978 / .956	

Table 6A: Early Care and Education

Indicator	lambda	*p* value
Center-based care, pre-k	.773	<.001
Center-based care, kinder	.565	<.001
Child attends private school	.417	<.001

Note: Fit statistics are not available because a single factor model with three indicators is exactly identified.

[6] I removed the indicator for sports because it loaded relatively weakly on the latent variable compared to the other indicators in the initial measurement model (λ=.40 versus λ>.43 for all other indicators). Doing so improved model fit ($\Delta\chi^2$ = 70.82, d.f.=4, p<.001).

Figure 1A: Second-order Time Investment Factor

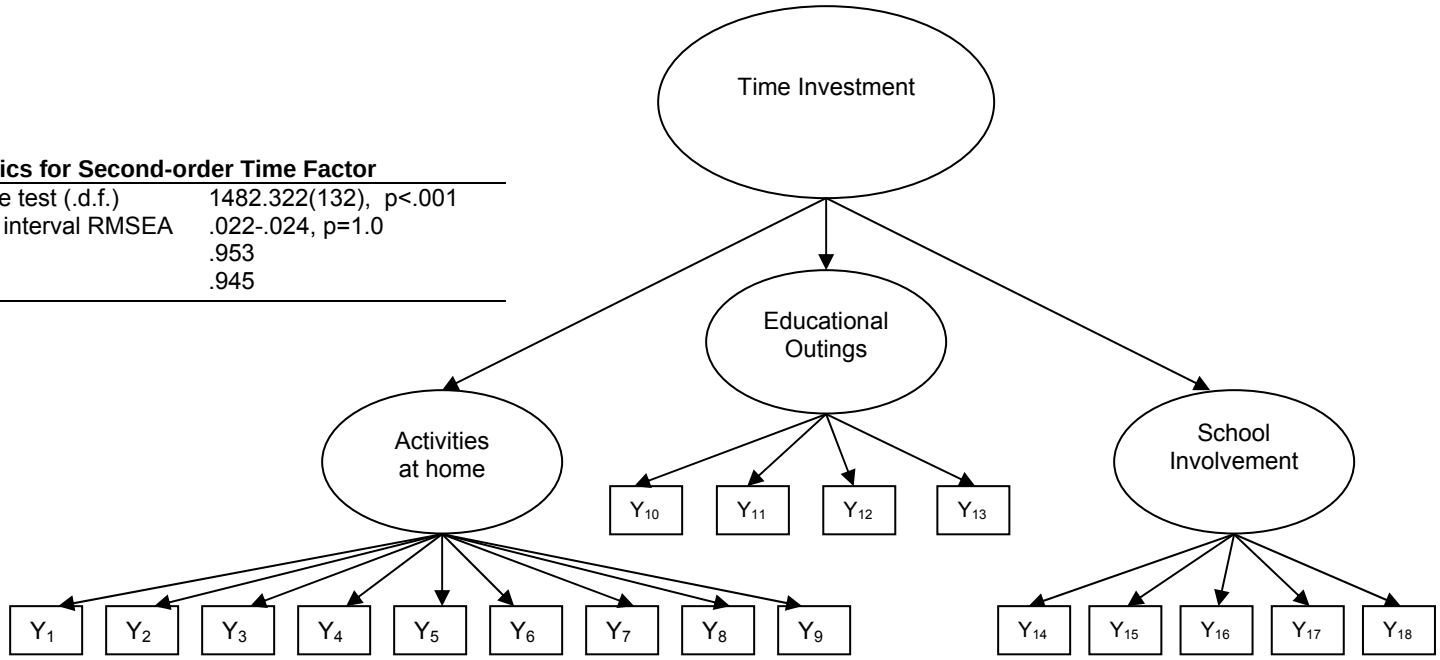


Table 7A
Fit Statistics for Second-order Time Factor

Chi-Square test (.d.f.)	1482.322(132), p<.001
90% conf. interval RMSEA	.022-.024, p=1.0
CFI	.953
TLI	.945

Table 8A: Factor Loadings for Second-order Time Factor

Panel A: Second-order Factor Loadings

	lambda		lambda		lambda
Activities at Home	.651	Educational Outings	.951	School Involvement	.535

Panel B: First-order Factor Loadings

Activities at Home	lambda	Educational Outings	lambda	School Involvement	lambda
Y_1 Read books	.572	Y_{10} Visited the library	.579	Y_{14} Attend open house	.631
Y_2 Tell stories to child	.579	Y_{11} Gone to concert, play, show	.488	Y_{15} Attend PTA meeting	.471
Y_3 Sing songs	.455	Y_{12} Visited a museum	.583	Y_{16} Attend school event	.598
Y_4 Help child do arts and crafts	.517	Y_{13} Visited a zoo, aquarium	.422	Y_{17} Acted as school volunteer	.709
Y_5 Involve child in chores	.412			Y_{18} Participated in fundraising	.540
Y_6 Play games	.564				
Y_7 Talk about nature/science	.561				
Y_8 Build things	.532				
Y_9 Do sports	.482				

Figure 2A: Second-order Material Investment Factor

Table 9A
Fit Statistics for Second-order Material Factor

Chi-Square test (.d.f.)	534.139(41), p<.001
90% conf. interval RMSEA	.022-.026, p=1.0
CFI	.954
TLI	.938

