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DISSERTATION

Assessing the Effects of Parental Decisions About School Type and Involvement on Early Elementary Education

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This document was submitted as a dissertation in September, 2006 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Richard Buddin (Chair), Laura Hamilton, and Gery Ryan.

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This dissertation is the fruit of hard work, lots of prayers, and the support of family and friends. It has been a great experience, I learned a lot, but I am glad it is over.

To my Nanay

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Abstract

Low achievement in public schools as well as wide achievement gaps between learners of color and low income and their white and higher income peers are persistent concerns in the United States K-12 schools. Two promising reforms have been proposed to improve educational outcomes: school choice and greater parental involvement.

The main goal of this study is to examine how school type and parental involvement affect elementary-level student achievement.

Although both school types and parent involvement have been the subject of extensive research, the literature is very limited in linking both, and even sparser in linking school types and parent involvement simultaneously to student achievement. This study contributes to the literature by linking school types and parent involvement to student achievement using nationally representative longitudinal data on early elementary grades in the United States.

The study found that school types (Catholic, other-religious, non-religious private schools; choice public, assigned public, assigned-also-chosen public schools) do not have any association with reading scores, but religious private schools tend to be negatively correlated with math scores. Among the 8 parental involvement variables tested, "academic expectations by parents for child" and "child reading at home" have robust correlations with reading and math scores. The study notes that "active school involvement" by parents have no correlation with reading scores, and very little association with math scores. The study also found that parents who choose schools other

than the assigned public school tend to be more involved -- school type and parent involvement are complements.

These findings hope to inform education policies and parent-involvement programs to equalize opportunities and bridge achievement gaps across different race/ethnicities, income levels and parental education background.

Chapter 1 – Introduction

1. Background and motivation

Low achievement in public schools as well as wide achievement gaps between learners of color and low income and their white and higher income peers are persistent concerns in the United States K-12 schools. Two promising reforms have been proposed to improve educational outcomes: school choice and greater parental involvement. The premise of school choice is that it would promote competition among schools and thereby encourage innovation and improved learning. School choice also gives parents more alternatives for their children in terms of school types. A more hands-on approach to improving outcome is to encourage parents to play a greater role in learning. Parental involvement might improve learning by directly reinforcing classroom skills and by indirectly improving the motivation of students to learn.

The main goal of this study is to examine how school type and parental involvement affect elementary-level student achievement. This study contributes to the existing body of literature by examining how school type and parental involvement work in concert with one another to improve achievement.

Although both school types and parent involvement have been the subject of extensive research, the literature is very sparse in linking both (Hausman and Goldring, 2000; Bauch and Goldring, 1995). The research is even sparser in linking school types and parent involvement simultaneously to student achievement. This study contributes to the literature by linking school types and parent involvement to student achievement

using nationally representative longitudinal data on early elementary grades in the United States.

Moreover, unlike other studies that only look at two or three school types (usually comparing charter schools or Catholic schools to traditional public schools), this research covers six school types (Catholic private schools, other-religion private schools, non-religious private schools, choice public schools[1], assigned-also-chosen public schools and assigned public schools). Potential nuances between school types may be lost if the study only distinguishes between "private and public" school types, or between "charter and traditional public" school types. The study attempts to distinguish between the marginal effects (if any) of different types within the private and public sectors. For example, assigned-also-chosen schools (assigned schools which are actively chosen by parents for their child) may be different from the non-chosen assigned public schools. The scope of this study is therefore broader, and informs policy discussion better, because it considers more school type alternatives. The models will be run on pooled nationally-representative data and on subgroups of race/ethnicity, income levels and parental education.

This research will help policymakers understand the potential effects of initiatives designed to increase student achievement, such as increasing access to different school types, or supporting parent involvement, such as direct volunteering in the child's school. The answers to the research questions in this study should also guide the development of school practices and programs that lead to more parent involvement in specific school types. The findings also hope to inform education policies and parent-involvement programs to equalize opportunities and bridge achievement gaps across different race/ethnicities, income levels and parental education background.

[1] Refers to charter, magnet and "open-enrollment" public schools

2. Research questions

1. Do parental decisions about school type and involvement (school- and child-level) affect student achievement? The study examines whether different forms of school types and parent involvement have different effects on student achievement. In addition, the study examines whether these effects vary across subgroups of race/ethnicity, income levels and parental education.
2. How are school type and parent involvement related – are they substitutes or complements? Do parents become more or less involved if the child is in a certain school-type?

3. Scope of the study

This study will use nationally representative data on students in third grade from the Early Childhood Longitudinal Study (United States): Kindergarten Class (ECLS-K) of 1998-1999, Longitudinal Data from Kindergarten to Third Grade. The education outcome of interest in this study is student achievement (for children in third grade in school year 2001-2002), as measured by scores on reading and mathematics assessments.

The focus here is on school-type effects and parent involvement on early elementary outcomes in general. School choice is "actual" choice already made by parents for their children, manifested by the school-type the third grader is in. The dataset presents these choices as: assigned public school, chosen public school (charter, magnet schools, public school chosen through open enrollment), assigned public school is also chosen school, religious private school, and non-religious private school. The scope of

this study regarding choice is general and certainly broader than that covered under the No Child Left Behind (NCLB) Act. It is not limited by the scope of the NCLB, which only allow transfer of the child to another public school if the state says that the child's assigned public school is "in need of improvement"[2]. The school types considered in this study are also more specific and numerous than those covered by many school choice studies, which tend to focus on a particular type of choice such as public charter schools or religious private schools.

Meanwhile, parent involvement at both the school and the home are included. Parent involvement at home includes parenting practices and learning activities at home. Parent involvement at school looks at voluntary school involvement such as participation in parent-teacher meetings and talking with parents of children in child's class.

The analytic strategy includes controlling for confounding factors that may affect student achievement, such as parent and child characteristics including child's previous scores in kindergarten.

4. Policy relevance

The answers to the research questions will inform policy in several ways. If a specific school type has a significant positive effect on student achievement, policy should consider whether funding should focus on (1) increasing access to school choice through policy tools such as vouchers, lotteries, tax credits, open enrollment, etc., (2)

[2] School in Need of Improvement — This is the term *No Child Left Behind* uses to refer to schools receiving Title I funds that have not met state reading and math goals (according to Adequate Yearly Progress standards) for at least two years. If the child's school is labeled a "school in need of improvement," it receives extra help to improve and the child has the option to transfer to another public school, including a public charter school. Also, the child may be eligible to receive free tutoring and extra help with schoolwork. (http://www.ed.gov/nclb/overview/intro/parents/parentfacts.html, 2006)

increasing school choices for similar types, and (3) discovering what aspect of this school type makes it effective and use this information to improve existing schools.

The effect of the different kinds of parent involvement on student achievement also needs to be assessed. Programs that support parent involvement should be informed by evidence regarding the types of involvement that are most likely to lead to improved achievement, and for which subgroups. Does parental volunteering at the school really help? What about academic expectations for the child or having TV rules? These parent-involvement programs should also be informed as to how parent involvement can be influenced most effectively.

Showing whether or not there is heterogeneity across subgroups should further inform policy to better support children from at-risk groups. Do different types of parent involvement and school types affect student achievement similarly across race/ethnicity, poverty level, and parent education? If they do, the study could inform the design of parent involvement programs for black or Hispanic children in public assigned schools. For example, in the Parents Assuring Student Success (PASS) program, parents collaborate with the school to learn how to supplement schoolwork by instructing their children at home in academic tasks such as reading and time management (Bar, 1993). The PASS program can be targeted specifically for at-risk children who could benefit the most from an improved learning environment at home.

Furthermore, the relationship between school type and parent involvement has to be understood. Do certain school types encourage or lead to more parent involvement? And if they do, how can policies or programs facilitate more parent involvement within the school types that need it?

The study hopes to inform policy on whether or not school practices and programs that lead to more parent involvement should be developed for parents who choose certain school types. Are parents of children in public assigned schools more or less involved compared to parents of chosen schools (public and private)? If, for example, the result of the study shows that student achievement in public assigned schools is lower than that of chosen schools, and at the same time parent involvement is less in assigned schools, then policy has to formulate incentives and programs to increase parent involvement. The policies could be implemented in the form of concrete school practices that encourage or inform parent involvement. To illustrate, a school-related parent education program model can be designed where parents of successful children can serve as models for sharing what they do well to inform other parents.

5. Organization of the study

Chapter Two contains the literature review on school choice and parent involvement. Under school choice, the general framework of the literature on choice and student achievement is discussed. This is followed by a discussion of how these studies treat parent involvement. Symmetrically for parent involvement studies, the general framework of parent involvement and student achievement is presented. A discourse on how studies on parent involvement treat school type effects follows. Finally, this chapter also discusses the literature that links school choice and parent involvement.

Chapter Three discusses the conceptual framework, data and analytic strategy. The conceptual framework is of two parts: the theoretical model, and a discussion of the assumptions needed for empirical analysis. The section on data focuses on the key

dependent and independent variables, and includes a descriptive analysis of the patterns of relationships between the variables. The section on analytic strategy starts with a discussion of endogeneity and error terms that are neither independent nor identically distributed, followed by a discussion on how these problems are addressed. Two kinds of models that can be used to address endogeneity, and the merits and demerits of these models, are presented.

In Chapter Four, the findings of the study are provided. Findings show that school type does not have any significant correlation with reading scores, while private schools have a negative correlation with math scores. Academic expectations of parents for their child, as well as reading at home, are two of the parent involvement variables that show consistent correlation with student achievement. Moreover, parents of choosers also tend to be more involved. School type and parent involvement variables seem to be complements rather than substitutes.

Chapter Five provides the conclusions and policy implications of the study, as well as the recommendations for future research.

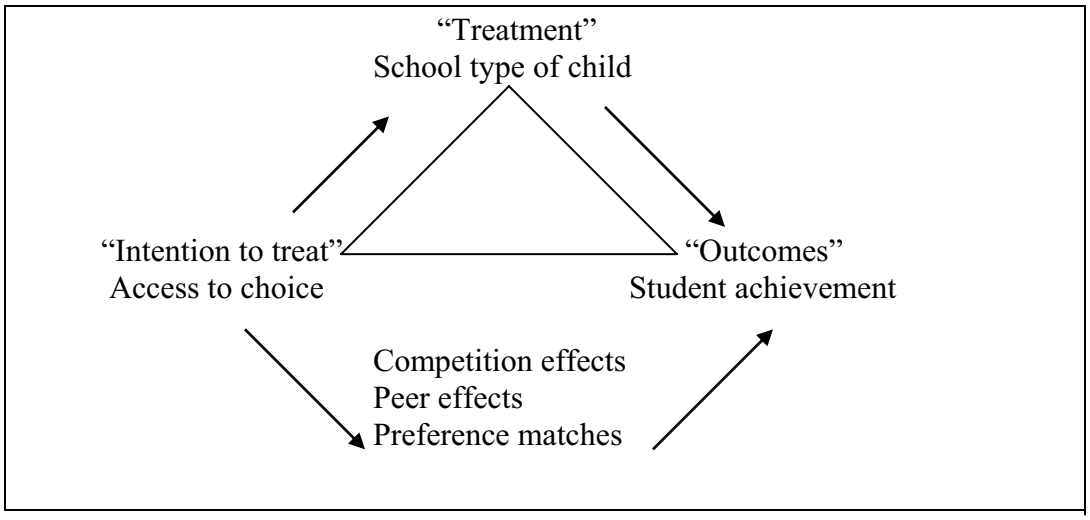
Chapter 2 –Parental Decisions and Academic Achievement: A Review of Literature

1. The school choice literature

This review of literature on school choice will have two parts: There will be a discussion of the general framework of the literature on school choice and student achievement, followed by a discussion of how these studies treat (or do not treat) parent involvement.

School choice is currently one of the main foci of education reform efforts, as indicated by the accompanying studies that evaluate these policy efforts. Studies on school choice and student achievement, which have had mixed results, generally come in two categories: those that focus on the effect of choice policies on students after the choice has been made, and those that focus on the effect of choice on schools. The first category of school-choice studies can further be segregated into those that look at the effect of "access to choice" on student achievement, and those that look at the effect of "actual choice about school types" on the same. The second category, meanwhile, can be further specified into those that focus on the effect of "access to choice" on school quality through competition effects, peer effects, and preference matches (see Figure 1). Note though that studies are not always clear-cut and may combine both categories in their approaches. In any case, the discussion below will focus on the first category, specifically on the effects of school types on student achievement.

Figure 1. General framework of literature on school choice and student



School type and student achievement

Selection bias is a major problem that may distort estimates of how school type affects student achievement. Students are not assigned to choice schools are random, rather, the sorting of students into choice schools reflects the decision of their parents to transfer their child from a traditional to a choice school. As a result of this sorting, the test scores of students in choice schools might be higher (or lower) than those of a nearby traditional school, because the students "selecting" the choice alternative might have better (or worse) background or preparation than those students remaining at the traditional school. This selection process means that test scores might differ between traditional and choice schools entirely because of the composition of students at each type of school, irrespective of any differences in the learning environment at these different types of schools.

The selection bias in school type effects can be reduced by adjusting student achievement scores with comprehensive measures of the background and preparation for students attending each type of school. These measures are typically limited, however, so

some selection bias is likely to remain and distort the observed differences in school type effects. For example, suppose that students at private schools are disproportionately drawn from families with greater wealth than students at traditional schools. If family wealth is not measured empirically, then comparisons of test scores in traditional and private schools might overstate the "true" differences in the learning environment between these types of schools. This would occur if family wealth provided students with better access to learning activities in the home over and above the activities provided by the school.

Longitudinal studies provide an alternative approach to isolate the effects of school type on student achievement. If students are observed over multiple years, then an analysis of the pattern of achievement gains over time might substantially reduce the selection bias and improve the measure of school type effects. This value-added approach looks at the gains in student achievement over time and compares whether test scores change more for students in some types of schools than in others. By tracking student progress over time, the models implicitly control for ability, student background and preparation and focus attention on how current school inputs affect achievement.

Many studies on school choice have focused on charter school effects, and several have focused on Catholic school effects. The control group for these studies is usually the traditional public schools. Studies on other school types such as non-Catholic private schools and assigned-also-chosen public schools are either sparse or non-existent.

Although charter schools may satisfy family preferences regarding various aspects of the educational environment, results are mixed regarding the academic quality of charter schools in comparison to the local public school alternative. Studies on effect

of charter schools on achievement in California, Texas, Florida, North Carolina and Chicago show mixed results.

Zimmer and Buddin (2003) showed that charter school student achievement could be slightly worse compared to comparable students in conventional public schools in California. They used four kinds of data and approaches to compare student achievement in charter and traditional public schools: school-level performance, statewide non-longitudinally linked student-level data, longitudinally linked student-level data, and the competitive effects of charter schools. Zimmer and Buddin state that the third approach using individual student tracking data provides the best estimates of the effects of charter schools, as it allows them to adjust for student background characteristics that are treated as unobservables in their first two approaches. In their longitudinal approach, they used an alternative fixed-effect model that used the longitudinal nature of the data to difference out the unobserved student-specific factor that does not vary over time. Another model they used was the random-growth model that generalizes the fixed-effects model to allow for individuals to differ not only with respect to an unobserved student-specific factor but also on the rate of test score growth over time. Results for both models were similar. The fixed-effects model show that in math, charter school students score 0.7 and 0.4 percentile points lower in elementary and secondary schools, respectively, than do students with comparable backgrounds in traditional public schools. Meanwhile, charter school students in secondary schools score 0.3 percentile points higher in reading. Their results show that student achievement is comparable between charter and traditional public schools. Significant differences appear only when charter schools are broken by type: nonclassroom-based schools perform lower than traditional public

schools, while classroom-based charter schools performed slightly higher in certain subjects.

Hanushek, et al (2005) use panel data on student achievement in Texas for students in grades 4 through 7 in charter schools. The approach uses a value-added model of achievement growth as dependent variable, with a dummy variable indicating whether the child's school is a charter or not. Other control variables are: dummy variable indicating school transfer, time-invariant student fixed-effects capturing all family and individual influences, and any systematic influences that vary over time. In particular, their results show that students in charter schools have less value-added in their scores compared to those in regular public schools at the beginning of charter school operations. This negative effect disappears by the second or third year of charter school operations, when their effects on student scores are no longer significantly different from those of the control group.

The longitudinal approach and results of Sass (2004) for Florida are similar to that of Hanushek et al. Sass uses scale scores from the Florida Comprehensive Achievement Test Norm-Referenced Test (FCAT-NRT). He focused on the sample of Florida public school students in grades 3-10 in 2001/2002 who took the current FCAT-NRT and also who took the same test in each of the two previous school years. Controlling for student-level fixed effects and child's previous scores, Sass finds that student achievement is lower in new charter schools. By the second year of operation, charter schools have similar effects as traditional public schools in reading. Charter school effects are at par with traditional public schools by the fourth year of operation.

Bifulco and Ladd (2004) analyze achievement data for North Carolina students over 1996-2002, tracking 5 cohorts of students from grades 3-8. Their sample has

496,000 students. Controlling for student fixed effects, Bifulco and Ladd found that the negative effects of charter schools in North Carolina on achievement continue to be large and statistically significant even for schools that have been operating for five years.

Hoxby and Rockoff (2005) also looked at the impact of charter schools on student achievement in grades 1-8 in Chicago, using lottery results as an instrumental variable. Their analysis of the Chicago International Charter Schools suggest that students who go to charter schools have higher subsequent achievement (about 6-7 percentile points in math and 5-6 percentile points in reading) than students who are lotteried-out and attend regular public schools. Since most of the students apply in the kindergarten through fifth grades, these effects are what most students experience. The effects of charter schools for students applying to grades 6-8 were statistically insignificant. However, the results are based on fewer numbers of students who apply to later grades and therefore do not produce balanced groups of charter and regular school students.

The Hoxby and Rockoff results run counter to that of Cullen et al (2003) who use lottery data from 194 separate lotteries at 19 high schools in Chicago, containing 19,520 applications submitted by 14,438 students in Spring 2000 and Spring 2001. Like Hoxby and Rockoff, Cullen et al use the lottery results as the instrumental variable. The study finds no difference between winners and losers (in their study, they focused on sought-after high school programs) on traditional outcome measures such as test scores or school attendance. This result is true for a variety of subgroups of students and does not depend on the program offered in the school. Their findings are consistent with an even stronger conclusion that attending the so-called "better" schools does not systematically improve short-term academic outcomes. What they do find is that school choice may improve non-traditional outcomes such as disciplinary incidences and arrest rates.

There are several studies on the effects of being in Catholic schools on student achievement. The so-called "Catholic school effect" began with Coleman, Hoffer and Kilgore's (1982a, 1982b) study of the 1980 High School and Beyond (HSB) data, which found that students in Catholic schools, when compared to those in traditional public schools, did better by about 15-20% of a standard deviation in reading, vocabulary, and general mathematics. The data covered 58,000 high school students in over 1,000 schools in the US. Their control variables included student characteristics and family background, including parent's academic expectations for the child, amount of time spent on homework, and whether or not the parent is a volunteer at school. This study, however, only used cross-sectional HSB data and cannot make any causal statements.

A subsequent study by Hoffer, Greeley and Coleman (1985) did a longitudinal extension of the study using various analytical methods such as the regressor variable model (with previous test score as one of the controls), and the propensity score method (comparing Catholic school students with a matched sample of public school students). Their results found that students in Catholic schools do better (by an increment of 35-70% of a standard deviation) than students in public schools in reading, vocabulary, mathematics and science. Catholic-school effects in science and civics are negligible.

Willms (1985) also used the Coleman, Hoffer and Kilgore report as a starting point. He used four different models to tease out Catholic-school effects, with each model regressing senior test scores on sophomore pretest scores, ability indicators (sophomore pretest scores in reading, vocabulary, and basic mathematics) and a set of background variables on student and family characteristics. The background variables varied per model: three of the models include background measures from published studies that used the HSB data, while the fourth one includes only the most important control

variables. Willms found that on average, the Catholic-school effect was only about 5% of a standard deviation. Public schools had a small advantage in science and civics, while Catholic schools did better in reading, vocabulary, mathematics and writing.

Hoffer, et al criticized the Willms study as using models that are over-controlled, since Willms uses sophomore test scores in reading, vocabulary and basic math as ability controls together with the sophomore score for the test being examined. Willms, however, notes an important caveat which Hoffer et al have been quiet about– the test scores used are relatively poor measures of academic growth during the junior and senior years of high school. Willms found that the tests used in the HSB[3] were not sensitive enough to the amount of coursework completed by the student during the intervention period. Willms performed a simple regression and found the gains to be smaller than expected compared to what appeared in the literature. He therefore concludes that the studies based on HSB were estimating sector differences with tests that show virtually zero growth for half of the sample and a very small amount of growth for the other half of the sample, much of which is achieved by students who did not attend school during the intervention period (students who dropped out before Grade 11).

More recent studies have disputed the Catholic-school effect as well as the more general private-school effect. Kim and Placier (2004) compared academic achievement of students in Catholic schools versus those in non-Catholic private schools. They used hierarchical linear models (HLM) (on student and school levels) on 1,789 students from 144 private schools drawn from the national Education Longitudinal Study of 1988. They selected students in private schools (Catholic, non-Catholic religious and non-religious

[3] The Education Testing Service of Princeton, New Jersey designed the HSB test battery. Seven tests are included. Reading, vocabulary and general mathematics measure basic academic skills. Advanced mathematics, writing, science and civics were developed to measure skills that are taught during the junior and senior years of high school.

private schools) from the 1988 Base Year Study of eighth graders and from the 1990 Follow-up Study of tenth graders. Controls included student's base year achievement test scores, student's initial GPA, minority status, gender, and family socioeconomic status. They found that for reading achievement, Catholic schools had a negative effect compared to non-Catholic private schools. For achievement in math, history/social studies and science, Catholic schools had no effect.

Lubienski and Lubienski (2006), meanwhile, used a large nationally representative sample to compare academic achievement in mathematics across charter, private (Catholic, Lutheran, conservative Christian, and other private schools) and public schools, for 4th and 8th grade students. They found that 4th grade students did worse in all types of private schools and in charter schools, compared to similar students in public schools. For 8th graders, they found that those in Catholic and conservative Christian schools did worse than those in public schools. Database used is the 2003 National Assessment of Educational Progress (NAEP), which contains data on 190,000 4th graders in 7,485 schools and over 153,000 8th graders in 6,092 schools. The study controls for student background as well as some school characteristics using HLM.

However, a major limitation of the study is the fact that the NAEP data only allows for cross-sectional analysis. The lack of control for student's previous score allows the Lubienski and Lubienski study to make correlational statements only. The concern with this approach is that students are not assigned to schools at random, so the cross-sectional results may say more about the pattern of sorting students into different types of schools than about the learning environment at those schools. Longitudinal data have allowed other authors to control for student-level unobservables that affect achievement and better isolate how school type affects achievement.

In sum, it is difficult to make any conclusion from the studies discussed above because their results are mixed, and data is limited.

Parent involvement in school choice literature

A limitation of the school choice literature is that it has not focused on potential bias from parent involvement. Research and reform efforts have both emphasized the role of parents in holding schools accountable (by having the option of school choice or "voting with their feet") and in having parents themselves become more responsive (parent involvement at the school and child level) in their children's education. However, school choice has been widely studied in recent years but usually without the mention of parent involvement. Parent involvement variables are treated either as unobservables or as fixed effects. Zimmer and Buddin (2003), Hanushek, et al (2005), Sass (2004) and Bifulco and Ladd (2004) combine parent involvement variables together with student characteristics as one fixed effect at the student level. The first three studies assume that parent involvement does not vary over time nor with respect to school-supplied inputs. Bifulco and Ladd allow the overall student fixed effects (which includes parent involvement and characteristics) to vary by year and grade.

Another example is the study by Hoxby and Rockoff (2005) on the impact of charter schools on student achievement in Chicago. On top of instrumental variables to address selection bias, they included covariates such as race/ethnicity, free lunch, and proxies for ability. Parent involvement, which, unlike the covariates they included in their models, can change after the child has transferred to a charter school and can bias their results, is not included.