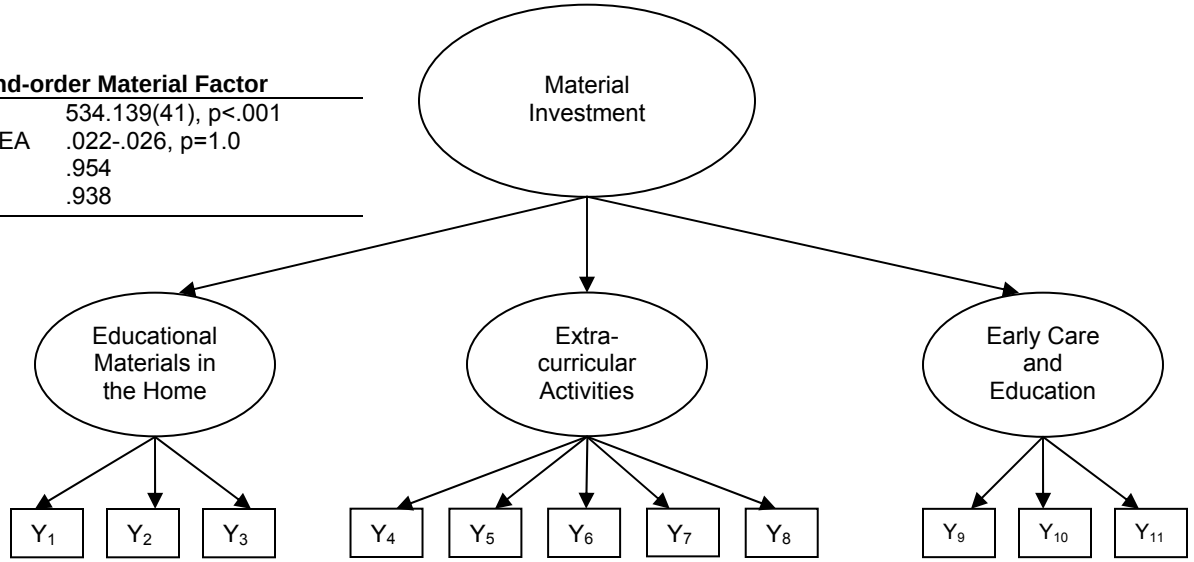


Table 10A: Factor Loadings for Second-order Material Factor

Panel A: Second-order Factor Loadings

	lambda		lambda		lambda
Educational Materials	.888	Extracurricular Activities	.608	Early Care and Education	.577

Panel B: First-order Factor Loadings

Educational Materials	lambda	Extracurricular Activities	lambda	Early Care and Education	lambda
Y_1 How many books child has	.765	Y_4 Dance lessons	.774	Y_9 Center-based care, pre-k	745
Y_2 No. of records, tapes, CDs	.705	Y_5 Organized clubs	.470	Y_{10} Center-based care, kinder	.452
Y_3 Home computer child uses	.624	Y_6 Takes music lessons	.603	Y_{11} Child attends private school	.597
		Y_7 Takes art lessons	.464		
		Y_8 Participates in performing	.646		

Table 11A: Factor Structure from Exploratory Factor Analysis

Home Activities						
Read books	**0.406(?)**	0.225	0.318	**0.412(?)**	0.225	0.073
Tell stories to child	**0.503**	0.102	0.253	0.187	0.113	-0.05
Sing songs	**0.407**	0.088	0.147	0.146	0.219	0.011
Help child do arts and crafts	**0.460**	0.089	0.216	0.166	0.106	-0.017
Involve child in chores	**0.361**	0.099	0.122	0.132	0.109	-0.033
Play games	**0.542**	0.112	0.168	0.138	0.061	-0.010
Talk about nature/science	**0.478**	0.166	0.232	0.256	0.107	0.056
Build things	**0.530**	0.108	0.174	0.122	-0.101	-0.045
Do sports	**0.499**	0.172	0.094	0.067	0.013	-0.058
Educational Outings						
Visited the library	0.253	0.296	**0.471**	0.288	0.196	0.052
Gone to concert, play, show	0.177	0.340	**0.411**	0.212	0.312	0.118
Visited a museum	0.211	0.259	**0.659**	0.246	0.213	0.135
Visited a zoo, aquarium	0.181	0.173	**0.486**	0.039	0.098	0.032
School Involvement						
Attended sporting events	0.195	**0.499**	0.152	0.206	0.130	0.126
Attend open house	0.133	**0.593**	0.318	0.399	0.256	0.115
Attend PTA meeting	0.114	**0.426**	0.270	0.150	0.196	-0.027
Attend school event	0.105	**0.552**	0.330	0.401	0.289	0.153
Acted as school volunteer	0.142	**0.643**	0.390	0.477	0.311	0.103
Participated in fundraising	0.138	**0.508**	0.259	0.345	0.261	0.192
Educational Materials						
How many books child has	0.214	0.455	0.260	**0.828**	0.300	0.266
No. of records, tapes, CDs	0.222	0.399	0.290	**0.658**	0.307	0.227
Home computer child uses	0.099	0.468	0.282	**0.556**	0.298	0.347
Participate in athletic events	0.121	0.617	0.192	**0.445 (?)**	0.299	0.344
Extracurricular Activities						
Dance lessons	0.023	0.269	0.240	0.366	**0.790**	0.231
Organized clubs	0.034	0.329	0.169	0.305	**0.398**	0.098
Takes music lessons	0.121	0.256	0.387	0.286	**0.528**	0.199
Takes art lessons	0.125	0.228	0.420	0.220	**0.389**	0.162
Participates in performing	0.097	0.274	0.227	0.190	**0.744**	0.106
Early Care and Education						
Center-based care, pre-k	0.008	0.277	0.191	0.337	0.199	**0.643**
Center-based care, kinder	-0.069	0.046	0.040	0.112	0.109	**0.659**
Child attends private school	-0.026	0.275	0.207	0.361	0.225	**0.428**

Note: Quartamin rotation is used for the EFA model.

Table 12A: Correlations among Latent Factors in the Exploratory Factor Analysis

		Factor Number				
Factor No.	Factor Name	1	2	3	4	5
1	Home Activities	1.000				
2	Educational Outings	0.183	1.000			
3	School Involvement	0.293	0.364	1.000		
4	Educational Materials	0.220	0.501	0.314	1.000	
5	Extracurricular Activities	0.077	0.335	0.311	0.350	1.000
6	Early Care and Education	-0.062	0.203	0.124	0.306	0.208

Figure 3A: The Final Measurement Model

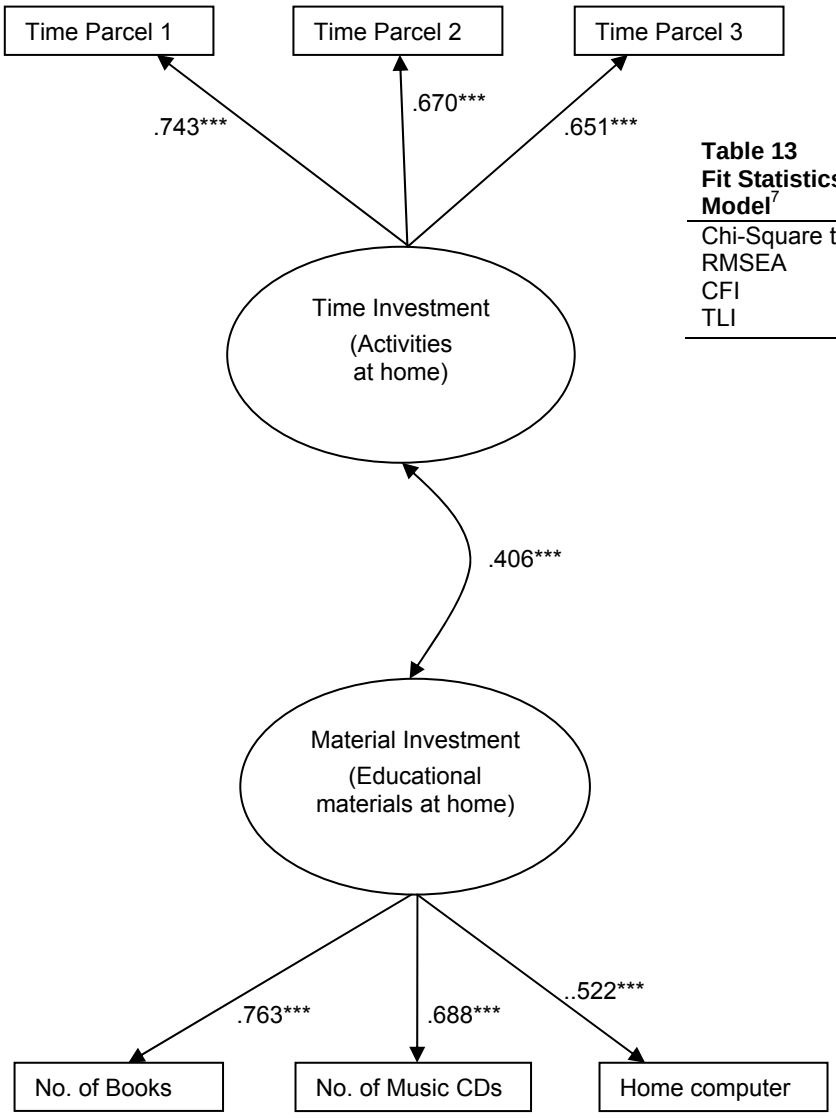


Table 13
Fit Statistics for Final Measurement Model[7]

Chi-Square test (.d.f.)	82.678(8), p<.001
RMSEA	.018 - .026, p=1.0
CFI	.984
TLI	.971

[7] Note that I employed the serpentine method of parceling time items, combining items that had high factor loadings with those that had relatively low factor loadings in the previous model. Parcel 1 is the mean of play games, build things, and read books. Parcel 2 is the mean of tell stories, arts & crafts, and involve child in chores. Parcel 3 is the mean of talk about nature, do sports, and sing songs.

APPENDIX B: Development and Estimation of the Mediation Models

Because there are a variety of ways investigators can include covariates in their models, I began by testing various options to determine which approach led to the best model fit. I considered the following options:

1) Baseline model which controls only for children's reading and math skills at kindergarten entry (Figure 4A),
2) Include a full set of controls only on the independent variables (Figure 5A),
3) Include a full set of controls only on the dependent variables (Figure 6A),
4) Include a full set of controls on the mediators and dependent variables (semi-partial approach, shown in Figure 7A),
5) Include a full set of controls on independent variables, mediators, and dependent variables (full-partial approach, shown in Figure 8A).

The full-partial model was the best fitting model and fit significantly better than the semi-partial model according to the chi-square difference test.[8] However, the RMSEA, CFI, and TLI were slightly better in the semi-partial model and the parameter estimates were nearly identical, as shown below in Tables 13A and 14A. Therefore, I selected the semi-partial approach, which is more parsimonious, for hypothesis testing.

Then I removed hypothesized paths that were not significant, e.g. from time investment to reading scores. Because the vast majority of paths from the school-level covariates to the mediator and outcome variables in the model were not significant, I also removed them from the model. Doing so led to a more parsimonious model without significant decrement to the RMSEA, CFI, or TLI.