In any case, these studies do not explicitly assess the effect of parent involvement on achievement. None of these studies had any information on parental involvement. The California, Texas, Florida, Chicago and North Carolina data are all drawn from school records data that do not record any measure of parental involvement or a variety of other family and student background factors that are likely to affect student achievement. The authors did not discard information about parental involvement—the information was not available in these studies. The advantage of using school records data is the large volume of records available at almost no cost, but the disadvantage is that the records are not as complete as researchers would like. Instrumental variables, fixed-effects and random-growth models help with some problems, but they are not a panacea, especially since parent behavior can change once the child is in a certain school type.

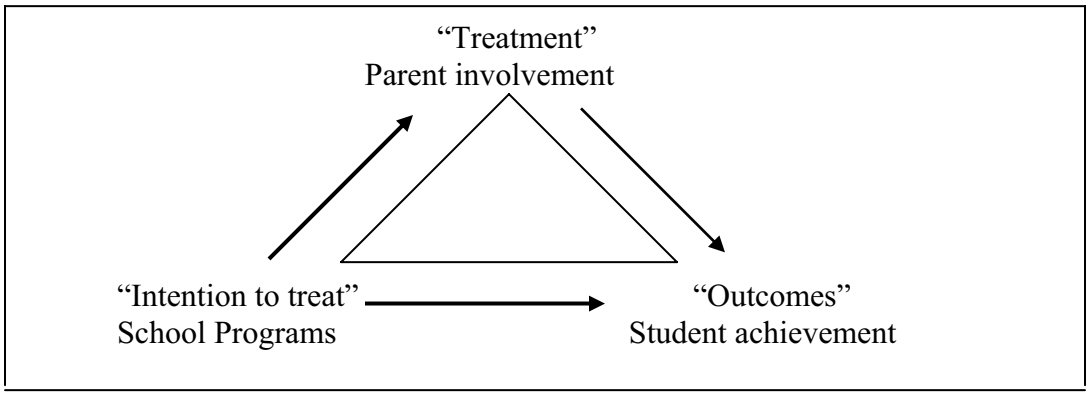
2. The parental involvement literature

Similar to the review of literature on school choice, this section on parent involvement will have two parts: There will be a brief discussion of the general framework of the literature on parent involvement and student achievement, followed by a discussion of how these studies treat (or do not treat) school choice.

A key factor behind student achievement other than parental school choice is parent involvement. The literature is extensive in showing the relationship between school programs, parent involvement in education and children's school performance (Figure 2). Parent involvement studies generally fall into three categories (Henderson and Mapp, 2002): (1) studies on the impact of family and community involvement on student

achievement; (2) studies on effective strategies to connect schools, families, and community; and (3) studies on parent and community organizing efforts to improve schools. This review focuses on the first category.

Figure 2. General framework of literature on parent involvement and student achievement



Parent involvement and student achievement

There are several ways of measuring and understanding parent involvement, as discussed by several authors who have developed various frameworks for such (Chrispeels, 1992, 1996, as cited in Chrispeels & Rivero, 2001; Eccles & Harold, 1996; Epstein, 1992; Grolnick & Slowiaczek, 1994; Hoover-Dempsey & Sandler, 1997). Epstein's (1992) measure of parent involvement is one of the most quoted in the literature, and has been adopted by practitioners such as the National Parent Teacher Association (National PTA, 1998). The Harvard Education Letter (1997) summarized the six types of family-school-community partnerships as follows, based on Epstein's studies:

i. Parenting: Families must provide for the health and safety of children, and maintain a home environment that encourages learning and good behavior in school. Schools provide training and information to help families understand their children's development and how to support the changes they undergo.

ii. Communicating: Schools must reach out to families with information about school programs and student progress. This includes the traditional phone calls, report cards, and parent conferences, as well as new information on topics such as school choice and making the transition from elementary school to higher grades.

iii. Volunteering: Parents can make significant contributions to the environment and functions of a school. Schools can get the most out of this process by creating flexible schedules, so more parents can participate, and by working to match the talents and interests of parents to the needs of students, teachers, and administrators.

iv. Learning at home: With the guidance and support of teachers, family members can supervise and assist their children at home with homework assignments and other school-related activities.

v. Decision-making: Schools can give parents meaningful roles in the school decision-making process, and provide parents with training and information so they can make the most of those opportunities. The opportunity should be open to all segments of the community, not just people who have the most time and energy to spend on school affairs.

vi. Collaboration with the community: Schools can help families gain access to support services offered by other agencies, such as healthcare, cultural events, tutoring services, and after-school child-care programs. They also can help families and

community groups provide services to the community, such as recycling programs and food pantries.

Many researchers use some variation of this framework. Ho and Willms (1996) studied the effects of parent involvement on eighth-grade student achievement, using data from the National Education Longitudinal Study (NELS) based on a sample of 24,599 students and their parents and teachers. They identified 12 parent involvement variables from the NELS that were compressed into four variables using principal components analysis. The four parent variables are: home discussions between parents and child, communication between parents and school, home supervision, and school participation by parents in volunteer activities and PTA meetings. They used hierarchical linear modeling and controlled for family socio-economic status, family structure, whether students were considered by their parents to have learning or behavioral problems, and child gender and ethnicity. They first used parent involvement factors as dependent variables to see how the other variables affected parent behavior. Then they used reading and math standardized scores as dependent variables. They found that the discussion of school-related activities at home had the strongest relationship with academic achievement. Parental participation at school had a moderate effect on reading achievement, but a negligible effect on math achievement. Ho and Willms admit that their study is potentially biased because they do not include prior academic achievement due to data unavailability. There is, however, another potential source of bias which they did not mention: school type of child as well as school-level variables.

Catsambis (1998), Shumow and Miller (2001), Fan and Chen (1999) and Desimone (1999) found that parent involvement with homework and parent-initiated

contacts with school were negatively related to student achievement. Parent involvement that is more "reactionary" than pro-active tend to show a negative relationship with student achievement.

Catsambis studied 13,500 families whose children stayed in school through 12th grade. She measured the connection of Epstein's six types of involvement with student achievement in high school. She controlled for race/ethnicity, education of parents, job, income, family size, whether parents were at home or working, language at home and engagement at school. On one hand, she found that parental behavior such as contacting the school, encouraging teens to graduate from high school rather than go to college, and supervising behavior were all associated with lower student achievement. When she controlled for problem behavior, the effects disappeared. On the other hand, she found positive correlations between student achievement when parents express high expectations, discuss going to college, and help students prepare for college.

Shumow and Miller used data from a national study of adolescents and looked at a subsample of 60 families to examine the impact of parent involvement during the middle grades. They found that parents of struggling students provide more help at home than parents of successful students. This may be because parents tend to help more with homework when students are not doing well in school.

Fan and Chen found a similar pattern in their meta-analysis of data from 25 studies conducted over the past 10 years. These studies suggest that parents are more involved, especially in terms of supervision, as a reaction to their children not doing well in school. Similar to other studies, Fan and Chen found that parent's aspirations and expectations have the strongest relationship with achievement.

Izzo et al (1999) did a three-year study of 1,200 urban New England children from kindergarten through third grade and looked at the effects of parent involvement on student achievement over time. They had four measures of parent involvement and five measures of student achievement. However, the Izzo et al study has issues on measurement error and respondent bias in the parent involvement variables, because of the way the parent involvement data were collected. The study uses the Teacher-Parent Survey that asks teachers to report on four aspects of parent school involvement: The first aspect is on the number of contacts teachers had with each child's parents during the year. The second aspect is based on answers from two questions that were averaged into a variable reflecting the quality of the teacher's interactions with each child's parents. The third aspect is on answers that were averaged from two questions into a variable reflecting teacher's perceptions about whether parents participated in school activities, and the final aspect is based on two questions that were averaged into a variable reflecting teacher's perceptions about whether parents engaged in activities at home to enhance their child's social and academic development. Students were randomly selected from 341 classrooms in 27 schools. Control variables included gender, grade level, family income and education, and ethnicity. They found that engaging in home activities[4] was the strongest positive predictor for math and reading achievement. The variable they used on parents' educational activities at home, however, was a rather vague yes/no binary variable. There was no explicit definition of the "educational activities at home" in the Izzo et al paper. And most importantly, the data on parent involvement was based on teacher's perceptions of involvement, not actual parent involvement.

[4] Based on the following survey items: In the past year, did this child's parent: engage in activities that foster academic development?…engage in activities that promote child's social skills with peers? Answers were coded as 0=No or Don't know, that is, if the teacher either did not know or did not perceive that the parent engaged in learning activities at home with child, and 1=yes.

Gutman and Midgley (2000) studied African-American students from 62 families during the transition between grades 5 and 6. The dependent variable is the students' grade point averages. They found that parent involvement as a single variable (the definition includes talking to students about school, checking homework, attending events and volunteering) did not appear to be related to student achievement. The insignificant results, however, may be because the components of parent variables used have a mix of negative and positive correlations with student achievement which cancelled each other out.

To test the hypothesis that the relationships between particular types of parent involvement and student achievement differ according to the student's race/ethnicity and family income level, Desimone (1999) used data from the National Education Longitudinal Study of 1988. She found that some parent involvement variables are more effective than others across different subgroups. Since she used cross-sectional, nonexperimental data without longitudinal analysis (previous child scores, for example were not included in the model because of unavailability for 8^{th} graders in her dataset), Desimone herself stated that causal relationships cannot be estimated with any confidence.

Desimone ran models (child scores as dependent variable, parental involvement as key independent variables) for each of the race/income subgroups. She looked at the resulting coefficients from the models and compared them across sub-groups (for example, she looked at the coefficient effects of parental volunteering on child scores across blacks, whites, etc.) Desimone found that school-level volunteering was a better predictor for White and middle-income student achievement than for Asian, Black, Hispanic and low-income students. Parent-Teacher Organization (PTO) involvement,

however, was associated significantly with achievement for the latter group of students. She also found that discussion with parents about school matters was a significantly better predictor for Whites than for Asian, Blacks or Hispanics, and for middle-income students compared with low-income students. Desimone recognizes that prior research has documented a positive relationship between achievement and high parental expectations. She found in her study that parental discussion with students about post-high school plans was associated with achievement outcomes for White and middle-income students, but not for low-income, Black and Hispanic students. She also found that parental help with homework was associated negatively with all measures of achievement, for students from all races/ethnicities and income levels.

Lee and Bowen (2006) examined the effect of five types of parent involvement on elementary student's academic achievement by race/ethnicity, poverty level and parent educational attainment. Their sample comprised of 415 third through fifth graders in a community in southeastern United States. The data was assessed with t tests, chi-square statistics, and HLM. They found that parents with different characteristics acted differently, and the types of involvement shown by parents from dominant groups (white, non-at-risk groups) had the strongest association with achievement. They found positive associations between achievement and parent involvement at school, and educational expectations had more than twice the effect of school involvement. Homework help had a negative correlation with achievement. This study, however, is only cross-sectional. The sample used is also limited, and the measure of achievement had reliability problems (scores were based on four teacher-report measures).

In sum, there seems to be a general positive relationship between home and school involvement of parents on student achievement, except for direct homework help

which has a consistent negative relationship with achievement across studies. However, the results of several studies should be interpreted carefully given that they only look at the correlations between variables; they are not causal. Moreover, the measure of student achievement was usually not reliable, and the sample used limited any inference to external validity.

School type in the parent involvement literature

School type is also not considered by studies linking parent involvement and student achievement. For example, studies by Ho and Willms (1996) look at parent involvement and socio-economic status and their effect on student achievement, but there was no mention of school choice. Desimone (1999), while looking at parental involvement effects on student achievement within the sub-groups of income and ethnicity, did not consider school type effects in her models. Catsambis (1998), Izzo et al (1999), Fan and Chen (1999) and Shumow and Miller (2001) all did not include school choice effects into their models.

3. Linking school choice and parent involvement

What about studies that look at the relationship between school choice and parent involvement? Though studies are few and results tend to be mixed, there are studies that posit that parents in choice schools are more involved than those in public assigned schools (Hausman and Goldring, 2000; Martinez et al., 1996; Wells, 1996).

Hausman and Goldring studied the link between parent involvement and the reasons they chose schools, in this case, magnet schools. They used survey data on

parents of fifth-grade children from two large urban school districts in which magnet schools are an integral part of the student assignment plans. The first district has 51,000 students, serving 46% of the students in magnet schools. The second district serves 36,091 students with 28% enrolled in magnet schools. Parent involvement is based on self-reports of their involvement at school measured by a seven-item Likert scale. Parents were asked the extent to which they were involved in various activities at school (such as serving as volunteer and attending fields trips, etc.). Hausman and Goldring found that parent's reasons for school choice (academic, convenience, discipline/safety and values) were generally less effective in predicting parent involvement than the parent background factor (such as income). Moreover, those parents who chose schools for values reasons reported greater levels of involvement at the school. Those who chose the schools for reasons of convenience, on average, live much closer to the schools. But this proximity did not result in a significant difference in level of involvement.

Other studies on the relationship between parent involvement and school choice were done on data from three cities by Bauch and Goldring (1995), on St. Louis by Wells (1993), on Milwaukee by Witte (1991) and Witte et al. (1992), and on California by Ogawa and Dutton (1997). Bauch and Goldring compare parent involvement across three school types in Chicago, Washington DC and Tennessee: Catholic schools, single-focus magnet schools and multi-focus magnet schools. The study included only parents of 12^{th}-grade students who reported choosing these schools or their specific magnet programs (N=575). The study tries to rule out selection bias by controlling for ethnicity, religion, education of parents, income, family structure. Discriminant analysis, a multivariate method that distinguishes between groups of respondents on the basis of discriminating variables, was used to determine differences among three school groups in terms of

parent involvement and school responsiveness. Parent involvement at school include: seeking information prior to enrollment, have current information about the school, receive information directly from their child or from school meetings, contact the school, attend school meetings and events, and serve on committees. Parent activities at home include: enforcing rules about maintaining good grades and doing homework, and about talking on the phone and holding a job. They found that parents of children in Catholic schools and in single-focus schools are more involved at school and at home compared to parents in multi-focus schools. The St. Louis study by Wells showed that parents who tended to be less involved were also less likely to be choosers. The Milwaukee study by Witte and Witte et al also suggested that they were complements—more involved parents were also more likely to take advantage of choice opportunities.

Ogawa and Dutton aimed to revisit the relationship between parent involvement and school choice in the light of Hirshman's (1970) concepts on exit and voice in public schools. Through regression analysis, they examined the relationship between parent satisfaction, parent involvement in school activities and in education-related activities at home and the likelihood that they would participate in three types of school choice programs (intradistrict options, interdistrict transfers, and state-funded vouchers). Using California data, their results show that choice and involvement are complements. That is, parents who were more involved have a higher likelihood to choose. However, their dependent variable was the "likelihood" of making school choices (key independent variables were actual parent involvement at school and at home). Results of this exploratory study may not be robust since "likelihood" does not always translate to actual choice.

The Cullen, Jacob and Levitt (2005) study on school choice noted parent involvement as an important "unobservable" in their school choice study on the Chicago Public Schools. To assess if students who opt out of schools are systematically different than other students, they investigate student and parent characteristics. One of these variables is parent involvement, data on which was culled from a survey conducted for a subset of their sample. They checked for correlation between parent involvement and school choice and found a general positive relationship. They found that students attending high-achieving schools have better educated parents and greater parental involvement in school activities. Hence, Cullen et al used instrumental variables to purge their estimates for the whole sample of the effects of these unobservables[5]. In a previous study, however, Cullen et al (2003) showed some evidence from their sub-sample survey that school quality and parent involvement are substitutes in the education production function. Their motivation for showing the sub-sample survey on parent involvement was to show that how parents react once the child is in a charter school may still bias their results despite using lottery results as the instrumental variable. Unlike the sub-sample survey in their 2005 study which only looked at parent involvement in school, their sub-sample survey in the 2003 study included questions on whether or not "parents help with homework most or all of the time", and "check if homework is done most or all of the time". While parent involvement in school matters consistently showed that parent behavior and school quality are complements, the parent behavior regarding direct involvement with homework showed that parent behavior and school quality are

[5] Note that if Cullen et al (2005) did not find that students who opt out are systematically different on "unobservable" dimensions, then there is no need to use instrumental variables. Or if they found a systematic difference, but that there are good proxies for these unobservables available for the entire sample (and not just a subset), then they can incorporate these proxies into the models instead of the instrumental variables.

substitutes. Cullen et al certainly looked at the parent involvement factor in their two papers, but only to discuss them at length as potential sources of bias. Parent involvement variables per se were not included in their main models because of data constraints (the surveys on parent involvement were only from a sub-sample of their data). Instead, parent involvement was treated as unobservables that had to be addressed by instrumental variables to avoid bias.

None of these studies have so far linked school choice and parent involvement using nationally representative longitudinal data. The key motivation of this dissertation is to contribute to the literature by empirically linking school choice (in this case, school type) and parent involvement, and linking both to student achievement, using nationally representative (United States) data.

Chapter 3 – Conceptual Framework, Data Description and Analytic Strategy

1. Conceptual framework

In this paper, I attempt to assess the effects of parental decisions about school type and involvement on academic achievement of third graders, treating both factors as "observables". To be able to draw the relevant policy implications, I also want to examine how decisions on school type and parent involvement are correlated, looking at whether or not they are substitutes or complements.

This section has two parts: the first part is on the theoretical model, and the second part is on the empirical assumptions to run the model.

The theoretical model

This part presents a simple conceptual model on how parents make decisions about school type and involvement, based on a theoretical model developed for school type effects on student achievement by Newhouse and Beegle (2006)[6].

Consider a one-period model in which parents select a school. Let the parents' utility be a function of the net income after tuition has been paid, the net time after parent involvement, the child's end-of-period academic achievement, and non-academic

[6] Newhouse and Beegle (2006) model parental utility as $U_j = \ln (Y_1 - P_j) + \delta \ln (Y_2 + kA_j) + \alpha A_j + \gamma O_j$, where Y_1 is household income in period 1, P_j is the tuition of school j, δ is the parent's discount rate, A_j is student achievement at the end of period 1 after attending school j, α is the parent's "valuation of academic achievement net of income gains associated with that achievemnt, and O_j are non-academic characteristics of the school valued by parents outside of achievement. Their model for student achievement is $A_j = Q_j + a Y_1 + b \alpha$, where Q_j is the quality of the school. They used these models to assess how school type affects student achievement in Indonesia.

preference matches[7]. The parents' utility is also assumed to be concave with respect to net income and net time, and increasing with respect to the student's academic achievement and to non-academic preference matches. The parents' utility function from their child attending the jth school is

$$U_j = \text{Log}\,(Y-P_j) + \text{Log}\,(T-PI_j) + \alpha A_j + \gamma O_j \qquad (1)$$

where

$$A_j = a_j\, Q_j + b_j\, PI_j + c\, Y \qquad (2)$$

In equation (1), Y represents household income, which is exogenous with respect to school type. P_j is the tuition paid for the school j, T is time, PI_j is parent involvement for the child who is in school j, α is the parents' valuation of academic achievement, A_j is the academic achievement of the child in school j, and O_j are the non-academic characteristics of the school. γ is the degree of preference matching between what the parents want and the school's non-academic characteristics.

Equation (2) assumes academic achievement to be a positive and linear outcome of school quality (Q_j), parent involvement (PI_j), and income (Y). The proxy variable for Q_j is school type. Y represents the socio-economic status (SES) of the family that includes income and education attainment. The assumption behind equation (2) is that parents with higher SES and who value education more (in terms of choosing school type and being more involved) will provide a household environment more favorable to

[7] In this study, "non-academic" preference matches would include: certain peer-group characteristics such as race/ethnicity or income levels; the religious affiliation of the school; school-home distance; safety; discipline; etc.

learning, so that parameters a, b and c are positive. There may be other factors that affect student achievement, but this theoretical framework highlights the three key sets of variables that are the focus of this study.

Equations (3-8) show why parents choose certain school types over the assigned school, and why they become more or less involved. If parents think their utility will be greater in other school types compared to their utility if the child stays in the assigned school, then they will choose to enroll their child in a school other than the assigned one. Parental choice basically depends on whether or not $\Delta U>0$.

$$\Delta U= U_{other} - U_{assigned} \quad (3)$$

Further assume that:

$$U_{assigned}= \text{Log } (Y-P_{assigned}) + \text{Log } (T-PI_{assigned}) + \alpha A_{assigned} + \gamma O_{assigned} \quad (4)$$

$$A_{assigned}= a_a\, Q_{assigned} + b_a\, PI_{assigned} + c\, Y \quad (5)$$

$$U_{other}= \text{Log } (Y-P_{other}) + \text{Log } (T-PI_{other}) + \alpha A_{other} + \gamma O_{other} \quad (6)$$

$$A_{other}= a_o\, Q_{other} + b_o\, PI_{other} + c\, Y \quad (7)$$

So that:

$$\Delta U= [\text{Log } (Y-P_{other}) + \text{Log } (T-PI_{other}) + \alpha A_{other} + \gamma O_{other}]-[\text{ Log } (Y-P_{assigned}) + \text{Log } (T-PI_{assigned}) + \alpha A_{assigned} + \gamma O_{assigned}] \quad (8)$$

So that:

$$\partial \Delta U/ \partial \alpha = (a_o\, Q_{other} - a_a\, Q_{assigned}) + (b_o\, PI_{other} - b_a\, PI_{assigned}) \quad (9)$$

$$\partial \Delta U / \partial \alpha > 0 \quad \text{if} \quad (a_o \, Q_{other} + b_o \, PI_{other}) > (a_a \, Q_{assigned} + b_a \, PI_{assigned}) \qquad (10)$$

From equations (9) and (10)[8], observe that a unit increase in parents' valuation of academic achievement increases parental utility only if the combined effects of school quality (as proxied by school type) and parent involvement in the "other" school type is greater than the combined effects of the same in the assigned school. This theoretical model leaves open the kind of relationship between Q and PI—it makes no assumptions on whether they are substitutes or complements. All that this framework shows is that for choice to be rational, the combined marginal effects of Q and PI should be greater in the non-assigned school type than in the assigned school type. The relationship between school type and parent involvement can either be complements or substitutes. One of the research questions for this study addresses this issue. The main point of this theoretical model is to show how parents can increase their utilities, in terms of school type and parent involvement, given their own valuation for their child's education.

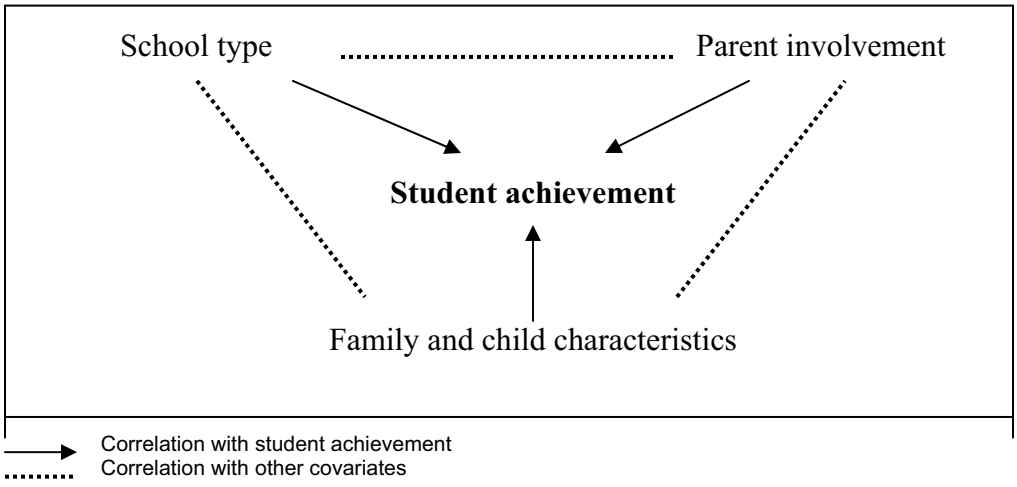
The empirical approach

This section discusses some assumptions needed to proceed with empirical analysis. Parental decisions are limited to two main factors: school type and their involvement with child education at home and school. Problems of selection bias and potential reverse causality need to be addressed.

[8] Q_j is a variable on school quality proxied by school type, and a is the corresponding marginal effect for that school type (a_o is for "other" school type, a_a is for the "assigned" school type). PI_j can either be a dummy or continuous variable of parent involvement, with b as its corresponding marginal effect on achievement (b_o is for parent involvement in the "other" school type, b_a is for parent involvement in the "assigned" school type).

To tackle some of the selection bias problem, the study incorporates student background and demographic characteristics[9] into the models (see Figure 3).

Figure 3. The Conceptual framework of the study



Reverse causality may be a significant problem here since parental decisions may in fact be driven by student achievement. Causality direction may run from student achievement to parental decisions. For example, some parents may enroll their child in a private primary school because the child did so well in kindergarten. Other parents, meanwhile, may enroll the child in public school because the child did so badly in kindergarten, and the parent feels that the child needs all the help he/she can get. Previous score can be used to address both selection bias and reverse causality. It controls for selection bias because the previous score incorporates previous inputs such as parent involvement. It also deals with (or at least limits) reverse causality because the previous

[9] An in-depth discussion of these issues can be found in the Analytic Strategy section of this study. The analytic approach will state the sources of bias that the models in this study will control for using the child's previous score, and will focus on how contemporaneous choice and involvement affect achievement.

score can proxy for ability, assuming that this previous score somehow determines parent behavior[10].

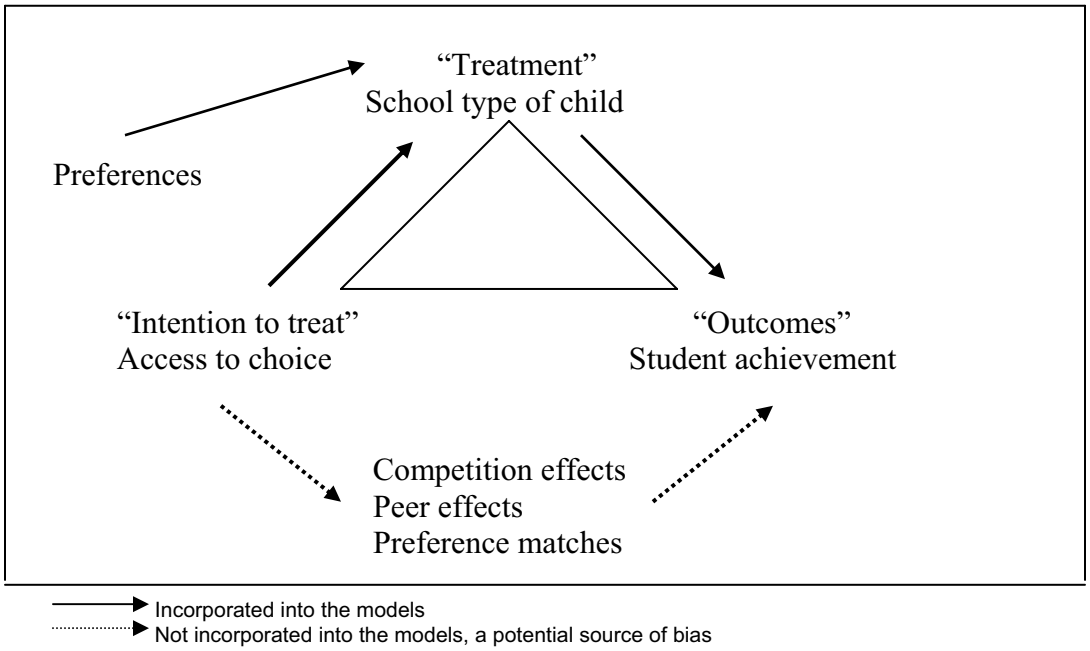
Parental decision on school type

School choice has been part of the US educational landscape over the past 30 years. As discussed in the review of literature, school-choice studies generally come in two categories: those that focus on the effect of choice on students, and those that focus on the effect of choice on schools. The first category of school-choice studies can further be segregated into those that look at the effect of "access to choice", and those that look at the effect of "actual choice about school types". This study falls under the second category. It looks at the effect of school types on student achievement using regular assigned schools as control.

This study examines the effect of "treatment" (school type) on "outcomes" (student achievement) (see Figure 4). The problem of heterogeneity in access to choice is an "intention to treat" problem. Heterogeneity in access to choice may be due to socio-economic factors, distance, etc. This heterogeneity, in turn, results in a selection bias in the distribution of students across "treatment" (actual parent decisions on school type). The problem is that students are not randomly assigned to schools and some differences in student ability are not observable. As a result, student sorting into schools might mask school "effects" on achievement.

[10] A detailed discussion on endogeneity and how to address it is presented in the section on Analytic Strategy.

Figure 4. School choice framework for this study



The approach here explicitly uses partial equilibrium. School type decisions made by parents are treated as a given, and this study looks at the effects from these decisions on student achievement. I assume that selection bias in the distribution of children among school types are due to two factors: 1) access to choice; and 2) preferences (Figure 4).

In general, students are guaranteed a spot in a previously-assigned neighborhood school, known in this study as the "assigned school", determined by the child's area of residence. Students may also be free to apply to other schools (public or private) of their choice, though access to these schools may be limited. Access to choice is limited by the ability to make that choice, thereby introducing a discrepancy between the "want" to choose a certain school type and "actual" choice. The nationally representative survey data used in this study shows some indication of this discrepancy in choice. While about 20% of the children in the 3rd grade sample live below poverty level, Catholic schools

only have 3% of their 3rd grade students living in poverty. But assigned public schools have 26%. Mothers of children in private schools also tend to be more educated: almost half (43%) of mothers of children in private schools have a college education or higher, while only 20% of them have that level of education in public schools (Table 7). These differences in student background characteristics may explain why of the six school types in this research, non-religious public schools have the highest mean test scores (a reading score mean of 125, and a math score mean of 97). Assigned public schools have the lowest mean scores of 107 for reading and 84 for math. While the framework of this study places access to choice as an "intention to treat" issue[11], the selection bias that occurs from variance in access to choice is considered. Access to choice may be influenced by the parents' socio-economic status. Indicators on race/ethnicity, income level, and parental education are included in the model.

This study incorporates the fact that some families move into neighborhoods with good schools, while some families stay in neighborhoods with limited choices. The survey data used in this study allows for these incorporations. This allows for an important distinction among assigned public schools: those that are actively chosen and those that are, simply, assigned. Parents "vote with their feet" by choosing a school district through choice of residence. This is the traditional form of choice that is by far the most pervasive and important form of choice in American elementary and secondary schooling today (Hoxby, 2002). Hoxby further relates that this traditional access to choice depends on the number, size and housing patterns of districts in the area of the parents' jobs. The examples she sites are two extremes: Boston and Miami. Boston has 70 school districts within a 30-minute commute of the downtown area and many more in

[11] This study focuses on the effects of "treatment" on the "treated".

the metropolitan area. Miami, meanwhile, only has Dade County as the lone school district that covers the whole metropolitan area. Using these insights from Hoxby, this study also include variables on geographic regions, as well as whether or not the child lives in a city.

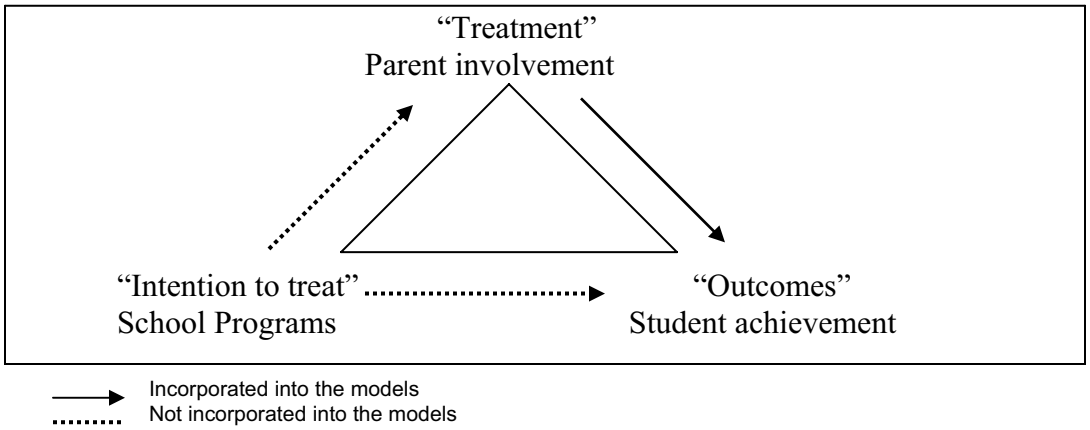
A potential source of bias not addressed in this study is the possibility that policies that promote access to school choice may lead to increased competition and better schools, positive effects from better peers or simply being able to attend a program that better suits the child's learning needs for idiosyncratic reasons (that could be related to parental preferences). Hoxby (2002) used data on different grade levels to look at school choice effects on school productivity in Milwaukee, Michigan and Arizona. She showed that public school students' achievement rose significantly and rapidly in response to competition, under each of the three reforms: vouchers in Milwaukee, charter schools in Michigan, and charter schools in Arizona.

If these positive effects exist, the impact of school type may be biased downwards. This study treats these factors as unobservables, and these unobservables may make school-type effects lower than they should be.

Parental decision on involvement

As shown in figure 5, this study will focus on the effect of the treatment (parent involvement) on the treated (student achievement). Many studies focus on how the intention to treat (school programs for parent-school-community involvement) affects the treatment (parent involvement) and the outcome (student achievement), but these will not be the focus here.

Figure 5. Framework for parent involvement for this study



Epstein (1992) has identified six important types of cooperation between families, schools, and other community organizations. These types are: parenting/home environment, communication from school to home, volunteering, learning at home, parental participation in school decision-making, and school-community collaboration. This study focuses on parent involvement. Per Epstein's descriptions, communication from school to home, as well as school-community collaboration, are school initiatives rather than parent initiatives, hence these will not be included in this study.

Heterogeneity likely exists in how much involvement parents give to their child's education. This study tests the hypothesis that parent involvement varies across school type, race/ethnicity and socio-economic factors. Regarding heterogeneity due to school type, this study assumes that there are basically three kinds of parents, given their child's school type: the first kind are those that will not get involved anyway, the second kind are those that will always get involved, and the third are those who will get involved depending on how they perceive the quality of the school type to be, controlling for other

factors. As regard to heterogeneity from race/ethnicity and socio-economic factors, this study assumes that parents from different groups may act differently.

To capture the effects of the different kinds of parents, interactions between parent involvement and race/ethnicity and socio-economic factors will be included in the models. Another way to capture heterogeneity is by running the models for each race/ethnicity, income group and education-level subgroup.

There is high correlation between parent involvement variables from the child's first and third grades in school, possibly because parent involvement tends to (but may not always) be habitual. This correlation between previous and current parent involvement is higher than their individual correlation with student achievement. This means that including the previous year's parent involvement variables results to a multicollinearity problem that will hurt the robustness of the models' results (that is, the regression coefficient of the current parent involvement may be erroneously lower than what it should be because of the inclusion of the previous year's parent involvement)[12].

2. Data description and summary statistics

This study focuses on young children (students in third grade) using the Early Childhood Longitudinal Study (United States): Kindergarten Class (ECLS-K) of 1998-1999, Longitudinal Data from Kindergarten to Third Grade. This dataset is rich because it incorporates survey responses from the child, the parents, the teachers and the schools from the child's kindergarten year to third grade. The unit of measure is at the child-level.

[12] Intuitively, the higher the correlation between independent variables, the more difficult it is to determine how much variation in the dependent variable each independent variable is responsible for. As a result, standard errors for the highly correlated independent variables become large even if their marginal effects remain unbiased, making it more likely for these marginal effects to be statistically insignificant.

The ECLS-K surveyed a nationally representative sample of the kindergarten cohort of 1998-1999, using a multi-stage sampling cluster design. The primary sampling units were counties or groups of counties. The second stage units were schools, and the final stage were students within these schools. The number of regular schools in the ECLS-K base year school sample (school year 1998-99) totals 1,162. Of these, 893 are public and 269 are private.[13]

Since the ECLS-K does not sample units with equal probability (it over-sampled on private schools and Asian and Pacific Islanders[14]), and there is the problem of non-response, there is a need to use weights to address the sampling bias. The ECLS-K third grade data are representative of the population cohort rather than all third-graders in 2001-02. The ECLS-K dataset excludes third graders who repeated second or third grade, or who are recent immigrants. The population cohort represented by the ECLS-K is approximately 96% of all third graders. This study uses the ECLS-K longitudinal dataset from kindergarten to third grade, with a sample size of 17,401[15] children from the original 21,387[16] in the base-year dataset. Completed child assessments among 1998-99 kindergarteners in spring-third grade (school year 2001-02) numbered 14,349 for all school types. Of this, the number of children who participated in the base year and first grade and third grade data collections is 13,698 (10,900 in original public schools and 2,798 in original private schools), representing 64% of the base year respondents. The set of weights used for this study is in the variable, C5PWO. This weight variable is used for child-level estimates associated with data collected through the parent interview. This is

[13] Data is from Table 4-2 from the User's Manual for the ECLS-K Third Grade (2004).
[14] These groups were sampled disproportionately to meet precision goals.
[15] The number of children with child identification numbers in the ECLS-K longitudinal K-3 dataset.
[16] Unweighted sample size during the fall-kindergarten collection round, from the User's Manual for the ECLS-K Third Grade (2004).

particularly important for the analysis of the effect of parent involvement on student achievement. These weights are used to analyze parent and child assessment data together, to ensure unbiased or efficient estimates.

Using the weights is helpful in adjusting for the effects of non-response which may not be random. At the end of Kindergarten (spring 1999, round 2 of the ECLS-K survey), there were 1,302 missing data from parent surveys. By spring of third grade (2002, round 5), there were 4,095. The missing parent data in round 5 can be due to multiple factors, such as moving to a school that was not followed in the study, parent refusal, or if the child's family moves and can not be located.

The dependent variables

The dependent variable of this study is academic achievement of early elementary students, as measured by the Item Response Theory (IRT) scores. Responses to items are modeled as a function of a person's level of the trait being measured and the characteristics of the items completed[17].

Specifically, the dependent variables will be the reading and math scores of students in third grade[18]. The ECLS-K dataset has children's scores on reading, mathematics and science. Only the reading and mathematics domains allow for comparison across grades, however. The K-1 assessment battery differed from that of the

[17] http://www.measurementexperts.org/learn/theories/theories_irt.asp
[18] The third grade reading assessment included items designed to measure the following: phonemic awareness, single word decoding, vocabulary, and passage comprehension. The mathematics assessment addressed the following: number sense, properties and operations; measurement; geometry and spatial sense; data analysis, statistics and probability; and pattern, algebra and functions (ECLS-K User's Manual, 2004).

third grade. The K-1 battery included the area of general knowledge while the third grade included the area of science.

To maximize the accuracy of measurement and reduce administration time, a two-stage cognitive assessment approach was used by the ECLS-K. At the first stage, a brief routing test was administered. This provided a rough estimate of each child's ability level. Children's responses from this test were used to select a second stage form of the appropriate level (low, middle or high levels) of difficulty according to each child's current level of ability.

The IRT procedures were used to calculate broad-based scores using the full set of assessment items in the domains. The IRT scale scores estimated children's performance on the whole set of assessment questions, calculating scores that can be compared regardless of which second-stage form a child takes. IRT scoring makes possible longitudinal measurement of gain in academic achievement over time.[19] The range of values for reading IRT scale scores is 0-154 points, while that for math is 0-123. These scores represent estimates of the number of items students would have answered correctly at each point in time if they have taken all 154 questions in the first- and second-stage reading forms, and 123 questions in the math forms.

For this study, reading and math IRT scores are treated as separate outcomes, assuming that the effects of interventions are often very different for reading and math. In particular, math often shows greater responsiveness to school-based interventions,

[19] Item Response Theory is the study of test and item scores based on assumptions concerning the mathematical relationship between abilities (or other hypothesized traits) and item responses (definition by Lawrence M. Rudner, http://edres.org/irt/, based on The Basics of Item Response Theory by Frank Baker). IRT procedure calculates scores that can be compared regardless of the second-stage form a child takes. It uses the pattern of right, wrong, and omitted responses to the items actually administered in an assessment and the difficulty, discriminating ability, and 'guess-ability' of each item to place each child on a continuous scale. To establish a common scale, items included were those in the routing tests plus a core set of items shared among the different second-stage forms and different rounds of data collection.

whereas reading is strongly influenced by out-of-school factors such as parents' literacy skills. Students get more exposure to literacy-based activities than to math-based activities outside of school. So if there is a strong effect in math and no effect in reading, using a combined outcome will show a weak overall effect, which does not really tell the whole story. In addition, most psychometricians object to combining math and reading test scores because the tests measure completely different (though correlated) constructs.

The math and reading IRT scores are standardized to having a mean of zero and a standard deviation of one[20]. This will allow for comparability of marginal effects between math and reading scores, as well as ease in interpretation of the resulting coefficients of the independent variables. With standardized scores, a coefficient will be interpreted as the marginal effect of a unit change in the independent variables on scores, expressed in terms of the score's standard deviation.

The key independent variables

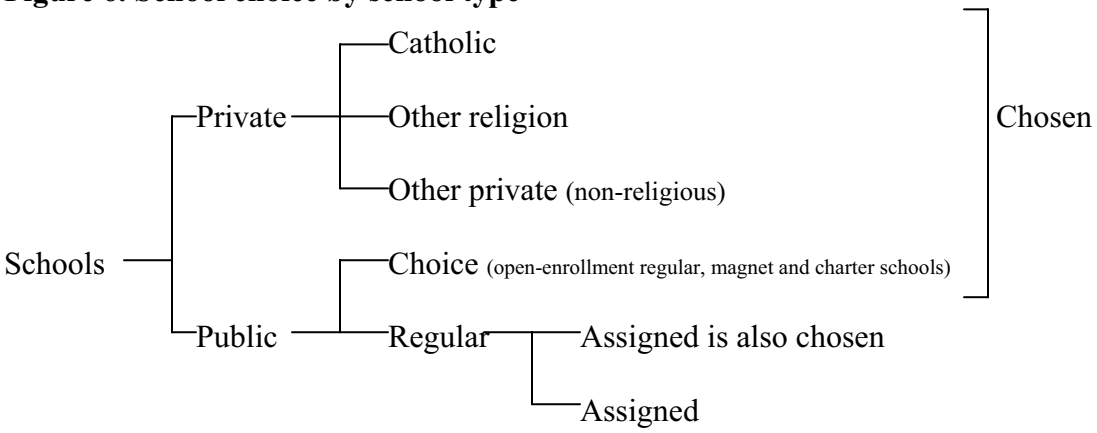
This study has two key independent variables: school type and parental involvement.

The school type variable constructed from the dataset gives six (6) categories of "school choice by school type". The categories are: Catholic school, other-religion private school, other (non-religious) private school[21], choice public school (regular[22], charter and magnet schools), public schools that are assigned and also chosen, and the regular assigned public school. The variables on choice from the dataset are used to

[20] Let Y_μ=sample mean score, and $\sigma=(\Sigma(Y- Y_\mu)^2/n)^{1/2}$, where Y is the raw score. So that: $Y_t=(Y- Y_\mu)/\sigma$, where Y_t is the standardized score.
[21] Includes special education schools that primarily serves children with disabilities
[22] Regular public school chosen by parent under open-enrollment policies

process the raw data and come up with the additional categories for the public schools. The school choice variable is taken from the parent instrument. It carries three response categories: school is assigned, school is chosen; assigned school is also chosen[23]. Note, though that for some 36% of the parent-respondents, their choice of where to live was determined by the current school of the child[24]. These items were used to determine which assigned schools were actually assigned-also-chosen schools.

Figure 6. School choice by school type



[23] The ECLS parent survey asks the following question: "Is this the child's regularly assigned school or a school that you chose?"
[24] The ECLS parent survey asks the following question: "Did you choose where to live so that child could attend his/her current school?" Answer categories were "yes or no".

Table 1. School types and their definitions

School type	Definitions
Catholic schools	Catholic schools are educational ministries of the Catholic Church. These schools develop their students through participation in the sacramental life of the Church, study of religion and theology, a full curriculum in secular subjects, and a variety of extra-curricular activities (Wikipedia, 2006).
Other-religion (non-Catholic) private schools	Religiously affiliated or denominational schools form a distinct category of private schools. Such schools teach religious lessons together with the usual academic subjects, to instill their particular faith's beliefs and traditions in the students who attend. Other religious groups represented in the K-12 private education sector include Protestants, Muslims, Jews and the Orthodox Christian sects such as the Russian, Greek and Byzantine (Wikipedia, 2006).
Other private (non-religious) schools	Non-religious private school identifies a privately funded and operated school that is not affiliated with any religion and is independent of the government-run system.
Charter schools	Freed of many restrictions placed on traditional schools, charter schools are reimbursed by the state for each student (equaling the average statewide per-pupil expenditure). In return, these schools are expected to achieve certain educational outcomes within a certain period (usually three to five years), or have their charters revoked by sponsors (a local school board, state education agency, or university) (CEPM, 2002).
Magnet schools	CEPM (2002) defines magnet schools as thematic islands of choice within a traditional district-assignment or controlled-choice plan, under a type of intra-district plan. Each magnet school subscribes to a particular educational philosophy or curricular specialty, drawing students who share that interest. Operating in an open-enrollment context, magnet schools have been used to desegregate urban schools in the North. Magnets emerged first in Milwaukee and Cincinnati during the 1970s, spreading to both northern and southern cities in subsequent decades (Elmore and Fuller 1996)
Assigned schools	Assigned schools are "traditional government schools" which are tax-funded, operated by government and has a politically elected school board.
Assigned-also-chosen schools	These are also “traditional government schools” but are actively chosen by parents, in some cases by transferring into the districts where these schools are. In the ECLS parent survey, respondents indicate that this assigned school “is also a chosen school”.

Parent involvement is classified into two levels: the school/classroom level and the child level. This study will test the hypothesis that parenting/home environment,

learning at home, and volunteering and parental participation in school decision-making affect student achievement. The variables for each type of parent involvement, and their data construction, are shown in table 2.

Table 2. Variables for each type of parent involvement

Type of parent involvement	Data construction
(a) Parenting practices at home	
Rules on TV programs child can watch	This is a dummy variable on whether or not the family has rules on the TV programs the child can watch.
Academic expectations of parent for child	This is based on how far parent expects child to go: (1) to receive less than high school diploma, (2) to graduate from high school, (3) to attend two or more years of college, (4) to finish a four- or five-year college degree, (5) to earn a master's degree or equivalent or to finish a Phd, MD or other advanced degree.
(b) Volunteering or school involvement	
Frequency of school involvement	The variable is a scaled combination of the following: (1) parent attended open house or back-to-school night; (2) parent attended PTA; (3) parent attended parent-teacher conference; (4) parent attended school or class event; (5) parent is into volunteering at school; (6) parent helped with school fund-raising; (7) parent has met child's teacher; and (8) parent talks with other parents from child's class (if parent has met with 1 or more other parents, this counts as 'yes'; if parent has met 0 other parents, this counts as 'no'). These were combined after factor analysis[25] showed them to have a common underlying factor.
(c) Learning activities at home	
Frequency child reads books outside of school	This is based on how often child reads outside school: (1) never, (2) once or twice a week, (3) three to six times a week, (4) everyday.
Family regularly receives newspapers and magazines	Family regularly receives magazines (count of 1) or newspapers (count of 1) or both (count of 2).
Child participated in or attended artistic or cultural activities	This is a dummy variable on whether or not child participated or attended any of the following cultural activities: dance lessons, music lessons, art classes, performing arts programs.
Family members play games or do puzzles with child	This is a dummy variable constructed based on whether or not parent or family members play games or puzzles with child in a typical week.
Frequency child does homework	This is based on how often child does homework either at home or elsewhere outside of school: (1) never, (2) less than once a week, (3) 1 to 2 times a week, (4) 3 to 4 times a week, (5) 5 or more times a week.

[25] Factor analysis aims to discover simple patterns in the pattern of relationships among the variables, to discover if the observed variables can be explained largely or entirely in terms of a much smaller number of variables called *factors* (Darlington, 2004). Since some of the variables in this study are dichotomous variables, tetrachoric correlations were used in the factor analysis (Ender, 2005).