Finally, after examining the modification indices, I added a covariance between the number of children's books and the number children's music CDs and tapes in the household, two indicators for the latent material investment factor. Adding this covariance led to significant improvement in model fit ($\Delta\chi^2 = 10.4$; d.f. =1; $p<.005$). After removing one additional parameter estimate that lost significance – the direct effect of parental education on first grade math skills - I arrived at my final model which has very good fit (RMSEA = .019; CFI = .975; TLI = .955). Remaining modification indices suggested that additional changes to the model would result in less than a 10% improvement in the chi square statistic. Attempts to test additional paths led to problems with model convergence. (The paths indicated by the remaining modification indices included covariances between indicator variables and cross loadings.)

[8] This is not surprising because model trimming often leads to a decrease in the chi-square statistic. However, the goal in SEM analysis is to a build the most parsimonious model that still fits the data well (Kline, 2005).

Table 13A
Fit Statistics for Models Comparing Different Approaches to Including Covariates
(n = 20,582)

	Baseline	Controls on IVs	Controls on DVs	Semi partial	Full partial
Chi-square	1553.7(38)***	8419.0(161)***	2107.0(126)***	979.2(92)***	1347.4(93)***
RMSEA	.050	.050	**.028**	**.022**	**.026**
CFI	.922	.698	.914	**.962**	**.954**
TLI	.877	.597	.877	.925	.894

Note: Values that indicate a well fitting model are bolded. Chi square test of model fit consistently rejects the null hypothesis that these models are a perfect fit due to the large sample size.

Table 14A
Total, Direct, and Indirect Effects for Models Comparing Different Approaches to Including Covariates
(n = 20,582)

	Baseline	Controls on IVs	Controls on DVs	Semi partial	Full partial
Parental Educ → Reading					
Total Effect	.114***	.318***	.055***	.054***	.054***
Total Indirect	.036***	.140***	.007	.006	.006
Indirect via Time	-.002	-.008*	.001	.001	.001
Indirect via Materials	.038***	.148***	.006	.005	.005
Direct Effect	.078***	.178***	.048***	.048***	.048***
Income → Reading					
Total Effect	.055***	.120***	.020*	.019*	.018*
Total Indirect	.018**	.064***	.003	.001	.001
Indirect via Time	.000	.000	.000	.000	.000
Indirect via Materials	.018**	.065***	.002	.001	.001
Direct Effect	.037**	.056***	.017^{+}	.017^{+}	.017
Parental Educ → Math					
Total Effect	.119***	.330***	.081***	.076***	.076***
Total Indirect	.063***	.179***	.030**	.023**	.023**
Indirect via Time	-.007**	-.016***	-.006*	-.005*	-.005*
Indirect via Materials	.070***	.195***	.035**	.029***	.029**
Direct Effect	.055***	.151***		.053***	.053***
Income → Math					
Total Effect	.052***	.123***	.015	.012	.011
Total Indirect	.033***	.085***	.015**	.009**	.009**
Indirect via Time	.000	-.001	.000	.000	.000
Indirect via Materials	.033***	.085***	.015**	.009**	.009**
Direct Effect	.019	.038**	.000	.003	.003

Note: Table displays standardized parameter estimates.
* p<.05, ** p<.01, ***p<.001