For parenting practices at home, a dummy variable is generated on house rules on television viewing. Continuous variables are also included on the parental expectations for the child's academic achievement. Parents were surveyed on how far in school they expect their child to go. The variable for volunteering or school involvement combines parental voluntary involvement at school during the school year. Each category was assigned a score of '1' if the parent answered yes to the activity[26], and the assumption is that the higher the summed-up score is, the more involved the parent is at school.

For learning activities at home, variables included are the frequency child reads books outside of school, and whether or not the family regularly receives newspapers or magazines or both. Dummy variables were created on whether or not family members play games or do puzzles with child, and whether or not the child participated in or attended artistic or cultural activities. The frequency child does homework is also included.

The explanatory variables

Explanatory variables include child and family characteristics. Child-level variables include gender, race/ethnicity, home language of child, whether or not the child transferred schools, and whether or not the child is in special education. A variable commonly treated as an unobservable that is included in this study is parent health, which is assumed to be correlated with parent involvement. The variable on health is from the parent survey of the ECLS, where the parent is asked to rate his/her health from poor to

[26] The categories are choices under one common survey question in the parent survey. An item on whether or not the 'parent took it on himself to contact child's teacher or school for any reason to do with child' was considered for inclusion, but factor analysis showed that this item did not belong to the group.

excellent[27]. Family-level variables included in the model are family poverty status[28], number of siblings in the household, mother's education, and family structure (two-parent or one-parent).

Patterns of relationships among key variables

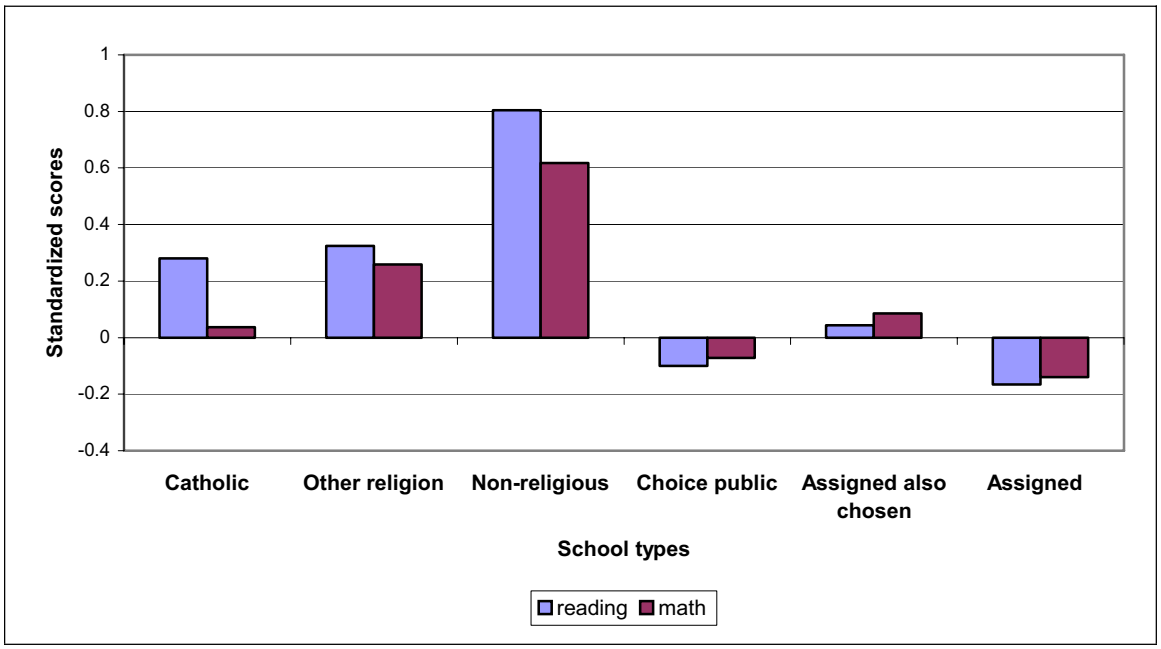
Basic patterns

Patterns of average student achievement by school type show that students in private schools do better than those in public schools. ECLS data show that students in non-religious private schools do best. The students that perform worst are those in public schools that are chosen (charter, magnet and open-enrollment public schools) as well as assigned. Private schools score high, but they have a very small share of students in the population, representing only 11 percent of third graders in the nation.

[27] Original rating in the ECLS dataset is as follows: 1=Excellent, 2=Very good, 3=Good, 4=Fair, 5=Poor. For ease in interpretation of its marginal effects on student achievement, the scale was reversed when included in the models.

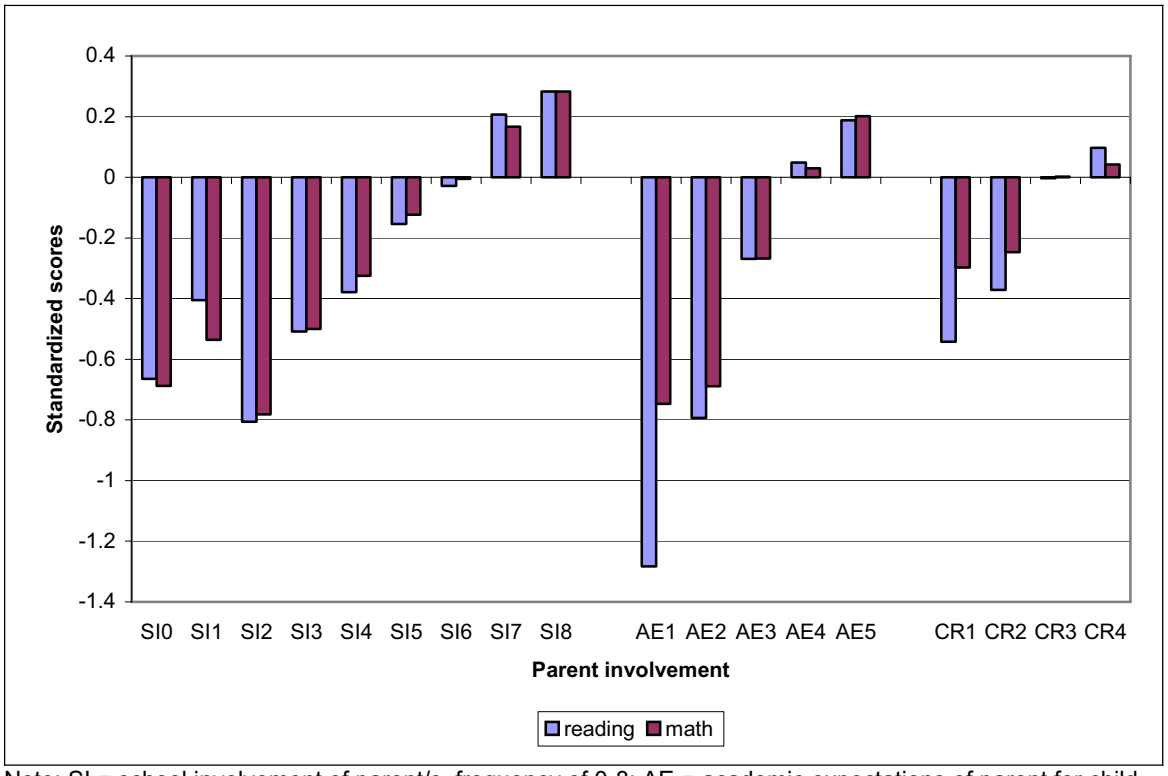
[28] Poverty status (a dummy variable on whether or not the family is below the poverty level) is used instead of a continuous variable on family income under the assumption that income effects on student achievement are asymmetric. That means that the marginal effect on achievement of a unit increase in income is not constant across income levels. Higher income does not always mean higher student achievement. Rather, student achievement is assumed to be more sensitive to whether or not the family lives in poverty. Using the poverty dummy variable also informs policy better since it highlights the group that is most at risk.

Figure 7. On average, student achievement is higher in private schools than in public schools.



In general, children of more involved parents also do better. This is true for all indicators of parent involvement used in this study: having tv rules at home, academic expectations for child, frequency of school involvement, frequency child reads books outside school, how regularly family receives reading materials at home, cultural exposure, playing games or puzzles with child, and the frequency child does homework.

Figure 8. On average, student achievement increases with parent involvement.



Note: SI = school involvement of parent/s, frequency of 0-8; AE = academic expectations of parent for child, range of 1-5; CR = child reads books outside school, frequency of 1-4.

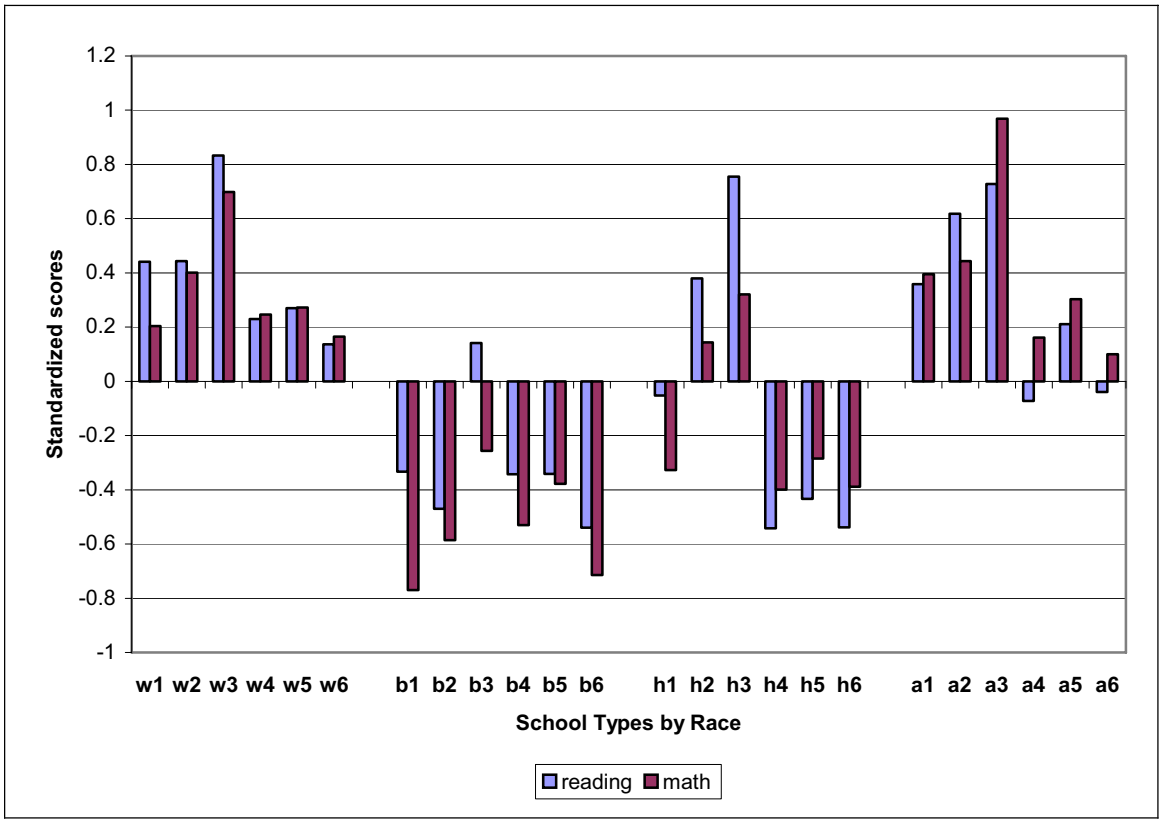
Effects of race/ethnicity, mother's education and poverty status

Race/ethnicity, mother's education and poverty status all affect the impact of school type and parent involvement on student achievement.

School type effects, for example, vary across race/ethnicity. Blacks consistently achieve below the average across school types, while whites always achieve above the average. Hispanics have a mixed performance, generally doing worse in public schools. Asians do better in private schools. Student achievement also varies across school types depending on mother's education. Children of mothers with a bachelor's degree or more always do better than average, no matter the school type. Children of those with less than

high school education do the worst, especially if they are in public schools. Poverty status also correlates with achievement. Children living below the poverty level do worse when they are in public schools, while those above the poverty level generally do better in private schools. Gender also affects scores. Male children did better in math across schools, and did worse than females in reading especially in public schools.

Figure 9. On average, whites and Asians do better than blacks and Hispanics.



Note: w = white, b = black, h = Hispanic, a = Asian; 1 = Catholic, 2 = other religious, 3 = non-religious, 4 = choice public, 5 = assigned-also-chosen, 6 = assigned

Race/ethnicity, mother's education and poverty status also affect how parent involvement impact student achievement. School involvement of parents, for example, have a general positive correlation with achievement. Whites and Asians have similar patterns. But its effects are muted for non-whites and non-Asians. Student achievement

among blacks, Hispanics and "other races" continue to be below average no matter the frequency of school involvement. School involvement also does not seem to have any correlation with student achievement for those whose mothers have less than high school education. While student achievement of those whose mothers have finished high school or has some college education shows a positive correlation to school involvement, students whose mothers have a bachelor's degree or higher had the strongest results. The same pattern holds for poverty status. Children who live above the poverty level respond more strongly to parent's school involvement compared to those who live below poverty level. These observations hold for other indicators such as academic expectation and the frequency child reads outside school. The general associations between parental involvement and student achievement are strongly affected by factors such as race/ethnicity, mother's education and poverty status.

Selection bias is a problem, hence the need for an analytic strategy that should tease out the real effects of school type and parent involvement on student achievement.

Parent involvement and school type

The patterns of parent involvement and school type are no less interesting. In general, white parents are the most involved in school across school types. Black parents of students in non-religious private schools have the highest academic expectations for their children. Asian parents, however, have consistently high expectations for their children across school types. Children of Asian parents also tend to read more consistently across school types. In terms of educational attainment, parents with at least a bachelor's degree have consistently more frequent school involvement across school

types, as well as high academic expectations for their children. Their children also tend to read outside school more frequently. Meanwhile, parents who live below the poverty level are less involved (in terms of school involvement, expectations for the child, and ensuring the child reads outside school) in the public schools compared to those who live above poverty level. There does not seem to be any difference in parental behavior among private schools, regardless of poverty status[29].

3. Analytic strategy

Dealing with error terms that are neither independent nor identically distributed

The students in the ECLS-K dataset are clustered within schools. This means that if ordinary least squares method is used, the corresponding standard errors of the coefficients are wrong and the results of tests for significance of the coefficients are invalid. If the clustering is not addressed by the model, the errors are neither independent nor identically-distributed (non-iid).

To address the non-iid problem, the study will use the survey commands under Stata, and explore the use of 'clustering' within these commands (version 9)[30], using the Taylor linearization approach to calculate for standard errors[31]. Using the survey commands incorporates the fact that the dataset used is not of a true random sample, but

[29] Summary tables showing descriptive statistics of variables used are in Appendix B.
[30] The survey commands of Stata 9 address the details for complex survey data.
[31] The Taylor expansion method estimates sampling errors of estimators based on complex sample designs. The Taylor method is appropriate for all designs where the first-stage sample is selected with replacement, or where the first-stage sampling fraction is small, as it usually is in practice. This method obtains a linear approximation for the estimator and then uses the variance estimate for this approximation to estimate the variance of the estimate itself (Fuller 1975, Woodruff 1971). When there are clusters, or primary sampling units (PSUs), in the sample design, the procedures estimate the variance from the variation among the PSUs.

is of a multistage probability design. This means that the resulting statistics may be more variable than they would be if the data were from a simple random sample.

To use the Taylor Series method of computing standard errors under STATA, the full sample weight, the sample design, the nesting stratum and the first-stage unit identifiers were required[32]. The stratum and first-stage unit (also known as the primary sampling unit) indentifiers needed to use the Taylor Series method were assigned in the ECLS-K dataset, taking care to ensure that there were at least two responding units in each stratum. A stratum that did not have at least two responding units was combined with an adjacent stratum[33].

Dealing with endogeneity

Wooldridge (2002) states that in applied econometrics, endogeneity could arise from omitted variables (selection bias), measurement error and reverse causality (or simultaneity in other cases). This section addresses the problems of selection bias and reverse causality. Note that the assumption on the source of endogeneity, as well as data availability, is key in determining the choice of methodology. Selection bias is addressed by the vector of explanatory variables including child and parent characteristics. In this study, the remaining source of endogeneity is assumed to be from unobservables such as "ability" that may affect parental decisions about school type and parent involvement. It may be argued, for example, that parents become more involved and/or would be willing to pay more (and so will choose a private over public school) for their child's education if

[32] "Variance Estimation", Chapter 4.7, ECLS-K User's Manual, 2004

[33] The following command was used to set the survey data in STATA:
svyset [pweight=C5PW0], strata(C5TPWSTR) psu(C5TPWPSU)
where: C5PW0 = full sample weight; C5TPWSTR = stratum variable; and C5TPWPSU = first-stage unit variable

their child did poorly at the beginning. However, the bias could go either way as shown below. A proxy for this unobservable is the child's previous achievement, as measured by his test scores in kindergarten[34].

To illustrate, let the coefficient for the key independent variable X_i be b_x. Let:

$b_x = (X_i'X_i)^{-1} X_i'Y_{i2}$

where $Y_{i2}=X_iB_x + Y_{i1}B_y + e_{i2}$.

Y_{i1} is the variable excluded in the model that computed the coefficient b_x. So that:

$b_x = (X_i'X_i)^{-1} X_i' (X_iB_x + Y_{i1}B_y + e_{i2})$

In terms of expectations, the expected b_x is:

$E(b_x) = B_x + (X_i'X_i)^{-1} X_i' Y_{i1}B_y$

b_x is biased if there is correlation between X_i and Y_{i1}, and if B_y is not equal to 0. If the product of $[X_i' Y_{i1}B_y]$ is positive, the bias is upward; if negative, the bias is downward. Using the example of parent involvement as X_i and previous scores as Y_{i1}, and assuming that $B_y>0$, b_x is biased downwards if parents get *more* involved when a child's previous scores are low. It is biased upwards if parents get *less* involved when previous scores are low.

Addressing the problem of endogeneity begins with a basic model of student achievement and parental decisions as follows:

[34] Child's previous score is an important control variable in studies that use student achievement as the key dependent variable. In cross-sectional studies discussed in Chapter 2, Desimone (1999), Lubienski and Lubienski (2006) and Coleman, Hoffer and Kilgore (1982a, 1982b) all state that their studies can not make any causal statements because of lack of data on child's previous scores.

$$Y_{i2} = a + X_i b_x + Z_i b_z + e_{i2}$$

In the basic model above, Y_{i2} is the score of child i in third grade (t=2). X_i is the vector of variables of parental decisions about school type and parent involvement, while Z_i is the vector of explanatory variables that include race/ethnicity and socio-economic status. As illustrated previously, there may be a serious reverse causality problem here because the treatment (parental decisions on school types and parent involvement) may be affected by past inputs and ability, which may be proxied for by the child's previous scores. Allison (1990) addresses this type of endogeneity problem by discussing two alternative models for the non-equivalent control group design. Unlike the case of a true random experiment, the non-equivalent control group design has individuals who are not randomly assigned to the treatment and control groups, and which may therefore differ substantially in their distributions of the previous score as well as other characteristics.

Allison discusses two models that aim to rule out the rival hypothesis that Y causes X, and greatly reduces the threat of spuriousness that some other variable causes both X and Y. This is important for this research, which aims to test the hypothesis that it is school choice and parent involvement that affect student achievement.

The two treatments discussed by Allison were the *change score method* (Y_2-Y_1=f[X, Z]) and the *regressor variable method* (Y_2=f[X, Z, Y_1]). Given Y_1 and Y_2 as measurements of the same variable at times 1 and 2, both models examine the relationship between X and Y_2 while "controlling" for Y_1. The dependent variable used will be IRT scores in reading and mathematics in spring of the child's third grade (Y_2). Y_1 will be the IRT score in spring of kindergarten. X is the vector of treatment variables

(in this case, school type and parent involvement) received by the child after time 1 (that is, after kindergarten). Z is the vector of variables that control for other student and parent characteristics. Since pupils may shift across the 6 school types of interest in this study after kindergarten, school transfers are included among the explanatory variables to control for this potential source of bias.

Model 1: The Regressor Variable Method

This model can be written as

$$Y_{i2} = a + bY_{i1} + cX_i + dZ_i + e_i, \text{ where } i = 1,\ldots,n. \quad (11)$$

Here, $X_i=1$ for units in the treatment group, $X_i=0$ for those in the control group, with c as the treatment effect. With the assumption that $E(e_i|Y_{i1},X_i)=0$, the ordinary least squares (OLS) regression of Y_2 on Y_1 and X yields unbiased estimates of the coefficients (Allison, 1990).

Todd and Wolpin (2003, 2004) have several restrictions, addressing bias and non-iid problems, for ordinary least squares to yield unbiased and consistent results using the "value-added formulation" (as they refer to the regressor variable and change score methods).

To understand these assumptions, let model 11 be restated as:

$$Y_{i2} = bY_{i1} + cX_{i2} + dZ_{i2} + \eta_{i2}, \quad (11a)$$

Todd and Wolpin present a regression analog (see 11b and 11c below), with X_{ij} as a vector of treatment inputs, Z_{ij} as a vector of control variables, and A_i as ability endowment, to consider all the underlying assumptions to make model 11a work:

$$Y_{i2} = c_1X_{i2} + c_2X_{i1} + c_3X_{i0} + d_1Z_{i2} + + d_2Z_{i1} + d_3Z_{i0} + g_tA_i +$$

$$\{f_1U_{i2} + f_2U_{i1} + f_3U_{i0} + E_{i2}\} \quad (11b)$$

Let $e_{i2}=\{f_1U_{i2} + f_2U_{i1} + f_3U_{i0} + E_{i2}\}$, where U_{it} are unobservables.

So that $Y_{i2}= c_1X_{i2} + c_2X_{i1} + c_3X_{i0} + dZ_{i2} + g_tA_i + e_{i2}$ (11c)

Subtracting bY_{i1} from both sides of (11c) and collecting terms yields:

$Y_{i2}= bY_{i1} + c_1X_{i2} + (c_2-bc_1)X_{i1} + (c_3-bc_2)X_{i0} + d_1Z_{i2} + (d_2-bd_1)Z_{i1} + (d_3-bd_2)Z_{i0} +$

$(g_2-bg_1)A_i + \{e_{i2}-be_{i1}\}$ (11d)

Todd and Wolpin state that to address bias and reduce (11d) into (11a), three conditions would suffice:

(1) Coefficients associated with observed inputs and control variables geometrically decline with distance, as measured by age, from the achievement measurement. Moreover, the rate of decline is the same for each input and control variable. This means that $c_2=bc_1$ and $c_3=bc_2$. For control variables, this means that $d_2=bd_1$ and $d_3=bd_2$.

(2) Condition (1) also holds for omitted inputs (unobservables U_{it}) so that $f_2=bf_1$, and that the contemporaneous omitted input is uncorrelated with the included inputs and previous score; or omitted inputs (all unobservables) are uncorrelated with included inputs and previous score.

(3) The impact of the ability endowment also geometrically declines at the same rate as input effects so that $g_2=bg_1$.

To ensure iid errors, Todd and Wolpin make the additional condition that "e_{it} must be serially correlated and the degree of correlation must exactly match the rate of decay of input effects (so that $\eta_{i2}=e_{i2}-be_{i1}= f_1U_{i2} + E_{i2} - bE_{i1}$ is an iid shock)".

Model 2: The Change Score Method

This model can be written as:

$$Y_{i2}- Y_{i1} = cX_{i2} + dZ_{i2} + \eta_{i2}, \qquad (12)$$

Compared to model 11a, the change score model has a more restrictive specification where b=1.

Todd and Wolpin discusses the underlying conditions for the change score method as follows: (a) the effect of each input and other control variables must be independent of the age at which it was applied ($c_2=c_1$, $c_3=c_2$, $d_2=d_1$ and $d_3=d_2$in equation 11d); and (b) the effect of the ability endowment must likewise be independent of the achievement age $g_2=g_1$ (also in equation 11d).

Choosing between the regressor variable and change score models

The school choice studies cited in the review of literature of this research use either the change score method (as was the case for Hanushek et al, 2005; and Bifulco and Ladd, 2004) or the regressor variable method (as was the case for Cullen et al, 2003 and 2005; and Hoxby and Rockoff, 2005). Sass (2004) uses both methods but, based on the conditions laid out by Todd and Wolpin (2003), he favors the regressor variable method over the change score method.

Allison discusses the conditions when one model is more appropriate than the other. Allison states that the regressor variable method is more appropriate than the change score method under the following conditions: (1) when Y_1 has a true causal effect on Y_2, *or* (2) when X is correlated with the transient components of Y_1. Meanwhile, he claims that the change-score method is superior whenever (1) X is temporally subsequent to Y_1 *and* (2) uncorrelated with the transient component of Y_1[35].

Choosing which models to use for this study is based on the data and conceptual framework of this research, checking which set of conditions they satisfy. First, does Y_1 have a true causal effect on Y_2? Allison clarifies that this causal condition can be satisfied if Y_2 varies as a function of Y_1, such as when Y is a stock variable. This condition is met since student achievement builds from kindergarten to third grade, and the IRT scores are a continuous measure. Note, however, that IRT scoring makes possible longitudinal measurement of *gain* in achievement over time, even though the assessments that are administered are not identical at each point (NCES, 2004). This means that as a measure of academic achievement, IRT scores can be used in the regressor variable model as well as in the change score method.

The second condition is therefore the key condition that determines which model to use. Is X correlated with the transient (period-specific) components of Y_1? Note that the source of endogeneity in this study comes from the likelihood that previous scores affect parental decisions, which means that X is likely to be correlated with the transient

[35] Bond (2006) provides a clear example of when the change score method would be better than the regressor variable method. He gives the example of his own teacher in statistics. The teacher asked his class to answer the question, "Among the three local grocery stores, Kroger, A&P, and Hi-Lo, who has the lowest prices?" The class was asked to answer this question at the beginning of the course, when the students did not know any statistical concepts yet, and at the end of the course. There was a stunning difference in the answers across the two time periods. The responses to the question did not figure in students' grades, but was used by the teacher to evaluate the effectiveness of his own teaching.

components of Y_1. For example, parents may decide to put child A in a private school and be more involved because the child did better (or worse) than some expectation or comparison group in kindergarten[36]. Since both alternative conditions for the regressor variable model are met, this study will use this model instead of the change score method. This condition on the correlation between X and Y_1 is key in addressing the endogeneity problem in this model.

The underlying conditions of the change score method is not compatible with the conceptual framework of this study, even if Hanushek et al (2005) and Bifulco and Ladd (2004) used the change score method. Sass (2004) states his misgivings about the assumptions in the change score method that b=1, giving the example that if this was so, then the quality of a child's kindergarten must have the same impact on their achievement at the end of age 5 as it does on their achievement at age 18. However, Sass does use the change score method as an alternative model to be able to compare his results with those of Hanushek et al and Bifulco and Ladd.

Another criterion to consider for choosing one model over another is reliability. If the regressor variable model is used, the reliability of the math score is .93 in spring-kindergarten and .95 in spring-third grade, while that of the reading score is .95 in spring-kindergarten and .94 in spring-third grade[37]. But if the change score method is used, the

[36] Allison (1990) uses some examples to show when the transient components of Y_1 are correlated with X. In his example, the treatment is participation in a SAT training program and the aim of the study is to determine if the program improves SAT scores. There is correlation between Y_1 and X in these scenarios: (1) The SAT is administered as a pretest to a group of high school seniors. Seniors who score below 400 are enrolled in the program, and those who score above are not. Or: (2) Seniors self-select into the SAS training program after seeing the results of a pretest administration.

[37] Source: Table 3-10 on "Reliability statistics of the Item Response Theory-based scores, by round of data collection and domain: School years 1998-99, 1999-2000, and 2001-02", from the ECLS-K User's Manual (2004).

reliability of the change score will only be .81 for math, and .89 for reading[38]. The scores for the regressor variable model are more reliable than those for the change score model[39].

In sum, the regressor variable method is the model of choice given the underlying conditions of the analysis as well as the reliability of results. However, the change score method will also be used as a second-best alternative model. The chapter on findings of the study will report the results from both models.

Is the regressor variable method enough to address endogeneity discussed in this study?

Additional ways to refine the model include adding fixed effects and instrumental variables, or running an alternative model to compare with the primary model's results.

[38] Formula for reliability of Y_{i2}- Y_{i1} is from Allison (1990): $(\rho^2 Y-\rho_{12})/(1-\rho_{12})$ where $\rho^2 Y$ is their common reliability (computed as the average of .94 for math and .95 for reading) and ρ_{12} is the correlation between Y_{i2} and Y_{i1} (computed at .69 for math and .53 for reading). All computations are based on Table 3-10 of the ECLS-K User's Manual (2004) and the ECLS-K third grade data.

[39] Measurement error, in the case of the regressor variable method, does not bias the results for as long as the errors in the sample are randomly distributed.

Table 3. How other studies treat prior student achievement

Studies (Dependent variable is student achievement.)	Treatment of prior student achievement[40]	Other controls used
Hanushek et al (2005)	Change score method	Student-level fixed effects (fixed family and individual influences)
Bifulco and Ladd (2004)	Change score method	Student-level fixed effects; grade-by-year fixed effects; gender, ethnicity, parent education
Sass (2004)	Regressor variable method; Change score method	Student-level fixed effects; current school inputs
Cullen et al (2005)	Regressor variable method in the basic model; students are grouped into quartiles based on prior grades in the IV model	IV (distance), child characteristics including social status indicator
Cullen et al (2003)	Regressor variable method	IV (lottery results), school- cohort fixed effects
Hoxby and Rockoff (2005)	Regressor variable method	IV (lottery results), grade group by year fixed effects

Note: IV – Instrumental variables

In addition to including previous student achievement in their models, Hanushek et al (2005), Sass (2004) and Bifulco and Ladd (2004) all use student-level fixed effects to address remaining endogeneity in their panel data. Cullen et al (2003) use school-cohort fixed effects and distance as instrumental variable to control for unobservables such as expectations for the future and parental involvement. Hoxby and Rockoff, meanwhile, use lottery results as instrumental variables as well as control variables for each student such as prior achievement that are observed before the lottery and that do not change over the sample period. Hoxby and Rockoff, however, do even not mention parent involvement once the child is in a charter school as a potential source of bias. This source of bias is not addressed by using lottery results as instrumental variables.

Similar to Cullen et al and Hoxby and Rockoff, this study incorporates previous score through the regressor variable method. Instead of instrumental variables or fixed

[40] Change score method in this table refers to the general method of using gain scores (difference between current and previous scores) as dependent variable. Regressor variable method in this table refers to the general method of using previous score as a control variable in the model.

effects, however, this study explicitly incorporates parent involvement and other parent and child characteristics which are all treated as unobservables by Hoxby and Rockoff and Cullen et al, or simply included as fixed effects by Hanushek et al, Sass, and Bifulco and Ladd. The motivating factor behind the inclusion of fixed effects and instrumental variables in the studies discussed above is the fact that the data sets used by the researchers are limited in terms of child and family characteristics as well as parent involvement indicators[41]. Fortunately, such is not the problem with the ECLS data set.

Assessing the relationship between school choice and parent involvement and their effects on student achievement

The objective of this section is to show how parent involvement correlates with school type. The dependent variable will be the different modes of parent involvement. The key independent variable will be school type. Explanatory variables such as previous math or reading test score, family structure, gender, race/ethnicity, poverty status, language spoken at home, parent's education, etc. will be included. This model will show the correlation between parent involvement and school types while controlling for the same variables used in the main models. Note, though, that this analysis is meant to be descriptive, it is not intended to show causal links.

[41] Using an instrumental variable would entail running a two-stage least square model to tease out key effects of two sets of key independent variables (school type and parent involvement) for this study. Note that this study looks at 6 school types and 8 indicators of parent involvement. Even if an appropriate set of instruments are available, the functional and operational challenges of running such a model must be daunting and has yet to be explored.

Chapter 4 – Findings of the Study

This section has two main parts corresponding to the two research questions in Chapter 1: (1) a discussion of the effects of school type and parent involvement on student achievement, using the overall sample and the sub-group samples; and (2) a discussion of the relationship between school type and parent involvement.

1. Effects of school type and parent involvement on student achievement

The set of models discussed in this section runs on the complete set of variables (regressors are school types, parent involvement, explanatory variables and previous scores). The regressor variable model, being the relevant model for this study, is run for reading and math scores. The change score method is also run as an alternative model whose results can be used to compare that of the regressor variable model.

From results on the pooled sample, at-risk groups (in terms of race/ethnicities, income levels and parental education) will be identified. To know how school types and parent involvement variables affect these at-risk groups, complete models will also be run for each group.

Findings from the overall sample

Results from the regressor variable model show that school type has no significant correlation with reading scores. For math, religious private schools have a negative correlation with scores (as much as 0.27 s.d. for Catholic schools), while assigned-also-

chosen schools have a consistent modest positive correlation. Among the parent involvement variables, parents' academic expectations and frequency child reads outside school have robust marginal effects on scores. School involvement had a negligible positive effect (0.02 s.d.) on math scores[42].

These results are confirmed by the change score method that regresses standardized gain scores on school types, parent involvement, and explanatory variables. For reading, results show that school types have no significant correlation with gain scores, except for religious private schools that negatively affect scores. For math, results consistently show that religious private schools have a negative effect. Another consistent finding is that assigned-also-chosen schools have a modest positive correlation with gain scores.

School involvement of parents also has a slight but consistent correlation with math gain scores. Parents' academic expectations have a robust correlation with reading and math gain scores. Frequency of reading outside school also has a consistent modest association with reading and math gain scores.

It is noteworthy that among the parent involvement variables tested here, the most highly correlated ones were not aimed at supervising the child's behavior, but rather were aimed at advising and guiding the child. This finding is similar to what Catsambis (1998)[43] found: Parents' educational expectations and encouragement are "by far the most important type of family practice that affects all measures of senior achievement". The positive findings on parents' academic expectations for the child are also supported

[42] Cohen (1988) cautiously defined effect sizes as "small, *effect size* = .2," "medium, *effect size* = .5," and "large, *effect size* = .8", stating that "there is a certain risk in inherent in offering conventional operational definitions for those terms for use in power analysis in as diverse a field of inquiry as behavioral science" (p. 25).

[43] The Catsambis (1998) study is discussed in the review of literature section on parent involvement.

by earlier studies on parent involvement (Fan and Chen (1999), Kellaghan et al (1993), Desimone (1999), Becher (1984), and Trivette and Anderson (1995)).

The positive findings on reading at home are likewise supported by earlier studies that student achievement can significantly improve when parents—regardless of their socio-economic position—encourage reading at home and are attentive to school-related learning activities at home (Topping and Whiteley, 1990; and Teale, 1986).

Table 4. Final set of models on effects all explanatory variables, previous scores and school type and parent involvement on student achievement

	Dependent variables are test scores or gain scores			
Independent variables	**Regressor variable method**		**Change score method**	
	Reading	**Math**	**Reading**	**Math**
School choice by school types				
Private – Catholic	-0.043	-0.276**	-0.106*	-0.392**
	(0.036)	(0.031)	(0.049)	(0.043)
Private – other religion	-0.034	-0.156**	-0.110	-0.240**
	(0.049)	(0.048)	(0.069)	(0.071)
Private – non-religious	0.029	-0.152	-0.183	-0.254
	(0.097)	(0.117)	(0.132)	(0.164)
Public – choice	-0.010	-0.008	-0.029	-0.013
	(0.033)	(0.027)	(0.043)	(0.038)
Public – assigned is also chosen	0.029	0.044*	0.013	0.058*
	(0.024)	(0.020)	(0.029)	(0.029)
Parent involvement variables				
Whether or not family has rules on TV programs child can watch	-0.013	-0.034	0.006	-0.039
	(0.039)	(0.032)	(0.050)	(0.045)
Academic expectations of parent for child	0.131**	0.090**	0.097**	0.108**
	(0.013)	(0.013)	(0.015)	(0.018)
Frequency of school involvement	0.012	0.015*	0.005	0.019
	(0.007)	(0.007)	(0.008)	(0.009)
Frequency child reads books outside of school	0.084**	0.039**	0.064**	0.047**
	(0.013)	(0.010)	(0.016)	(0.014)
Family regularly receives newspapers and magazines	0.031	0.009	0.025	0.006
	(0.019)	(0.014)	(0.022)	(0.019)
Child participated in or attended artistic or cultural activities	0.026	0.006	0.014	0.008
	(0.022)	(0.020)	(0.028)	(0.028)
Parents play games or do puzzles with child	0.004	0.045	-0.016	0.061
	(0.051)	(0.049)	(0.059)	(0.068)
Frequency child does homework	0.005	0.006	0.018	0.014
	(0.022)	(0.014)	(0.027)	(0.019)
Explanatory variables				
Test score in kindergarten	0.391**	0.598**		
	(0.012)	(0.011)		
Female	0.031	-0.235**	0.016	-0.314**
	(0.020)	(0.018)	(0.025)	(0.025)
Age	0.005	-0.036**	-0.028*	-0.064**
	(0.009)	(0.007)	(0.011)	(0.009)
Black	-0.405**	-0.382**	-0.423**	-0.490**
	(0.041)	(0.039)	(0.053)	(0.055)
Hispanic	-0.178**	-0.060	-0.159**	-0.058
	(0.035)	(0.032)	(0.045)	(0.044)
Asian	-0.098*	0.028	-0.200**	0.025
	(0.050)	(0.058)	(0.067)	(0.080)
Other race/ethnicity	-0.235**	-0.125	-0.243*	-0.154

	(0.087)	(0.076)	(0.108)	(0.106)
Child is in special ed	-0.720**	-0.490**	-0.656**	-0.617**
	(0.059)	(0.050)	(0.069)	(0.067)
Below poverty threshold	-0.123**	-0.087**	-0.097*	-0.107*
	(0.036)	(0.032)	(0.044)	(0.044)
Number of siblings	-0.034**	-0.003	-0.024	-0.004
	(0.010)	(0.008)	(0.012)	(0.012)
Mother's education – less than HS	-0.177**	-0.137**	-0.165**	-0.177**
	(0.050)	(0.033)	(0.061)	(0.045)
Mother's education – some college	0.059*	0.075**	0.045	0.095**
	(0.027)	(0.025)	(0.031)	(0.035)
Mother's education – BA or higher	0.223**	0.173**	0.158**	0.207**
	(0.027)	(0.026)	(0.034)	(0.035)
Home language is not English	-0.068	0.028	0.002	0.070
	(0.055)	(0.038)	(0.066)	(0.052)
Two-parent family structure	0.058*	0.007	0.043	0.006
	(0.027)	(0.023)	(0.035)	(0.032)
Health of parent	0.031*	0.032**	0.038*	0.043**
	(0.012)	(0.012)	(0.017)	(0.016)
Transferred schools K-1st grade	0.007	-0.013	0.001	-0.017
	(0.029)	(0.028)	(0.037)	(0.039)
Transferred schools 1st –3rd grade	0.007	0.004	-0.003	0.006
	(0.027)	(0.024)	(0.031)	(0.033)
Northeast	-0.042	-0.058	-0.003	-0.070
	(0.036)	(0.036)	(0.051)	(0.050)
Mid-west	-0.002	-0.051	0.057	-0.062
	(0.034)	(0.032)	(0.046)	(0.044)
West	-0.075*	-0.086*	-0.073	-0.112*
	(0.034)	(0.035)	(0.045)	(0.049)
City	-0.007	0.006	-0.004	0.009
	(0.028)	(0.029)	(0.037)	(0.041)
Constant	-0.889**	-0.380**	-0.647**	-0.421*
	(0.161)	(0.120)	(0.192)	(0.163)
Observations	9684	10043	9684	10043
R-squared	0.43	0.56	0.12	0.14

All dependent variables are standardized with a mean of 0 and a standard deviation of 1.
Control variables are public-assigned schools for school type, white for ethnicity, and mother's education-HS for mother's education.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

To sum, the general models show seven findings: (1) school type has no significant marginal effect on reading scores, (2) being in a religious private school negatively correlates with math scores, (3) voluntary school involvement by parents has no correlation with reading scores, while it has (4) a statistically significant but small correlation with math scores, (5) parental expectation on academic achievement of child and (6) the frequency child reads outside of school both have consistent significant marginal effects on reading and math scores. And last but not least, (7) race/ethnicity, poverty level, and mother's education have consistently strong impact on reading and math scores.

Findings from sub-group samples

The first part of the discussion of results has focused on the effects of school type and parent involvement on scores using pooled data[44]. The results showed that there are large achievement gaps between certain groups and their better-off peers. Black children persistently lagged behind white children by as much as 0.40 s.d. for math and reading. The results of this study regarding academic performance of black children are consistent with findings of Fryer and Levitt (2005), and Yeung and Pfeiffer (2005).

Hispanics, while lagging behind whites by 0.18 s.d. in reading, had no significant lag in math. Children who live below the poverty level score less than those who do not by 0.10-0.12 s.d.. Children whose mothers did not finish high school do worse than those whose mothers did (around 0.17 s.d.), while those whose mothers finished college or

[44] The overall effect is largely dominated by the effect for the largest group. The overall effect is roughly an average of the effects for each group weighted by the population share.

higher did better by as much as 0.22 s.d. compared to those whose mothers only finished high school. It is therefore important to discuss the effects of school type and parent involvement on student achievement within these different groups.

To equalize opportunities and bridge achievement gaps, it is imperative to understand group-specific outcomes and patterns. Within-group behaviors, activities or processes (such as parental decisions on school types and involvement) need to be analyzed to be able to design education policies and programs to address group-based achievement gaps. For example, are blacks in Catholic schools different from non-blacks in Catholic schools? Running a Chow test[45] on the coefficients of each interaction variable (between each treatment and the subgroup of interest) should help confirm the subgroup results. The coefficients are derived from running the regressor variable model using pooled data, this time including interactions between the subgroup of interest and key independent variables. This allows hypothesis testing, using the Chow test, on whether or not a particular school type or parent involvement works differently in one subgroup over the rest of the sample[46].

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[45] A Chow test is a test of whether the coefficients estimated over one group of the data are equal to the coefficients estimated over another (Gould, W., StataCorp, August 2005. www.stata.com/)

[46] For example, to test whether or not school types and parent involvement affect blacks differently, the first step is to run the *complete* model as follows:

reading_3rd grade=f(reading_kindergarten, child and parent characteristics, school types, parent involvement, school types * black, parent involvement * black, black subgroup)

The second step is to do the Chow tests as follows (Gould, 2005):

To test if the coefficients of blacks in each school type are the same as that for non-blacks:
test _b[cath*black]=0
test _b[otherrel*black]=0
test _b[otherpri*black]=0
test _b[choicepub*black]=0
test _b[asschopub*black]=0

To test if the coefficients of blacks for parent involvement are the same as that for non-blacks:
test _b[TV rules*black]=0

Regressor variable model, by race/ethnicity

Table 5 shows that for blacks, being in a Catholic school has a negative correlation with math test scores. Chow tests (table 16 in Appendix D) show that for math, blacks significantly do worse than non-blacks in Catholic schools. And while being in an "assigned also chosen school" has a significant positive correlation with math scores, this association is not significantly different between blacks and non-blacks.

Academic expectations positively correlated with reading scores for blacks, similar for non-blacks. However, for math scores, parent expectations have no significant association with math scores for blacks. This is supported by Chow test results that show that the correlation between parent expectation and math scores for blacks is significantly lower than those for non-blacks. Unlike for non-blacks, blacks also do not show any significant association between the frequency child reads outside school and student achievement. School involvement, just like for non-blacks, has a slight positive correlation for math scores of blacks. The other parent involvement variables show no correlation for student achievement of black children.

Math scores of Hispanic children are negatively associated with being in Catholic and non-Catholic religious schools, similar to that of non-Hispanics. Reading scores of

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test _b[expectations*black]=0
test _b[school involvement*black]=0
test _b[reading outside school*black]=0
test _b[family receives reading materials*black]=0
test _b[cultural exposure*black]=0
test _b[games with child*black]=0
test _b[did homework*black]=0

Hispanics, however, appear to be positively correlated with being in non-religious private schools, compared to non-Hispanics.

Academic expectations of parents have a positive correlation with Hispanic student achievement, but not differently from that of non-Hispanics. The positive correlation between math scores and the frequency child reads books at home, as well as the frequency of doing homework, however, are significantly higher for Hispanics than non-Hispanics.

Table 5. Marginal effects of school types and parent involvement on student achievement across whites, blacks and Hispanics

	Whites		Blacks		Hispanics	
School choice by school types	Reading	Math	Reading	Math	Reading	Math
Private – Catholic	-0.019	-0.265**	-0.336	-0.496**	-0.096	-0.260**
	(0.041)	(0.036)	(0.172)	(0.110)	(0.079)	(0.077)
Private – other religion	-0.023	-0.120*	-0.282	-0.219	-0.012	-0.370**
	(0.052)	(0.051)	(0.200)	(0.187)	(0.128)	(0.141)
Private – non-religious	-0.106	-0.243	-0.093	0.067	0.358*	-0.107
	(0.111)	(0.133)	(0.327)	(0.207)	(0.164)	(0.152)
Public – choice	-0.012	-0.018	-0.002	-0.040	-0.022	0.060
	(0.041)	(0.034)	(0.070)	(0.062)	(0.084)	(0.064)
Public – assigned is also chosen	0.013	0.001	0.044	0.133*	0.040	0.001
	(0.027)	(0.024)	(0.075)	(0.060)	(0.060)	(0.051)
Parent involvement variables						
Whether or not family has rules on TV programs child can watch	0.014	-0.039	-0.049	0.028	-0.004	-0.027
	(0.047)	(0.044)	(0.140)	(0.113)	(0.080)	(0.060)
Academic expectations of parent for child	0.154**	0.114**	0.096**	0.036	0.100**	0.089**
	(0.017)	(0.017)	(0.036)	(0.027)	(0.025)	(0.022)
Frequency of school involvement	0.016	0.013	0.005	0.033*	-0.001	0.003
	(0.009)	(0.008)	(0.015)	(0.017)	(0.015)	(0.014)
Frequency child reads books outside of school	0.088**	0.026*	0.057	0.053	0.091**	0.081**
	(0.015)	(0.013)	(0.033)	(0.029)	(0.025)	(0.021)
Family regularly receives newspapers and magazines	0.056**	0.032*	-0.016	-0.017	-0.009	-0.027
	(0.021)	(0.014)	(0.041)	(0.049)	(0.040)	(0.022)
Child participated in or attended artistic or cultural activities	0.093**	0.040	-0.118	-0.075	-0.049	-0.022
	(0.024)	(0.022)	(0.063)	(0.058)	(0.063)	(0.046)
Parents play games or do puzzles with child	0.006	0.052	0.147	0.085	-0.142	0.020
	(0.061)	(0.060)	(0.128)	(0.151)	(0.099)	(0.055)
Frequency child does homework	-0.030	-0.012	0.055	0.019	0.081	0.060*
	(0.021)	(0.018)	(0.032)	(0.031)	(0.077)	(0.030)
Observations	9684	10043	9684	10043	9684	10043
R-squared	0.38	0.52	0.40	0.53	0.46	0.53

These coefficients are based on models run on the full set of explanatory variables.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

Regressor variable model, by poverty level

According to the regressor variable models for the pooled sample, living below the poverty level decreases student achievement by 0.09-0.12 s.d. Running the models for income sub-groups show that for those living below poverty level, being in a choice public school has a positive correlation with student achievement of 0.14-0.19 s.d. compared to that of being in assigned public schools[47] (table 6). Chow test results show that the marginal effects of choice public schools are indeed significantly higher for those living below poverty level than for those living above poverty level. Meanwhile, being in non-religious private schools has a negative association with math scores by 0.81 s.d.

As in other sub-groups as well as in the overall sample, school type does not affect reading scores for those above the poverty level, while being in religious private schools negatively affects math scores (0.16-0.29 s.d.). Being in an assigned-also-chosen public school increases math scores by 0.04 s.d. These marginal effects, however, are not significantly different across the poor and non-poor.

Student achievement of both income groups is positively correlated with academic expectations, and the frequency child reads outside school. Reading scores of those living in poverty, however, are negatively correlated with exposure to cultural activities (-0.14 s.d.). In general, Chow test results show that the marginal effects of parent involvement variables are similar across income groups (below and above poverty), except for exposure to cultural activities.