Figure 4A: Baseline Model

Controls only for reading and math at kindergarten entry

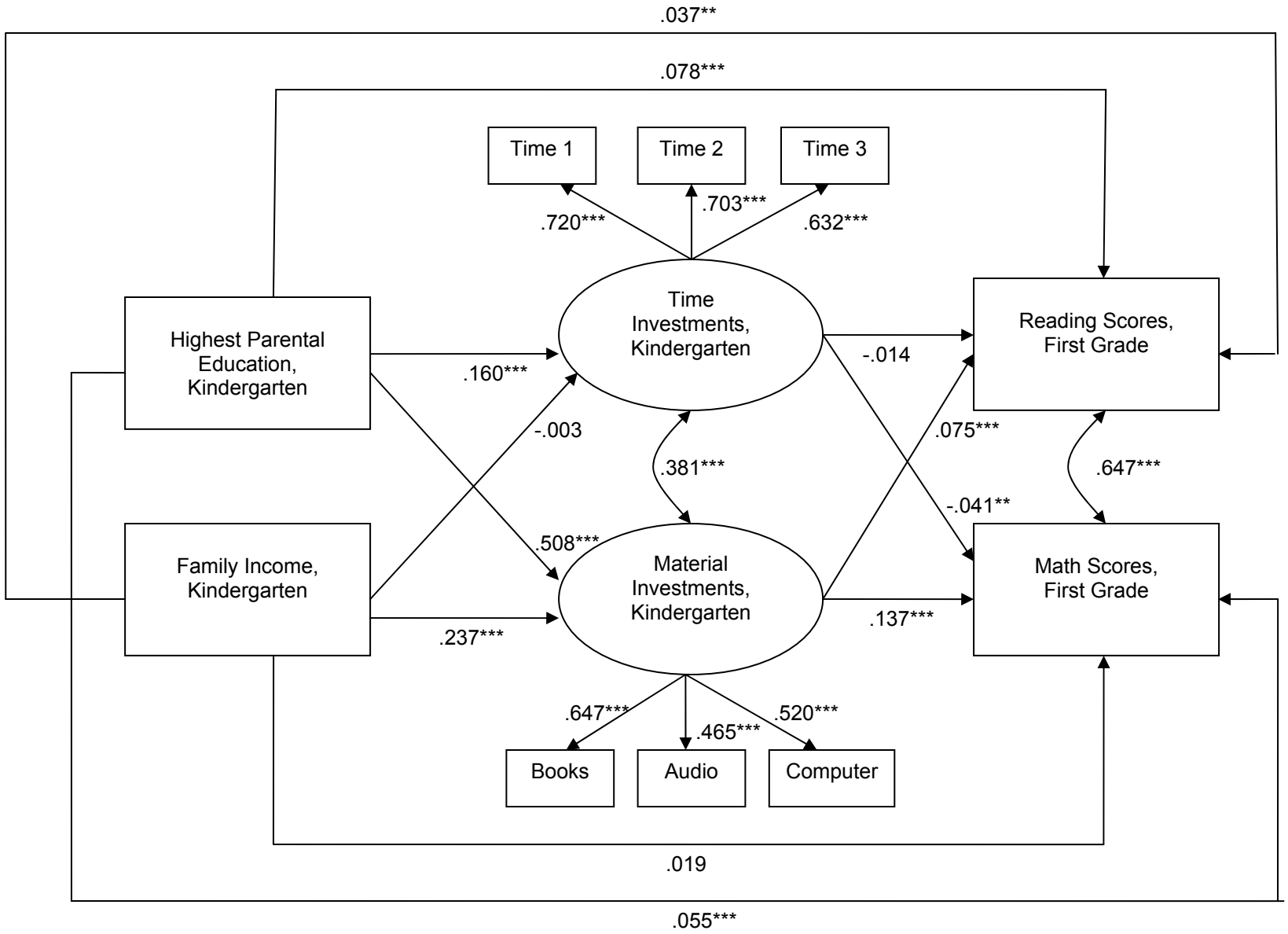


Figure 5A: Model with Controls on Independent Variables

Controls for full set of covariates