[47] In the general sample, students from families that live below poverty level comprise about 20% of the third-grade students in choice schools (compared to 26% in assigned public schools and around 4% in private schools).

Table 6. Marginal effects of school types and parent involvement on student achievement across income groups

	Below poverty level		Above poverty level	
School choice by school types	Reading	Math	Reading	Math
Private – Catholic	-0.189	-0.130	-0.034	-0.287**
	(0.184)	(0.153)	(0.036)	(0.033)
Private – other religion	0.136	-0.126	-0.034	-0.161**
	(0.214)	(0.158)	(0.048)	(0.049)
Private – non-religious	-0.103	-0.810**	0.042	-0.124
	(0.289)	(0.269)	(0.098)	(0.117)
Public – choice	0.193*	0.143*	-0.054	-0.047
	(0.077)	(0.066)	(0.033)	(0.026)
Public – assigned is also chosen	-0.007	0.034	0.029	0.044*
	(0.058)	(0.050)	(0.023)	(0.021)
Parent involvement variables				
Whether or not family has rules on TV programs child can watch	0.072	0.031	-0.028	-0.034
	(0.085)	(0.070)	(0.040)	(0.036)
Academic expectations of parent for child	0.139**	0.075**	0.125**	0.095**
	(0.027)	(0.027)	(0.016)	(0.013)
Frequency of school involvement	0.010	0.009	0.012	0.015
	(0.016)	(0.011)	(0.007)	(0.008)
Frequency child reads books outside of school	0.066*	0.027	0.091**	0.044*
	(0.028)	(0.026)	(0.015)	(0.010)
Family regularly receives newspapers and magazines	-0.001	0.007	0.040*	0.011
	(0.036)	(0.029)	(0.020)	(0.014)
Child participated in or attended artistic or cultural activities	-0.138*	-0.039	0.061**	0.016
	(0.053)	(0.052)	(0.021)	(0.019)
Parents play games or do puzzles with child	-0.012	0.178	-0.001	-0.013
	(0.097)	(0.095)	(0.057)	(0.051)
Frequency child does homework	0.063	0.045	-0.018	-0.004
	(0.051)	(0.025)	(0.016)	(0.014)
Observations	9684	10043	9684	10043
R-squared	0.45	0.51	0.38	0.54

These coefficients are based on models run on the full set of explanatory variables.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

Regressor variable model, by mother's education

In the regressor variable model for the pooled sample, results showed that children whose mothers have less than high school education were at a disadvantage. The mother's education level is positively correlated with the child's achievement.

In terms of reading achievement, children of mothers with less than high school education tend to benefit in non-religious private schools as well as in choice public schools. These findings are supported by Chow test results that show that marginal effects of these school types are significantly higher for those whose mothers have less than high school education.

Academic expectations of parents have strong positive correlations with student achievement across the different education backgrounds. The frequency of child reading outside school also has positive correlations with achievement across the different education background. The frequency child does homework, however, has a significantly stronger positive correlation with reading scores for those with poorly educated mothers.

Table 7. Marginal effects of school types and parent involvement on student achievement across mother's education background

	Less than high school		Finished high school only		Finished college or better	
School choice by school types	Reading	Math	Reading	Math	Reading	Math
Private – Catholic	0.405	-0.025	-0.026	-0.281**	-0.017	-0.273**
	(0.210)	(0.210)	(0.076)	(0.049)	(0.050)	(0.052)
Private – other religion	0.072	-0.308	0.117	-0.139	0.036	-0.095
	(0.281)	(0.313)	(0.089)	(0.087)	(0.066)	(0.057)
Private – non-religious	0.937**	-0.133	-0.084	-0.309	0.134	-0.035
	(0.129)	(0.215)	(0.096)	(0.177)	(0.103)	(0.122)
Public – choice	0.343**	-0.004	-0.068	-0.050	0.017	0.090
	(0.128)	(0.073)	(0.054)	(0.048)	(0.060)	(0.049)
Public – assigned is also chosen	0.030	-0.064	-0.052	0.024	0.102**	0.061
	(0.077)	(0.068)	(0.041)	(0.039)	(0.039)	(0.038)
Parent involvement variables						
Whether or not family has rules on TV programs child can watch	0.041	0.017	0.036	0.009	-0.111	-0.074
	(0.100)	(0.071)	(0.068)	(0.060)	(0.061)	(0.066)
Academic expectations of parent for child	0.141**	0.094**	0.130**	0.090**	0.194**	0.144**
	(0.030)	(0.026)	(0.022)	(0.020)	(0.030)	(0.027)
Frequency of school involvement	0.032	0.014	-0.002	0.007	0.007	0.012
	(0.019)	(0.018)	(0.014)	(0.013)	(0.014)	(0.013)
Frequency child reads books outside of school	0.077*	0.067*	0.059**	0.015	0.125**	0.044*
	(0.036)	(0.033)	(0.020)	(0.017)	(0.020)	(0.022)
Family regularly receives newspapers and magazines	0.035	-0.004	0.047	0.022	0.065	0.008
	(0.060)	(0.034)	(0.026)	(0.027)	(0.036)	(0.032)
Child participated in or attended artistic or cultural activities	-0.101	-0.078	0.001	0.001	0.086**	0.006
	(0.081)	(0.075)	(0.040)	(0.031)	(0.032)	(0.028)
Parents play games or do puzzles with child	-0.169	0.059	0.181**	0.100	-0.025	0.054
	(0.104)	(0.080)	(0.070)	(0.068)	(0.096)	(0.096)
Frequency child does homework	0.134**	0.081	-0.019	-0.017	-0.043*	0.005
	(0.047)	(0.044)	(0.024)	(0.022)	(0.021)	(0.023)
Observations	9684	10043	9684	10043	9684	10043
R-squared	0.47	0.50	0.38	0.50	0.32	0.49

These coefficients are based on models run on the full set of explanatory variables.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

2. Parent involvement and school types

The theoretical model discussed in Chapter 3 left open the relationship between school type and parent involvement. There is no a priori assumption in the framework about whether the two key independent variables are substitutes (negatively correlated as variables explaining student achievement) or complements (positively correlated). School type and parent involvement would be "substitutes" if parents who choose schools are *less* involved, and "complements" if choosers are *more* involved.

The lack of an a priori assumption in this case is deliberate, since this study aims to analyze how school type and parent involvement are correlated. The models in this section intend to show association, not causation. The models are based on the same framework as the regressor variable models for the pooled sample, hence they use the same variables that were previously used to explain student achievement. But this time, the dependent variable is parent involvement. The methodology used in this section is different from that of Ogawa and Dutton (1997), who look at the *likelihood* of school choice (as the dependent variable) given parent involvement (as one of their key independent variables). Instead, the models below look at how parent involvement is associated with *actual* choice (child is already in specific school type). The results are therefore anchored in actual data rather than in "likelihoods".

The ECLS data indicate that parents who put their children in private schools were more likely to think that their child is at least as clever as same-age children[48].

[48] The weighted mean for this 'cleverness' variable is 90% for the third-grade sample. But the weighted mean of the same variable for the private school types are all higher than the sample mean, at 93% for Catholic schools, 93% for non-Catholic religious schools, and 98% for non-religious private schools. Those in public schools have lower means, at 89% for choice public schools, 90% for assigned-also-chosen schools, and 89% for assigned public schools.

Parental decisions on school type seem to be a 'vote of confidence' by parents on their child.

Regression results of Table 8 show that having TV rules at home is weakly correlated with school types and other explanatory variables. This partly explains why having rules on TV programs the child can watch also had no significant correlation with student achievement for the pooled and sub-group samples.

Academic expectations of parents for child, which has robust marginal effects on student achievement, also has strong correlations with school type. Academic expectations for children in all other school types are higher than those in assigned public schools. Among the parent involvement variables used in the models, previous score (a proxy for ability) is most correlated to academic expectations. Interestingly, blacks have the highest academic expectations for their children among the race/ethnicity categories, followed by Hispanics and Asians who all have higher academic expectations for their children than whites. Mother's education and family income have proportional effects on expectations.

Voluntary school involvement is highest among parents whose child is in Catholic schools, followed by non-Catholic private schools and choice public schools. It is lowest among those in assigned public schools. It is also strongly affected by socio-economic status as well as by ethnic culture. Whites predominate over the other races/ethnicities in school involvement, followed by Hispanics and blacks. The race/ethnicity group which is least involved is the Asian group. The more educated the mothers are, the more they get involved in school. Other interesting factors that correlate highly with school involvement are family structure (those in 2-parent structures are more involved). Parents of children who are transferees are less involved, likewise with those whose children are

less healthy and are living below the poverty level. Language is also an important factor in school involvement, as non-English speakers are less involved than English speakers. Previous score of child in kindergarten also affects school involvement, though only modestly compared to the socio-economic factors.

Those who are in choice public schools and in assigned-also-chosen schools read more than children in other schools. Race/ethnicity has practically no marginal effect. Reading outside of school is strongly related to gender. Female children have a stronger tendency to read outside of school. However, mother's education has no big effect, with children of mothers with at least a bachelor's degree reading slightly more (0.14 s.d.) than children of mothers with only a high-school education.

Meanwhile, those in Catholic and in non-religious private schools belong to families that receive magazines and newspapers regularly. Children of more educated mothers and those in private schools are more likely to receive magazines and newspapers regularly and also get more exposure to cultural activities.

Children in schools other than the assigned school also have more probability to get cultural exposure. The probability is higher if the child is female, and if the mother is educated.

The probability that the family plays games or does puzzles with the child is not affected by school type.

The frequency the child does homework, however, increases if the child is in a religious (Catholic or other) private school.

Table 8. How school type, explanatory variables and previous scores affect parent involvement

	Dependent variables are parent involvement variables							
Independent variables	**TV rules**	**Academic expectations**	**School involvement**	**Reads outside school**	**Family receives reading materials**	**Cultural activities**	**Play games and puzzles**	**Frequency did homework**
School choice by school types								
Private – Catholic	0.026**	0.169**	0.909**	-0.041	0.095**	0.116**	0.009	0.169**
	(0.010)	(0.031)	(0.058)	(0.034)	(0.028)	(0.024)	(0.009)	(0.041)
Private – other religion	0.030	0.136**	0.562**	-0.031	-0.000	0.126**	-0.003	0.165**
	(0.015)	(0.044)	(0.104)	(0.046)	(0.030)	(0.027)	(0.014)	(0.054)
Private – non-religious	-0.000	0.183**	0.322*	0.031	0.104*	0.176**	0.011	-0.016
	(0.027)	(0.048)	(0.146)	(0.057)	(0.048)	(0.044)	(0.016)	(0.088)
Public – choice	0.007	0.069*	0.390**	0.087*	-0.004	0.064**	0.010	0.058
	(0.010)	(0.032)	(0.060)	(0.036)	(0.027)	(0.017)	(0.008)	(0.037)
Public – assigned is also chosen	0.003	0.093**	0.328**	0.050*	0.036	0.061**	-0.003	0.023
	(0.008)	(0.024)	(0.048)	(0.023)	(0.021)	(0.016)	(0.007)	(0.026)
Explanatory variables								
Math score in kindergarten	-0.003	0.167**	0.132**	0.078**	0.061**	0.022**	0.004	-0.029*
	(0.004)	(0.013)	(0.023)	(0.013)	(0.010)	(0.006)	(0.003)	(0.012)
Female	0.010	0.098**	0.120**	0.236**	-0.004	0.210**	0.006	0.023
	(0.006)	(0.019)	(0.040)	(0.022)	(0.016)	(0.014)	(0.005)	(0.022)
Age	0.000	-0.021*	-0.008	-0.024**	-0.008	-0.004	-0.004	-0.012
	(0.002)	(0.008)	(0.015)	(0.008)	(0.007)	(0.005)	(0.002)	(0.009)
Black	0.038**	0.236**	-0.275**	0.085*	-0.053	0.093**	0.001	0.126**
	(0.011)	(0.043)	(0.072)	(0.040)	(0.033)	(0.028)	(0.012)	(0.044)
Hispanic	-0.010	0.185**	-0.161*	0.054	-0.124**	-0.014	-0.005	0.088*
	(0.013)	(0.046)	(0.076)	(0.038)	(0.033)	(0.021)	(0.009)	(0.035)
Asian	-0.053*	0.135*	-0.423**	0.067	0.003	0.082*	0.021	0.094
	(0.027)	(0.059)	(0.098)	(0.069)	(0.048)	(0.036)	(0.020)	(0.050)
Other race/ethnicity	-0.009	-0.084	-0.404**	-0.023	-0.032	0.062*	0.008	-0.108
	(0.019)	(0.054)	(0.124)	(0.049)	(0.047)	(0.031)	(0.011)	(0.114)
Child is in special ed	-0.002	-0.150**	-0.122	-0.001	0.097*	-0.012	0.019	-0.150**
	(0.015)	(0.048)	(0.079)	(0.049)	(0.038)	(0.026)	(0.011)	(0.056)
Below poverty	-0.017	-0.082*	-0.271**	0.001	-0.121**	-0.010	-0.003	-0.050

	threshold	(0.012)	(0.033)	(0.064)	(0.035)	(0.033)	(0.016)	(0.009)	(0.039)
Number of siblings	0.001	-0.019	-0.026	0.014	0.004	-0.001	0.002	0.003	
	(0.003)	(0.010)	(0.022)	(0.010)	(0.009)	(0.005)	(0.002)	(0.007)	
Mother's education – less than HS	-0.024	-0.085	-0.483**	0.025	-0.123**	-0.046*	-0.034*	0.030	
	(0.013)	(0.053)	(0.098)	(0.038)	(0.034)	(0.019)	(0.013)	(0.041)	
Mother's education – some college	-0.005	0.236**	0.369**	0.042	0.128**	0.075**	-0.006	0.002	
	(0.008)	(0.030)	(0.048)	(0.032)	(0.022)	(0.012)	(0.008)	(0.026)	
Mother's education – BA or higher	-0.002	0.464**	0.739**	0.137**	0.297**	0.230**	-0.009	0.035	
	(0.009)	(0.030)	(0.047)	(0.028)	(0.021)	(0.016)	(0.008)	(0.029)	
Home language is not English	-0.029	0.391**	-0.293*	0.004	-0.278**	0.020	-0.094**	0.215**	
	(0.019)	(0.054)	(0.119)	(0.045)	(0.036)	(0.022)	(0.013)	(0.056)	
Two-parent family structure	0.035**	0.034	0.433**	0.096**	0.175**	0.024	0.009	0.001	
	(0.011)	(0.027)	(0.046)	(0.030)	(0.023)	(0.016)	(0.009)	(0.031)	
Health of parent	0.009	0.074**	0.124**	0.044**	0.029**	0.011	0.010*	0.027*	
	(0.005)	(0.013)	(0.024)	(0.013)	(0.011)	(0.008)	(0.004)	(0.012)	
Transferred schools K-1st grade	0.015	-0.021	-0.164*	0.016	-0.018	-0.015	0.015	-0.021	
	(0.010)	(0.039)	(0.074)	(0.039)	(0.033)	(0.018)	(0.009)	(0.041)	
Transferred schools 1st –3rd grade	-0.003	-0.007	-0.336**	-0.019	-0.053*	-0.001	-0.006	0.032	
	(0.009)	(0.030)	(0.052)	(0.028)	(0.025)	(0.017)	(0.008)	(0.028)	
Northeast	-0.014	0.029	-0.096	-0.008	0.114**	-0.021	0.008	0.117**	
	(0.011)	(0.040)	(0.062)	(0.037)	(0.031)	(0.019)	(0.008)	(0.042)	
Mid-west	-0.019	-0.078*	-0.038	-0.021	0.067*	-0.049**	0.010	-0.187*	
	(0.011)	(0.034)	(0.079)	(0.033)	(0.032)	(0.017)	(0.008)	(0.074)	
West	-0.018	0.084*	0.003	0.026	0.037	0.050**	-0.012	0.030	
	(0.010)	(0.038)	(0.080)	(0.045)	(0.026)	(0.017)	(0.008)	(0.045)	
City	0.001	0.047	-0.023	-0.012	-0.014	-0.020	-0.008	0.076*	
	(0.008)	(0.028)	(0.055)	(0.026)	(0.021)	(0.014)	(0.006)	(0.038)	
Constant	0.863**	3.304**	4.894**	2.833**	1.060**	0.157**	0.917**	4.131**	
	(0.028)	(0.083)	(0.131)	(0.083)	(0.060)	(0.047)	(0.026)	(0.084)	
Observations	10376	10397	10151	10409	10424	10421	10421	10419	
R-squared	0.02	0.17	0.24	0.05	0.18	0.12	0.03	0.05	

Note: Linear probability modeling was used for models with binary parent involvement variables ("TV rules", "cultural activities" and "play games and puzzles") as dependent variables.
Control variables are public-assigned schools for school type, white for ethnicity, mother's education-HS for mother's education, and south for region.
Standard errors in parentheses; * significant at 5%; ** significant at 1%

Chapter 5 – Conclusions and Policy Discussions

1. Conclusions

Chapter 4 examined the effects of parental decisions about school type and involvement on reading and math scores. In general, this study indicates that academic achievement responds to some parent involvement variables and not to school type[49]. Figure 10 shows that marginal effects of school types disappear, or even become negative, once confounding variables are controlled for. In the case of parent involvement, however, marginal effects of academic expectations and of child reading at home remain statistically significant after controlling for confounding variables (figure 11).

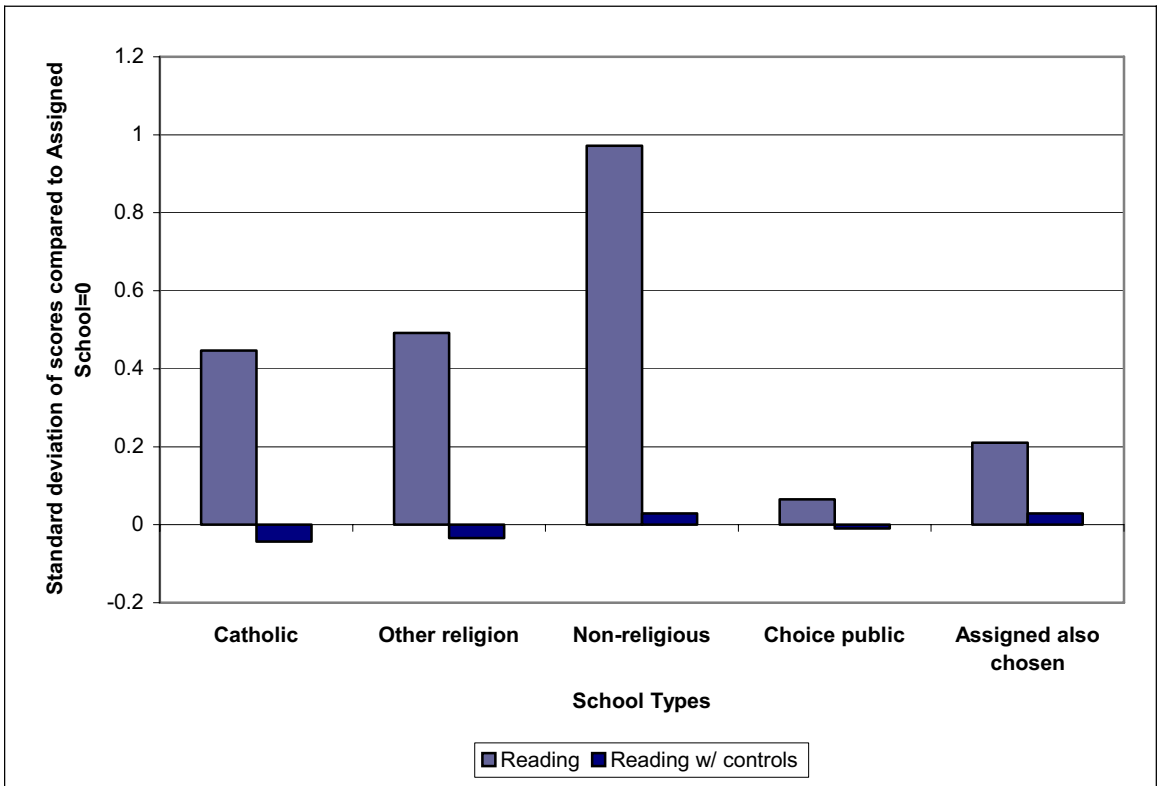
Moreover, results show that race/ethnicity, poverty status and mother's education have robust marginal effects on student achievement as well as strong correlations with school type and parent involvement. This affirms the assumption behind this study which seeks to improve student achievement by addressing the "changeable" factors which affect scores, such as school type and parent involvement, to make up for the effects of "unchangeable" socio-economic factors[50]. Running the regressor variable model on the overall sample as well as on the sub-groups reveal statistical relationships among the covariates which inform policy on addressing at-risk groups.

This study has three sets of results: the first set applies to the overall sample of third-grade children in the US. The second set applies to the various sub-groups of

[49] In reading scores, for example, school type does not have a significant marginal effect, while parent involvement variables such as academic expectations and having the child read outside the school do. Their marginal effects are significantly different from zero.

[50] It could be argued that socio-economic factors are changeable through broad public policy, but the change could happen more gradually over the longer term compared to promoting access to choice or parent involvement.

Figure 10. School type differences disappear after controlling for parent involvement, previous scores, family and child characteristics and location.



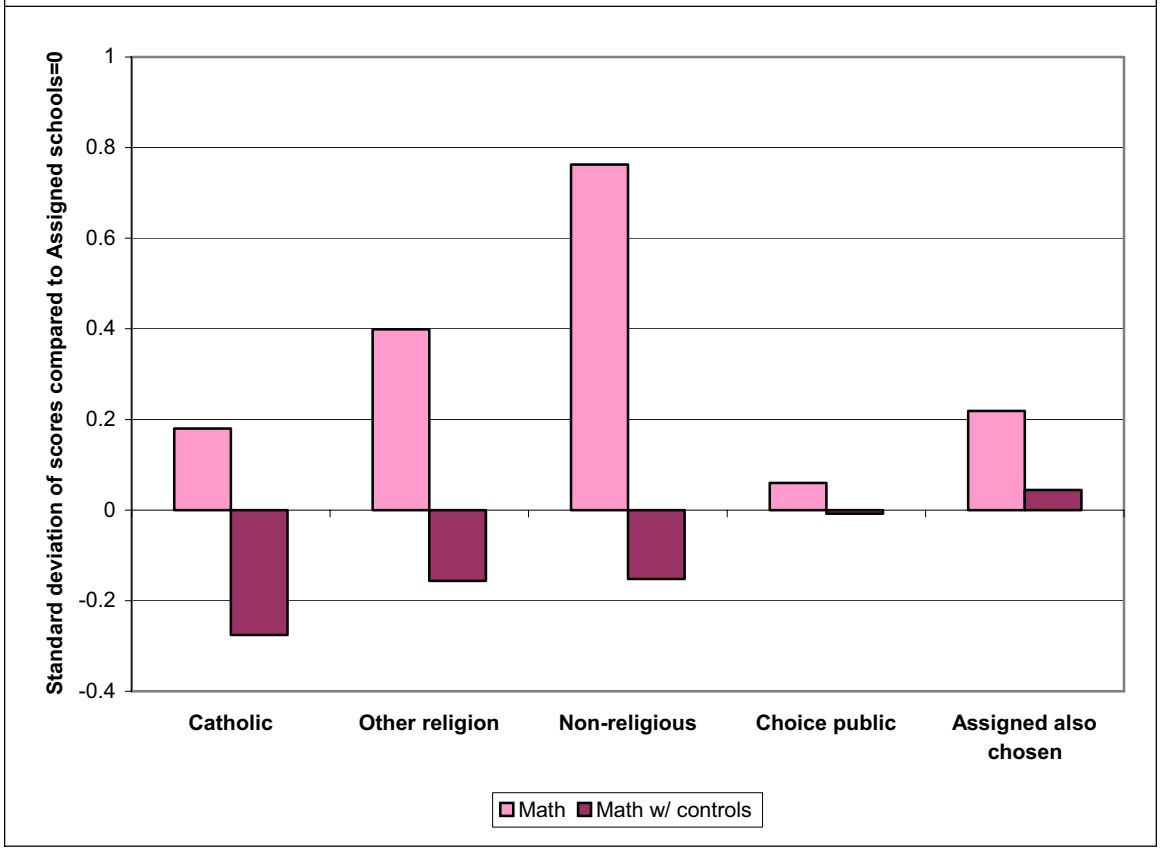
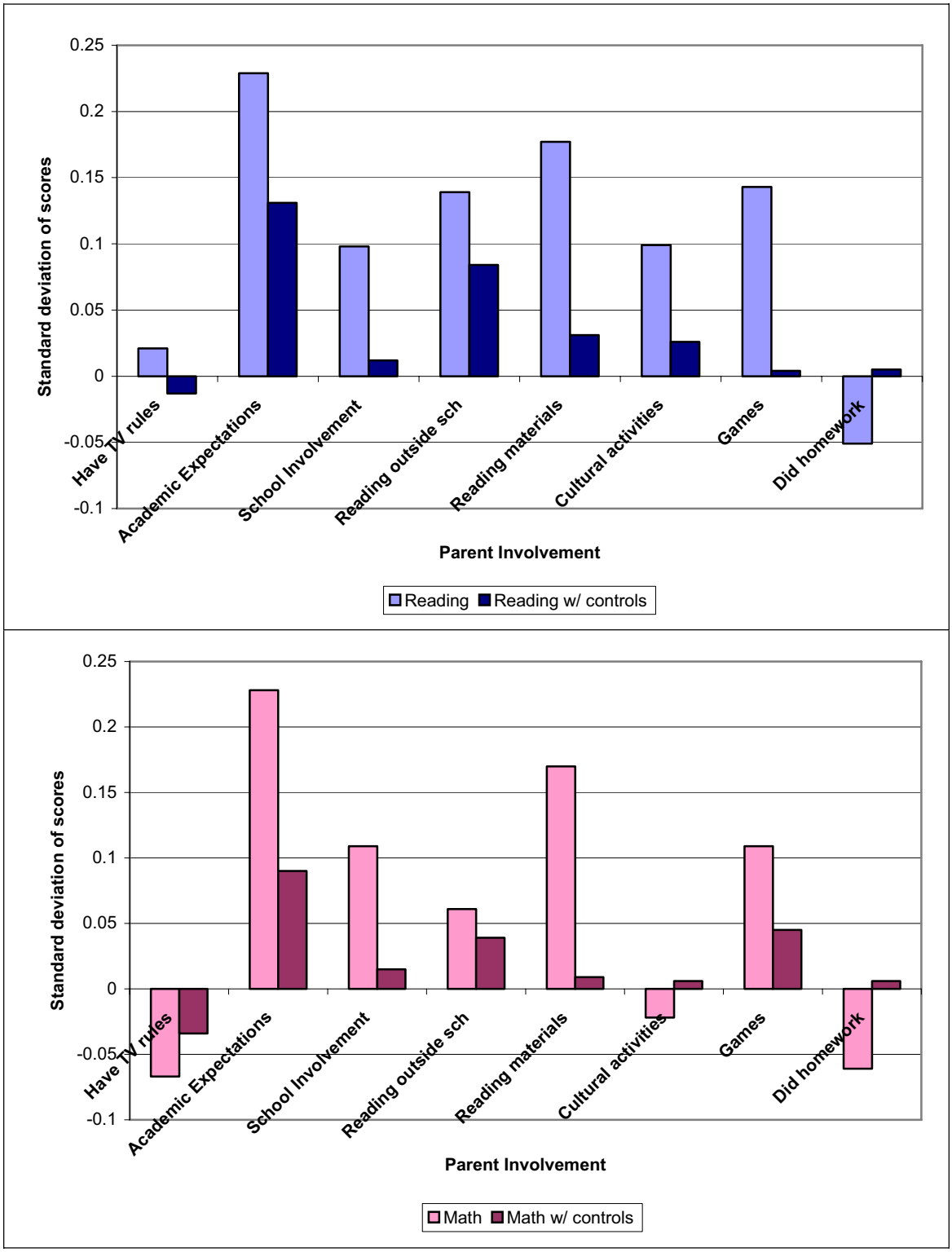


Figure 11. Unlike school type, a few parent involvement correlations persist after controlling for school type, previous scores, family and child characteristics and location.



race/ethnicity, poverty level, and mother's education. And the third set applies to the analysis of the relationship between school types and parent involvement.

School type and parent involvement: results for overall sample

The results from the final models for the overall sample show seven findings: (1) school type has no significant correlation with reading scores, (2) being in a religious private school negatively correlates with math scores, (3) voluntary school involvement by parents has no association with reading scores, while it has (4) a statistical but small correlation with math scores, (5) parental expectation on academic achievement of child has the strongest correlation with achievement among the parent involvement variables, followed by (6) the frequency child reads outside of school. And finally, (7) race/ethnicity, poverty level, and mother's education have strong and robust impacts on reading and math scores.

It is tempting to conclude that parents, not schools, make student achievement. However, the results of the study should be interpreted with caution, especially for those referring to school type effects. Lack of statistical effects of school types on student achievement should not be interpreted to mean as school choice being useless in promoting achievement. The lack of differentiation in achievement across school types after controlling for student characteristics and parental involvement may mean that competition effects from non-assigned schools have increased public school quality. Studies on competition effects, however, show mixed results[51]. Hoxby (2002) looked at the effect of

[51] Positive competition effects from increased access to choice, such as the presence of more charter schools, can only occur if all parents homogeneously value school quality more than other school characteristics (such as proximity, religion, or race/ethnicity composition). Heterogeneous preferences among parents may lead access-to-choice policies to result to "vertical integration" instead of overall improvement across schools

access to choice on school quality and compared performance of regular public schools before and after "significant competition" from school choice set in. Regression methodology using difference-in-differences (includes school and year fixed effects) was used with access to choice as key independent variables, specifically evidence from vouchers in Milwaukee, charter schools in Michigan, and charter schools in Arizona. The unit of analysis was the school, with "productivity", the key dependent variable, defined as the score for each school in a district/municipality divided by the per pupil expenditure for the same school. She found that "access to choice" increases the productivity of regular public schools as they responded to competition effects. From her results, it looks like regular public schools that face choice-driven incentives can be induced to raise their productivity. Sass (2004) likewise found that for Florida, controlling for pre-existing traditional public school quality, competition from charter schools is associated with improved achievement in nearby traditional public schools. Sass computes this net effect as ranging at around 4-8 percent of the average annual achievement gain. Buddin and Zimmer (2003) also investigated the competition effect of charter schools in California through a survey among charter school principals. They found that while there was little impact on operational practices, 11.6% of the 90 principals from matched traditional public schools have made changes in their instructional practices. However, in a 2005 paper that uses California data on survey responses of principals in traditional public schools, Buddin and Zimmer found that public school principals felt little competitive pressure from charters. They also found that charter competition (measured in terms of distance, number of charters and other alternatives, share of students in charters, and students lost to other

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(Hastings, Kane and Staiger, 2005). In a study of revealed preferences of parents based in Washington DC, Schneider and Buckley (2002) show that the key school characteristic that well-educated parents care about was race/ethnicity composition.

schools) did not improve the performance of traditional public schools. For North Carolina, Bifulco and Ladd (2004) likewise conclude that charter schools appear to have no statistically significant effects on student achievement in traditional public school students.

School type and parent involvement: results for sub-groups

While school type effects appear insignificant for the overall sample, they do affect student achievement in some sub-groups. Math scores of black children, for example, benefit from being in assigned-also-chosen schools by a modest 0.13 s.d. Hispanic children do better in reading scores by as much as 0.36 s.d. when in non-religious private schools. Children in families living in poverty benefit by being in choice public schools by 0.19 s.d. for reading and 0.14 s.d. for math. Being in non-religious private schools and choice public schools also greatly improve the reading scores (by 0.94 s.d. and 0.34 s.d. respectively) of those whose mothers have less than high school education.

Groups that are not at-risk –white children or those with well-educated mothers or those who live above poverty level – generally show that school types do not affect reading scores[52], and that religious private schools are negatively correlated to math scores[53].

The results across sub-groups for correlations between student achievement and parent expectations, child reading outside school and school involvement are similar to that of the pooled sample. The oft-repeated need for voluntary school involvement is not supported by results in this study, as school involvement has no correlation with reading and only a negligible correlation with math scores, for blacks. Having TV rules has no

[52] Note though that assigned-also-chosen schools may have a positive effect of .10 s.d. on reading scores of children with highly educated mothers.
[53] Note though that choice public schools and assigned-also-chosen schools may have a modest effect of .04-.09 s.d. on math scores.

correlation with student achievement. The frequency of doing homework actually helped at-risk groups such as Hispanics and those with poorly educated mothers. Exposure to cultural activities positively affected reading scores, but only for groups that are not at-risk (children who are either white, not living in poverty, or whose mothers have a college degree or better). Compared to their better off peers, achievement of at-risk children such as blacks, those living below poverty level and those with less-educated mothers have a negative correlation with exposure to cultural activities. It is possible that the "cultural activities" these children are exposed to are different from that of their better-off peers, and may not be as helpful to academic achievement.

Hispanic students benefit more than other race/ethnicities by the frequency they read outside school. Reading scores of children of poorly educated mothers also benefit slightly from reading outside school. And lastly, the frequency child does homework seems to help at-risk children more than non-at-risk ones.

Some of the results are difficult to interpret. For example, parent expectations do not show any association with math scores of black children. The same is true for the frequency child reads outside school, which does not correlate with reading scores of black third-graders in the sample. It is possible that these results can be due to validity problems for these items in the sample of black parents. There is a need to increase the sample size of blacks to validate these results. But it is also likely that there is something in the culture of the black sub-group that leads to these results.

The relationship between school type and parent involvement

Another finding of this study is that school choice and parent involvement are complements in producing achievement. Children who are in school types other than the assigned public school have parents who are generally more involved in terms of voluntary school involvement, academic expectations for child, the frequency child reads outside school, and exposure of child to cultural activities. These indicate that parents who choose are different from parents who do not choose. While this in itself is not a new finding, it is interesting to note the results that indicate that those who choose are also more involved.

The results show an intuitive agreement with the theoretical framework discussed in Chapter 3 on parental utility and academic achievement[54]. The combined marginal effects of a chooser's school-type quality and parent involvement within that school type should be greater than the combined marginal effects of a non-chooser's. If school type has no correlation with student achievement as in the case of reading scores, parent involvement

[54] To demonstrate, let there be 2 sets of children who are similar in terms of the explanatory variables used in this study. The 2 sets of children only differ in terms of school type and parent involvement. Suppose one set is in Catholic schools, and the other is in assigned public schools. Based on the results of the regressor variable model from the pooled sample (Table 4), as well as from the findings that choosers tend to be more involved as parents (Table 8), below are the combined effects for the two sets of children:

Combined effects of school type and parent involvement on reading scores

Key Independent Variables	Children in Catholic schools			Children in assigned public schools		
	Marginal effects	Units*	Total	Marginal effects	Units*	Total
School type	0.00	1	0.00	0.00	0	0.00
Academic expectations	0.13	4	0.52	0.13	3	0.39
Freq. child reads outside school	0.08	2	0.16	0.08	2	0.16
Family receives newspapers/mags	0.03	2	0.06	0.03	0	0.00
Total in terms of standard dev			0.74			0.55

*Values are hypothetical for parent involvement variables, based on the findings that choosers also tend to be more involved as parents, except for child reading outside school.

The combined effects above show that children in Catholic schools do better than those in assigned schools, consistent with the theoretical model in Chapter 3:
$\partial \Delta U / \partial \alpha > 0$ if $(a_o \, Q_{other} + b_o \, PI_{other}) > (a_a \, Q_{assigned} + b_a \, PI_{assigned})$

has to make up for that non-effect, to ensure that the decision to choose leads to an increase in parental utility.

2. Policy discussions

To improve academic achievement and address achievement gaps between non-at-risk and at-risk groups, policy should focus not only on schools, but also on parents.

On school types

Though results of this study show lack of school type effects on achievement, it would be a mistake to conclude that school choice (either by promoting new schools of alternative types, or increasing access to choice through vouchers) should not be supported.

Choice must provide some benefits to parents over and above the assigned school. Perhaps the benefit is not in student achievement, but the parents must have some perceived gain in exercising their choice.

On parent involvement

While school-type effects appear to be nil, there is no mistaking the evidence that a few parent involvement variables have strong associations with student achievement. The parent involvement variables that had consistently robust associations with student achievement were academic expectations of parent for child and the frequency the child reads books outside school. Marginal effects of these particular parent involvement variables appear robust despite the strong explanatory power of different family characteristics such as race/ethnicity, poverty status and mother's education. The marginal

effects on student achievement of academic expectations and child reading at home generally held true for results from the overall sample as well as from the sub-groups per race/ethnicity, income and mother's education. The positive correlation between academic expectations and achievement are consistent with the results of Catsambis (1998), Desimone (1999) and others such as Astone and McLanahan (1991) and Milne et al. (1986).

Other than nuances from race/ethnicity and socio-economic factors, it is important to note some nuances from the gender factor. There are strong gender associations with student achievement (females do better in reading, but do worse in math than boys) as well as with parent involvement. That is, parents tended to be more involved in school and had higher academic expectations for their child if the child is female. Female children also tended to read more outside of school, and were more likely to be exposed to cultural activities. Aside from gender, another nuance to consider is math and reading abilities—current math scores had greater associations with previous scores (the proxy for ability) than reading scores.

Despite that fact that these observations are based on correlations from longitudinal analysis, the marginal effects may still be biased from unobservables. The implications from these correlations, however, may inform programs that aim to strengthen parenting and learning at home – there may be more attention given to reading than math skills at home. Parents may also need to be educated on the learning patterns of female and male children, and how their different strengths can be supported while also bridging the gap between such differences.

While voluntary school involvement in itself may not correlate with reading scores and only incrementally correlate with math scores, it may help increase parent's academic

expectations for the child, as well as promoting more reading activities for the child outside of school. If the objective is to increase student achievement, parent involvement organizations should consider supporting programs that build on the robust associations of parental academic expectations and reading activities at home on student achievement, instead of advocating that parents should be more involved in schools. Indeed, the results of this study point toward the need for schools with at-risk early elementary students to educate the parents of these students about the value of academic expectations and reading activities at home. Parents of at-risk students may need to be educated, perhaps through their child's school, with regard to parent involvement. Therefore, if policymakers want to ensure academic excellence they should not only look at schools, but also include the education of parents in the light of appropriate parent involvement.

3. Recommendations for next steps

This study has simultaneously run models using school types and parent involvement as key factors of achievement, bridging the gap in the literature using nationally representative longitudinal data.

However, there is a need to understand why student achievement across school types tends to be similar for reading scores once confounding variables are controlled for.

Moreover, research is needed to ascertain whether or not Catholic and other private schools indeed affect math test scores negatively. Qualitative studies are also needed to know what it is about being in Catholic and other private schools that lead to such a negative correlation with math scores. Are schools structurally different now compared to how they were before? Bryk et al (1993) conclude that, after a 10-year research, students in

Catholic schools do better than those in public schools. Their qualitative analysis behind the numbers led them to attribute the positive Catholic-school-effect to the following: a common core of academic work for all students; a supportive, communal style of organization; decentralized governance; and an inspirational ideology. A decade after the publication of their book, do these attributes still hold? And if they do, did anything else change in the Catholic school structure?

The increasing use of test-based accountability systems across many states since the 1990s offers an alternative hypothesis on why religious private schools and traditional public schools differed in math scores. It is possible that the pressure from these accountability systems on public schools has served to put more emphasis on math courses in public schools, compared to Catholic schools.

Homeschooling as an alternative school type is growing in popularity in the US. It would be useful for policy to include homeschooling in a future round of school-type study.

Presumably, parents with high expectations are taking steps that indirectly help their children in school, but these steps have not been measured in this paper. Doing this would be outside the scope of the study that is on the correlation of treatment, not of intention-to-treat, with the treated. Studies on appropriate activities, how these activities would be taught, and the effectiveness of any training would fill in the missing steps in advocating a policy of educating parents on involvement to raise their child's academic achievement. Another interesting area of study is to analyze the possibility that there is something in non-assigned school types that change parent behavior once the child is in it, not just in terms of school involvement but in terms of parental practices and learning activities at home as well.

APPENDIX A
School Choice Overview

Table 9. School choice across different states

(Reprinted from the National Conference of State Legislatures, 2006)

Charter Schools	Inter-District	Intra-District	Tuition Tax Credits	Vouchers
Alaska	Arizona	Alabama	Arizona	Cleveland, OH
Arizona	Arkansas	Connecticut	Iowa	Milwaukee, WI
Arkansas	California	Georgia	Minnesota	Florida
California	Colorado	Indiana	Illinois	
Colorado	Idaho	Kentucky		
Connecticut	Iowa	Maine		
Delaware	Louisiana (limited)	New York		
District of Columbia	Massachusetts	North Carolina		
Florida	Minnesota	South Carolina		
Georgia	Missouri (voluntary)	Texas		
Hawaii	Nebraska			
Idaho	New Hampshire (voluntary)			
Illinois	New Jersey (voluntary)			
Kansas	North Dakota			
Louisiana	Ohio			
Massachusetts	Oklahoma			
Michigan	Oregon			
Minnesota	South Dakota			
Mississippi	Tennessee			
Missouri	Utah			
Nevada	Washington			
New Hampshire	Wisconsin			
New Jersey				
New Mexico				
New York				
North Carolina				
Ohio				
Oklahoma				
Oregon				
Pennsylvania				
Rhode Island				
South Carolina				
Texas				
Utah				
Virginia				
Wisconsin				
Wyoming				

* Puerto Rico has both charter school and inter-district school choice options.

At present, promoting access to school choice can either be in the form of (CEPM, 2002): (1) intra-sectional choice (forms excluding private schools): magnet schools, intra- and inter-district controlled-choice plans, charter schools, and contracted schools; (2) intersectional choice (forms including private schools): vouchers, tax credits, and scholarships; (3) alternative schools; and (4) home schooling.

Option (1) allows students to attend any public school within or across districts in the state, if it does not upset desegregation guidelines and if space is available. Student funding from the state usually follows the student to the new school districts. Generally, parents are responsible for providing transportation to the boundaries of the new school districts, though in some states, low-income families receive transportation aid. Option (2) allows students in public schools to shift to private schools at the government's expense.

The NCLB transfer option falls under option (1), and allows students in low-performing schools (those that fail to meet a state's adequate yearly progress goals) to transfer to another public school that did make adequate yearly progress. However, as stated earlier in this study, school choice options do not always work in guiding parents to transfer their child outside the assigned school. For school year 2004-2005, data reveals that only 1% of total eligible students for NCLB choice actually transferred schools (Center on Education Policy, 2005). This was also reported by the LA Times article below:

> …But in Los Angeles, only 215 students switched to better campuses last year out of nearly 204,000 who were eligible.
>
> In Chicago, 1,097 students out of 270,000 transferred.
>
> And in New York, 6,828 out of 230,000 students moved to other campuses.

Source: Duke Helfand and Joel Rubin, LA Times, November 8, 2004

Kim and Sunderman (2004) show that the NCLB transfer option was not widely used. No district in their study was able to approve all transfer requests. They also found that in general, districts with fewer transfer requests were more likely to grant transfers. Moreover, parents whose transfer requests were approved often chose to keep their children in the neighborhood schools[55].

Kim and Sunderman reveal that parents may have good reasons for staying – schools that were chosen to accept transfers did not have substantially higher achievement levels or lower poverty rates, on average, than schools required to offer the transfer option under NCLB. From the point of view of parents, the receiving school does not look any different from their current non-performing school. The available options may simply not have been appealing.

If the policy objective is to let parents have real school options for the child, other choice options should therefore be explored such as vouchers/scholarships that allow the child to transfer from public to private schools, or put up more choice public schools such as charter and magnet schools.

[55] Kim and Sunderman (2004) cite the example of Fresno where only 62 of the 111 students (56%) whose transfer requests were approved actually moved out of their neighborhood school.

APPENDIX B

Descriptive Statistics

Table 10. The IRT test scores

Reading	Observations	Mean	Std. Dev	Minimum*	Maximum*
Spring 3rd grade	13,348	108.80	19.66	42.36	148.95
Spring Kindergarten	16,003	38.95	13.34	14.29	124.40
Gain Scores	13,052	69.71	16.24	-8.28	120.76
Mathematics					
Spring 3rd grade	13,326	85.66	17.42	30.06	120.42
Spring Kindergarten	15,976	32.16	11.32	7.31	96.53
Gain Scores	13,030	53.23	12.31	11.44	93.77

*Possible range is 0-154 for reading, and 0-123 for mathematics.

Table 11. General descriptive statistics (unweighted)

	Obs	Mean	Std. Dev.	Min	Max
Dependent variables					
Reading score in 3rd grade	12801	109.872	18.659	42.36	148.95
Math score in 3rd grade	12843	86.583	16.827	30.57	120.42
School choice by school types					
Private – Catholic	12679	0.126	0.331	0	1
Private – other religion	12679	0.057	0.232	0	1
Private – non-religious	12679	0.015	0.121	0	1
Public – choice	12679	0.123	0.329	0	1
Public – assigned is also chosen	12679	0.247	0.431	0	1
Public – assigned	12679	0.430	0.495	0	1
Parent involvement variables					
Whether or not family has rules on TV programs child can watch	11748	0.918	0.273	0	1
Academic expectations of parent for child	11892	3.967	0.838	1	5
Frequency of school involvement	11618	5.980	1.667	0	8
Frequency child reads books outside of school	11796	3.242	0.816	1	4
Family regularly receives newspapers and magazines	11827	1.389	0.725	0	2
Child participated in or attended artistic or cultural activities	11816	0.447	0.497	0	1
Parents play games or do puzzles with child	11818	0.942	0.232	0	1
Frequency child does homework	11805	4.323	0.803	1	5
Explanatory variables					
Female	13378	0.501	0.500	0	1
Age	13066	3.559	1.406	1	6
Child is in special ed	13604	0.065	0.246	0	1
White	12795	0.589	0.491	0	1
Black	12795	0.117	0.322	0	1
Hispanic	12795	0.178	0.383	0	1
Asian	12795	0.060	0.238	0	1
Other race/ethnicity	12795	0.053	0.224	0	1
Below poverty threshold	12857	0.177	0.381	0	1
Number of siblings	11930	1.544	1.130	0	11
Mother's education – less than HS	12688	0.121	0.326	0	1
Mother's education –HS	12688	0.293	0.455	0	1
Mother's education – some college	12688	0.326	0.468	0	1
Mother's education – BA or higher	12688	0.258	0.437	0	1
Home language is not English	12784	0.143	0.350	0	1
Two-parent family structure	11930	0.786	0.410	0	1
Health of parent	11750	4.366	0.799	1	5
Transferred schools K-1st grade	13135	0.093	0.291	0	1
Transferred schools 1st –3rd grade	12968	0.174	0.379	0	1
Northeast	13276	0.186	0.389	0	1
Mid-west	13276	0.262	0.439	0	1
West	13276	0.233	0.423	0	1
South	13276	0.317	0.465	0	1
City	13276	0.386	0.486	0	1

Table 12. General descriptive statistics, by school type (weighted)