on income and parental education only

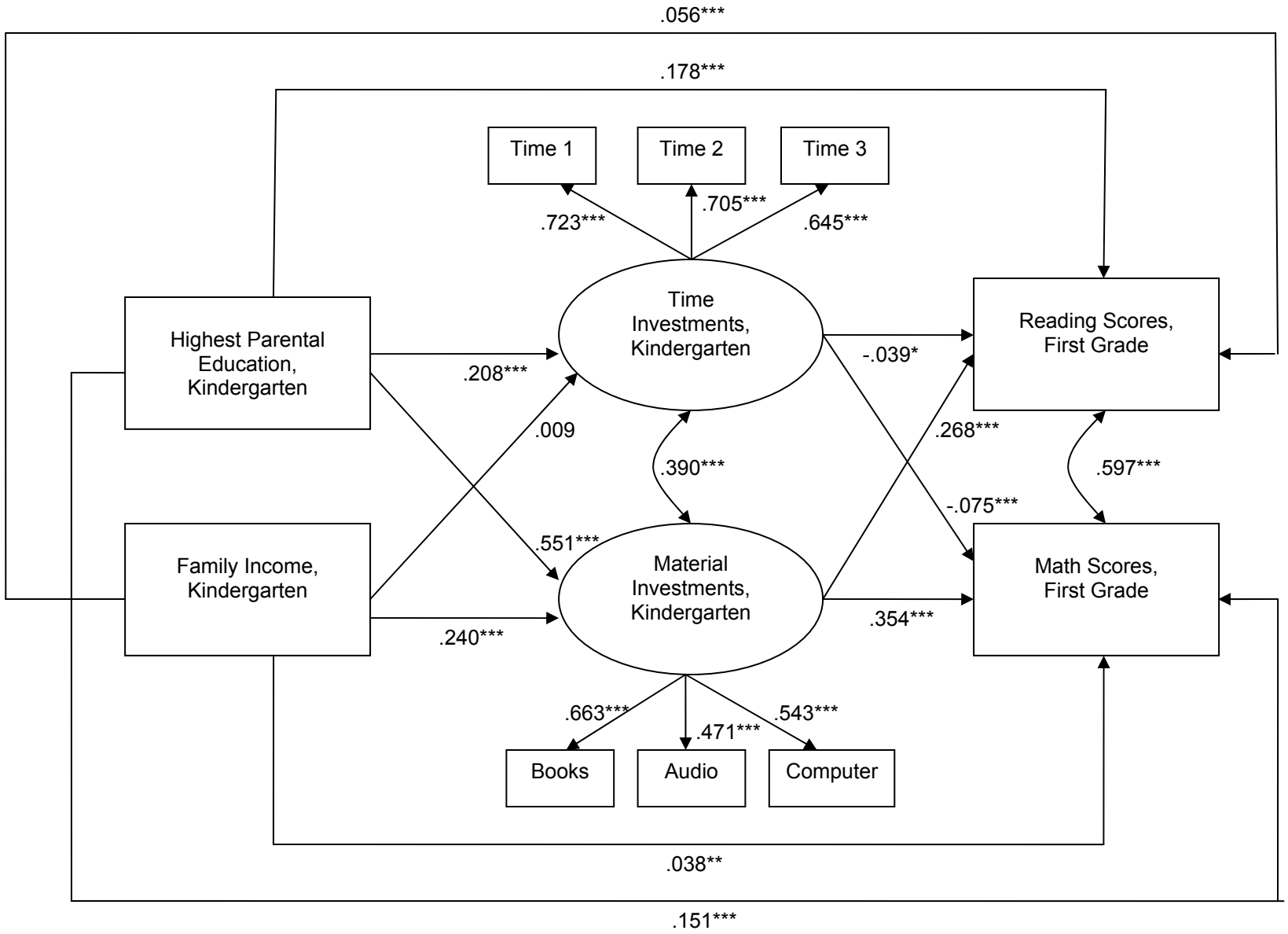


Figure 6A: Model with Controls on Dependent Variables

aControls for full set of covariates on reading and math outcomes only