	General	Private			Public		
Dependent variables		Catholic	Other religion	Non religious	Choice	Assigned is also chosen	Assigned
Reading score in 3rd grade	109.648 (0.450)	115.709 (0.789)	116.626 (0.950)	123.637 (2.214)	108.423 (0.737)	111.126 (0.505)	107.178 (0.523)
Math score in 3rd grade	86.397 (0.416)	88.081 (0.807)	91.557 (0.913)	96.493 (2.453)	85.625 (0.623)	88.259 (0.447)	84.504 (0.436)
School choice by school types							
Private – Catholic	.064 (0.005)						
Private – other religion	.044 (0.005)						
Private – non-religious	.011 (0.003)						
Public – choice	.137 (0.006)						
Public – assigned is also chosen	.279 (0.007)						
Public – assigned	.463 (0.008)						
Parent involvement variables							
Whether or not family has rules on TV programs child can watch	0.921 (0.003)	0.946 (0.008)	0.947 (0.014)	0.926 (0.024)	0.917 (0.010)	0.921 (0.005)	0.915 (0.004)
Academic expectations of parent for child	3.928 (0.016)	4.165 (0.028)	4.165 (0.048)	4.411 (0.049)	3.947 (0.035)	3.973 (0.020)	3.812 (0.020)
Frequency of school involvement	5.850 (0.039)	6.953 (0.055)	6.663 (0.085)	6.622 (0.153)	5.847 (0.064)	5.988 (0.050)	5.427 (0.047)
Frequency child reads books outside of school	3.232 (0.014)	3.241 (0.029)	3.261 (0.038)	3.423 (0.057)	3.257 (0.030)	3.269 (0.021)	3.177 (0.019)
Family regularly receives newspapers and magazines	1.337 (0.013)	1.592 (0.026)	1.491 (.033)	1.687 (0.050)	1.256 (0.024)	1.375 (0.018)	1.260 (0.017)
Child participated in or attended artistic or cultural activities	0.425 (0.007)	0.541 (0.022)	0.571 (0.029)	0.711 (0.051)	0.427 (0.014)	0.447 (0.012)	0.362 (0.009)
Parents play games or do puzzles with child	0.941 (0.003)	0.961 (0.008)	0.954 (0.011)	0.959 (0.014)	0.941 (0.007)	0.942 (0.005)	0.940 (0.003)
Frequency child does homework	4.325 (0.020)	4.437 (0.034)	4.427 (0.052)	4.315 (0.072)	4.357 (0.037)	4.320 (0.025)	4.301 (0.024)
Explanatory variables							
Child is as clever (or better) as same-age children (from parent surveys)	0.905 (0.004)	0.933 (0.009)	0.932 (0.013)	0.970 (0.019)	0.898 (0.010)	0.904 (0.007)	0.899 (0.006)
Child was highly motivated during assessment (from direct assessment)	0.607 (0.007)	0.668 (.022)	0.670 (0.025)	0.701 (0.043)	0.595 (0.017)	0.647 (0.012)	0.568 (0.010)
Female	0.504 (0.006)	0.507 (0.018)	0.549 (0.023)	0.557 (0.042)	0.487 (0.017)	0.511 (0.011)	0.497 (0.009)
Age	3.547 (0.021)	3.570 (0.065)	3.709 (0.095)	3.607 (0.193)	3.452 (0.053)	3.517 (0.037)	3.572 (0.027)
Child is in special ed	0.068 (0.004)	0.014 (0.004)	0.020 (0.008)	0.006 (0.006)	0.071 (0.009)	0.069 (0.006)	0.080 (0.005)
White	0.596 (0.011)	0.733 (0.026)	0.760 (0.037)	0.695 (0.053)	0.524 (0.020)	0.631 (0.015)	0.557 (0.014)
Black	0.142 (0.008)	0.071 (0.015)	0.101 (0.026)	0.049 (0.026)	0.157 (0.015)	0.128 (0.011)	0.162 (0.010)
Hispanic	0.192 (0.009)	0.133 (0.019)	0.091 (0.022)	0.145 (0.039)	0.220 (0.017)	0.164 (0.010)	0.218 (0.012)
Asian	0.027 (0.002)	0.029 (0.007)	0.017 (0.007)	0.039 (0.011)	0.027 (0.003)	0.037 (0.004)	0.020 (0.002)

Other race/ethnicity	0.043 (0.003)	0.032 (0.008)	0.029 (0.008)	0.070 (0.021)	0.070 (0.010)	0.038 (0.004)	0.040 (0.004)
Below poverty threshold	0.198 (0.007)	0.030 (0.006)	0.042 (0.012)	0.037 (0.016)	0.196 (0.014)	0.172 (0.010)	0.255 (0.011)
Number of siblings	1.519 (0.015)	1.540 (0.049)	1.452 (0.090)	1.243 (0.119)	1.425 (0.038)	1.524 (0.025)	1.553 (0.021)
Mother's education – less than HS	0.133 (0.006)	0.029 (0.009)	0.021 (0.009)	0.019 (0.011)	0.134 (0.014)	0.120 (0.009)	0.167 (0.009)
Mother's education –HS	0.303 (0.007)	0.186 (0.017)	0.206 (0.023)	0.061 (0.028)	0.334 (0.016)	0.291 (0.011)	0.332 (0.009)
Mother's education – some college	0.326 (0.006)	0.364 (0.019)	0.333 (0.027)	0.275 (0.040)	0.327 .017	0.321 (0.011)	0.324 (0.009)
Mother's education – BA or higher	0.237 (0.007)	0.419 (0.024)	0.437 (0.033)	0.643 (0.055)	0.204 .014	0.266 (0.013)	0.175 (0.008)
Home language is not English	0.121 (0.006)	0.058 (0.011)	0.041 (0.013)	0.062 (0.026)	0.139 .012	0.118 (0.009)	0.134 (0.009)
Two-parent family structure	0.732 (0.007)	0.852 (0.017)	0.831 (0.025)	0.862 (0.038)	0.704 .017	0.753 (0.012)	0.698 (0.010)
Health of parent	4.344 (0.014)	4.447 (0.036)	4.452 (0.037)	4.587 (0.073)	4.276 (0.029)	4.369 (0.022)	4.302 (0.018)
Transferred schools K-1st grade	0.191 (0.010)	0.179 (0.032)	0.173 (0.039)	0.139 (0.053)	0.209 .020	0.192 (0.015)	0.188 (0.012)
Transferred schools 1st – 3rd grade	0.255 (0.011)	0.153 (0.026)	0.129 (0.024)	0.203 (0.075)	0.294 .020	0.244 (0.016)	0.277 (0.014)
Northeast	0.186 (0.011)	0.273 (0.041)	0.146 (0.044)	0.120 (0.049)	0.114 .014	0.213 (0.017)	0.183 (0.013)
Mid-west	0.230 (0.012)	0.360 (0.047)	0.306 (0.058)	0.110 (0.061)	0.231 .020	0.237 (0.017)	0.203 (0.013)
West	0.228 (0.012)	0.151 (0.030)	0.148 (0.036)	0.443 (0.128)	0.314 .022	0.178 (0.014)	0.246 (0.015)
South	0.355 (0.010)	0.215 (0.042)	0.406 (0.064)	0.306 (0.102)	0.331 (0.032)	0.375 (0.015)	0.376 (0.013)
City	0.364 (0.013)	0.485 (0.045)	0.513 (0.060)	0.513 (0.121)	0.451 (0.023)	0.286 (0.016)	0.350 (0.016)

Note: Figures in parenthesis are standard errors.

APPENDIX C

Basic models and their variants

Below are three sets of models. The first set of models regresses IRT scores on explanatory variables and on either school types or parent involvement variables. The second set of models combines school types and parent involvement in one model. One variant of this set shows the model with explanatory variables, another variant shows the model without explanatory variables. The third set of models is the regressor variable set that includes previous scores. This set is an analog of the models in the separate literatures on school choice and parent involvement. One version of this set runs the model only with parent involvement variables; the other version runs it with only school type variables. The basic models run the regressions with the test scores regressed on explanatory variables and on either school types or parent involvement.

The first set of models (table 13) show that students do better in reading and math when in school types other than in the assigned public school. Being in a catholic school, however, is associated with a decrease in math scores even in this basic model. Parent involvement (in terms of academic expectations, frequency of school involvement, frequency child reads outside school and family regularly receives newspapers and magazines), meanwhile, have a general positive association with reading and math scores.

Table 13. First set of models on effects of explanatory variables and school type or parent involvement on student achievement

	Dependent variables are test scores			
Independent variables	**Reading**		**Math**	
	Model 1a	**Model 1b**	**Model 1a**	**Model 1b**
School choice by school types				
Private – Catholic	0.064		-0.180**	
	(0.041)		(0.046)	
Private – other religion	0.089		0.011	
	(0.048)		(0.051)	
Private – non-religious	0.381**		0.234*	
	(0.095)		(0.114)	
Public – choice	0.033		0.037	
	(0.035)		(0.034)	
Public – assigned is also chosen	0.069**		0.086**	
	(0.026)		(0.026)	
Parent involvement variables				
Whether or not family has rules on TV programs child can watch		-0.018		-0.077*
		(0.039)		(0.039)
Academic expectations of parent for child		0.186**		0.188**
		(0.014)		(0.014)
Frequency of school involvement		0.020*		0.030**
		(0.009)		(0.008)
Frequency child reads books outside of school		0.121**		0.076**
		(0.014)		(0.014)
Family regularly receives newspapers and magazines		0.054**		0.048**
		(0.019)		(0.016)
Child participated in or attended artistic or cultural activities		0.049*		0.010
		(0.022)		(0.023)
Parents play games or do puzzles with child		0.044		0.048
		(0.047)		(0.046)
Frequency child does homework		-0.005		-0.026
		(0.018)		(0.017)
Explanatory variables				
Test score in kindergarten				
Female	0.101**	0.052*	-0.283**	-0.313**
	(0.021)	(0.021)	(0.021)	(0.022)
Age	0.041**	0.041**	0.050**	0.050**
	(0.008)	(0.008)	(0.008)	(0.008)
Black	-0.432**	-0.470**	-0.611**	-0.625**
	(0.043)	(0.042)	(0.045)	(0.045)
Hispanic	-0.249**	-0.265**	-0.209**	-0.221**
	(0.041)	(0.042)	(0.039)	(0.038)
Asian	0.052	0.033	0.107	0.078
	(0.055)	(0.052)	(0.064)	(0.062)

Other race/ethnicity	-0.316**	-0.265**	-0.295**	-0.255**
	(0.059)	(0.058)	(0.056)	(0.058)
Child is in special ed	-0.972**	-0.933**	-0.928**	-0.875**
	(0.061)	(0.058)	(0.054)	(0.053)
Below poverty threshold	-0.245**	-0.201**	-0.225**	-0.177**
	(0.038)	(0.038)	(0.037)	(0.037)
Number of siblings	-0.052**	-0.052**	-0.010	-0.007
	(0.011)	(0.011)	(0.010)	(0.010)
Mother's education – less than HS	-0.271**	-0.242**	-0.249**	-0.211**
	(0.047)	(0.046)	(0.043)	(0.042)
Mother's education – some college	0.169**	0.096**	0.204**	0.131**
	(0.027)	(0.027)	(0.027)	(0.027)
Mother's education – BA or higher	0.512**	0.353**	0.541**	0.375**
	(0.029)	(0.030)	(0.030)	(0.030)
Home language is not English	-0.242**	-0.290**	-0.127**	-0.157**
	(0.046)	(0.048)	(0.045)	(0.046)
Two-parent family structure	0.115**	0.073*	0.071*	0.024
	(0.030)	(0.030)	(0.029)	(0.028)
Health of parent	0.061**	0.036**	0.067**	0.044**
	(0.014)	(0.013)	(0.015)	(0.015)
Transferred schools K-1st grade	0.024	0.031	-0.026	-0.014
	(0.041)	(0.040)	(0.038)	(0.036)
Transferred schools 1st –3rd grade	0.005	0.013	-0.019	0.003
	(0.033)	(0.032)	(0.031)	(0.030)
Northeast	-0.080*	-0.092**	-0.115**	-0.128**
	(0.036)	(0.034)	(0.037)	(0.035)
Mid-west	-0.085**	-0.075*	-0.102**	-0.108**
	(0.033)	(0.031)	(0.035)	(0.033)
West	-0.086*	-0.112**	-0.114**	-0.137**
	(0.040)	(0.039)	(0.037)	(0.036)
City	-0.015	-0.025	0.008	-0.020
	(0.029)	(0.028)	(0.028)	(0.027)
Constant	-0.336**	-1.404**	-0.222*	-1.082**
	(0.082)	(0.134)	(0.088)	(0.129)
Observations	10557	10181	10588	10210
R-squared	0.30	0.34	0.28	0.32

All dependent variables are standardized with a mean of 0 and a standard deviation of 1.
Control variables are public-assigned schools for school type, white for ethnicity, mother's education-HS for mother's education, and south for region.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

Leaving out explanatory variables, school type and parent involvement variables display strong effects on reading and math scores (Model 2a in table 14). Choice public schools, however, continue to have correlation with scores. And Catholic schools consistently have negative marginal effects on math scores. Adding explanatory variables decrease the effects of school types on scores to insignificance (Model 2b). For reading, only being in a non-religious private school still increased scores by 0.27 s.d., with assigned-also-chosen public schools increasing scores by a modest 0.04 s.d. For math, being in assigned-also-chosen public schools increase scores by 0.06 s.d. Being in Catholic schools decrease math scores by 0.23 s.d. Meanwhile, the marginal effects of parent involvement variables such as academic expectation, frequency of reading outside school by child, and receiving magazines and newspapers at home remain robust for both reading and math scores. For math, however, exposure to cultural activities, playing games and puzzles among parents and child, frequency of doing homework and having TV rules were insignificant.

Table 14. Second set of models on effects school type and parent involvement on student achievement

	Dependent variables are test scores			
Independent variables	**Model 2a (without explanatory variables)**		**Model 2b (with explanatory variables)**	
	Reading	**Math**	**Reading**	**Math**
School choice by school types				
Private – Catholic	0.164**	-0.081	0.011	-0.230**
	(0.045)	(0.052)	(0.042)	(0.043)
Private – other religion	0.236**	0.181**	0.038	-0.015
	(0.060)	(0.061)	(0.048)	(0.043)
Private – non-religious	0.562**	0.385**	0.275**	0.136
	(0.102)	(0.133)	(0.101)	(0.124)
Public – choice	-0.020	-0.017	-0.004	0.004
	(0.042)	(0.045)	(0.034)	(0.034)
Public – assigned is also chosen	0.095**	0.116**	0.041	0.059*
	(0.027)	(0.028)	(0.025)	(0.024)
Parent involvement variables				
Whether or not family has rules on TV programs child can watch	0.020	-0.065	-0.018	-0.074*
	(0.045)	(0.042)	(0.039)	(0.037)
Academic expectations of parent for child	0.220**	0.224**	0.185**	0.188**
	(0.015)	(0.016)	(0.015)	(0.017)
Frequency of school involvement	0.093**	0.106**	0.019*	0.033**
	(0.010)	(0.011)	(0.008)	(0.009)
Frequency child reads books outside of school	0.139**	0.061**	0.121**	0.074**
	(0.015)	(0.014)	(0.013)	(0.012)
Family regularly receives newspapers and magazines	0.170**	0.166**	0.053*	0.048**
	(0.023)	(0.018)	(0.021)	(0.017)
Child participated in or attended artistic or cultural activities	0.085**	-0.027	0.047*	0.010
	(0.025)	(0.023)	(0.023)	(0.021)
Parents play games or do puzzles with child	0.143**	0.111*	0.045	0.049
	(0.055)	(0.052)	(0.056)	(0.053)
Frequency child does homework	-0.051*	-0.061**	-0.004	-0.023
	(0.024)	(0.022)	(0.021)	(0.017)
Explanatory variables				
Test score in kindergarten				
Female			0.051*	-0.314**
			(0.022)	(0.022)
Age			0.041**	0.051**
			(0.010)	(0.009)
Black			-0.468**	-0.627**
			(0.044)	(0.050)
Hispanic			-0.264**	-0.219**
			(0.040)	(0.042)
Asian			0.029	0.074
			(0.052)	(0.068)

Other race/ethnicity			-0.266**	-0.255**
			(0.089)	(0.084)
Child is in special ed			-0.931**	-0.884**
			(0.057)	(0.053)
Below poverty threshold			-0.199**	-0.182**
			(0.037)	(0.039)
Number of siblings			-0.052**	-0.006
			(0.010)	(0.010)
Mother's education – less than HS			-0.242**	-0.211**
			(0.048)	(0.045)
Mother's education – some college			0.095**	0.133**
			(0.030)	(0.029)
Mother's education – BA or higher			0.345**	0.380**
			(0.029)	(0.031)
Home language is not English			-0.289**	-0.164**
			(0.052)	(0.048)
Two-parent family structure			0.072*	0.026
			(0.028)	(0.028)
Health of parent			0.035**	0.043**
			(0.012)	(0.014)
Transferred schools K-1st grade			0.032	-0.014
			(0.034)	(0.033)
Transferred schools 1st –3rd grade			0.015	-0.002
			(0.030)	(0.029)
Northeast			-0.090*	-0.117**
			(0.037)	(0.042)
Mid-west			-0.073	-0.095*
			(0.038)	(0.041)
West			-0.111**	-0.135**
			(0.040)	(0.040)
City			-0.024	-0.004
			(0.031)	(0.035)
Constant	-2.133**	-1.756**	-1.408**	-1.127**
	(0.164)	(0.153)	(0.165)	(0.159)
Observations	10830	10862	10179	10208
R-squared	0.16	0.14	0.34	0.32

All dependent variables are standardized with a mean of 0 and a standard deviation of 1.
Control variables are public-assigned schools for school type, white for ethnicity, mother's education-HS for mother's education, and south for region.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

The third set of models show an analogy of the models found in the separate literature for school choice and for parent involvement in relation to student achievement, which treat each other as "unobservables". Model 3a in table 15 shows the results when scores are regressed without school types. For reading and math scores, academic expectations and the frequency child reads outside school remain significant.

Model 3b regressed scores on all the variables except parent involvement. For reading and math, only the marginal effects from assigned-also-chosen schools (at a modest 0.05-0.06 s.d.) remained significant. For math, being in Catholic schools or in other religious private schools have negative effects in scores.

Table 15. Third set of models on effects all explanatory variables, previous scores and school type or parent involvement on student achievement

	Dependent variables are test scores			
Independent variables	**Model 3a (parent involvement only)**		**Model 3b (school type only)**	
	Reading	**Math**	**Reading**	**Math**
School choice by school types				
Private – Catholic			-0.014	-0.258**
			(0.035)	(0.034)
Private – other religion			-0.004	-0.146**
			(0.050)	(0.049)
Private – non-religious			0.060	-0.135
			(0.092)	(0.111)
Public – choice			0.008	0.004
			(0.034)	(0.027)
Public – assigned is also chosen			0.046	0.056**
			(0.024)	(0.022)
Parent involvement variables				
Whether or not family has rules on TV programs child can watch	-0.015	-0.038		
	(0.039)	(0.032)		
Academic expectations of parent for child	0.131**	0.088**		
	(0.013)	(0.013)		
Frequency of school involvement	0.012	0.010		
	(0.006)	(0.007)		
Frequency child reads books outside of school	0.085**	0.042**		
	(0.013)	(0.010)		
Family regularly receives newspapers and magazines	0.032	0.009		
	(0.019)	(0.014)		
Child participated in or attended artistic or cultural activities	0.025	0.001		
	(0.022)	(0.020)		
Parents play games or do puzzles with child	0.002	0.044		
	(0.051)	(0.050)		
Frequency child does homework	0.004	0.002		
	(0.022)	(0.014)		
Explanatory variables				
Test score in kindergarten	0.391**	0.594**	0.421**	0.619**
	(0.012)	(0.011)	(0.012)	(0.011)
Female	0.032	-0.234**	0.063**	-0.218**
	(0.020)	(0.018)	(0.019)	(0.016)
Age	0.004	-0.036**	0.003	-0.040**
	(0.009)	(0.007)	(0.009)	(0.007)
Black	-0.404**	-0.378**	-0.375**	-0.369**
	(0.041)	(0.039)	(0.040)	(0.039)
Hispanic	-0.178**	-0.062	-0.160**	-0.047
	(0.035)	(0.032)	(0.035)	(0.031)
Asian	-0.094	0.033	-0.095	0.045
	(0.050)	(0.058)	(0.053)	(0.059)
Other race/ethnicity	-0.236**	-0.129	-0.260**	-0.133
	(0.088)	(0.078)	(0.089)	(0.079)
Child is in special ed	-0.717**	-0.479**	-0.734**	-0.500**

	(0.059)	(0.050)	(0.064)	(0.049)
Below poverty threshold	-0.122**	-0.078*	-0.149**	-0.099**
	(0.036)	(0.032)	(0.037)	(0.032)
Number of siblings	-0.034**	-0.004	-0.031**	-0.002
	(0.010)	(0.008)	(0.010)	(0.008)
Mother's education – less than HS	-0.176**	-0.136**	-0.200**	-0.155**
	(0.050)	(0.033)	(0.053)	(0.032)
Mother's education – some college	0.058*	0.070**	0.104**	0.101**
	(0.028)	(0.026)	(0.027)	(0.026)
Mother's education – BA or higher	0.221**	0.158**	0.321**	0.235**
	(0.028)	(0.027)	(0.026)	(0.024)
Home language is not English	-0.065	0.038	-0.021	0.053
	(0.055)	(0.038)	(0.047)	(0.036)
Two-parent family structure	0.057*	0.003	0.080**	0.023
	(0.027)	(0.023)	(0.027)	(0.023)
Health of parent	0.031*	0.033**	0.048**	0.043**
	(0.012)	(0.012)	(0.012)	(0.011)
Transferred schools K-1st grade	0.007	-0.012	-0.003	-0.021
	(0.029)	(0.028)	(0.031)	(0.028)
Transferred schools 1st –3rd grade	0.007	0.014	-0.001	-0.005
	(0.027)	(0.024)	(0.027)	(0.023)
Northeast	-0.043	-0.066	-0.025	-0.053
	(0.037)	(0.038)	(0.039)	(0.037)
Mid-west	-0.005	-0.065	-0.005	-0.058
	(0.034)	(0.034)	(0.035)	(0.033)
West	-0.076*	-0.087*	-0.051	-0.077*
	(0.034)	(0.036)	(0.034)	(0.036)
City	-0.014	-0.018	0.002	0.014
	(0.028)	(0.030)	(0.029)	(0.030)
Constant	-0.876**	-0.330**	-0.128	0.153*
	(0.160)	(0.119)	(0.073)	(0.068)
Observations	9686	10045	10037	10412
R-squared	0.43	0.55	0.41	0.55

All dependent variables are standardized with a mean of 0 and a standard deviation of 1.
Control variables are public-assigned schools for school type, white for ethnicity, mother's education-HS for mother's education, and south for region.
Standard errors in parentheses
* significant at 5%; ** significant at 1%

APPENDIX D

Table 16. Testing how different coefficients are for key independent variables across at-risk groups (data reported below are F-stats from Chow tests)

	Blacks vs non-blacks		Hispanics vs non-hispanics		Poor vs non-poor		Less than HS vs others		HS vs others	
School choice by school types	Reading	Math	Reading	Math	Reading	Math	Reading	Math	Reading	Math
Private – Catholic	3.19	4.22*	0.61	0.00	0.70	1.04	4.25*	1.18	0.06	0.31
Private – other religion	1.93	0.15	0.01	2.69	0.61	0.05	0.08	0.32	2.07	0.00
Private – non-religious	0.15	1.28	6.10*	0.11	0.23	5.26*	31.21**	0.00	1.50	1.07
Public – choice	0.05	0.18	0.00	1.30	8.99**	7.61**	8.95*	0.00	2.22	1.73
Public – assigned is also chosen	0.03	2.66	0.07	0.84	0.36	0.03	0.00	3.17	5.84*	0.77
Parent involvement variables										
Whether or not family has rules on TV programs child can watch	0.10	0.35	0.08	0.15	1.28	0.68	0.33	0.41	0.78	0.73
Academic expectations of parent for child	1.14	4.42*	0.62	0.27	0.18	0.50	0.01	0.09	1.15	0.63
Frequency of school involvement	0.64	1.22	2.19	2.30	0.01	0.25	0.99	0.03	3.31	2.70
Frequency child reads books outside of school	0.98	0.26	0.08	4.81*	0.63	0.37	0.07	0.66	2.30	2.45
Family regularly receives newspapers and magazines	1.61	0.47	1.73	3.48	0.97	0.01	0.08	0.50	0.01	0.06
Child participated in or attended artistic or cultural activities	5.87**	2.17	1.09	0.16	13.95**	1.08	4.02*	2.15	1.62	0.34
Parents play games or do puzzles with child	1.93.	0.09	2.64	0.05	0.01	3.31	2.70	0.09	9.77**	1.32
Frequency child does homework	2.18	0.10	1.58	4.93*	2.60	3.14	10.53**	4.13*	1.06	1.13

Using the Chow test, each subgroup coefficient was compared to the rest of the group, i.e. Blacks were compared to non-blacks, Hispanics to non-Hispanics, etc. Models used were the full regressor-variable models (all explanatory variables included). * significant at 5%; ** significant at 1%

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