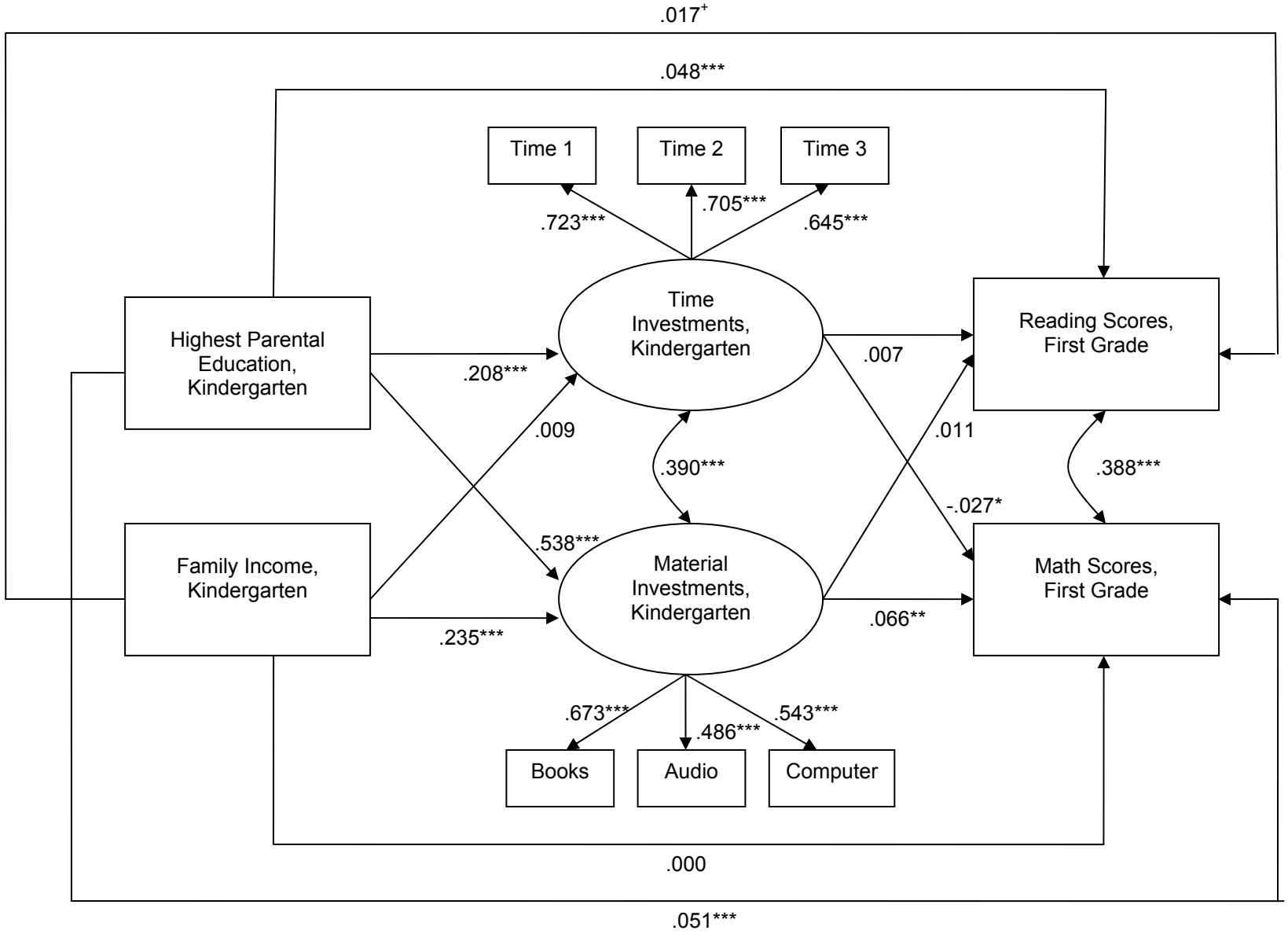


Figure 7A: Model with Semi-partial Controls

Controls for full set of covariates on mediators and outcomes

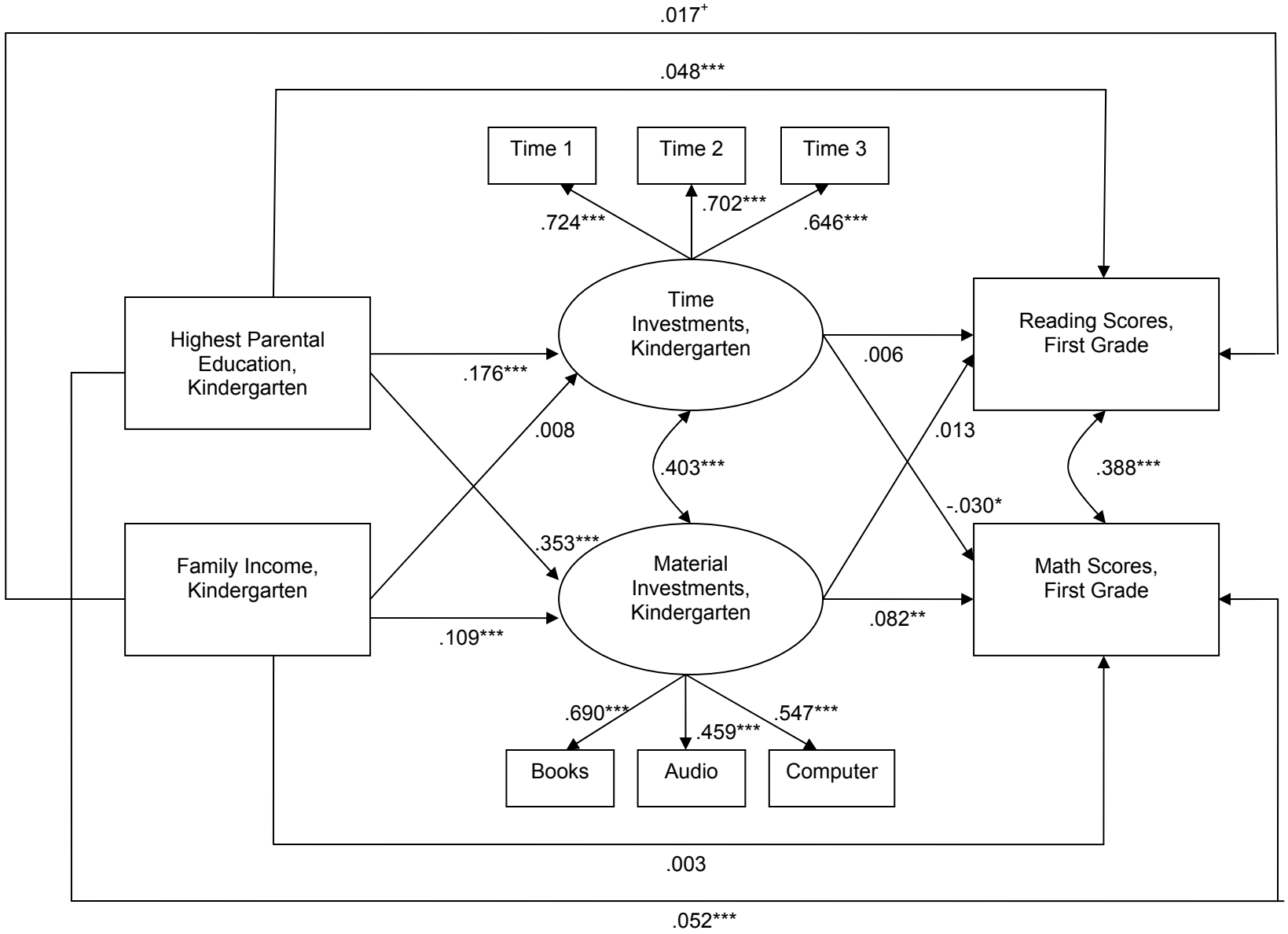
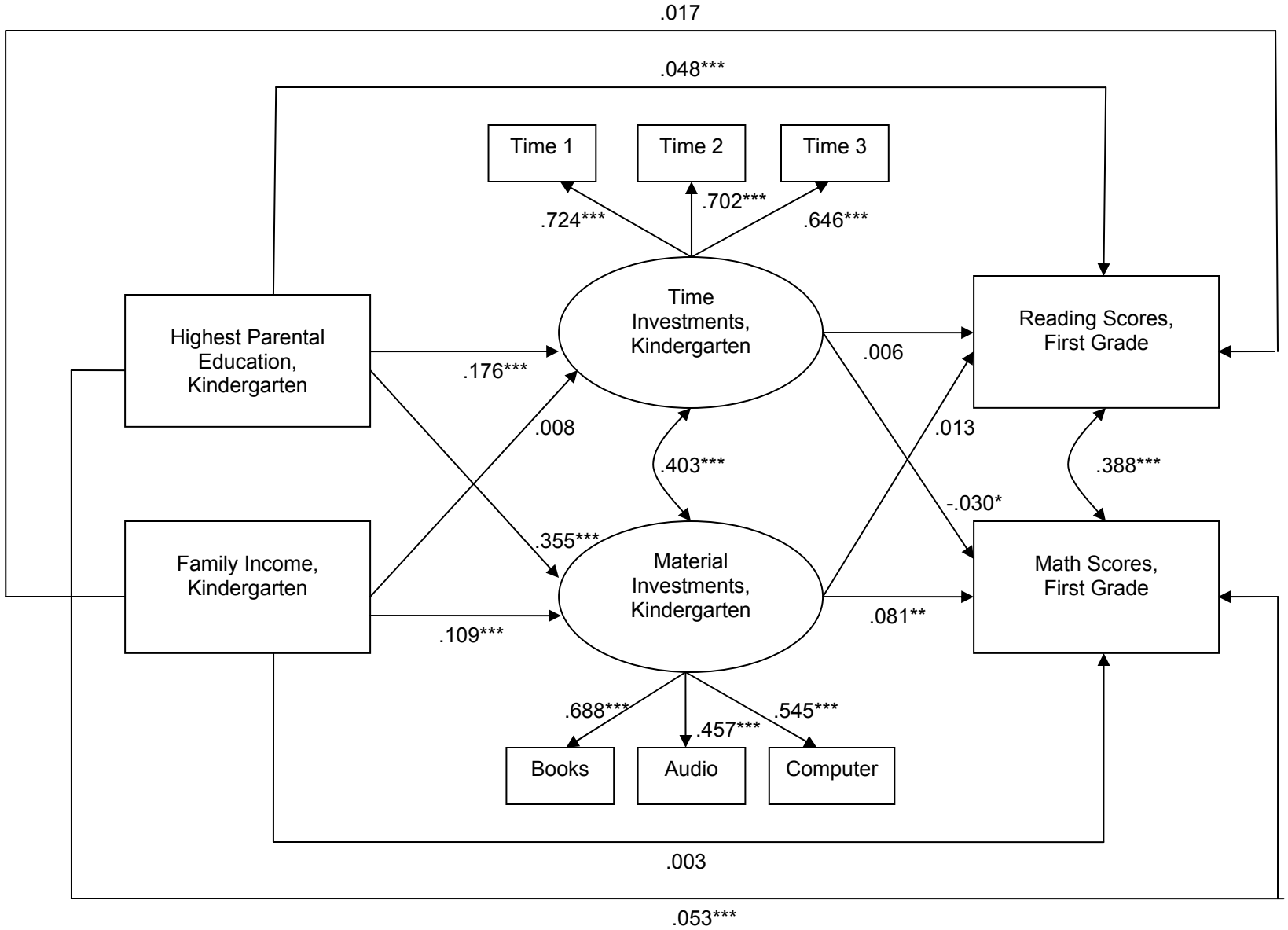


Figure 8A: Model with Full-partial Controls

Controls for full set of covariates on independent variables, mediators, *and* outcomes



Appendix C: Results for Mediation Models with Covariate Coefficients Shown

Table 15A

Coefficients for all Variables in Baseline Model for Children's Spring First Grade Achievement

	Time Investment	Material Investment	Reading, 1st Grade	Math, 1st Grade
Maternal education	.203***	.510***	.035	-.012
Family income, log	.005	.164***	-.006	-.038
Material investment	---	---	.515***	.641***
Time investment	---	---	-.087**	-.139***
Black	-.027	-.293***	.076***	.016
Hispanic	-.056**	-.231***	.065***	.042
Asian	-.007	-.083***	.055***	.012
Other race/ethnicity	.021	.070***	.004	-.008
Child is female	-.001	.026*	.046***	-.082***
No. of children	-.001	.020	-.101***	-.051***
Father has more education	.013	.135***	-.016	-.032
Father has less education	-.063***	-.117***	-.018	-.002
Cohabitating	.010	.075***	.004	.004
Single or separated	-.028	-.219***	.025	.048
Mother's work hours	-.052***	-.026	-.043***	-.015
Mother is foreign-born	-.118***	-.160***	.043**	.065***
Child has a disability	.015	-.014	-.166***	-.156***
Child repeated kindergarten	-.011	-.014	-.011	.008

* p<.05; ** p<.01; *** p<.001; Table displays standardized regression coefficients from a structural equation model that estimates equations simultaneously for all four dependent variables. Paths that are not estimated are indicated with dashes (---).

Table 16A

Coefficients for all Variables in Baseline Model for Children's Fall Kindergarten Achievement

	Time Investment	Material Investment	Reading, 1st Grade	Math, 1st Grade
Maternal education	.204***	.494***	.039	.013
Family income, log	-.003	.168***	-.028	-.034*
Material investment	---	---	.584***	.672***
Time investment	---	---	-.119***	-.143***
Black	-.025	-.310***	.149***	.085***
Hispanic	-.040**	-.231***	.054**	.028
Asian	-.008	-.092***	.091***	.073***
Other race/ethnicity	.017	-.081***	.022*	.006
Child is female	-.003	.033***	.035***	-.040***
No. of children	.004	.025*	-.122***	-.076***
Father has more education	.025	.118***	-.002	-.006
Father has less education	-.048***	-.117***	-.026	-.020
Cohabitating	-.017	-.077***	-.002	.007
Single or separated	-.044***	-.201***	-.003	.017
Mother's work hours	-.051***	-.028**	-.033***	-.026*
Mother is foreign-born	-.121***	-.159***	.062***	.052**
Child has a disability	.020	-.006	-.097***	-.124***
Child repeated kindergarten	-.015	-.014	.076***	.059***

* p<.05; ** p<.01; *** p<.001; Table displays standardized regression coefficients from a structural equation model that estimates equations simultaneously for all four dependent variables. Paths that are not estimated are indicated with dashes (---).

Table 17A
Coefficients for all Variables in Baseline Model for Children's Learning From Kindergarten to First Grade

	Time Investment	Material Investment	Reading, 1st Grade	Math, 1st Grade
Maternal education	.185***	.445***	.031	-.008
Family income, log	.000	.146***	.011	-.020
Material investment	---	---	.043	.197***
Time investment	---	---	.002	-.051**
Black	-.023	-.274***	-.008	-.040*
Hispanic	-.051*	-.209***	.033*	.020
Asian	-.007	-.084***	.008	-.027**
Other race/ethnicity	.023	-.060***	-.008	-.009
Child is female	-.003	.027*	.047***	-.055***
No. of children	.004	.036**	-.029***	.001
Father has more education	.010	.124***	.012	-.009
Father has less education	-.058***	-.098***	-.004	.009
Cohabitating	.013	-.065***	-.004	.000
Single or separated	-.023	-.199***	-.027	.015
Mother's work hours	-.050***	-.018	-.018*	.003
Mother is foreign-born	-.115***	-.152***	.008	.033*
Child has a disability	.022	.014	-.083***	-.073***
Child repeated kindergarten	-.016	-.028**	-.073***	-.040***
Math skills, kindergarten	.017	.136***	.315***	.583***
Reading skills, kindergarten	.044**	.069***	.415***	.060***

* p<.05; ** p<.01; *** p<.001; Table displays standardized regression coefficients from a structural equation model that estimates equations simultaneously for all four dependent variables. Paths that are not estimated are indicated with dashes (---).